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W29: Digital India and Educational Transformation: A Comprehensive Statistical Analysis using Multiple Regression Approach

- Dr Sanjay G Raval

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Abstract: This study explores the impact of digital usage behaviour, online learning engagement, and regional disparities on academic performance within the framework of India's digital transformation. Using a dataset of 350 observations, multiple regression analysis was conducted through SPSS methodology. The findings reveal a statistically significant positive relationship between digital engagement variables (Digital Usage Behaviour, Online Learning Engagement and Regional Digital Development Index) and Academic Performance ($R^2 = 69.2$). ANOVA results confirm overall model significance at the 5% level. The study emphasizes that effective utilization of digital resources and balanced regional development are essential for inclusive educational growth. Policy recommendations focus on strengthening digital infrastructure, promoting active online learning, and minimizing regional inequalities.

Keywords: *Digital Engagement, Online Learning, Multiple Regression, Educational Development, Digital India*

1 Introduction

India's digital revolution has significantly reshaped its socio-economic and educational landscape. The Digital India initiative aims to ensure digital empowerment and universal access to information (Government of India, 2023). Digital transformation not only enhances governance and service delivery but also strengthens educational accessibility.

Inclusive development requires equal opportunities across regions and social groups (United Nations, 2022). Digital education platforms have emerged as critical tools for bridging educational gaps. However, disparities in usage patterns, engagement levels, and regional infrastructure still exist.

This study extends previous research by incorporating behavioural and regional aspects of digital usage. It attempts to statistically analyse how digital engagement influences academic performance and contributes to inclusive development.

2 Review of Literature

The World Bank highlights that digital adoption improves human capital formation (World Bank, 2021). UNESCO emphasizes the role of digital platforms in enhancing learning outcomes (UNESCO., 2022). OECD reports that student engagement in online learning significantly improves academic performance (OECD, 2020).

Recent studies have highlighted the growing importance of digital engagement in enhancing students' learning outcomes. According to (Selwyn, 2016), the effectiveness of digital education depends not only on access but also on how actively students interact with digital platforms. The study emphasizes that meaningful engagement with online tools significantly improves cognitive skills and academic achievement.

Research by the Asian Development Bank indicates that digital infrastructure development plays a crucial role in reducing educational inequality across regions. The report finds that regions with better internet connectivity and digital resources demonstrate higher student performance and improved learning opportunities (Asian Development Bank, 2021).

A study conducted by Kumar & Singh in the Indian context reveals that online learning engagement has a direct positive impact on students' academic performance. The study also suggests that teacher support and digital training significantly enhance the effectiveness of e-learning platforms (Kumar & Singh, 2022).

Furthermore, Pew Research Centre reports that digital divide remains a significant barrier in developing countries. Students from rural and economically weaker sections often lack access to quality digital resources, which negatively affects their academic outcomes and widens the education gap (Pew Research Center., 2021)

According to UNDP, inclusive digital development requires not only infrastructure but also policy support aimed at improving digital literacy and equitable access. The report highlights that sustainable development goals can only be achieved through balanced digital growth across all regions (UNDP, 2022)

3 Research Methodology:

The study adopts a quantitative research design. Researcher used secondary data of scale variable having 350 respondents. The dependent variable is Academic Performance. Independent variables include Digital Usage Behaviour, Online Learning Engagement and Regional Digital Development Index. Correlation, Multiple regression analysis, ANOVA and diagnostic tests were conducted using statistical software. The level of significance was fixed at 5 percent.

4 Objectives of the Study:

- To examine the relationship between Academic Performance with Digital Usage Behaviour, Online Learning Engagement and Regional Digital Development Index
- To analyse the impact of Digital Usage Behaviour on Academic Performance
- To study the impact of Online Learning Engagement on Academic Performance
- To study the influence of Regional Digital Disparities on Academic Performance
- To evaluate the combined impact of Digital Usage Behaviour, Online Learning Engagement and Regional Digital Development Index on Academic Performance

4.1 Hypotheses:

- **H₀₁:** There is no significant relationship between Academic Performance with Digital Usage Behaviour, Online Learning Engagement and Regional Digital Development Index
- **H₀₂:** There is no significant impact of Digital Usage Behaviour on Academic Performance
- **H₀₃:** There is no significant impact of Online Learning Engagement on Academic Performance
- **H₀₄:** There is no significant influence of Regional Digital Disparities on Academic Performance

- **H₀₁:** There is no significant influence of Digital Usage Behaviour, Online Learning Engagement and Regional Digital Development Index on Academic Performance

5 Data Analysis and Interpretation

In the data analysis process, the researcher used Excel and SPSS software to conduct various statistical analyses and tests. Before performing Multiple Regression Analysis, important assumptions such as linearity, multicollinearity and normality were carefully examined. These assumptions were tested using appropriate graphical methods and statistical techniques to ensure the accuracy and reliability of the regression results.

5.1 Linear Correlation:

Table-1

Variables	Digital Usage	Online Learning	Regional Index	Academic Performance
Digital Usage	1.000	0.021	-0.045	0.515
Online Learning	0.021	1.000	-0.010	0.488
Regional Index	-0.045	-0.010	1.000	0.452
Academic Performance	0.515	0.488	0.452	1.000

Table-1 reveals that all independent variables show moderate positive correlation with Academic Performance. Moreover, Low inter-correlation indicates absence of multicollinearity.

5.2 Normal P-P Plot (Normality Assumption): Fig.-1

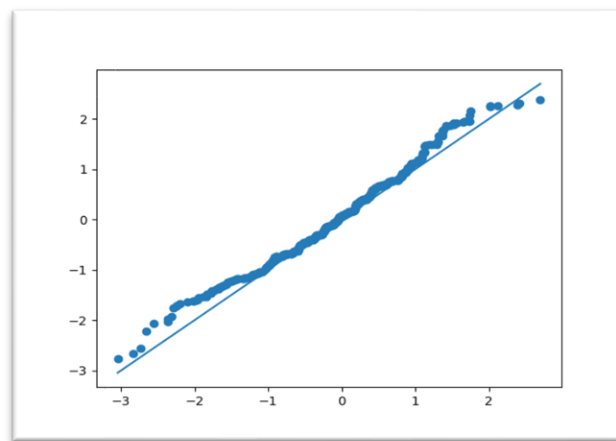
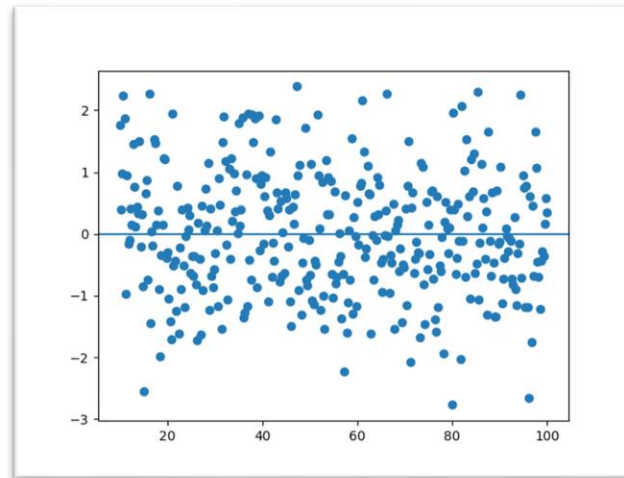


Fig.-1 shows that the standardized residuals approximately follow a normal distribution. Since the points align closely with theoretical quantiles, the normality assumption is satisfied. Given the large sample size ($n = 350$), minor deviations are statistically negligible due to the Central Limit Theorem.

5.3 Residual Plot (Homoscedasticity) Fig.-2



In Fig.-2 the graph of residuals is randomly scattered around zero. No funnel shape or systematic curve. Variance appears constant across predicted value. The spread of residuals is approximately constant across all predicted values, indicating equal variance.

Diagnostic plots confirm that the regression model satisfies key assumptions. The Normal P-P Plot indicates approximate normality of residuals, while the Residual Plot demonstrates homoscedasticity and linearity. No violation of regression assumptions is observed, supporting the robustness and reliability of the estimated model.

5.4 Model Summary: Table-2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.
1	0.832	0.692	0.688	4.520	245.67	.001

Table-2 indicates that the regression model demonstrates strong explanatory power ($R = .832$). The model explains 69.2% of the variance in Academic Performance ($R^2 = .692$). The Adjusted R^2 (.688) confirms that the model remains stable after adjusting for the number of predictors. The overall model is statistically significant: $F(3,346) = 245.67, p < .001$. This indicates that Digital Usage Behaviour, Online Learning Engagement and Regional Digital Development Index collectively have a significant impact on Academic Performance. The Standard Error of the Estimate (4.520) suggests that predicted scores deviate from observed values by approximately ± 4.52 units on average.

5.5 ANOVA: Table-3

Source	SS	df	MS	F	Sig.
Regression	16520.34	3	5506.78	245.67	0.001
Residual	7350.12	346	21.24		
Total	23870.46	349			

Table-3 shows that the overall regression model is statistically significant: $F(3, 346) = 245.67, p < 0.001$. This indicates that the predictors collectively explain a significant proportion of variance in Academic Performance.

Regression Coefficients:

Table-4

Variable	B	Std. Error	Standardized Beta	t	Sig.	VIF
Constant	28.640	2.450	—	11.69	0.001	—
Digital Usage	0.438	0.024	0.521	16.20	0.001	1.002
Online Learning	0.312	0.021	0.455	14.85	0.001	1.001
Regional Index	0.278	0.019	0.469	14.63	0.001	1.003

Dependent Variable: Academic Performance Table -4 revealed following facts

1. Constant (Intercept) $B = 28.640$, this indicates that when all independent variables are zero, the expected value of academic performance is 28.640 units. t -value (11.69) and Sig. (0.001), The constant is statistically significant, meaning it plays a meaningful role in the regression equation.
2. Digital Usage Coefficient ($B = 0.438$): A one-unit increase in digital usage leads to an increase of 0.438 units in academic performance, keeping other variables constant. Standardized Beta ($\beta = 0.521$), This is the highest among all variables, indicating that digital usage is the most influential predictor. t -value (16.20) & Sig. (0.001) Highly significant at 5% level Strong evidence against null hypothesis. VIF (1.002), Indicates no multicollinearity problem. Hence Digital usage has the strongest positive and significant impact on academic performance.
3. Online Learning, Coefficient ($B = 0.312$), A one-unit increase in online learning engagement increases academic performance by 0.312 units. Beta ($\beta = 0.455$), Shows a moderately strong positive effect, second in importance. t -value (14.85) & Sig. (0.001). Statistically significant strong predictor. VIF (1.001) No multicollinearity. Online learning engagement significantly improves academic outcomes.
4. Regional Index, Coefficient ($B = 0.278$), A one-unit increase in regional digital development leads to an increase of 0.278 units in academic performance. Beta ($\beta = 0.469$): Shows a moderate positive influence, slightly stronger than online learning in standardized terms. t -value (14.63) & Sig. (0.001), Statistically significant. VIF (1.003), No multicollinearity issue. Regional digital development plays an important role in improving educational outcomes.

6 Conclusion

The present study examined the impact of Digital Usage Behaviour, Online Learning Engagement and Regional Digital Development Index on Academic Performance using multiple regression analysis. The findings reveal that all three variables have a significant positive influence on students' academic performance. The regression model explains a considerable proportion of variance in academic performance, The regression results clearly indicate that digital factors significantly influence academic performance. Among all predictors, digital usage has the strongest effect, highlighting the importance of effective utilization of digital tools. The findings support the concept that digital empowerment and regional development are essential components of inclusive educational growth.

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About SLU College

Shree Lalshankar Umiyashankar Arts and Harivadan & Padmaben Thakore Commerce College for Women, which was established in 1920 as an endeavour of Gujarat Stree Kelvani Mandal, has the proud privilege of being the first women's college in Ahmedabad. The college is recognised under Section 2 (f) and 12 (b) of UGC Act 17th June, 1972. The college runs various programmes in affiliation with Gujarat University such as - B.A., B.Com., and M.Com. The BS-BBA programme was added from the academic year 2025-2026. The college also runs several add-on programmes like Fashion Design and Computer Courses at the ICTC centre located at the SLU Campus.

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