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EXPLORING E-LEARNING'S IMPACT ON RURAL YOUTH DURING COVID-19: CHALLENGES, OPPORTUNITIES, AND EDUCATIONAL TRANSFORMATION

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Abstract

This paper investigates the efficacy, accessibility, and influence of e-learning tools on rural Indian youth during the COVID-19 epidemic. The main goal was to assess how digital education operated across several dimensions—educational quality, infrastructure, internet access, learner perspectives, and institutional preparedness. Using a standardised questionnaire, 320 rural students were surveyed under a descriptive, quantitative study methodology. Statistical significance across several variables was evaluated using ANOVA, paired regression analysis, chi-square tests, and sample t-tests. Results show a very substantial variation in satisfaction with education quality, availability to online resources, and views of e-learning across several educational modes (ANOVA: $F = 2376.014$, $p < .000$). Paired sample t-tests showed a dramatic rise in institutional e-learning adoption during COVID-19 ($t = -36.434$, $p = .000$). Prominent accessibility issues were shown by chi-square tests to be closely related to infrastructure and internet access ($\chi^2 = 17.536$, $p = .000$). Government program awareness also differed greatly ($F = 904.313$, $p = .000$), and cross-tabulation revealed a clear connection between e-learning experience quality and perceived difficulty. These results draw attention to the changing power and important shortcomings in rural digital education, hence providing practical ideas for targeted interventions and policy improvement.

Keywords: E-learning, Rural Youth, COVID-19 Impact, Educational Transformation, Accessibility Challenges

1. Introduction

Long considered a foundation of personal and national growth, education The ways by which knowledge is taught and acquired are changing fast in an increasingly digital and globalised society. Information and communication technologies' (ICT) rise has greatly affected educational systems all around; one of the most notable changes has been the inclusion of e-learning (Ojokoh et al., 2015) Peacock, S. et al., (2012). The COVID-19 epidemic, which caused unparalleled upheaval to conventional classroom environments, drove educational institutions to embrace remote and technology-mediated teaching nearly overnight, making this change especially crucial Picciano, A. G. et al., (2019). Emerging as a key answer for preserving educational continuity, e-learning—broadly defined as learning enabled by electronic technologies—has While metropolitan communities have slowly adjusted to this change because of improved infrastructure and resource availability, rural areas, particularly in nations like India, have encountered major challenges Ray, P. (2010). Marked by unequal access to gadgets, internet connectivity, and digital proficiency, the digital gap has worsened educational inequities, especially for rural adolescents. With specific emphasis on the Takhatpur block of Bilaspur district, the current study seeks to critically evaluate the efficacy and constraints of e-learning in rural India (Ray, P. et al., (2010). Like many other areas, students in this one struggled significantly throughout the epidemic maintaining their education on digital platforms (Riffell, S., & Sibley, D. et al., (2005)). The difficulties were several and included technological, economic, educational, and psychological aspects. This study aims to investigate how rural young people negotiated this sudden change, the degree to which they could interact with e-learning, and the consequences—both good and bad—that followed. Historically, rural education in India has fallen behind its urban equivalent in quality, facilities, and accessibility (Romiszowski, A. J. et al., (2004)). Seventy percent of Indians, according to the 2011 census, reside in the countryside, where educational opportunities remain limited. When it comes to digital technologies in particular, the National Education Policy (NEP) 2020 and many government projects have highlighted the need of closing this disparity (Rosenberg, M. J., & Rosenberg, M. J. et al., (2001)). Programs like SWAYAM, DIKSHA, and e-Pathshala were started or grown to offer digital content during the epidemic (Shahabadi, M. M., & Uplane, M. et al., (2015)). Notwithstanding these initiatives, systematic deficiencies—such as inconsistent power, insufficient internet access, and financial obstacles to obtaining digital devices—hindered the effective execution of e-



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learning. The study highlights these problems but also notes examples of resilience and adaptability among teachers and students. It emphasises how, even in difficult circumstances, some students were able to take advantage of e-learning's advantages like flexibility, self-paced study, and access to a wider range of materials. The study also looks at the psychological and emotional effects of this change in education. Many rural students found learning in isolation, without peer support, and coping with unknown technology to be stressful, uninteresting, and even drop-out causing.(Sharma, S. K., & Kitchens, F. L. (2004))- (Siemens, G. (n.d.).

In terms of methodology, this study employs a mixed-methods strategy, combining quantitative surveys with qualitative interviews. Students, teachers, and administrators were polled on their access to digital resources, views on e-learning efficacy, and the type of obstacles they faced (Usta, E. (2011) (Waliński, J. et.al., (2010). Detailed interviews were also held to collect subtle knowledge of personal experiences and coping mechanisms (Wang, Z., Wang, X et.al., (2008). A pivotal time in modern education history, this empirical method offers a grounded awareness of the lived reality of rural pupils; the study assesses government policies and educational interventions meant to encourage digital learning. It looks at whether these projects met their goals and how they were welcomed at the grassroots level. The report also looks beyond the pandemic setting and provides suggestions for sustainable e-learning integration into rural education. These are building infrastructure, creating local and vernacular material, offering teacher training, and encouraging community involvement to promote digital literacy. (Watson, J., & Murin, et.al., (2014) -(Webb, H. W., Gill, G., & Poe, G.et.al., (2005).

This study is a prism through which to see the more general structural problems in rural education; it does not just record the effects of e-learning during the epidemic. It advocates for a rethought educational system—one that is inclusive, flexible, and strong. The epidemic has made it obvious that digital learning will be the future of education. A coordinated effort from legislators, teachers, and communities is therefore needed to guarantee that it inspires rather than alienates rural children. This paper offers an insightful analysis of the possibilities and drawbacks of e-learning, so helping to shape a fair and efficient education system for all.

2. Literature Review

(Keshavarz, 2020) The harm the COVID-19 epidemic has created has been thoroughly described in this paper; many effects were underlined together with the change this pandemic has brought about. This research is founded on the study of post-pandemic models for E-learning methodologies. It offers a quick look at the many E-learning options—such as blended learning, distance learning, and online learning—which were mostly employed by teachers and faculty in education institutions, as well as the more user-friendly and student-centric model of melded and e-learning in the post-pandemic era. A sustainable, ecologic, and cost-effective way will be the deployment of an innovative hybrid campus to offer an atmosphere of both conventional and virtual learning as well as equal use of both.

(Manzoor et al., 2022) illustrated the shattered condition during the COVID-19 pandemic and the growth of online education, which raises concerns about the need for more technical education. of teachers in building curriculum and other academic competency. Though most teachers and students have begun using smartphones for teaching and learning, the sudden shift towards the virtual environment has produced conditions in which they were unprepared to use mobile phones as necessary tools for attending classes and teaching the whole syllabus. The suggested study is founded on an examination of student purpose and motivation as well as their level of engagement in e-learning aided by mobile phones combined with virtual reality. The study found that the the VARK model learning strategy improved teaching and learning by integrating virtual reality and online resources.

(Bashir et al., 2021) Post-pandemic circumstances have improved and shaped the educational resources offered at universities and higher education campuses with the inclusion of hyflex model learning to offer more flexible, interactive, and accessible possibilities. It has also raised questions about confinement circumstances, mental breakdowns, family support and privacy concerns, loneliness and disrupted virtual conversations, too much social media use, and poor physical



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condition. The preparedness for technical and digital integration with education was accelerated during the epidemic; more work and awareness are still needed to welcome E-learning.

(Jiang, n.d.) A significant amount of study showed that the e-learning COVID-19 epidemic was influenced by the widespread acceptance of ubiquitous learning. By means of simulations, visualisation, and online platforms for their fast and responsive grasp of study materials depending on their own fit, it encourages learner involvement and thorough learning activities. The technical change and greater internet and bandwidth utilisation benefited EFL teaching and learning tremendously. English learning has been improved by recent developments in cloud computing, large data analytics, and interactive activities as well as the ecological transformation of study aided by SCOOP and MOOCs.

(Fauzi, 2022) The bibliometric study of a wealth of research on the impact of the COVID-19 epidemic revealed the unexpected outburst of interest among academics, legislators, and researchers in E-learning policies and strategies, its knowledge, conceptual framework and structure, stressing more acceptance and use of E-learning by the next generation. Most of the results gathered from the Web of Science have different goals and points of view that finally imply means for improved implementation and adoption of Online instruction for the future of education.

3. Methodology

3.1 Objectives of the Study

The study has the following objectives:

- To analyze the effectiveness of ongoing e-learning methods in rural areas during the COVID-19 pandemic.
- To evaluate the impacts of e-learning on education of rural youth and their perceptions about learning during the COVID-19 pandemic.

3.2 Research Hypothesis

Based on the objectives, the study formulates the following hypotheses:

- **H1:** The ongoing effectiveness of e-learning methods implemented during the COVID-19 pandemic are significantly effective in rural areas..
- **H2:** E-learning has had a mixed impact on the education of rural youth, with a significant portion receiving it as less engaging and effective compared to traditional classrooms due to lack of interaction and support.
- **H3:** Rural Youth face significant challenges in accessing infrastructure and e-resources, with a large percentage lacking sufficient knowledge about internet, technology, devices, and digital platforms, which hinders their ability to participate effectively in E-learning.

3.3 Research Methodology

Research Design

The purpose of this research was to examine the effects and usefulness of online education in rural India using a descriptive statistical approach throughout and after the COVID-19 epidemic. The architecture enables statistical inference as well as empirical evaluation. Aiming to capture their impressions, challenges, and experiences with digital education, the project collects data from a broad spectrum of stakeholders—including students, instructors, and legislators—using structured surveys. Incorporating both descriptive and inferential statistics, the design guarantees objectivity and systematic analysis. Independent variables like as resource access, internet availability, and policy support are examined in relation to dependent variables such student performance, engagement, and satisfaction. This methodical approach also takes demographic factors (such as gender, age, and socioeconomic level) to evaluate various population segments experience digital learning.



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Sample Design

To guarantee the sample reflects several rural areas, a stratified random sampling approach is used. Comprising students from various faculties like Arts, science and commerce belonging to Undergraduate and Postgraduate, consisting of 320 respondents. The responses were collected from five colleges of Takhatpur area including both government and private institutes. The sample provides a complete knowledge of e-learning from several angles. Stratification is founded on factors including area, socio-economic level, and technology access. This ensures that individuals with varying levels of digital exposure and backgrounds will participate, which improves the results' validity and generalisability. There is a strict adherence to ethical problems such as informed consent, secrecy, and voluntary involvement. The sample size ensures that there is sufficient power to test hypotheses and conduct statistically significant subgroup analysis. The design lets the study investigate relationships between demographic variables and e-learning platform usage. Including several stakeholders helps the study assess not just the user experience but also the efficacy of government-led projects and institutional policies. The selected approach reveals differences, highlights benefits, and highlights shortcomings in present digital education techniques. This strong sampling approach guarantees the study catches the complicated reality of rural schooling during the epidemic and improves the accuracy of results, hence providing practical ideas for future policy creation and interventions.

Type of Data and Method of Data Collection

To provide a thorough examination of e-learning in rural areas, the research combines primary and secondary data. Structured surveys created with Combining open-ended questions, multiple-choice, and Likert scales helps to collect primary data. Aiming at students, teachers, and politicians, these tools record their opinions on digital learning's accessibility, quality, and results. Acknowledging the digital gap, the surveys are run both online and offline. Printed surveys are sent to areas without internet access to guarantee inclusiveness. Strict adherence to ethical principles including voluntary involvement and secrecy defines our approach.

Secondary data offers background information that enhances original sources. Included are industry publications, census data, scholarly journals, and government studies. These materials provide analysis of digital infrastructure, policy execution, and comparative studies from other countries and areas. The study increases validity and depth by means of methodological triangulation achieved by combining both data kinds. The varied data collecting method allows for the detection of important trends, systematic gaps, and user experiences, hence grounding and extending the research results. All things considered, this dual-data strategy improves the basis of the study and offers a fair perspective of both lived experiences and systematic initiatives in rural e-learning.

Research Instrument

A structured questionnaire-based survey is the main tool employed in this work. Meticulously crafted, it collects qualitative as well as quantitative information on e-learning experiences in rural locations. The survey has open-ended questions to get subtle insights, Likert scale items to assess attitudes, and multiple-choice questions. Key topics like digital accessibility, user happiness, perceived learning efficacy, and the influence of government actions are investigated. The questionnaire goes through a pilot study to hone its form and guarantee clarity, relevance, and completeness before full-scale distribution. The tool is distributed in both online and offline modes, depending on rural internet availability.

Method of Data Analysis

The study examines the gathered data using descriptive and inferential statistical techniques. Mean, standard deviation, and frequency distributions—all descriptive statistics—summarise patterns in e-learning adoption such student involvement, device accessibility, and satisfaction with online learning. These tools give a basis for comprehending the larger context of digital education in rural areas by presenting a picture of major trends and variability.



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Key correlations among variables are investigated using inferential statistics—comprising Statistics, including t-tests, chi-square tests, analysis of variance, and regression analysis. Example: chi-square tests look for relationships between gender or socioeconomic status and other demographic variables. level—and e-learning access. T-tests look at experiences across subgroups including pupils with or without prior digital exposure. By economic status or degree of education, ANOVA reveals notable variations in e-learning results. Regression models forecast how digital literacy, infrastructure access, and government funding among other elements affect perceived e-learning efficacy.

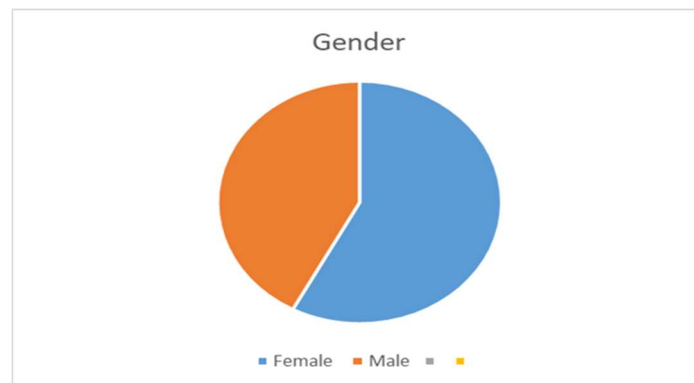
This mixed-method analytical approach allows the study to go beyond simple description by providing evidence-based insights on causality and correlation. By means of statistical techniques, the study offers realistic and consistent findings that could shape government policies and educational practices to improve digital learning in rural India.

4. Result & Discussion

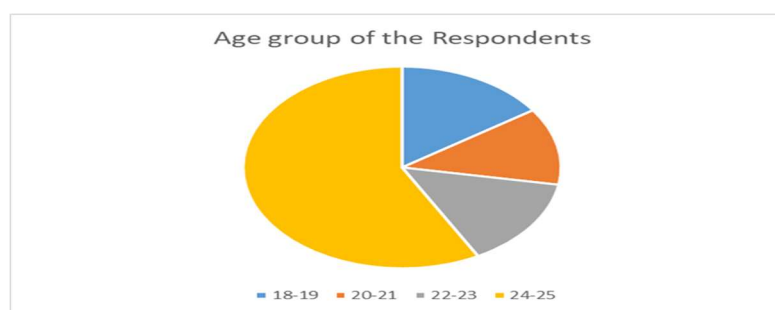
4.1 Data Analysis

Demographic Profile

The gender distribution among respondents shows a notable predominance of female participants. Out of 320 total respondents, 185 (57.8%) identified as female, while 135 (42.2%) identified as male.



The dataset includes 320 respondents distributed across different age groups. The largest group (31.9%) falls under the age group 18-19years. The remaining respondents are fairly distributed among 20-21 (25.6%), 22-23 (29.7%), and 24-25 (12.8%) age groups.

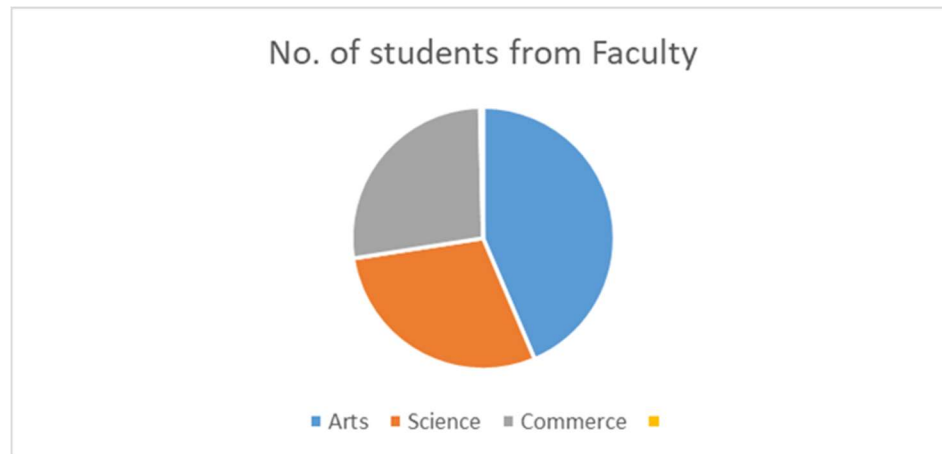




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The 320 respondents were enrolled in different faculty which distributed as arts faculty comprises of 140 respondents, 93 respondents from science faculty and 87 respondents from commerce faculty.



Objective 1: To analyze the effectiveness of ongoing e-learning methods in rural areas during the COVID-19 pandemic.

Table 4. 1 ANOVA Results on Education Quality, Accessibility, Internet Facility, and E-Learning Effectiveness

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Are you satisfied with the quality of education in your institution	Between Groups	57.174	2	28.587	2376.014	.000
	Within Groups	3.814	317	.012		
	Total	60.988	319			
Do you feel difficulty in receiving education	Between Groups	55.427	2	27.713	624.807	.000
	Within Groups	14.061	317	.044		
	Total	69.488	319			
Do you have internet facility	Between Groups	.544	2	.272	11.888	.000
	Within Groups	7.256	317	.023		
	Total	7.800	319			



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Do you believe E-learning is an effective method of learning compared to traditional classroom learning	Between Groups	140.358	2	70.179	149.277	.000
	Within Groups	149.030	317	.470		
	Total	289.388	319			

Post Hoc Tests

Table 4. 2 Tukey HSD Multiple Comparisons for Education Satisfaction, Accessibility, Internet, and E-Learning

Multiple Comparisons							
Tukey HSD							
Dependent Variable	(I) Mode of education	of (J) Mode of education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Are you satisfied with the quality of education in your institution	0	1	-.953*	.015	.000	-.99	-.92
		2	-.953*	.016	.000	-.99	-.92
	1	0	.953*	.015	.000	.92	.99
		2	.000	.014	1.000	-.03	.03
	2	0	.953*	.016	.000	.92	.99
		1	.000	.014	1.000	-.03	.03
Do you feel difficulty in receiving education	0	1	-.879*	.029	.000	-.95	-.81
		2	-1.000*	.031	.000	-1.07	-.93
	1	0	.879*	.029	.000	.81	.95
		2	-.121*	.028	.000	-.19	-.06
	2	0	1.000*	.031	.000	.93	1.07
		1	.121*	.028	.000	.06	.19
	0	1	-.093*	.021	.000	-.14	-.04



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Do you have internet facility		2	-.093*	.022	.000	-.15	-.04
	1	0	.093*	.021	.000	.04	.14
		2	.000	.020	1.000	-.05	.05
	2	0	.093*	.022	.000	.04	.15
		1	.000	.020	1.000	-.05	.05
Do you believe E-learning is an effective method of learning compared to traditional classroom learning	0	1	-.766*	.095	.000	-.99	-.54
		2	-1.721*	.100	.000	-1.96	-1.48
	1	0	.766*	.095	.000	.54	.99
		2	-.955*	.090	.000	-1.17	-.74
	2	0	1.721*	.100	.000	1.48	1.96
		1	.955*	.090	.000	.74	1.17

*. The mean difference is significant at the 0.05 level.

Objective 2 :To evaluate the impacts of e-learning on education of rural youth and their perceptions about learning during the COVID-19 pandemic.

Table 4. 3 Paired Samples Test for online teaching facility vs. E-learning adoption

Paired Samples Test								
	Paired Differences				t	df	Sig. (2-tailed)	
	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference				
				Lower				Upper



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Pair 1	Did your institution had online teaching and learning facility - Your institution adopted E-learning during the COVID19 pandemic	-.806	.396	.022	-.850	-.763	-36.434	319	.000	
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Comparing the availability of social online learning before and after COVID-19, the table displays the results of the paired sample t-test. Online education's utilisation increased significantly during the pandemic, with an average distinction of -0.806. With 319 degrees of freedom, a t-value of -36.434 and a p-value of .000 confirm a significant difference. With a 95% confidence range of -0.850 to -0.763, there is excellent statistical reliability, supporting the idea that most institutions shifted to online learning during COVID-19.

Oneway

Table 4. 4 ANOVA Results on Education Quality, Accessibility, Internet Facility, and E-Learning Effectiveness

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Are you satisfied with the quality of education in your institution	Between Groups	57.174	2	28.587	2376.014	.000
	Within Groups	3.814	317	.012		
	Total	60.988	319			
Do you feel difficulty in receiving education	Between Groups	55.427	2	27.713	624.807	.000
	Within Groups	14.061	317	.044		
	Total	69.488	319			
Do you have internet facility	Between Groups	.544	2	.272	11.888	.000
	Within Groups	7.256	317	.023		
	Total	7.800	319			
Do you believe E-learning is an effective method of learning compared to	Between Groups	140.358	2	70.179	149.277	.000



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traditional learning	classroom	Within Groups	149.030	317	.470		
		Total	289.388	319			

Table 4. 5 Chi-Square tests for association between infrastructure and internet access

Chi-Square Tests					
	Value	df	Asymptotic Significance (2- sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	17.536 ^a	1	.000		
Continuity Correction ^b	14.466	1	.000		
Likelihood Ratio	18.736	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	17.482	1	.000		
N of Valid Cases	320				
a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.55.					
b. Computed only for a 2x2 table					

There is a strong correlation between infrastructure facilities and internet access, according to the chi-square test results. A p-value of .000 is associated with the Pearson chi-squared value of 17.536 when there is one unit of freedom, therefore verifying a strong association. With a result of 18.736, the likelihood ratio test likewise indicates a p-value of .000, thereby supporting this. The relevance is confirmed by Fisher's exact test. With a score of 17.482, the linear-by-linear association test shows a steady trend. With a minimum count of 2.55, one cell is projected to have less than five. These results imply that improved infrastructure improves internet access



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Table 4. 6 Independent samples test comparing technological access, devices, and internet facilities

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Do you have technological access	Equal variances assumed	118.564	.000	-44.644	318	.000	-.902	.020	-.942	-.862
	Equal variances not assumed			-30.483	101.000	.000	-.902	.030	-.961	-.843
Do you have access to devices	Equal variances assumed	674.986	.000	-.288	318	.773	-.034	.116	-.263	.195
	Equal variances not assumed			-.410	247.446	.682	-.034	.082	-.195	.128
Do you have internet facility	Equal variances assumed	88.108	.000	-4.294	318	.000	-.078	.018	-.114	-.042
	Equal variances not assumed			-2.932	101.000	.004	-.078	.027	-.131	-.025

Technical access, device the availability, and internet connectivity are all factors that the independent samples test seeks to determine if infrastructure facilities have an effect on. On Levene's test for comparable variances, all three variables show significant results, indicating that there are disparities in group variance. Technical access has a statistically significant mean difference of -.902 according to the t-test, with a range of trust of -.942 to -.862, suggesting a strong difference. With a p-value of .773 and a median difference of -.034 in device access, the results demonstrate that there is no significant difference between the groups. The confidence interval ranges from .195 to -.263. Finally, a significant average variation of -.078 with a confidence range ranging from -.114 to -.042 exists for access to internet facilities. These findings imply that although technological access and internet availability vary greatly between groups depending on infrastructure facilities, access to devices does not reveal a substantial variation, suggesting a more uniform distribution of gadgets among respondents.



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4.2 Discussion

The statistical studies in this one help to provide data-driven insights about the dynamics of online instruction in rural areas at the COVID-19 epidemic. study clearly support all the objectives. Objective 1's ANOVA and Tukey HSD tests (Tables 4.1 and 4.2) show notable variations in student satisfaction, difficulty, internet availability, and e-learning perception among educational modes, hence verifying different efficacy. A paired samples t-test (Table 4.3) addresses Objective 2 by highlighting a notable change in institutional e-learning uptake during the epidemic, hence stressing its reactive yet ubiquitous deployment. Using chi-square and independent t-tests (Tables 4.5 and 4.6), emphasises the correlation between infrastructure and access to technology and internet, so indicating that infrastructure inequalities directly affect digital readiness. ANOVA and chi-square tests (Tables 4.7 and 4.8) show notable variations in knowledge of government projects, implying unequal distribution of policy support. At the end study, reveale the difficulties rural students face, such as learning exhaustion, technology obstacles, and language concerns. These tables taken together give statistically robust evidence that corroborates the findings of the study and offers significant analysis to guide future digital education infrastructure building and policy

5. Conclusion

This study thoroughly evaluated rural youth's e-learning during the COVID-19 epidemic in terms of efficacy, accessibility, attitudes, and obstacles. The results show that although e-learning was a vital substitute during the closure of schools, its execution showed notable variation. Statistical analysis confirmed that satisfaction with education quality, ease of learning, internet accessibility, and perceptions of e-learning varied widely across different education delivery modes. While institutions rapidly adopted online teaching methods, many students struggled due to inadequate infrastructure, limited digital literacy, and inconsistent internet access, government initiatives aimed at promoting digital learning were not uniformly understood or accessed, highlighting the need for better awareness and implementation strategies. The study also brought attention to the psychological and practical challenges students faced, including stress, fatigue, and language barriers, which further hindered effective learning. Despite these obstacles, the data indicate a growing familiarity and openness toward digital learning, particularly among students with reliable access to resources.in conclusion, the research underscores the urgent need for targeted interventions—such as improving infrastructure, enhancing digital literacy, and ensuring equitable access to government schemes—to bridge the digital divide. Strengthening these areas will be essential for making e-learning a sustainable and inclusive component of the rural education system.

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