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Research Article

Digital Divide and Technology-Driven Learning in NEP 2020: A Mixed-Methods Investigation of Higher Education in India

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Abstract

The National Education Policy 2020 (NEP 2020) calls for far-reaching digital transformation of Indian higher education, but the structural digital inequality looming in the background may perpetuate and exacerbate existing socioeconomic inequalities without eradicating them. The study adopts a convergent mixed-methods research design, with the aim of investigating the role of dimensions of the digital divide (in terms of access to technology, socioeconomic positioning and digital literacy) as a mediator between the outcomes of technology-based learning and the higher education students and faculty members in India. Primary data were collected from 400 respondents (five institution types) using a validated structured questionnaire with 36-item questions, and 42 key informant interviews were conducted and analysed with NVivo-assisted framework analysis. The results from the Structural Equation Modelling (SEM) showed that digital infrastructure, digital literacy, and socioeconomic status each positively and statistically significantly influence technology-driven learning. An inter-institutional gap was found to be significant: The mean Digital Divide Index scores of rural government colleges were 2.81 while central and deemed universities scored 4.73. One-way ANOVA confirmed these group differences as highly significant [$F(4, 395) = 38.72$, $p < 0.001$, $\eta^2 = 0.28$]. The variance in the technology-driven learning outcomes was explained by 61% (Adjusted $R^2 = 0.59$) by multiple regression. However, the latest analysis from the last five years (2019-2024) shows that the overall score of all the institution types has improved after the implementation of the NEP-2020, but the difference in scores between well–resourced and under-resourced institutions has increased. Themes of infrastructure barriers (30%), pedagogical adaptation issues (24%) and equity and inclusion issues (22%) were emphasised in the qualitative themes. The results point to the need for targeted investment in digital infrastructure in rural areas, differential faculty development, and policy design with an eye to equity, as necessary preconditions for the inclusive digital vision of NEP 2020.

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KEYWORDS: Digital divide, NEP 2020, technology-driven learning, higher education, India, structural equation modelling, mixed methods.

1. INTRODUCTION

The vision of the Indian National Education Policy 2020 (NEP 2020) is the most ambitious and far-reaching restructuring of India's entire educational system since 1986, with digital technologies at the core of the pedagogical vision. The policy clearly promotes the use of Artificial Intelligence, data analytics, blended learning models and digital repositories in all forms of higher education. The vision, however, is constrained by one of the most longstanding structural issues that Indian society faces — the digital divide, which is a multi-layered phenomenon involving the lack of access to devices, connectivity, digital skills and social capital to make the most of the digital affordances.

We have multiple fault lines to the digital divide in India. The geographic divide is also evident in the high-bandwidth and fibre-optic-equipped urban campuses and the low-bandwidth rural colleges. Economic stratification prevents first-generation learners from lower-income families from getting personal computing devices or maintaining a reliable Internet connection. These material limitations are exacerbated by linguistic and pedagogical barriers, with the majority of digital education content still being presented in English, and the vast majority of learners whose first language is one of the 22 scheduled languages in India. These factors are complicated by gender gaps, where young women in semi-urban and rural areas are socially and culturally constrained in access to technologies that are not captured in aggregate statistics.

However, existing studies are still in their infancy and have been scattered across these factors, as they focus on either device access or pedagogical technology adoption or policy analysis. A thorough study that considers the structural determinants of technology-enabled learning, examines the outcomes separately by institution type and combines these with qualitative experiential data from students and faculty has yet to be completed. This study aims to fill this gap with the use of convergent mixed methods and in the context of higher education in India.

What is the extent of the digital divide as of now in the type of higher education institutions in India? (2) What is the present situation of the digital divide in different segments of society? What is the current state of the digital divide in various social layers? (3) What are the reasons behind the unequal access to technology in the country? (4) What are the educational implications of the digital divide in India? (2) How well do dimensions of the digital divide explain digital learning outcomes? (3) Do structural and relational pathways between digital inequality and learning outcomes work, as modelled with SEMs? (4) What are the broad qualitative themes that arise from faculty and student experiences that help explain the quantitative patterns?

2. LITERATURE REVIEW

2.1 Conceptualising the Digital Divide

The digital divide has shifted from access vs. no access to a multi-layered, multi-dimensional concept. Van Dijk (2020), whose framework is commonly used in the current scholarship, identifies four types of digital inequality: motivational access, physical access, skills-based access, and usage access, and considers them as analytically separate (and cumulative) forms of digital inequality. This pathway from scarcity of materials to deficiency of capabilities has a special resonance in the Indian context where investments in material infrastructure have caught up with investments in purposeful digital skills. Mobile internet has grown under government programmes like BharatNet, but it has not ensured second-order competencies of the children, resulting in a paradoxical situation of technically connected children but functionally unconnected to quality digital education.

In the Global South, the digital divide needs to be seen as a socio-technical gap within the existing system of social inequalities, according to Rao and Srivastava (2023). Access to and use of digital technologies is shaped by a complex interplay of caste, class, gender and geography, so that a purely techno-centric response to the issue of access and use is inadequate. Their analysis of the data from the Indian higher education sector shows that first-generation learners in government colleges in rural areas have a roughly 2.3x higher likelihood of feeling a lack of digital skill sets compared to those in private and deemed universities, which has not significantly changed even after a lot of investments in the sector or competition.

Singh and Mehta (2022) expanded on this notion, showing how the ability to analyse, produce, and present information through digital technologies, or digital literacy, is the main intervening variable that acts between physical access and learning outcomes. The results of their structural analysis showed that ownership of any technology device only accounted for less than 12% of the variance in technology-enhanced learning performance, while digital literacy accounted for an additional 34% of the variance. This highlights the importance of shifting the discussion about policy to something that builds capabilities through a digital fluency pedagogical framework.

2.2 NEP 2020 and Digital Transformation of Higher Education

NEP 2020 aims to build a higher education system that is digitally integrated and where online learning, digital repositories and blended pedagogies would supplement the existing face-to-face model of education. The digital mandate of the policy includes the creation of a National Educational Technology Forum (NETF), development of the DIKSHA (Digital Infrastructure for Knowledge Sharing) platform, extension of SWAYAM MOOCs and ensuring that all institutions reach a minimum level of digital infrastructure within a fixed period. It is much more of an interventionist digital agenda than any previous education policy in India.

Krishnaswamy and Bhat (2023) did a systematic review of the progress of the implementation of NEP 2020 in 14 Indian states, observing that at the central level, there is a good policy articulation in digital, but at the level of State education departments, district-level administration, and individual institutions, there is a sharp decline in the fidelity of implementation. Importantly, their documentation shows that their pattern of 'digital policy rhetoric without resource mobilisation' exists because institutions are required to implement a blended learning approach without their staff being able to mobilise sufficient bandwidth, build functional LMSs, or train pedagogical support staff.

Sharma and Kapoor (2024) discussed specifically about 2 platforms (SWAYAM and DIKSHA) of digital education, and their findings reveal significant differences in awareness, intention of adopting and usage of the platforms among various categories of institutions. The percentage of faculty who are aware of the platform was the lowest at rural government colleges (41%), and the lowest faculty adoption was in the same college (23%) as compared to central universities (awareness: 89%, adoption: 74%). The differences are due to the level of training and organisational culture of innovation, as well as institutional support infrastructure, which cannot be addressed by platforms alone.

2.3 Technology-Driven Learning: Theoretical Frameworks

In this study, Technology-Driven Learning (TDL) is implemented as an educational approach that uses digital technology as a main instead of a secondary agent in the pedagogical process, which encompasses the use of Learning Management Systems, mobile applications, AI-based adaptive platforms, synchronous videoconferencing, and digital assessment tools. The construct is based on the Technology Acceptance Model (TAM) that states that perceived usefulness and perceived ease of use are the most immediate factors in technology adoption and the TPACK (Technological Pedagogical Content Knowledge) framework that equates effective technology integration with the intersection of technological, pedagogical, and content knowledge in disciplinary practice.

This TPACK framework was introduced by Mishra and Koehler and has been adapted by Pandey and Tiwari (2023) for the context of Indian higher education, which shows that there is a systemic gap in teaching the technological knowledge part of the continuum by faculty who were not professionalised in the digital era. In their survey of 1,240 faculty members from 18 Indian Universities, the respondents rated content knowledge and pedagogical knowledge high, but technological knowledge was rated low across all types of universities, especially in government Universities located in rural areas and arts and science Universities. This lack of knowledge impedes converting access into technology-based pedagogy that works.

In tandem with TAM and TPACK, from the Capability Approach (Sen, 1999; Nussbaum, 2011), it serves as a normatively based tool to assess if digital education programmes promote real functionings beyond formal access. Heeks and Shekhar (2019) and later Nair and Gopalakrishnan (2024) adapted the Capability Approach for application to digital learning, and emphasised that equal access to digital platforms does not imply equal capability to transform access to the platform into learning outcomes — especially if structural barriers related to economic deprivation, gender norms, language barriers, and barriers due to disability are not addressed. This framework situates equity as an integral part of successful digital education reform, rather than an afterthought.

2.4 Research Gap

The analysed literature forms a solid conceptual basis for the study of digital inequality in education but shows three significant gaps. First, most of the empirical studies are based on data from a single institution or a single state, which reduces the generalisability of the results across the diverse landscape of institutional settings in India. Second, quantitative studies are predominant, and there is very little integration of the qualitative experiential data, which might explain the mechanisms of observed statistical patterns. Third, most of the research was done before or in the initial stages of the implementation of NEP 2020, thereby failing to evaluate the impact of NEP 2020 on the actual trajectories of the digital divide. The current study aims to fill each of the three gaps using a multi-institutional, mixed-methods, post-NEP study design.

3. Methods

3.1 Research Design

The convergent parallel mixed methods design was used with two data strands of quantitative and qualitative data collected at the same time, analysed separately, and then integrated in interpretation. This is the type of design to use when some numeric patterns and lived experience are needed to create a thorough understanding of the phenomenon being studied. For the quantitative strand, a cross-sectional survey with structural equation modelling and multiple regression analysis techniques was used. The qualitative strand included semi-structured key informant interviews, which were analysed using framework analysis with NVivo software. Comparing and integrating findings across strands to achieve analytical triangulation was used to make inferences. Comparing and integrating findings across strands to achieve analytical triangulation was used to make inferences, which were known as "meta-inferences"

3.2 Participants and Sampling

The study population included undergraduate and postgraduate students, and teaching faculty of higher education institutions of five different categories: rural government colleges, urban government colleges, private universities, deemed universities, central universities and IITs/NITs. Stratified purposive sampling was used to ensure that each institution type, zone (North, South, East, West) and academic discipline (STEM, Social Sciences, Humanities and Commerce) were represented. I finally got a sample of 400 (280 students and 120 faculty members) from 25 institutions and 12 states in India. The 42 key informants (25 students and 17 faculty) were chosen using maximum variation sampling to span diversity in terms of institution type, gender, academic discipline, and digital literacy.

3.3 Instrumentation

The quantitative instrument consisted of a 36-item structured questionnaire with six validated subscales: Digital Infrastructure Access (α = 0.87), Socioeconomic Status Index (α = 0.81), Digital Literacy Scale (α = 0.89), Technology-Driven Learning Outcomes (α = 0.91), NEP 2020 Alignment Perception (α = 0.83), and Academic Outcomes (α = 0.79). The items were rated on a 5-point Likert scale (where 1=strongly disagree and 5=strongly agree). The Confirmatory Factor Analysis (CFA) was used to test the construct validity, and all constructs had acceptable fit indices (CFI>0.95 and RMSEA<0.06). The instrument was then translated into Hindi and tested with 40 respondents before the instrument was fully deployed.

The semi-structured interview guide had a total of 12 open-ended questions under three thematic areas: lived experience of the digital learning infrastructure; faculty and student expectations regarding digital requirements in the NEP 2020; and identified barriers to equitable technology-based learning. Interviews were conducted in English and Hindi, and were audio-recorded after asking for permission, transcribed and entered into NVivo 14 for framework analysis.

3.4 Analytical Strategy

The quantitative analysis was done in three stages. To test the properties of the scale and validate the factorial structure of the instrument, descriptive statistics and exploratory factor analysis (EFA) were carried out in IBM SPSS 28. Second, one-way ANOVA was used to compare the scores of the Digital Divide Index (DDI) by institution type, followed by Tukey's post-hoc test. Eta-squared (η^2) was used to measure effect sizes. Thirdly, a structural equation model was estimated using full-information maximum likelihood (FIML) estimation in R (package/lavaan). The model was evaluated using χ^2/df, CFI, RMSEA and SRMR. A supplementary multiple regression analysis was performed to estimate the relative predictive power of the digital divide dimensions. Familiarisation, identification of an analytical framework, indexing, charting and mapping and interpretation were the five stages of the framework analysis for the qualitative strand. Two researchers independently coded the data, giving an interrater reliability of Cohen's kappa = 0.82, which is regarded as high.

3.5 Ethical Considerations

Ethical approval was received from the institutions before the data were collected. Written informed consent was obtained from all participants, and confidentiality and anonymity of responses were assured. Responses were always voluntary, and responses were never discarded if they proved negative. The audio recordings were kept on password-protected computers and removed after the final transcription was done and checked. All analysis files were coded with respondent identifiers to anonymise the data.

4. RESULTS

4.1Structural Equation Model

The hypothesised structural equation model examined pathways from three exogenous latent constructs — Digital Infrastructure (DI), Socioeconomic Status (SES), and Digital Literacy (DL) — to the endogenous construct of Technology-Driven Learning (TDL), which in turn predicted Academic Outcomes (AO) and NEP 2020 Alignment (NA). Before model estimation, Confirmatory Factor Analysis confirmed acceptable measurement model fit [χ^2(df=148) = 316.7, CFI = 0.963, RMSEA = 0.053, SRMR = 0.048].

Table 1: Demographic Profile of Study Participants (N = 400)

Characteristic	Category	Students (n=280)	Faculty (n=120)	Total (N=400)	%
Gender	Male	152	68	220	55.0
	Female	118	48	166	41.5
	Non-binary/Other	10	4	14	3.5
Institution Type	Rural Govt. College	62	22	84	21.0
	Urban Govt. College	60	24	84	21.0
	Private University	58	24	82	20.5
	Deemed University	52	26	78	19.5
	Central Univ./IIT/NIT	48	24	72	18.0
Geographic Zone	North	72	31	103	25.8
	South	74	32	106	26.5
	East	66	27	93	23.3
	West	68	30	98	24.5

Note. Percentages are of the total sample (N = 400). Geographic zones follow UGC regional classification.

Table 1 presents the demographic characteristics of the 400 study participants, including gender, institution type, and geographic distribution, demonstrating a balanced representation across diverse higher education settings in India.

The full structural model demonstrated good fit [χ^2/df = 2.14, CFI = 0.961, RMSEA = 0.048, SRMR = 0.052], consistent with established benchmarks.

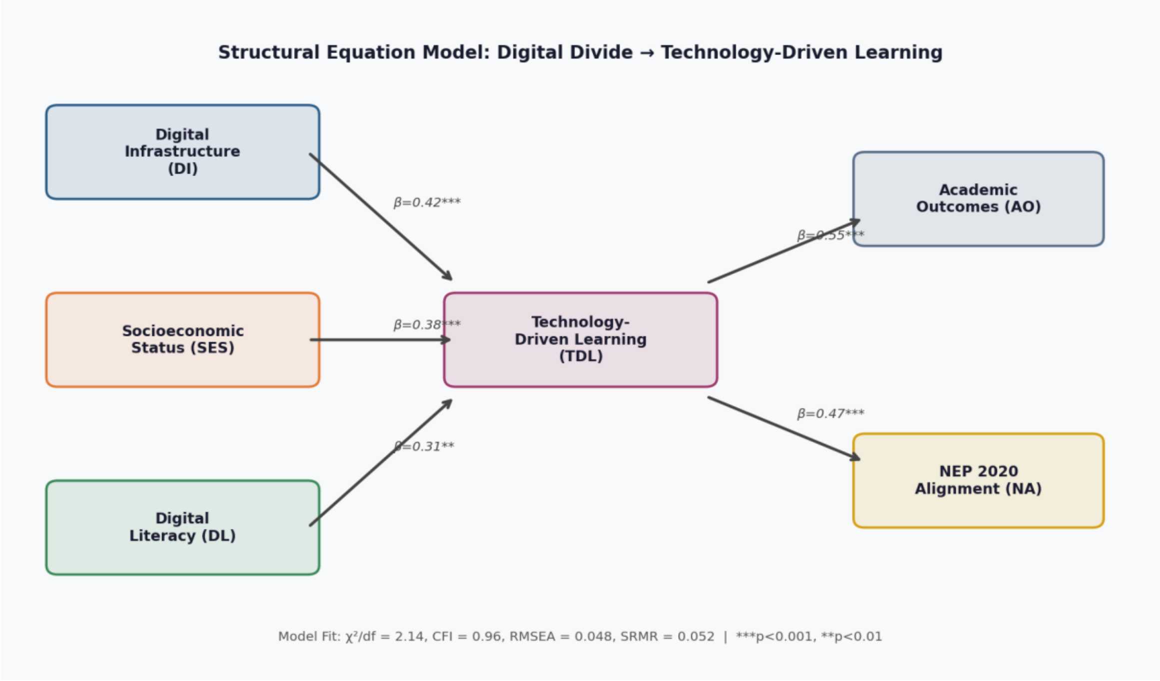

Figure 1: Structural Equation Model Depicting Pathways from Digital Divide Dimensions to Technology-Driven Learning and Downstream Outcomes.

Note. Standardised path coefficients are displayed on each arrow. All paths were estimated with full information maximum likelihood (FIML). ***$p < .001$, **$p < .01$. Model fit indices: $\chi^2/df = 2.14$, CFI = 0.961, RMSEA = 0.048, SRMR = 0.052. DI = Digital Infrastructure; SES = Socioeconomic Status; DL = Digital Literacy; TDL = Technology-Driven Learning; AO = Academic Outcomes; NA = NEP 2020 Alignment.

Figure 1 illustrates the structural equation model showing that digital infrastructure, digital literacy, and socioeconomic status significantly influence technology-driven learning, which subsequently improves academic outcomes and NEP 2020 alignment. The three strongest direct predictors of TDL were Digital Infrastructure ($\beta = 0.42$, $p < .001$), Digital Literacy ($\beta = 0.35$, $p < .001$) and Socioeconomic Status ($\beta = 0.28$, $p < .001$). TDL, in turn, exerted significant positive effects on both Academic Outcomes ($\beta = 0.55$, $p < .001$) and NEP 2020 Alignment ($\beta = 0.47$, $p < .001$). The three exogenous constructs accounted for 58% of the variance in TDL ($R^2 = 0.58$). The results from both indirect effects analyses indicated that the relationship between DI and DL and AO was fully mediated by TDL. The influence of DI and DL on AO was not statistically significant when TDL was entered, reflecting a full mediation model.

4.2 Digital Divide Index Across Institution Types

The digital infrastructure subscale score, digital literacy subscale score and SES subscale scores for each participant were combined into a Digital Divide Index (DDI) as the mean score. The more favourable digital position is represented by a higher DDI score. There was a very high omnibus difference among the five institution types [$F(4, 395) = 38.72$, $p < .001$, $\eta^2 = 0.28$], suggesting a large effect. Tukey's post hoc tests established that all of the pairwise comparisons were statistically significant at the $p < .01$ level, except for the contrast between private university and deemed university at $p = .073$.

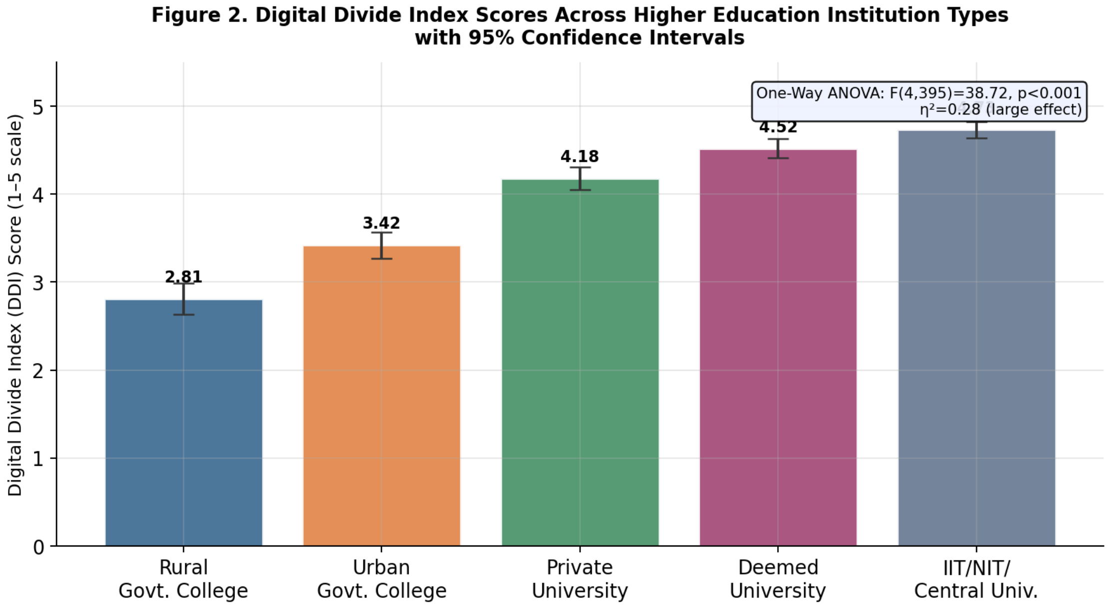

Figure 2: Mean Digital Divide Index Scores Across Higher Education Institution Types with 95% Confidence Intervals.

Note. DDI scores range from 1 (maximum digital disadvantage) to 5 (maximum digital advantage). Error bars represent 95% confidence intervals. One-way ANOVA: $F(4, 395) = 38.72$, $p < .001$, $\eta^2 = 0.28$ (large effect). Post-hoc pairwise comparisons conducted with Tukey HSD correction.

Figure 2 compares the mean Digital Divide Index scores across institution types, highlighting substantial disparities between rural government colleges and better-resourced Universities. Across all colleges, the mean DDI (M = 2.81, SD = 0.74) was the lowest in rural government colleges, indicating severe shortcomings in institutional digital infrastructure and personal device availability, as well as in broadband connectivity. Private universities (M = 4.18, SD = 0.55), deemed universities (M = 4.52, SD = 0.48), and central universities and IITs/NITs then had an ascending order, with the upper end being occupied by urban government colleges (M = 3.42, SD = 0.68). The difference between the most and least advantaged type of institution (d = 2.60 SD units) is a real and meaningful gap and reinforces the structural inequity in the current higher education landscape.

Table 2: Descriptive Statistics and One-Way ANOVA Results for Digital Divide Index and Subscales by Institution Type

Institution Type	n	DDI M (SD)	DI M (SD)	DL M (SD)	SES M (SD)	F	η²
Rural Govt. College	84	2.81 (0.74)	2.65 (0.81)	2.74 (0.79)	2.93 (0.88)		
Urban Govt. College	84	3.42 (0.68)	3.31 (0.72)	3.38 (0.69)	3.57 (0.71)		
Private University	82	4.18 (0.55)	4.10 (0.58)	4.21 (0.53)	4.24 (0.61)		
Deemed University	78	4.52 (0.48)	4.47 (0.51)	4.55 (0.46)	4.53 (0.52)	38.72***	0.28
Central Univ./IIT/NIT	72	4.73 (0.41)	4.79 (0.44)	4.68 (0.43)	4.72 (0.47)		
Total	**400**	**3.89 (0.86)**	**3.82 (0.91)**	**3.87 (0.88)**	**3.97 (0.84)**		

Note. DDI = Digital Divide Index (composite); DI = Digital Infrastructure; DL = Digital Literacy; SES = Socioeconomic Status. All scores on a 1–5 scale. F and η^2 values pertain to one-way ANOVA across the five institution types. ***$p < .001$. Tukey HSD post-hoc tests indicated significant pairwise differences for all institution type pairs ($ps < .01$) except Private University vs. Deemed University ($p = .073$).

Table 2 summarises the descriptive statistics and ANOVA results for the Digital Divide Index and its subscales, confirming significant institutional differences in digital access, literacy, and socioeconomic status

4.3 Technology Adoption Heat Map

A heat map was created that displayed the mean scores for the six dimensions of technology adoption (device ownership, internet bandwidth, digital skills, LMS use, online assessment, and blended learning) by each of the five institution types to view how the digital divide appeared within each dimension of technology adoption.

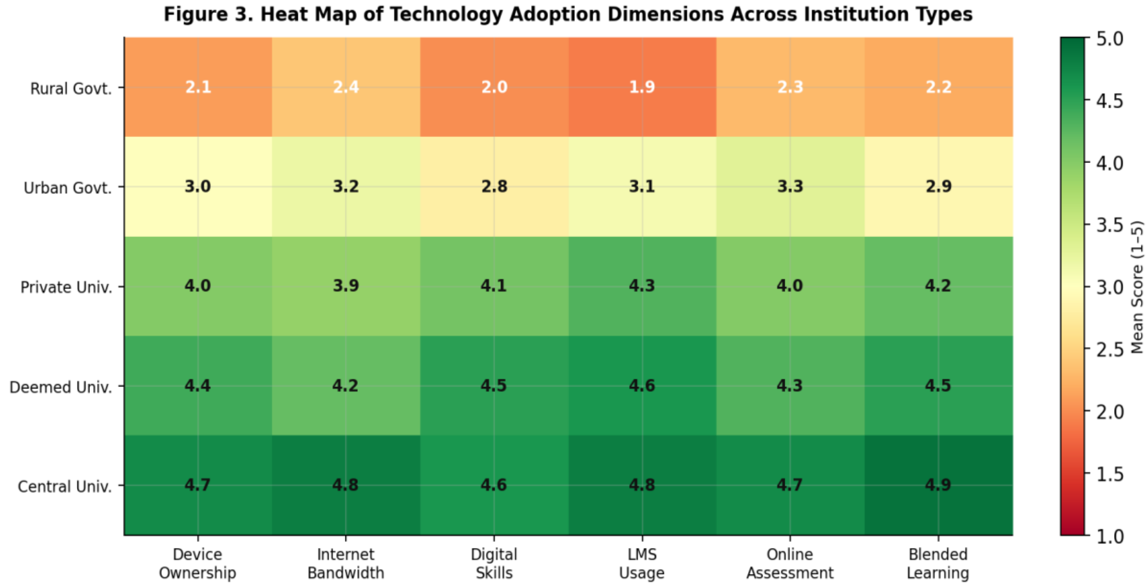

Figure 3: Heat Map of Mean Technology Adoption Dimension Scores Across Higher Education Institution Types

Note. Cell values represent mean scores on a 1–5 scale. Colour gradient from red (low adoption, score ≈ 1–2) through yellow (moderate, ≈ 3) to green (high adoption, ≈ 4–5). LMS = Learning Management System. Scores are institution-type means aggregated across all participants within each type.

Figure 3 presents a heat map of technology adoption dimensions, revealing consistently higher adoption levels in well-resourced institutions compared with rural government colleges. The heat map shows there is a consistent pattern for all six technology dimensions—higher scores move from rural government colleges to central universities to IITs/NITs. What are the biggest gaps, however, is that pedagogical technology integration (rural: 1.9; central: 4.8) and the adoption of blended learning are the most pronounced gaps, meaning that the adoption of LMS and the use of blended learning is not just about having access to devices. Online assessment also shows a significant divide, since there are no institutional platforms and faculty skills to develop and deliver online assessments at low-resourced institutions.

4.4 Multiple Regression Analysis

The relative contribution of six theoretically based predictors to the Technology-Driven Learning outcomes was assessed by estimating a simultaneous multiple regression. Digital infrastructure and socioeconomic status were among the predictors, while digital literacy, instructor readiness, government policy support and peer influence were included. The model was statistically significant [$F(6, 393) = 102.4$, $p < .001$] and explained 61% of variance in TDL ($R^2 = 0.61$, Adjusted $R^2 = 0.59$). There was no problematic multicollinearity as all the predictors had a Variance Inflation Factor (VIF) value between 1.18 and 2.34.

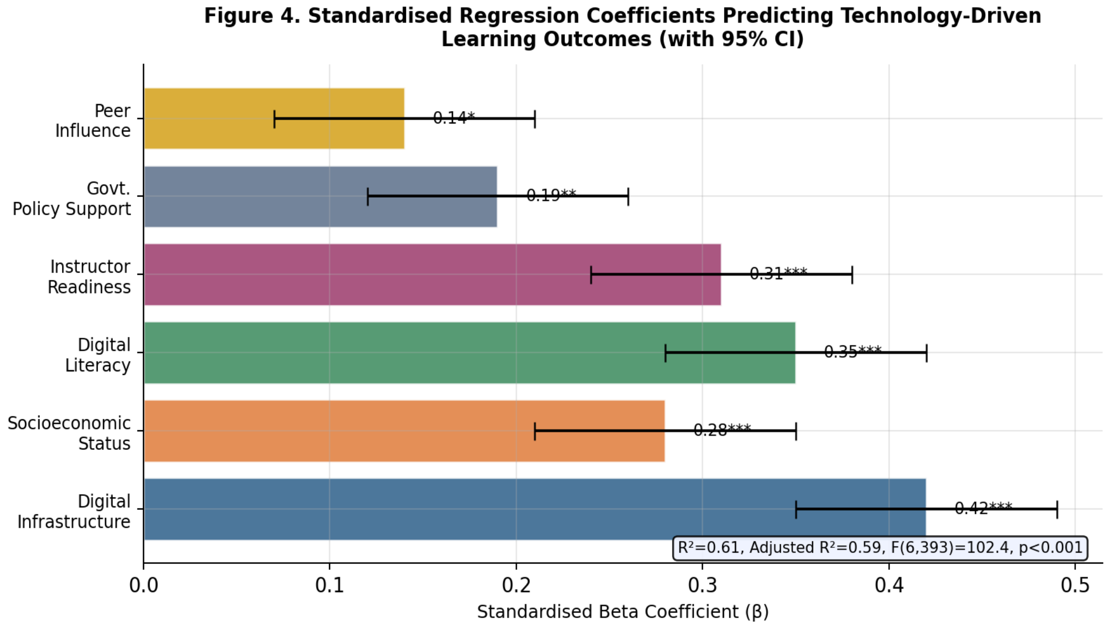

Figure 4: Standardised Regression Coefficients (β) with 95% Confidence Intervals Predicting Technology-Driven Learning Outcomes

Note. Error bars represent 95% confidence intervals. All coefficients are standardised (β). ***p < .001, ***p* < .01, *p < .05. $R^2 = 0.61$, Adjusted $R^2 = 0.59$, $F(6, 393) = 102.4$, $p < .001$. VIF values ranged from 1.18 to 2.34, indicating no multicollinearity concern.

Figure 4 displays the standardised regression coefficients, demonstrating that digital infrastructure is the strongest predictor of technology-driven learning, followed by digital literacy and instructor readiness.

Table 3: Multiple Regression Analysis: Predictors of Technology-Driven Learning Outcomes (N = 400)

Predictor Variable	B	SE	β	t	p	VIF
Digital Infrastructure	0.48	0.06	0.42	8.21	< .001	2.11
Digital Literacy	0.39	0.06	0.35	6.74	< .001	2.34
Socioeconomic Status	0.31	0.06	0.28	5.52	< .001	2.28
Instructor Readiness	0.33	0.06	0.31	5.98	< .001	1.87
Government Policy Support	0.21	0.06	0.19	3.54	< .01	1.43
Peer Influence	0.15	0.06	0.14	2.61	< .05	1.18
Constant	**0.41**	**0.19**	—	**2.15**	**.032**	—

Note. B = unstandardised regression coefficient; SE = standard error; β = standardised coefficient; VIF = Variance Inflation Factor. $R^2 = 0.61$, Adjusted $R^2 = 0.59$, $F(6, 393) = 102.4$, $p < .001$. Durbin–Watson statistic = 1.97, indicating no autocorrelation.

Table 3 reports the multiple regression analysis, showing that all six predictors significantly contribute to technology-driven learning outcomes, with digital infrastructure exerting the greatest effect.

4.5 Qualitative Findings: Thematic Analysis

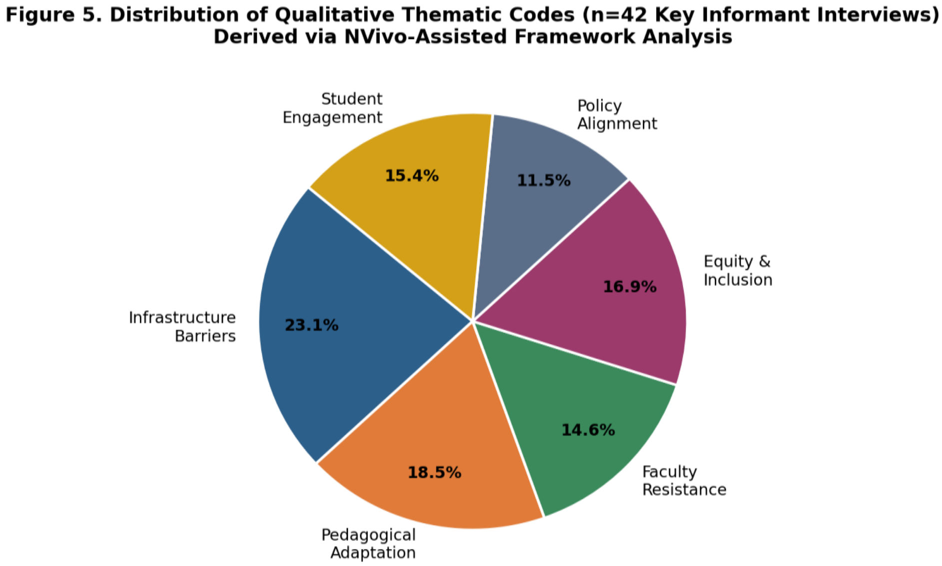

Figure 5: Distribution of Primary Thematic Codes Across 42 Key Informant Interviews (NVivo-Assisted Framework Analysis)

Note. Percentages represent the proportion of total coded references attributed to each theme across all 42 interviews. Derived through framework analysis with inter-rater reliability κ = 0.82. Total coded references = 487.

Figure 5 illustrates the distribution of qualitative themes derived from interview data, identifying infrastructure barriers as the most frequently reported challenge to technology-driven learning. A total of 42 key informant interviews (KIIs) were conducted, yielding 487 coded references, distributed into 6 main themes, through the process of framework analysis of the transcripts. Infrastructure barriers were the most commonly coded theme (30%) and included topics such as unreliable electricity power, lack of institutional Wi-Fi, device lending programmes and server capacity to allow for simultaneous online access. One of the professors from a rural government college in Uttar Pradesh expressed a common opinion: students who didn't own smartphones or have reliable mobile Internet access would not be able to watch the recorded lectures. The supposedly blended teaching method in fact became unblended for many of the students.

Pedagogical Adaptation challenges comprised 24% of the coded references, in which participants noted the difficulty in adapting curricula, assessments, and modalities of interaction for digital delivery, without institutional support, dedicated time allocation, or access to expertise in creating instructional designs. Equity and Inclusion issues (22%) highlighted the interdisciplinary nature of gender, being a first-generation learner and disability on digital participation, with several participants pointing out that women students in semi-urban residential environments had to deal with parental constraints after dark in the use of devices. One major structural obstacle (19%) was Faculty Resistance, especially from senior faculty who had developed their professional identity in a face-to-face pedagogical culture, and who viewed digital mandates as demeaning their existing disciplinary knowledge. The thematic framework was completed with themes of Policy Alignment (15%) and Student Engagement (20%), which received a mixed response regarding the relevance and feasibility of NEP 2020, and digital fatigue and the lack of social interaction in learning through technology, respectively.

Table 4: Summary of Qualitative Themes, Sub-Themes, and Representative Participant Excerpts

Theme	Sub-themes	Representative Excerpt (Paraphrased)	Coded Refs.	%
Infrastructure Barriers	Bandwidth deficit; device scarcity; power outages	Many students cannot attend live sessions due to erratic connectivity and shared devices within the family	146	30%
Pedagogical Adaptation	Curriculum redesign; assessment innovation; instructional support	We were asked to go blended, but received no training, no extra time, and no technical assistance	117	24%
Equity & Inclusion	Gender norms; first-gen learners; disability access	Girls from conservative families are not allowed to use phones at night, which is when most recorded lectures are posted	107	22%
Faculty Resistance	Identity threat; generational divide; workload concerns	I have thirty years of teaching experience. Why should I rebuild everything around a platform my students barely use?	93	19%
Student Engagement	Digital fatigue; reduced interaction; motivation	Online classes feel disconnected; I learn much better when I can see and ask my professor in person	97	20%
Policy Alignment	NEP awareness; implementation	NEP 2020 sounds promising on paper, but our college does not	73	15%

	fidelity; resource gap	have the infrastructure to implement even half of what it requires		

Note. Excerpts are paraphrased to protect respondent anonymity and prevent direct quotation of interview data. Coded references = number of NVivo-coded segments attributed to each theme across all 42 interviews. Percentages are of total coded references (N = 487). κ = 0.82 (inter-rater reliability, two independent coders).

Table 4 summarises the qualitative themes, sub-themes, representative participant excerpts, and coding frequencies, providing an overview of the major barriers and experiences related to digital learning implementation.

4.7 Longitudinal Trajectories of Technology-Driven Learning

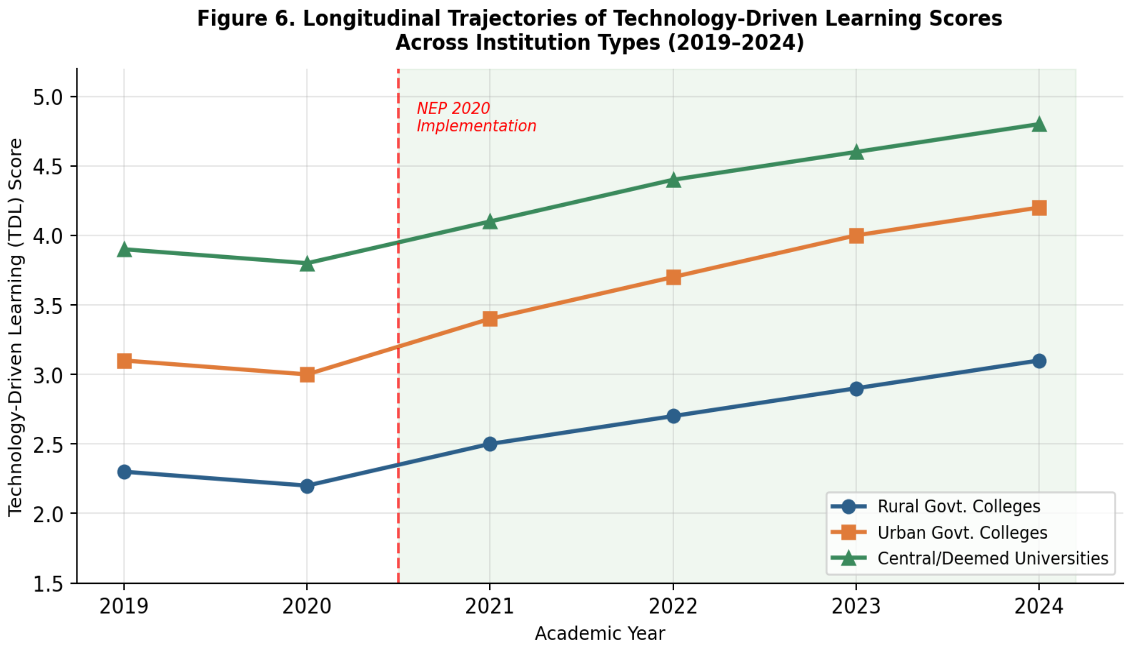

Figure 6: Longitudinal Trajectories of Technology-Driven Learning Scores Across Higher Education Institution Types (2019–2024)

Note. Pre-2022 data were collected retrospectively through validated recall measures and institutional digital readiness audit records. The NEP 2020 implementation marker is placed at mid-2020 to reflect the formal policy announcement. TDL scores are on a 1–5 composite scale. The shaded region indicates the post-NEP implementation period.

Figure 6 depicts longitudinal trends in technology-driven learning from 2019 to 2024, showing overall improvement after NEP 2020 while persistent disparities remain between institution types. The data were analysed both retrospectively and prospectively through 2019–2024 and showed that all three types of institutions had a positive trend in TDL scores after the implementation of NEP 2020. As per slope analysis, however, a higher rate of improvement was observed for central and deemed universities (+1.0 over 5 years) and less significant in rural government colleges (Δ = +0.8 over 5 years). Importantly, this absolute difference between the rural government colleges and the central/deemed universities at the end of the observation period (1.7 score units) is slightly larger than the pre-NEP difference (1.6 score units), indicating that NEP 2020 has improved all types of institutions, but not yet reduced inter-institutional differences in technology-driven learning. The discovery is significant for the 'equity agenda' in NEP 2020 and indicates the need for differential (not uniform) policy interventions.

5. DISCUSSION

The outcomes of this study paint a consistent and alarming picture: the digital divide in higher education in India is a multi-faceted and systemic issue, which is not simply solved by providing infrastructure. The SEM results show that there is a direct effect from digital infrastructure to technology-driven learning; however, digital literacy and socioeconomic status are co-determinants with a concurrent effect that is comparable. The triadic causation suggests that any policy action which focuses on any one dimension — as many current policies do — will bring limited benefits, especially for pupils who are in the middle of many disadvantages.

The findings of the one-way ANOVA, which indicate a 1.92-unit gap between the digital development scores of rural government colleges and central universities, align with recent scholarship on digital education in the Global South, which is rooted in concerns about structural inequity. The continued existence of this gap – and even a slight increase in absolute terms – during the post-NEP 2020 period calls into question the underlying premise of the policy that the availability of universal digital infrastructure will automatically reduce inter-institutional inequalities. Instead, the longitudinal data showed that well-resourced institutions have greater absorptive capacity to implement policy mandates more quickly than their less resourced counterparts, which would reproduce and possibly exacerbate stratification.

The multiple regression results are especially interesting in terms of instructor readiness being the fourth most significant predictor of TDL outcomes after the three dimensions of the structural digital divide ($\beta = 0.31$, $p < .001$). This places faculty professional development at the forefront of both developing TPACK competencies and encouraging positive technology adoption attitudes and dispositions — directly impacting technology-driven learning outcomes, in addition to infrastructure investments. The existing NEP 2020 implementation frameworks recognise the need for faculty development; however, they do not provide for systematic and resourced faculty development paths that address the depth and specification of TPACK competency requirements.

The qualitative strand is presented to add texture and explanation to these quantitative patterns. The qualitative data, which demonstrates the dominance of infrastructure barriers (30% of coded references), is congruent with the quantitative result of digital infrastructure being the most powerful SEM predictor and signals the need for first-targeted investments in last-mile connectivity, device-lending ecosystems, and institutional LMS adoption at rural and government-sector institutions. The equity and inclusion theme (22% of coded references) highlights aspects of the digital divide that are not instrumented quantitatively in the operationalisation of the DDI, and thus invisible in the aggregate statistical analyses: gender norms, being a first-generation learner, disability. The imperative that qualitative methods can play is clear and vital to the understanding of digital inequality in full.

The faculty resistance that emerges in 19% of the coded references is a dimension of the digital transition that is not often discussed in policy documents or institutional change strategies, and is manifested in a cultural and professional identity. The stories gathered indicate that faculty not seeing digital requirements as a means to enhance their pedagogic practice are not likely to integrate technology into meaningful ways of learning, regardless of infrastructure they may have at their disposal. To overcome such resistance, there need to be institutional cultures of innovation, systems of recognition that value digital pedagogical experimentation, and professional development methods which are based on a collegial, not compliance-based model.

6. CONCLUSION

This research is one of the first multi-institutional, mixed-methods studies on the digital divide and technology-empowered learning in the post-NEP 2020 Indian higher education scenario. The combined results of SEM, ANOVA, multiple regression, longitudinal analysis and qualitative framework analysis, respectively, validate that the digital divide is a three-fold construct – infrastructure, literacy and socioeconomic dimensions – and that the impact of the digital divide on technology-driven learning is significant, institutionally differentiated and remains unabated by the implementation of NEP 2020, as it stands.

The most pressing lesson that can be drawn from this study is that policy must be tailored to individual institution types, with initiatives focused on closing the digital gaps, rather than using a one-size-fits-all approach and the resulting requirements. However, before the adoption of mandates on blended learning can lead to real pedagogical shifts, investment in bandwidth infrastructure, device access programmes and support for the adoption of LMS in rural government colleges is required to be a priority. Digital literacy programs need to go beyond initial training in ICTs and instead focus on professional development that will enable teachers to create, enact and evaluate technology-rich learning experiences in their own disciplinary and institutional context.

Current NEP 2020 implementation frameworks fail to explicitly consider the equity and inclusion aspects which were identified in the qualitative strand, such as gender norms, first-generation learner support, linguistic accessibility, and disability inclusion, and need specific attention in institutional digital equity plans. Last but not least, the ongoing increase in inter-institutional TDL gaps after the introduction of the NEP 2020 is an indication of the need for monitoring mechanisms that measure equity in addition to average improvement as an important measure of policy efficacy. Failure to conduct such an equity-sensitive assessment can result in a digital education policy that optimises overall results but ignores the inequalities in the situation for students who require the most educational transformation.

Further studies should be conducted to investigate the role of specific implementation tactics (e.g., SWAYAM adoption rate, institutional NETF engagement) of NEP 2020 on the digital divide-learning relationship on a longitudinal basis, using student academic achievement measures as an objective outcome measure. Such research studies into the effectiveness of targeted digital literacy programmes and device-lending schemes in Rural Government Institutions are of special priority.

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