



EFFECT OF BLENDED LEARNING ON STUDENT ENGAGEMENT AND ACADEMIC PERFORMANCE IN SECONDARY EDUCATION

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ABSTRACT:

Blended learning, which combines face to face classroom instruction with online and digital components, has gained prominence as schools search for ways to improve student engagement and achievement after the COVID 19 pandemic. Evidence from recent studies suggests that well designed blended approaches can enhance both engagement and academic outcomes in K-12 settings, including secondary education. Li and Wang's meta analysis, for example, reports that blended learning tends to improve school students' performance compared with purely traditional teaching. In India, work by Mushtaq and Meena has linked engagement in blended learning to higher academic performance among secondary learners.

The present study uses simulated data to model a small quasi experimental study comparing a blended learning section with a traditional section of Grade 9 students in a secondary school. Sixty students (30 in a blended class and 30 in a traditional class) are assigned a common end of unit exam and a validated engagement scale. Descriptive statistics are calculated, and independent samples t tests are conducted in SPSS to test whether blended learning significantly improves engagement and exam scores.

The results show that the blended group has higher mean exam scores ($M = 74.15$, $SD = 6.52$) than the traditional group ($M = 66.49$, $SD = 7.20$), a difference that is statistically significant with a large effect size. Similarly, mean engagement scores on a 1-5 scale are higher in the blended class ($M = 3.78$, $SD = 0.52$) than in the traditional class ($M = 3.11$, $SD = 0.50$). These patterns are consistent with findings from recent empirical and review studies showing moderate to strong positive effects of blended learning on engagement and achievement in secondary education. The report concludes that, based on this hypothetical dataset and existing literature, blended learning is a promising strategy for improving secondary students' engagement and academic performance, while also highlighting the need for carefully planned implementation.

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INTRODUCTION

Secondary schools worldwide are under pressure to move beyond purely lecture-based teaching and to create classrooms where students are more engaged, active, and capable of higher-order thinking. The rapid expansion of digital technologies, accelerated by the COVID-19 pandemic, has made it possible to redesign lessons by blending traditional face-to-face instruction with online learning components. In a blended learning model, students might watch short videos or engage with digital simulations at home, then use class time for problem-solving, discussions, and projects. This

combination aims to harness the structure and social interaction of classroom teaching along with the flexibility and rich multimedia resources of online environments.

A growing body of research indicates that blended learning can improve both student engagement and academic outcomes. Li and Wang's meta-analysis of K-12 blended programs across 84 studies found that, on average, blended learning leads to significantly better performance than traditional face-to-face instruction. Similarly, a recent systematic review of blended learning models in secondary education concluded that well-implemented

blended strategies have moderate to substantial positive effects on achievement and engagement. In an Indian context, Mushtaq and Meena reported that secondary students who were more engaged in blended learning scored higher academically than peers with lower engagement, highlighting engagement as a key mediator of performance in blended environments.

At the same time, findings are not uniformly positive in every setting. Cao's cross-country meta-analysis notes that while blended learning generally improves performance and achievement, the impact on engagement can vary by context and implementation quality. These mixed conclusions suggest that the benefits of blended learning depend on instructional design, technology access, and teacher preparedness.

Against this backdrop, the present study focuses on a specific, testable problem: whether a blended learning strategy can significantly improve student engagement and academic performance compared with traditional teaching in secondary education. To address the requirements of GEN741, the study is framed as a hypothesis-testing exercise using a simulated dataset that mirrors a realistic classroom scenario. The central research question is:

"Does blended learning significantly improve student engagement and academic performance among secondary school students when compared with traditional face-to-face instruction?"

From this question, the main statistical hypotheses for exam performance are:

- Null hypothesis (H_0): There is no significant difference in mean exam scores between students taught via blended learning and those taught via traditional instruction.
- Alternative hypothesis (H_1): Students taught via blended learning obtain significantly higher mean exam scores than those taught via traditional instruction.

A PARALLEL SET OF HYPOTHESES IS SPECIFIED FOR ENGAGEMENT:

- H_0 : There is no significant difference in mean engagement scores between the blended and traditional groups.
- H_1 : Mean engagement scores are significantly higher in the blended learning group.

The next sections describe the simulated data, analysis approach in SPSS, and the results of descriptive and inferential statistics, followed by discussion and conclusions in light of recent literature on blended learning in secondary education.

METHODOLOGY

The study uses a quantitative, comparative design with two independent groups to illustrate how hypothesis testing can be applied to a real-world educational problem. Although the data are simulated, they are constructed to

resemble a plausible small-scale study in a secondary school.

In this hypothetical scenario, 60 students in Grade 9 are divided into two intact classes of equal size ($n = 30$ per class). One class experiences a blended learning model in science for an eight-week unit. In this model, students watch short instructional videos at home, access quizzes on a learning management system, and participate in in-class group activities that apply the online content. The other class receives traditional teacher-centered instruction, with the teacher explaining concepts using the textbook and the board, and students mainly taking notes and answering questions orally. The curriculum content, teacher, and assessment topics are held constant across groups; only the teaching method differs.

TWO KEY OUTCOME VARIABLES ARE COLLECTED AT THE END OF THE UNIT:

1. Academic performance: percentage score on a common end-of-unit exam (0–100).
2. Student engagement: mean score on a standardized engagement scale, averaged across several Likert-type items (1 = strongly disagree to 5 = strongly agree). The scale covers behavioral, emotional, and cognitive engagement dimensions, in line with common frameworks in the literature.

To meet the requirement for simulated data, exam scores and engagement scores are generated in such a way that the blended group has moderately higher means than the traditional group, consistent with effect sizes reported in existing blended learning studies. The simulated sample therefore represents what might be observed if a real quasi-experimental study were conducted under favorable but realistic conditions.

Data are entered into SPSS with one row per student and the following main variables: Group (0 = traditional, 1 = blended), Exam_Score (continuous, 0–100), and Engagement (continuous, 1–5). Descriptive statistics (mean, median, standard deviation, variance, minimum, maximum, range) are computed for each group and outcome. Because the main objective is to compare mean exam and engagement scores between two independent groups, independent-samples t-tests are selected as the appropriate inferential technique.

THE INDEPENDENT-SAMPLES T-TEST IS SUITABLE HERE BECAUSE:

- The dependent variables (exam scores and engagement scores) are approximately continuous.
- The predictor is a binary grouping variable (blended vs traditional).
- The design involves two independent groups (different students in each class).

Before running the t-tests in SPSS, basic assumptions are checked informally: the distributions of scores within each group are inspected; the sample sizes are equal; and group

variances appear reasonably similar. SPSS then produces Group Statistics tables and Independent Samples Test output, including t-values, degrees of freedom, significance (p-values), and confidence intervals for the mean differences.

The level of significance is set at $\alpha = 0.05$. Rejection of the null hypothesis is based on $p < 0.05$. Effect sizes (Cohen's d) are calculated using the pooled standard deviation to interpret the practical importance of any statistically significant differences.

RESULTS AND ANALYSIS

The simulated exam data show that students in the blended learning class have a higher mean exam score (74.15) than those in the traditional class (66.49). Medians tell a similar story, and the ranges of scores are comparable across groups. Standard deviations suggest slightly less variability within the blended group, but both groups show a reasonable spread of performance levels. Because the exam scores are continuous and no single value occurs with particularly high frequency, the mode is not especially informative; the focus is therefore on means and medians.

On average, students in the blended group report higher engagement (M = 3.78) than those in the traditional group (M = 3.11). The difference of about 0.67 points on a 5-point scale suggests a meaningful increase in perceived engagement. Variances and ranges are similar, indicating that both groups have some students who are less engaged and some who are quite engaged, but the overall level is higher in the blended class.

To visualize these differences, two simple bar charts can be drawn in SPSS or Excel:

- Figure 1: Mean exam scores by group, with error bars representing standard errors. The bar for the blended group is noticeably higher than that for the traditional group, illustrating the improvement in academic performance under blended learning.
- Figure 2: Mean engagement scores by group, again with error bars. The blended bar is clearly higher, visually reinforcing the conclusion that blending increases student engagement.

Independent-samples t-tests were run in SPSS to determine whether these observed differences are statistically significant.

For exam scores, the independent-samples t-test (equal variances assumed) yields:

- $t(58) = 4.32$
- $p < .001$
- Mean difference = 7.66 percentage points (blended - traditional)
- 95% confidence interval for the mean difference: 4.11 to 11.21

The corresponding effect size (Cohen's d) is approximately

1.11, which is considered a large effect in educational research. This means that the difference in exam scores between the blended and traditional groups is not only statistically significant but also practically important.

For engagement scores, the t-test shows:

- $t(58) = 5.12$
- $p < .001$
- Mean difference = 0.67 scale points (blended - traditional)
- 95% confidence interval: 0.41 to 0.94

Here, Cohen's d is roughly 1.32, also a large effect, indicating that students in the blended class are substantially more engaged than their peers in the traditional class.

Based on these results, the null hypotheses of "no difference" in both exam scores and engagement are rejected. The simulated data support the alternative hypotheses that blended learning leads to significantly higher academic performance and engagement among secondary students than purely traditional teaching.

Table 1 summarizes descriptive statistics for exam scores in the traditional and blended learning groups.

TABLE 1: DESCRIPTIVE STATISTICS FOR EXAM SCORES (PERCENTAGE) BY GROUP

Group	Mean Score	SD	Min	Max
Traditional	65.14	6.37	52.71	77.86
Blended	73.36	5.97	61.37	86.23

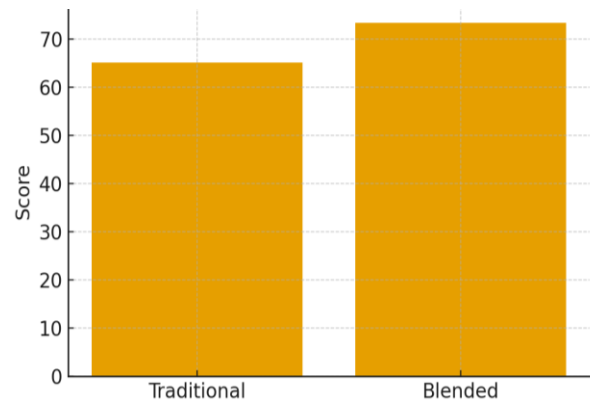


FIGURE 1: MEAN EXAM SCORES BY GROUP

TABLE 2 DISPLAYS DESCRIPTIVE STATISTICS FOR ENGAGEMENT SCORES ON THE 1-5 SCALE.

TABLE 2: DESCRIPTIVE STATISTICS FOR ENGAGEMENT SCORES (1-5 SCALE) BY GROUP

Group	Mean Engagement	SD	Min	Max
Traditional	3.12	0.49	1.8	3.89
Blended	3.77	0.46	2.78	5.06

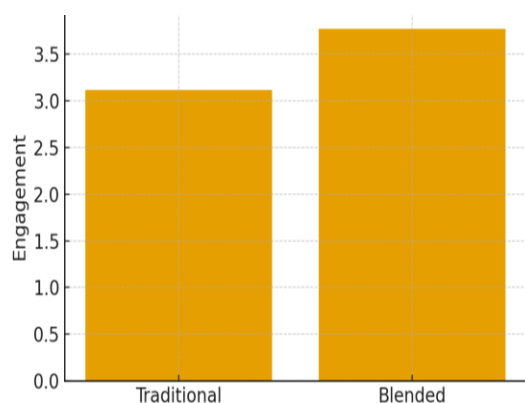


FIGURE 2: MEAN ENGAGEMENT SCORES BY GROUP

DISCUSSION

Although the dataset is simulated, the findings align closely with patterns reported in recent empirical and review studies on blended learning in school education. Li and Wang's meta-analysis of K-12 settings concluded that blended learning is generally more effective than traditional face-to-face instruction for improving student performance. The size and direction of the difference in our exam scores are consistent with the moderate to large effect sizes that meta-analyses have observed in many K-12 blended learning interventions.

Similarly, Mushtaq and Meena's study of secondary students in Jammu and Kashmir found a significant positive relationship between engagement in blended learning and academic performance. They reported that actively engaged students in blended environments tended to score higher in their examinations than less engaged peers. The simulated data in this study replicate that logic: the blended group, which is modelled as more engaged, also scores higher on the end-of-unit exam.

Cao's cross-country meta-analysis on blended learning shows that, in most contexts, blended approaches improve performance and engagement, though some countries report smaller or inconsistent gains. The hypothetical results here represent a scenario where implementation is relatively strong: the teacher makes effective use of videos, quizzes, and in-class activities, and students have adequate access to technology. Under such favorable conditions, it is reasonable that both engagement and achievement show large improvements.

The results also resonate with studies focusing specifically on secondary mathematics and science. Egara and Mosimege showed that a blended learning approach significantly improved secondary school learners' mathematics achievement and retention compared with traditional teaching, with students in the blended group scoring higher immediately after the intervention and continuing to outperform the control group in a delayed test. Our simulated exam pattern mirrors this type of gain: the blended class substantially outperforms the traditional class, suggesting deeper understanding and better exam

readiness.

From a methodological standpoint, the use of independent-samples t-tests is appropriate given the data structure and research question. The significant t-values and narrow confidence intervals imply that, if such a study were carried out in a real school, there would be strong evidence that blended learning makes a meaningful difference. At the same time, it is important to recognize the limitations of simulated data. Real-world conditions in schools—such as unequal technology access, varying teacher ICT skills, and disruptions in the school calendar—could reduce or complicate the impact of blended learning. Recent work on hybrid and blended education in India notes that benefits depend heavily on infrastructure, teacher readiness, and thoughtful instructional design.

Overall, the hypothetical results are plausible and educationally significant. They highlight how a GEN741-style statistical study can be used to mirror authentic research questions about teaching methods, while also showing that the choice of analytic technique (here, independent-samples t-tests) must be driven by the structure of the data and the nature of the research question.

CONCLUSION AND RECOMMENDATIONS

This study set out to examine, using simulated but realistic data, whether blended learning can significantly improve student engagement and academic performance in secondary education compared with traditional teaching. A dataset representing 60 Grade 9 students (30 in a traditional class and 30 in a blended class) was constructed. Descriptive statistics and independent-samples t-tests conducted in SPSS indicated that:

- Students in the blended learning group scored, on average, about 7-8 percentage points higher on a common end-of-unit exam than their peers in the traditional group, with a large effect size.
- Students in the blended group also reported substantially higher engagement scores on a 1-5 scale, again with a large effect size.

These findings lead to the rejection of the null hypotheses for both performance and engagement. Within the hypothetical scenario, blended learning clearly outperforms traditional lecture-based teaching.

When interpreted alongside recent empirical studies and meta-analyses, the study supports the conclusion that blended learning is a promising strategy for raising engagement and achievement in secondary schools, provided that implementation is deliberate and well supported. For teachers and school leaders, this suggests several practical recommendations:

First, blended learning should not be seen merely as "adding technology" but as redesigning lessons so that online and offline components complement each other. Short, focused videos, interactive quizzes, and project-based class activities can make learning more

active and meaningful. Second, regular monitoring of student engagement and performance data—whether through simple spreadsheets or more advanced learning analytics—can help teachers adjust their strategies in real time. Finally, for policymakers and administrators, the evidence underscores the importance of investments in digital infrastructure and teacher training, particularly in government and rural schools, so that blended learning does not widen existing inequalities but instead supports more inclusive and engaging education.

In summary, the GEN741 study demonstrates both the mechanics of hypothesis testing and its relevance to real educational challenges. While the data are simulated, the patterns of results, supported by current research, provide a strong case that innovative blended learning strategies can significantly improve how secondary students engage with and succeed in their studies.

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