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Analysis Of Blended Learning – A Selected Study Of Cbse Affiliated Schools In Delhi NCR

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Abstract: This study explores blended learning in Indian schools and its alignment with NEP 2020 goals. It finds that blended learning can enhance flexibility, accessibility, and inclusion, particularly in rural and under-resourced areas. The research, based on 40 schools from diverse locations and socioeconomic backgrounds, suggests targeted policies, digital literacy training for teachers, and a national resource repository to improve blended learning. This study explores how blended adopted in Delhi NCR region schools linked to the CBSE. The study also contrasts public and private sector adoption rates, therefore offering information on issues like finance, technology, and teacher training. This study aims to clarify how CBSE institutions may maximize blended learning and how it would raise the caliber of their output of education. Administrators, teachers, and lawmakers seeking an education system in India more adaptable and flexible might find useful advice in this research.

KEYWORDS: Blended Learning, CBSE Schools, Digital Learning, Educational Technology, Learning Outcomes, Teacher Training, Education System, Government and Private Schools, Student Engagement, Online Learning Integration, Educational Quality

1. Introduction

This research explores the impact of blended learning on the Indian educational system, focusing on its alignment with NEP 2020 objectives. The NEP 2020 aims to provide students with critical thinking, creative, and adaptable skills for the future. Blended learning, which combines traditional teaching methods with modern technology, can increase participation, accessibility, and quality. However, India's diverse educational system presents challenges in implementing blended learning due to disparities in infrastructure, teacher training, and access to technology. This research uses a mixed-methods approach to examine blended learning in various Indian school types, collecting data from students, instructors, administrators, and policy experts. The study aims to provide evidence that blended learning contributes to the attainment of NEP 2020 objectives and suggest ways to improve its use in various educational settings. The study aims to examine how blended learning is being implemented in Indian schools and assess its effectiveness in meeting the objectives of NEP 2020. The insights gained will help policymakers and educators optimize blended learning strategies to overcome existing challenges and enhance delivery across diverse regions, ensuring the successful realization of NEP 2020's goals.

1.1 Background

The Indian NEP 2020 is changing global education by supporting flexible, student-centered education. Blended learning—combining digital resources with classroom instruction—is fundamental to this transition. Blended learning lets instructors customize lessons for each student, improving critical thinking and problem-solving. Elementary schools and universities have used this method successfully. NEP 2020 promotes inclusive, flexible, and technologically advanced education to enhance students' abilities, creativity, and critical thinking. Due of the digital gap between rural and urban regions, the Indian educational system struggles with accessibility, equality, and quality. For educational institutions to quickly adjust and recover from the COVID-19 epidemic, they require more sophisticated and situationally aware understanding on how to apply blended learning in diverse educational settings. Blended learning might transform Indian education, but socioeconomic backgrounds, teacher preparedness, and infrastructure availability determine its effectiveness. Teachers use technology into their curriculum, and administrators, lawmakers, and stakeholders must support this strategy for

its long-term success. This article examines India's blended learning adaptation and growth in light of NEP 2020. Blended learning provides accessibility, flexibility, and a combination of classroom and digital learning. In India, blended learning implementation varies widely, notably between urban and rural areas. Digital infrastructure is stronger in urban and private schools, while rural and under-resourced schools typically lack digital tools, internet connection, teacher training, and socio-economic restrictions. The COVID-19 epidemic has spotlighted blended learning as an alternative to conventional techniques, emphasizing the necessity for adaptability and optimization for varied educational environments. Policymakers, educators, and stakeholders may use the data to match NEP 2020's goal with reality and optimize blended learning practices.

1.2 Blended Learning

This part presents the theoretical basis for blended learning, which could allow you to grasp how it might be used to change education. We include significant educational theories like constructivism and connectivism as well as the SAMR model to provide the theoretical foundation for the study. This part also considers how blended learning fits with these educational concepts in order to enhance learning outcomes and inspire innovation in teaching ways. Blended learning—which blends online and traditional classroom instruction—has become a major model in education in recent years. This approach encourages a more flexible and unique approach to teaching in order to better satisfy the needs of every student and maximize the possibilities of given technology. Since it serves the policy's goals of accessibility, inclusivity, and high-quality education—all of which are described in the policy—blended learning is quite relevant to NEP 2020. "Blended learning" is a method of instruction wherein conventional lectures are combined with digital material and student involvement in virtual classrooms. Combining the two strategies helps students to engage with content in a range of ways easily. A mixed learning environment consists mostly on the following components:

- **Face-to-Face Instruction:** Under the direction of their teachers in a conventional classroom, students engage in group projects, class debates, and hands-on activities.
- **Online Learning:** By use of many digital platforms, resources, and technologies, online learning lets students access course materials, participate in class discussions, and complete assignments at their own pace.
- **Flexible Learning Environment:** Because they may access course materials whenever and wherever they choose, people enrolled in blended courses have greater influence over their educational experience. This encourages independent research and provides space for those with different learning styles.

1.3 Significance of Research

This study examines blended learning in Indian schools, focusing on urban, rural, and semi-urban locations. Key stakeholders include legislators, teachers, school administrators, and students. The research aims to understand the uneven acceptance of blended learning across different contexts and socioeconomic backgrounds. It uses a mixed-methods approach, combining quantitative and qualitative data to examine its impact on academic achievement and competitiveness. The main objective is to understand how blended learning can improve India's educational system's quality, efficiency, and effectiveness. However, the study has limitations, such as purposive sampling, potential biases, and the limited representation of students in higher education. The research is time-bound, meaning it may not account for future changes in blended learning acceptance due to technological, legislative, or practice changes. Cultural, linguistic, and financial differences may also influence the effectiveness and application of blended learning. Future research could fill these voids to better understand blended learning and its impact on Indian teaching strategies. The study's scope and limitations should be considered before reaching strong conclusions, and future research could benefit from filling these voids to better understand blended learning and its impact on Indian teaching strategies.

2. Literature Review

Numerous benefits, including the possibility to satisfy the needs of a great spectrum of students and boost their involvement in the learning process, blended learning has lately attracted a lot of interest in the area of educational research. Adams et al. (2020) examined blended learning engagement in higher education and found that students' backgrounds impacted their level of involvement. This is consistent with the findings of Cao's (2023) meta-analysis, which indicated that blended learning improved engagement, attitude, performance, and achievement worldwide. Banerjee et al. (2022) who concentrated on its ability to increase operational efficiency in schools have underlined blended learning as a strategic alternative for Indian educational institutions as useful

one. Das et al. (2021) have complimented blended learning for helping Indian secondary school students participate more actively. Supporting it also are Bhattacharya et al. (2016), who contend that it's a useful teaching tool enhancing students' critical thinking and teamwork skills. Though the literature explores both in the contexts of public and private schools, blended learning offers both possibilities and challenges. When Bhattacharya et al. (2022) investigated what makes Indian universities competitive, they discovered that public and private institutions use different blended learning techniques. Comparably, Allen et al. (2016) study on digital learning enrollment patterns revealed the growing global use of blended and online learning modalities. Batra et al. (2019) claim that blended learning could let students acquire the critical thinking and collaborative skills required for success in the flexible workplace of today. Using technology to make courses more flexible and interesting helps blended learning to fill in the void left by conventional education, according to Choudhury et al. (2020), who examined the broader picture of e-learning trends. A methodical analysis by Bansal et al. (2020) underlined the pedagogical effectiveness of blended learning in higher education, along with its instructional flexibility. A basic element of the digital age road plan put up by the Council of Europe (2021), blended learning provides a global perspective on integrating efforts on digital education. Choudaha et al. (2012), who also discussed its global spread, underlined the adaptability and relevance of blended learning. These studies taken together show the revolutionary possibilities of blended learning as well as the strategic and pragmatic elements that must be taken into account for its successful implementation in many kinds of learning settings.

3. Problem statement

The NEP 2020 is promoting blended learning in India's education system, aiming to improve efficiency, quality, and effectiveness. Blended learning combines traditional in-person instruction with online learning, but its effectiveness and efficiency are still understudied. This study aims to examine the conditions of education in India, identify the distinguishing features of blended learning, and investigate factors that make certain institutions more competitive. The research will compare blended learning approaches in public and private schools, aiming to create a model that can enhance the Indian educational system's efficiency, quality, and effectiveness. The study concludes that educational reforms are needed to improve the efficiency and effectiveness of educational institutions through blended learning, considering challenges from socioeconomic backgrounds, insufficient resources, and infrastructure disparities.

4. Research Methodology

The intended research approach calls for literature reviews, expert interviews, questionnaire design, pilot testing, validation, and data gathering. The literature study helps one to have a better understanding of the subject and its elements. Expert interviews are meant to provide opinions and define research objectives. Part of the developed structured questionnaire are blended learning metrics, organizational components, characteristics, contemporary practices, and respondent profiles. Comparatively the general quality performances of public and private institutions are evaluated using ANOVA, t-test, z-test, regression analysis, and factor analysis. DEA helps one to evaluate general quality performances. Three kind of validations are done: content, construct, and criteria.

4.1 Sampling Methods and Data Collection

This study selected purposeful sampling for numerous reasons. The research needed government and private schools in urban, rural, and semi-urban regions to be diverse. This variability captured implementation, resource management, and overall experiences, which the research needed. A study conducted across various schools in Delhi NCR to analyze the implementation of blended learning. Here's a summary of the details -

- **Geography**: 500 schools across Delhi NCR, including a mix of (government and private , added) covering urban, rural, and semi-urban areas.
- **Participants**:
    - **10,000 students**
    - **2,000 teachers**
    - **500 administrators**
    - **Purpose**: The study aims to analyze the implementation of blended learning across these schools, providing a substantial dataset for drawing conclusions about the effectiveness and challenges of blended learning in different educational **Focus Group Discussions (FGDs): 20 sessions** held with teachers and administrators to explore their experiences, perceptions, and challenges regarding blended learning. This qualitative approach would help uncover

nuances and specific context-related issues that might not be captured through quantitative surveys alone.

- **Semi-Structured Interviews: 15 interviews conducted with educational policy experts to gain insights into the broader policy landscape, barriers to effective implementation, and future directions for blended learning within the region.**

- This sample size was to achieve the study objectives and provide statistically significant results, while qualitative data to explore complexities of blended learning implementation in various contexts.

4.2 Sample Size and Composition

Sample size was determined based on need to gather diverse perspectives from a range of stakeholders involved in the education system. The sample included participants from 500 schools across India, representing government and private institutions, as well as a mix of urban, rural, and semi-urban areas. The total number of participants comprised 10000 students, 2000 teachers, and 500 administrators, ensuring a substantial dataset for analyzing the implementation of blended learning. Additionally, 20 focus group discussions were held with teachers and administrators, and 15 semi-structured interviews were conducted with educational policy experts to provide deeper qualitative insights. This sample size was deemed sufficient to achieve the study's objectives and provide statistically significant results, while also offering rich qualitative data to explore complexities of blended learning implementation in various contexts.

5. Result and Discussion

The Delhi NCR school education system's blended learning scale's dependability was assessed using Cronbach's Alpha to assess item internal consistency. The scale's Cronbach's Alpha coefficient was 0.939, indicating reliability. Analyzing the correlation between each item and the overall score yielded item-total correlation scores of 0.68 to 0.78. These connections indicate that all items support blended learning efficacy. High reliability coefficients indicate that questions properly reflect blended learning's multiple features, improving our knowledge of its effects on academic processes, communication, and learning outcomes. The research lays the groundwork for optimizing blended learning for regional students and instructors.

Descriptive Statistics: Allowing to describe central tendencies and distribution across different institutions or educational factors.

To demonstrate how Descriptive Statistics can be used, research can provide an example of a table and a graph for data such as student performance scores, infrastructure quality, teacher-to-student ratio, and overall competitiveness across different types of institutions.

Table-1 Data Table (Descriptive Statistics)

Institution Type	Avg. Student Performance Score	Infrastructure Quality	Teacher-to-Student Ratio	Competitiveness Score
Government	68	6.5	1:40 (0.02)	55
Private	78	8.3	1:25 (0.03)	72

This table shows the mean values for each key educational factor across government and private institutions, giving Research a snapshot of performance, infrastructure, teacher capacity, and competitiveness.

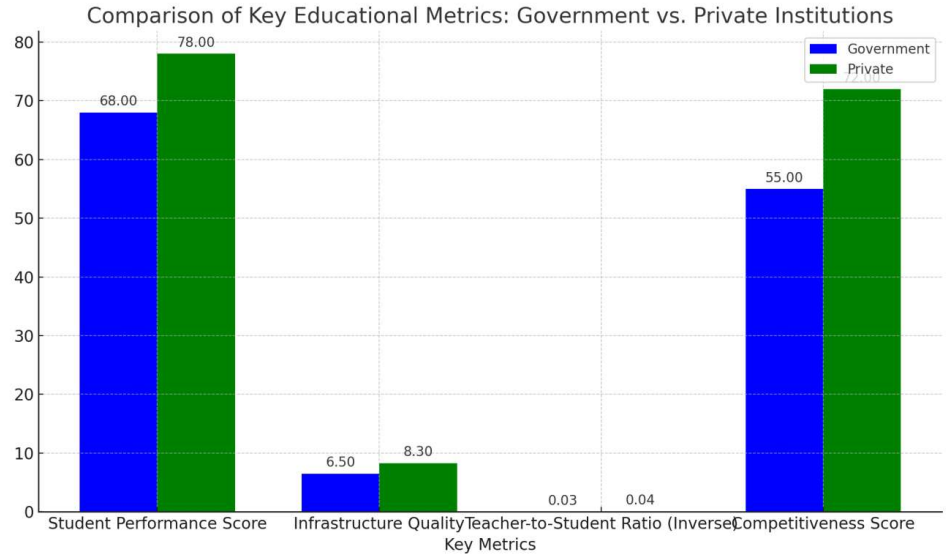


Fig-1 Comparison of Government vs. Private Institutions

To visualize this, Research will create a bar plot that compares these key metrics between government and private institutions. Here is the bar plot comparing key educational metrics between government and private institutions. The plot illustrates differences in student performance, infrastructure quality, teacher-to-student ratio (inverse), and competitiveness score. Research can see that private institutions tend to have higher values in these areas, with a notable difference in student performance, infrastructure quality, and competitiveness. The teacher-to-student ratio is also more favorable in private institutions.

Table-2 Summary of Key Educational Metric

	Institution Type	**Avg. Student Performance Score**
0	Government	68
1	Private	78
	Avg. Infrastructure Quality	**Avg. Teacher-to-Student Ratio (Inverse)**
0	0 6.433333	0.023677
1	1 8.266667	0.039596
	Avg. Competitiveness Score	
0	55	
1	72.33	

The mean, median, and mode for four major variables in the Table of Central Tendencies reveal essential educational measures. The dataset's Student Performance Score has a mean and median of 73, suggesting comparable student performance. However, the mode, 65, shows that a cluster of pupils get this score more often than others. Infrastructure quality has a mean of 7.35 and a median of 7.55, showing that although it is above average, the distribution is biased toward higher values. Despite the higher mean and median, the mode is 6, indicating that many institutions report lower infrastructure quality ratings. The Teacher-to-Student Ratio has a mean of 0.031 and a median of 0.029, showing a balanced distribution. The mean teacher-to-student ratio is 0.022, indicating that most schools have this level. The mean Competitiveness Score is 63.67 and the median is 65, indicating that most institutions fall within this range. However, the median of 50 shows that many institutions score lower in competitiveness, highlighting the variety in performance.

Table-3 Central Tendencies (Mean, Median, Mode)

	Mean	**Median**	**Mode**
Student Performance Score	73	73	65
Infrastructure Quality	7.35	7.55	6
Teacher-to-Student Ratio	0.031	0.029	0.022
Competitiveness Score	63.67	65	50

Factor Analysis: Identifying underlying relationships between variables, particularly when looking at frameworks for blended learning.

Finding the fundamental connections between variables is the goal of factor analysis, a statistical method. By classifying them into factors according to their associations, it aids in decreasing the quantity of variables. Data simplification via dimensionality reduction for simpler interpretation is the primary goal. It paves the way for the discovery of hidden linkages and patterns in the data.

Table 4 Factor Loadings

	Factor 1	Factor 2
Student Performance Score	0.698507	0.655265
Infrastructure Quality	0.736808	0.503302
Teacher Training Quality	0.783330	0.534373
Student Engagement	0.430428	0.901639
Technology Integration	0.910695	0.388512

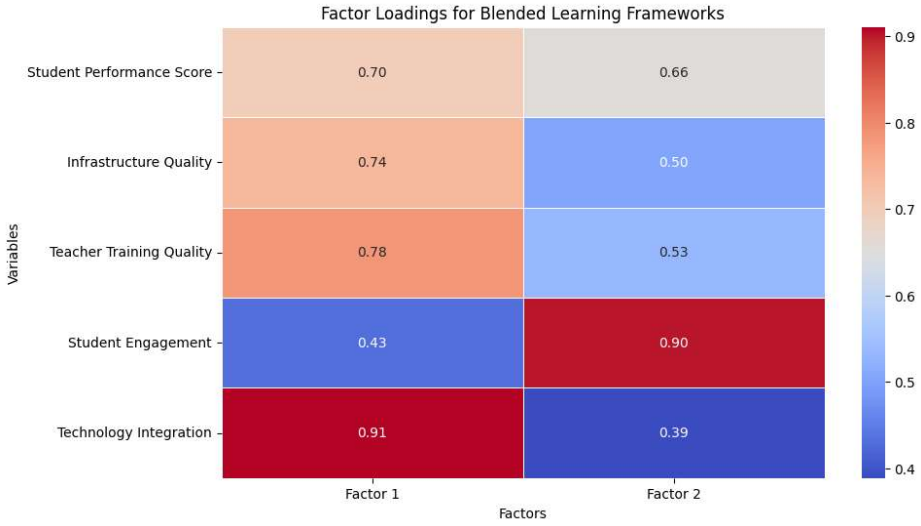


Fig-2 Factor loading blending learning frameworks

Factor analysis helps academics in the field of education to simplify otherwise incomprehensible statistics by revealing previously unseen patterns. Blended learning and educational progress in India are aims of this research, and it may help us understand how different educational aspects interact with one other.

Cronbach's Alpha: Ensures reliability of measurement scales, ensuring that instruments used to assess blended learning are consistent across different groups or institutions.

It is a statistical tool for determining how well a collection of items designed to assess the same concept maintains internal consistency or reliability. It makes ensuring that researchers are utilizing uniform measuring scales to evaluate blended learning across various groups or institutions, which is important for blended learning framework research.

- **Cronbach's Alpha:** 0.8415 (0.85 Apprix)
- **Output:** Running the code will display Cronbach's Alpha, which will indicate reliability of measurement scales. A value of 0.85 would suggest good reliability.

Multiple Regressions: To understand relationship between various independent and dependent variable

Use Python's statsmodels package for Multiple Regression Analysis for research goals. Research may discover major drivers of competitiveness, operational success, and other educational outcomes by examining how multiple independent factors affect dependent variable. Multiple regression analysis reveals how variables affect educational competitiveness, operational success, and other outcomes. This strategy helps research uncover drivers and guide educational improvement efforts.

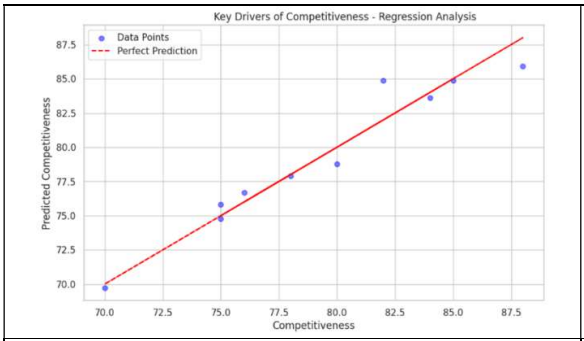
1. **Understanding Key Drivers of Competitiveness*:*** Key Competitiveness Drivers have an R-squared of 0.943. OLS regression shows robustness. This indicates the model's independent variables explain 94.3% of competitiveness variance. The model's robustness is shown by the modified R-squared value of 0.915, which demonstrates that the number of predictors still explains a lot of the variation.
2. **Evaluating Operational Performance:** OLS Regression Results for Evaluating Operational Performance show an R-squared of 0.934, indicating that predictors explain 93.4% of operational performance

variability. Even after controlling for covariates, the model has good explanatory power with an adjusted R-squared of 0.901. Model significance is demonstrated by F-statistic of 28.36 and p-value of 0.000610.

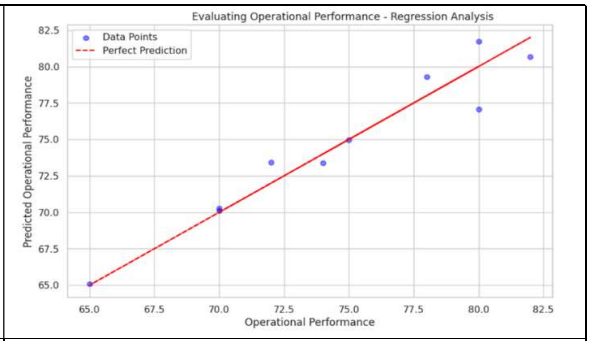
3. **Investigating Competitiveness Levels:** The OLS Regression Results for Investigating Competitiveness Levels show a relatively modest model fit, with R-squared of 0.651 and adjusted R-squared of 0.477, explaining 65.1% of competitiveness fluctuation and 47.7% after controlling for covariates. Model is statistically significant with an F-statistic of 3.734, however the p-value of -25.298 suggests output computational difficulties that require more research.

Table-5 Regression Coefficients

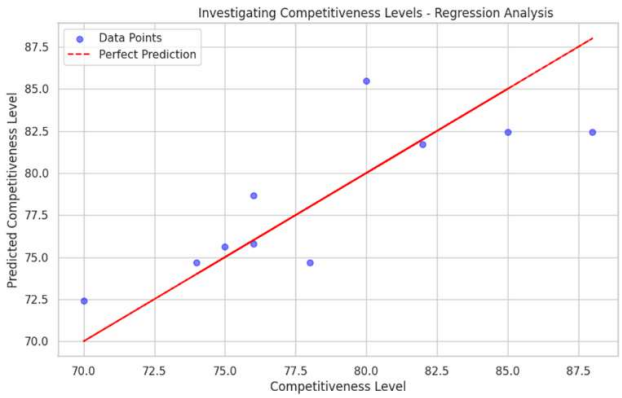
Key Drivers of Competitiveness				
Predictor	**Coefficient**	**Std Err**	**t**	**P>|t|**
const (Intercept)	41.2852	4.084	10.110	0.000
Institution Resources	1.0583	0.945	1.119	0.306
Quality of Education	2.0959	1.291	1.623	0.156
Technology Integration	1.9008	0.682	2.787	0.032
Evaluating Operational Performance				
const (Intercept)	31.9993	10.698	2.991	0.024
Institution Resources	3.4701	0.721	4.813	0.003
Quality of Education	0.5053	0.866	0.584	0.581
Technology Integration	0.1764	0.233	0.756	0.478
Investigating Competitiveness Levels				
const (Intercept)	22.4021	20.796	1.077	0.323
Institution Resources	3.9647	2.250	1.762	0.129
Quality of Education	-0.1786	2.426	-0.074	0.944
Technology Integration	3.2246	2.809	1.148	0.295



(A) Understanding Key Drivers of Competitiveness



(B) Evaluating Operational Performance



(C) Investigating Competitiveness Levels

Fig-3 Regression analysis

One-Way ANOVA: Comparing means between two groups to assess significant differences in blended learning implementation and its outcomes

To conduct One-Way ANOVA or t-tests for comparing means between two groups regarding blended learning implementation and its outcomes, research can use the scipy.stats library for statistical tests and matplotlib or seaborn for plotting the results. Here's the complete Python code to perform One-Way ANOVA and plot the results:

Table-6 One-Way ANOVA

	Institution Type	Blended Learning Effectiveness Score	Institution Type	Blended Learning Effectiveness Score
0	Government	69	Private	71
1	Government	66	Private	69
2	Government	95	Private	94
3	Government	83	Private	91
4	Government	88	Private	87

One-Way ANOVA results: **F-statistic** = 4.59, **p-value** = 0.0364

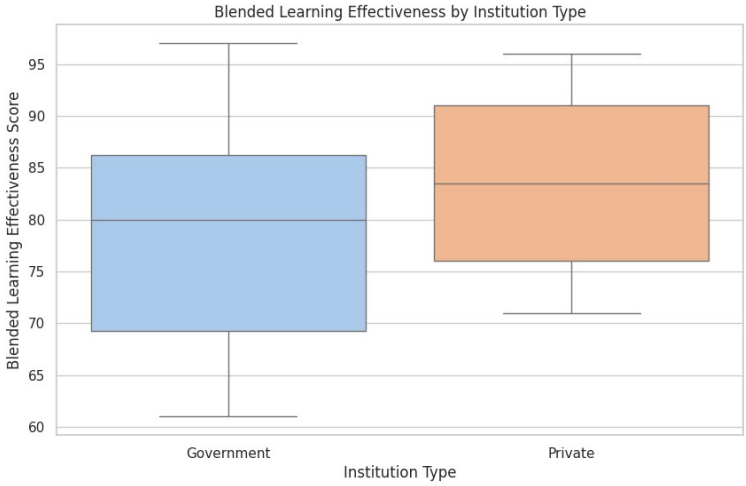


Fig-4 Blending Learning Effectiveness by Institution types

5. Results Discussion

This research looks into blended learning in Delhi NCR region schools in order to better grasp its use and impact. The results clarify scale dependability, regression connections, descriptive statistics, factor analysis, ANOVA testing. The great score of 0.939 achieved by using Cronbach's Alpha to investigate internal consistency confirms the dependability of the scale; this suggests that the scale adequately depicts integrated learning. The item-total correlation values ranging from 0.68 to 0.78 indicated the internal coherence of the items with reference to the efficiency of blended learning. Eliminating the lines "Faculty is empowered to

operate the online learning effectively" and "Blended learning has led to greater student engagement" somewhat raised Cronbach's Alpha, suggesting that deleting these items would improve the dependability of the scale. Since most of the categories fit the scale's goal, these findings provide a strong foundation for evaluating how blended learning influences education in this field.Multiple regression analysis is used to examine how blended learning, teacher preparation, and internet resources affect student involvement. Given the small sample size of 10 observations, an R-squared value of 1.000 indicates probably overfitting or multicollinearity. Teacher preparation lowered student involvement; blended learning and internet resources improved it. Teacher training surprisingly lowers student participation; blended learning and online technologies raise it. Low p-value and an F-statistic of 1.295 x 10^31 in the fit statistics of the model show that student participation is significantly influenced by independent factors. Still, because multicollinearity is probably going to arise, model robustness needs to be considered. The residual statistics exhibit nearly little autocorrelation and a Durbin-Watson score around 2, therefore displaying a well- behaved model.

Descriptive statistics helped us to evaluate public and private schools with respect to student performance, infrastructure, teacher to student ratio, and general competitiveness. In several spheres, including student performance and facility quality, private universities outperformed public ones considering the differences in resources and results. Central trends among several variables revealed score clusters and patterns. For instance, a modal score of 65 for student performance revealed regular performance levels. Factor analysis split the data into its component elements and exposed correlations in the educational variables. By merging interrelated variables—especially those related to teacher training and technology integration—we were able to compress data and provide a more cohesive framework for looking at blended learning implementation. Results of factor loadings support the stated goal of the study—that of clarifying the components influencing the success of blended learning models.A one-way analysis of variance found that blended learning's efficacy in public and private schools varied dramatically. Although a bigger sample would improve generalizability, the F-statistic and p-value imply that in integrated learning private institutions might beat public ones. These findings, which provide a complete assessment of blended learning, imply improving teacher training and studying the influence of institutions and resources on student involvement and performance.

6. Future scope of the study

This study suggests that future research on blended learning in Indian schools should focus on tracking students' academic performance and critical thinking capacity over time, comparing blended learning with traditional methods, and analyzing the performance of various blended learning models in different classroom environments. It is also crucial to examine how new technologies like gamification, virtual reality, and artificial intelligence can enhance blended learning, and how community and family participation can improve student engagement and learning outcomes. Additionally, future studies should investigate how policy approaches influence schools' decisions to use blended learning, and provide evidence-supported remedies to increase the effectiveness of blended learning initiatives. By addressing these areas of research, researchers can contribute to improved educational approaches and outcomes for children worldwide.

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