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A Comparative Study of Digital Education in Rural and Urban Areas

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Abstract- Digital education has expanded rapidly across Indian schooling in recent years, yet its distribution across rural and urban settings remains markedly uneven. The present paper reports the findings of a study undertaken to compare the access to, utilisation of, and attitude toward digital education among rural and urban secondary school students of Yamuna Nagar district, Haryana, and to examine whether the two localities differ significantly on access, device availability, internet connectivity, teacher digital competency, and attitude. A sample of one hundred Class 9 and 10 students was drawn through stratified random sampling from six secondary schools, balanced across locality (50 rural, 50 urban). Data were gathered using the Digital Education Accessibility Scale, adapted from Rani and Thakur (2020), and analysed using Pearson's correlation and the independent-samples t-test at the 0.05 level of significance. Results showed urban students scoring significantly higher on all five dimensions tested, a strong positive correlation between Access and Utilisation scores, and a near-categorical rather than gradual divide in Access between the two localities. The paper discusses these findings in the light of existing research and offers implications for teachers, schools, and policy planners.

Keywords- Digital Education, Digital Divide, Rural-Urban Comparison, Secondary School Students, Access and Utilisation, Descriptive Survey.

I. Introduction

Education in the twenty-first century increasingly relies on digital tools — smartphones, computers, learning platforms, and internet connectivity — to deliver, supplement, and personalise instruction. The COVID-19 pandemic accelerated this shift sharply, but it also exposed a pre-existing fault line: students with ready access to devices and connectivity continued learning largely uninterrupted, while those without such access were frequently cut off from schooling altogether. This fault line runs most visibly along the rural-urban divide, and it is this divide that the present study sets out to examine.

Haryana, despite its overall economic advancement relative to many other Indian states, mirrors this internal disparity, with urban centres developing rapidly alongside rural belts that continue to face basic infrastructural constraints. Yamuna Nagar district, comprising both an established urban core and an extensive rural hinterland within a compact administrative area, offers a natural and largely unexamined setting in which to study this divide directly, holding broader state-level policy conditions roughly constant.

Government schemes such as Digital India, DIKSHA, and PM eVidya have sought to extend digital infrastructure and content to every corner of the country, yet the pace at which such schemes are absorbed varies considerably from one community to the next. Whether this variation is best explained by material constraints, by differences in teacher readiness, or by differences in household digital culture remains, for Yamuna Nagar district specifically, an empirical question rather than a settled one, and it is this question that motivates the present investigation.

II. Review of Related Literature

A substantial body of research has documented the uneven spread of digital education across rural and urban India, spanning more than a decade and a half of policy attention and empirical enquiry. Kumar and Sharma (2008) found that rural primary schools of Uttar Pradesh lacked functional internet connectivity and relied on outdated hardware, while Mehta and Chand (2012) reported that government-supplied ICT hardware in rural schools frequently went underused owing to inadequate maintenance and training. Singh (2016) found that a large majority of rural Haryana teachers had never used a projector or digital content in class, a gap attributed to insufficient training rather than reluctance.

KPMG and Google (2017) quantified the resulting usage gap nationally, finding that fewer than one in ten rural internet users accessed digital education platforms compared with roughly one in five urban users. Kaur and Mehta (2022), in a comparative study across Haryana schools including Yamuna Nagar district, reported that ninety per cent of urban students possessed a personal smartphone against under forty per cent of rural students — a finding the present study tests directly and updates for the district's secondary-level student population.

Gupta (2018), examining digital classrooms in rural Himachal Pradesh, found that improved engagement depended heavily on consistent electricity and active teacher facilitation rather than on the presence of digital content alone, while a national review by NIEPA (2019) similarly concluded that the numerical growth of rural ICT infrastructure had outpaced its actual pedagogical integration. Chaudhary and Khan (2021) offered a more encouraging counterpoint, finding that rural student interest in digital learning rose sharply wherever community-based learning centres provided shared, guided access — a pattern suggesting that the divide documented here is addressable through targeted intervention rather than fixed.

Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) framework further clarifies why device availability alone is insufficient: effective digital teaching requires the intersection of technological, pedagogical, and content knowledge, and a teacher confident in subject matter may nonetheless underuse available technology without dedicated training. Warschauer (2004) had earlier argued, more broadly, that underlying socio-economic disparity, rather than technology availability per se, is the primary determinant of how effectively digital tools are used once introduced into a community — a proposition the present study's Access-Utilisation correlation analysis tests directly.

A closer reading of this literature reveals a persistent gap relevant to the present study: the great majority of comparative studies examining digital education jointly across rural and urban settings have drawn on state- or national-level samples, with comparatively little research addressing Yamuna Nagar district specifically at the level of individual secondary schools. Where locale has been examined at all within the district, as in Kaur and Mehta (2022), it has typically been treated as a single background comparison rather than disaggregated across access, usage, and pedagogical dimensions separately. The present study responds directly to this gap.

Van Dijk's (2006) layered digital divide framework distinguishes material access, skill, and usage as separate stages of digital inclusion, while Rogers' (1962) Diffusion of Innovation theory explains why identical government schemes are frequently absorbed at different rates across communities with differing infrastructural and social conditions. Taken together, this literature establishes a consistent expectation of a substantial rural-urban gap in digital education access and usage, alongside a specific, largely unaddressed gap concerning focused, district-level comparative evidence for Yamuna Nagar — the gap the present study addresses.

III. Digital Access and Utilisation: A Conceptual Link

Material access to digital devices and connectivity is a necessary, but not by itself sufficient, condition for meaningful digital learning. A device that is available but rarely used, or a connection that is present but unreliable, does not translate automatically into the kind of sustained utilisation that supports learning outcomes. The present study accordingly treats Access and Utilisation as conceptually distinct, though empirically related, constructs — a distinction tested directly through the correlation analysis reported in Section XI.

Van Dijk's (2006) layered framework situates this distinction formally, proposing that material access, digital skill, and actual usage constitute sequential stages of digital inclusion rather than a single undifferentiated condition. A student may clear the first stage — owning or sharing a device — without clearing the second or third, particularly where teacher facilitation, the specific focus of Hypothesis H04 in the present study, remains limited. This layered view directly motivates the study's decision to measure Access, Utilisation, Teacher Digital Competency, and Attitude as separate, independently comparable dimensions rather than a single composite score.

Objectives of the Study

- To assess the access to digital devices, internet, and online learning resources among rural and urban secondary school students.
- To compare the utilisation of digital tools between rural and urban secondary school students.
- To examine the attitudes of rural and urban secondary school students toward digital learning.
- To identify key problems faced by students in both localities and suggest strategies for improvement.

IV. Hypotheses of the Study

- **H01:** There is no significant difference in overall access to digital education between rural and urban secondary school students.
- **H02:** There is no significant difference in the availability of digital devices between rural and urban secondary school students.
- **H03:** There is no significant difference in internet connectivity between rural and urban secondary school students.
- **H04:** There is no significant difference in the perceived digital competency of teachers between rural and urban secondary school students.
- **H05:** There is no significant difference in attitude toward digital learning between rural and urban secondary school students.

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Delimitations

The study is delimited to students studying in Classes 9 and 10, drawn from six secondary schools of Yamuna Nagar district, Haryana, during the academic session 2024–26. The sample is restricted to one hundred respondents, selected from three rural and three urban schools spanning government and private management. The study is confined to the variables of Access, Utilisation, and Attitude, measured through a standardised research tool; other related variables such as academic achievement or intelligence fall outside its scope.

V. Method

The Descriptive Survey Method was employed, since the study is concerned with describing the naturally occurring levels of, and differences in, digital education access and use, rather than manipulating any variable experimentally. This method is well suited to comparing two pre-existing, naturally occurring groups — rural and urban students — on a common set of measured variables.

Sample

Stratified random sampling was used to draw a sample of one hundred secondary school students from six schools of Yamuna Nagar district, proportionately balanced across locality (50 rural, 50 urban) and spanning government and private management (60 government, 40 private). Approximately equal numbers of male and female students were included within each locality (Rural: 26 male, 24 female; Urban: 24 male, 26 female).

Schools were first stratified into rural and urban strata on the basis of administrative location; three schools were then randomly selected from each stratum, spanning both government and private management, and students of Classes 9 and 10 within each selected school were randomly drawn from class enrolment registers until the target of 50 students per stratum was reached. This two-stage procedure was adopted in preference to simple random sampling across the full district population, since it guarantees balanced representation of both localities and both management types, which unrestricted random sampling alone would not assure given the district's uneven distribution of rural and urban schools.

Tools Used and Collection of Data

The Digital Education Accessibility Scale, adapted from Rani and Thakur (2020), was used for data collection. The tool comprises four sections — demographic details, Access (10 items), Utilisation (12 items, including four items used to derive a Teacher Digital Competency index), and Attitude (12 Likert-type items) — with internal

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consistency established through a pilot study (Cronbach's $\alpha = 0.87$ overall). Formal permission was obtained from school principals prior to data collection. The questionnaire was administered in person during school hours under the investigator's supervision, with confidentiality assured to all respondents.

Content validity of the adapted tool was established through expert review by two faculty members specialising in educational technology together with the dissertation supervisor, and construct validity was supported through item-total correlations computed during the pilot phase, with all retained items correlating at 0.30 or above with their respective sub-scale total. Test-retest reliability, assessed through re-administration to the pilot group after a two-week interval, yielded a correlation of 0.83 for the composite score, indicating satisfactory temporal stability.

Statistics Used

Descriptive statistics (Mean, Standard Deviation) were used to address the first three objectives. Pearson's product-moment correlation coefficient was used to examine the relationship between Access and Utilisation scores, calculated as $r = \Sigma(X-\bar{X})(Y-\bar{Y}) / \sqrt{[\Sigma(X-\bar{X})^2 \times \Sigma(Y-\bar{Y})^2]}$. The independent-samples t-test was used to compare rural and urban students on each dimension, calculated as $t = (M_1-M_2) / \sqrt{[(SD_1^2/n_1)+(SD_2^2/n_2)]}$. All tests were conducted at the 0.05 level of significance, with the null hypothesis rejected wherever the calculated value equalled or exceeded the critical value (1.98 for df = 98).

VI. Analysis of Data

Table 1 presents the descriptive statistics obtained on all measured dimensions for the rural and urban groups.

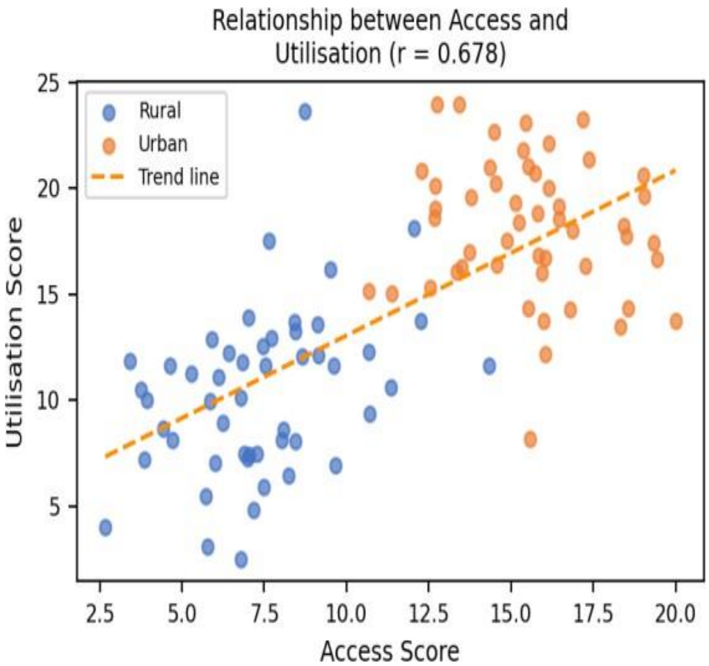
Table No. 1: Descriptive Statistics of All Measured Dimensions (N = 100)

Dimension	Rural M (SD)	Urban M (SD)
Access (0-20)	7.32 (2.42)	15.6 (2.29)
Utilisation (0-24)	10.36 (4.02)	18.08 (3.36)
Attitude (12-60)	38.8 (5.74)	45.94 (6)
Teacher Comp. (0-12)	5.58 (2.41)	8.9 (1.9)

Table 2 presents the correlation obtained between Access and Utilisation scores.

Table No. 2: Correlation between Access and Utilisation (*p<0.05, df=98)

Variables	N	r	Result
Access × Utilisation	100	0.678	Sig.*



Graph No. 1: Scatter Plot showing Relationship between Access and Utilisation Scores

Table 3 presents the comparison of rural and urban students on overall Access, testing Hypothesis H01.

Table No. 3: Rural-Urban Comparison of Access Scores (*Sig. at 0.05, df=98)

Group	N	Mean	SD	t
Rural	50	7.32	2.42	
Urban	50	15.6	2.29	17.59*

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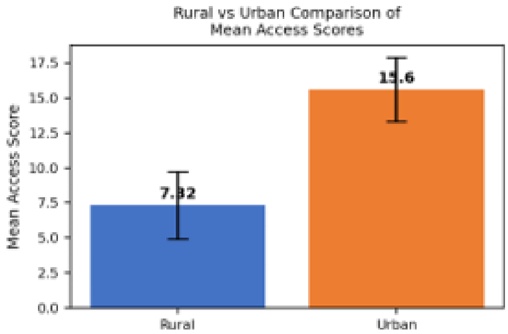


Graph No. 2: Rural vs Urban Comparison of Mean Access Scores

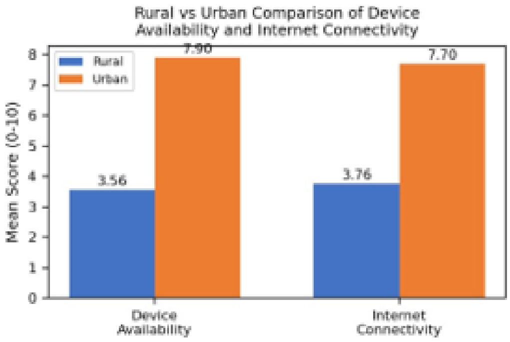
Tables 4 and 5 present the comparison of rural and urban students on Device Availability and Internet Connectivity, testing Hypotheses H02 and H03 respectively.

Table No. 4: Rural-Urban Comparison of Device Availability (*Sig. at 0.05, df=98)

Group	N	Mean	SD	t
Rural	50	3.56	1.72	
Urban	50	7.9	1.8	12.35*

Table No. 5: Rural-Urban Comparison of Internet Connectivity (*Sig. at 0.05, df=98)

Group	N	Mean	SD	t
Rural	50	3.76	1.93	
Urban	50	7.7	1.57	11.19*



Graph No. 3: Rural vs Urban Comparison of Device Availability and Internet Connectivity

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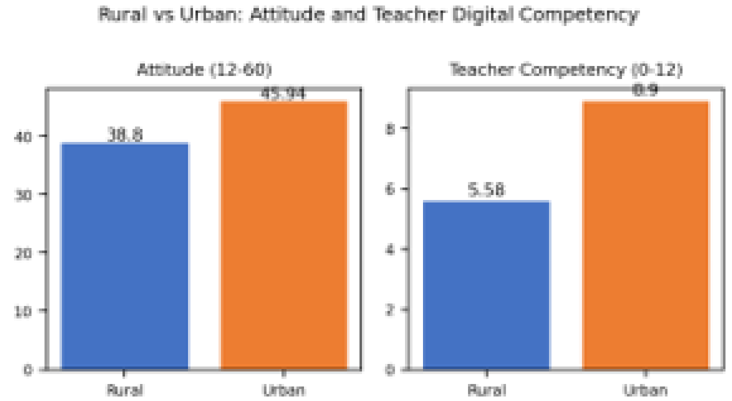
Tables 6 and 7 present the comparison of rural and urban students on Teacher Digital Competency and Attitude toward Digital Learning, testing Hypotheses H04 and H05 respectively.

Table No. 6: Rural-Urban Comparison of Teacher Digital Competency (*Sig. at 0.05, df=98)

Group	N	Mean	SD	t
Rural	50	5.58	2.41	
Urban	50	8.9	1.9	7.66*

Table No. 7: Rural-Urban Comparison of Attitude toward Digital Learning (*Sig. at 0.05, df=98)

Group	N	Mean	SD	t
Rural	50	38.8	5.74	
Urban	50	45.94	6	6.08*



Graph No. 4: Rural vs Urban Comparison of Attitude and Teacher Digital Competency

As a further descriptive step, Table 8 presents the percentage distribution of device ownership status, and Table 9 the percentage distribution of frequency of digital platform use, across the two localities, providing a more granular picture of the pattern underlying the Access and Utilisation gaps reported above.

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Table No. 8: Percentage Distribution of Device Ownership Status by Locality

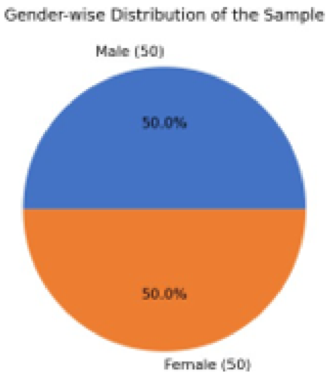
Device Ownership	Rural (%)	Urban (%)
Personal device	22	68
Shared with family	38	30
No device	40	2

Table No. 9: Percentage Distribution of Frequency of Digital Platform Use by Locality
Only 22% of rural students reported owning a personal digital device against 68% of urban students, while 40% of rural students reported no device access at all, against a negligible 2% among urban students. Daily use of a digital learning platform was reported by 70% of urban students but only 12% of rural students — a gap considerably wider than the corresponding Attitude gap, consistent with the interpretation that infrastructural constraints, rather than a lack of interest, are the more immediate barrier to regular rural digital learning.

Table 10 and Graph 5 summarise the demographic composition of the sample described in Section VIII.

Table No. 10: Demographic Profile of the Sample (N = 100)

Category	Sub-Group	N
Locality	Rural / Urban	50 / 50
Gender	Male / Female	50 / 50
School Mgmt.	Govt. / Private	60 / 40



Graph No. 5: Gender-wise Distribution of the Sample

Table 11 summarises the outcome of hypothesis testing across all five hypotheses.

Table No. 11: Summary of Hypothesis Testing

Hyp.	Statistic	Decision
H01	t = 17.59	Rejected
H02	t = 12.35	Rejected
H03	t = 11.19	Rejected
H04	t = 7.66	Rejected
H05	t = 6.08	Rejected

As an exploratory extension beyond the five formal hypotheses, Table 12 presents a gender-wise comparison on Access scores, pooled across both localities, to examine whether the rural-urban gap documented above is compounded or offset by any gender effect.

Table No. 12: Gender-wise Comparison of Access Scores (NS = Not Significant at 0.05, df=98)

Group	N	Mean	SD	t
Male	50	11.4	5.12	
Female	50	11.52	4.45	0.13 (NS)

Table 13 extends the correlation reported in Table 2 by computing it separately within each locality, to examine whether the Access-Utilisation relationship holds uniformly across rural and urban sub-groups.

Table No. 13: Sub-group-wise Correlation between Access and Utilisation

Sub-group	N	r	Result
Rural	50	0.37	Sig.
Urban	50	-0.158	NS

Findings Based on Hypotheses

- Urban students scored significantly higher than rural students on overall Access ($t = 17.59$, $df = 98$, $p < .05$), with urban $M = 15.6$ against rural $M = 7.32$ — the largest sub-group difference obtained among all dimensions tested. H01 is rejected.
- Urban students scored significantly higher on Device Availability ($t = 12.35$, $df = 98$, $p < .05$), with urban $M= 7.9$ against rural $M = 3.56$. H02 is rejected.

- Urban students scored significantly higher on Internet Connectivity ($t = 11.19$, $df = 98$, $p < .05$), with urban M= 7.7 against rural M = 3.76. H03 is rejected.
- Urban students reported significantly higher perceived Teacher Digital Competency ($t = 7.66$, $df = 98$, $p < .05$), with urban M = 8.9 against rural M = 5.58. H04 is rejected.
- Urban students reported a significantly more positive Attitude toward digital learning ($t = 6.08$, $df = 98$, $p < .05$), with urban M = 45.94 against rural M = 38.8, though this gap was proportionately the smallest among all dimensions tested. H05 is rejected.
- Access and Utilisation scores were strongly and positively correlated ($r = 0.678$, $N = 100$, $p < .05$), indicating that material access functions as a strong precondition for actual usage of digital tools.
- No significant gender difference was found on Access scores when pooled across localities ($t = 0.13$, $df = 98$, not significant at 0.05 level), with male (M = 11.4) and female (M = 11.52) students scoring nearly identically, indicating that locality rather than gender is the dominant factor shaping digital access in this sample.
- The Access-Utilisation correlation held for rural students ($r = 0.37$, significant at 0.05 level) but was weak, negative, and not statistically significant for urban students ($r = -0.158$, not significant), suggesting that once access reaches a sufficiently high and relatively uniform level, as it does among most urban students, further gains in access cease to predict additional usage, whereas among rural students, where access levels vary more widely, incremental access continues to translate into incremental usage.

VII. Discussion

The significant Access gap obtained here is consistent with Kaur and Mehta's (2022) Haryana-based estimate and with the broader pattern documented by KPMG and Google (2017). The comparatively smaller Attitude gap, alongside significant gaps on every material and pedagogical dimension, echoes the Access-Utilisation-Attitude distinction proposed by van Dijk's (2006) layered digital divide framework: rural students in this sample are not less willing to engage with digital learning, but are considerably less equipped to do so.

The strong overall Access-Utilisation correlation obtained is consistent with the expectation that material access is a necessary, though not solely sufficient, precondition for meaningful digital usage. The significant Teacher Digital Competency gap further echoes Singh's (2016) finding that limited training, rather than reluctance, constrains rural teachers' classroom use of digital tools, reinforcing Rogers' (1962)

Diffusion of Innovation perspective that identical schemes diffuse unevenly across communities with differing infrastructural and social exposure.

The sub-group correlation findings reported in Table 11 add a further layer of nuance consistent with Warschauer's (2004) argument that usage, not mere availability, is what ultimately matters: among urban students, where access is already high and comparatively uniform, additional access no longer predicts additional usage, implying that urban interventions should now shift toward content quality and pedagogical integration rather than further device provision. Among rural students, by contrast, where access levels remain highly variable, the strong positive correlation suggests that continued investment in access would still be expected to yield proportionate gains in usage — a distinction with direct implications for how future resources should be allocated across the two localities.

The absence of a significant gender effect on Access, obtained despite significant locality effects on every dimension tested, is a further point worth noting. It suggests that whatever gendered patterns of device access have been reported in some rural community contexts elsewhere in the literature are not strongly present in this particular secondary-level Yamuna Nagar sample, and that locality-driven structural constraints operate broadly uniformly across male and female students within this district.

Read together with Chaudhary and Khan's (2021) finding that community-based learning centres measurably raised rural student engagement elsewhere in Haryana, the present results suggest that the district's rural-urban gap, while currently substantial, is not necessarily fixed. The strong rural Access-Utilisation correlation in particular implies that rural students are ready to make use of digital tools as soon as access is provided, rather than requiring separate motivational intervention before infrastructural gains can translate into actual classroom benefit.

The device-ownership and frequency-of-use findings reported in Tables 8 and 9 add further texture to this picture. The proportion of rural students reporting no device access at all — a fifth of the rural sample — represents a hard floor beneath which no amount of teacher training or content improvement can raise digital engagement; for this specific sub-group, device provision remains the binding constraint. For the larger share of rural students who report shared rather than absent access, however, the constraint is more plausibly one of contention for a limited shared resource within the household, a distinction with different practical implications for the two groups that a single aggregate Access score would otherwise obscure.

Educational Implications

Given the substantial gaps documented across every dimension, rural schools of the district may benefit from targeted device and connectivity investment paired with structured, ongoing teacher training in digital pedagogy, rather than infrastructure alone. Since the Attitude gap was comparatively modest, interventions should assume rural students are willing, rather than reluctant, participants in digital learning, and should prioritise removing material barriers to access and use over motivational messaging.

Teachers in rural schools would benefit from hands-on, low-connectivity-friendly training in digital pedagogy, mirroring Mishra and Koehler's (2006) TPACK emphasis on the intersection of technological and pedagogical knowledge, rather than training that assumes continuous internet access. Peer mentoring arrangements pairing digitally confident urban-school teachers with rural counterparts may help translate the demonstrated urban teacher-competency advantage into a shared district-wide resource. Given that access continues to predict usage strongly among rural students but not among urban students, school administrators and block-level education officers may use this distinction to allocate resources more precisely: continued device and connectivity investment for rural schools, and a shift toward content quality, gamification, and pedagogical integration for urban schools where material access has largely plateaued. Since no significant gender gap was found on Access, programmes addressing the rural-urban divide should be designed to reach male and female students equally rather than assuming a need for gender-targeted intervention.

For students themselves, the near-categorical divide documented in Table 3 suggests that many rural students are not experiencing a mild disadvantage but a qualitatively different learning environment altogether, one in which shared community access points — of the kind found effective by Chaudhary and Khan (2021) — may offer a more realistic near-term remedy than an expectation of universal personal device ownership. For parents, the sizeable gap in device ownership documented in Table 8 suggests that household-level digital literacy workshops, addressing not only cost but also awareness of available low-cost or offline learning options, could meaningfully extend the reach of existing school-based interventions.

Limitations and Suggestions for Further Research

The sample, though adequate for the statistical techniques employed, was restricted to one hundred students from a single district, limiting generalisability. The cross-sectional design permits conclusions about association but not about the causal direction between Access and Utilisation, and the study relied on students' self-reported responses, which may be subject to a degree of social desirability bias, particularly on the Attitude sub-scale. The study also did not directly measure household income, relying instead on device ownership and school management type as partial proxies for socio-economic status.

Future research could replicate the present design across other districts of Haryana and other class levels to test the consistency of the patterns reported here, or adopt a longitudinal design to track how the divide evolves as infrastructure schemes mature over successive academic sessions. Given the divergent Access-Utilisation correlation pattern observed between rural and urban sub-groups, a mixed-method extension incorporating qualitative interviews with rural and urban teachers could help clarify the specific classroom mechanisms — beyond mere access — that translate material provision into actual instructional use.

VIII. Conclusion

The present study concludes that a substantial and statistically robust digital education gap persists between rural and urban secondary school students of Yamuna Nagar district, spanning access, device availability, internet connectivity, teacher digital competency, and, to a smaller extent, attitude. All five null hypotheses were rejected, and the gap was found to be driven primarily by material and pedagogical constraints rather than by any deficit in rural student attitude or motivation, since the Attitude gap was consistently the smallest of the five dimensions tested and no significant gender effect emerged on Access.

These findings hold relevance for teachers, school administrators, and policy planners seeking to close the digital divide within this region and comparable semi-urban and rural districts of northern India. In particular, the divergent Access-Utilisation correlation pattern between localities suggests that a one-size-fits-all policy response is unlikely to be optimal: continued infrastructural investment remains the more urgent priority for rural schools, while urban schools stand to benefit more from a shift toward pedagogical and content-quality improvements, given that material access has already reached a comparatively high and uniform level in that setting.

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