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Digital Literacy and AI Tool Usage among Public Library Users in Rural India: A Multi-State Survey

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Abstract: *Public libraries in rural developing regions face structural friction as service delivery transitions toward digital and AI-driven frameworks. Utilizing a sequential explanatory mixed-methods design, this study examines baseline digital literacy and artificial intelligence tool awareness among rural public library patrons across four Indian states: Madhya Pradesh, Bihar, Rajasthan, and West Bengal. Phase one surveyed 847 adult library users using a validated 15-item digital literacy scale alongside recognition-based AI metrics. Phase two contextualized these quantitative patterns through semi-structured interviews and 16 focus group discussions with 32 public librarians. Empirical findings indicate a pronounced skills deficit, with only 34.2% of patrons attaining moderate or advanced digital competency. Demographic disparities were notable: 75.6% of female respondents remained at basic literacy levels compared to 59.7% of males, while AI awareness dropped steeply from 47.8% among young adults (18–25 years) to 9.5% for patrons over age 45. Although ChatGPT was the most widely recognized generative platform (28.6%), habitual usage was minimal (4.2%). Qualitative thematic analysis attributed these gaps to erratic digital infrastructure, a lack of localized training programs, language barriers, limited AI familiarity among frontline staff, and persistent socio-cultural constraints on female mobility. These insights demonstrate that meaningful technological inclusion requires targeted, multilingual, and gender-responsive capacity-building frameworks rather than passive infrastructure expansion.*

Key words: *Digital Literacy, Artificial Intelligence, Public Libraries, Rural India, Information Access, Mixed-Method.*

1. Introduction- The way in which human beings gain access to, process, and use information has been revolutionized by digital technology in all areas of life. In countries like India, where I work, this process has high stakes for socio-economic development (Chib et al., 2016), educational performance (Wills & Choudrie, 2009) and democratic participation (Irani et al., 2010; Strover, 2019). Historically, public libraries have been situated as the community focal point for access to information and lifelong learning, and they now find themselves in an era of unparalleled change as they navigate this digital shift (Alajmi & Albudaiwi, 2020). Generative AI tools, like ChatGPT and others, have introduced a new layer of complexity to these issues in the process forcing library users and service providers alike to learn how new possibilities work (Baidoo-Anu & Owusu Ansah, 2023). India has a rural population of about 65% and there's a deep rooted digital divide that could lead to millions being left out from the benefits of technological advancement (Soni, 2018). Although there have been successful schemes under the government such as the PMGDISHA, which managed to train 6.39 crore citizens in rural India by March 2024, and National Mission on Libraries for up-gradation of about 9,000 libraries in the country (Press Information Bureau), there are wide disparities in digital literacy levels among rural population (Sharma, 2025). Recent surveys report that only 25 per cent of rural households are digitally literate when compared to 61% in urban regions, thus indicating that the classic urban-rural divide is persistent (Strover, 2019). Rural libraries in India are uniquely placed in the information environment and frequently serve as access points for reading media and digital resources for families whose ownership of personal technology is scarce (Arindam, 2019). These facilities have the potential to serve as community digital hubs that can offer means not only to access information, but also to acquire critically needed digital competencies among their patrons (Halder, 2021).

The widespread availability of AI-based tools offers opportunities as well as challenges to libraries and their patrons. Studies show that AI-based applications can contribute to improving information retrieval, personalized learning, and library workflow (Bawack et al., 2021). But the use of this technology needs a basic digital literacy and sensibility lacking in rural areas. Research from diverse settings has shown that the uptake of AI is associated with income and education levels, as well as access to a technology infrastructure. These dynamics among rural Indian public library users need to be understood to plan interventions (Bai & Yang, 2025). The study fills an important void in assessing the digital literacy levels and awareness of AI tools among rural public library users in India. Through a well-rounded multi-state survey design, this study attempt to offer empirical evidence that could help policy makers and library professionals to plan library services and promotion plans on digital inclusion in rural areas.

Though digital inclusion captures attention in rich empirical literature, a void persists on the interplay of digital literacy, AI tool awareness, and rural library provision in Indian settings. Although prior



research has explored digital divides in urban settings and focused on limited technologies, fewer case studies have used mixed methods across multiple states to describe the depth of digital skills deficits in rural populations as well as the local conditions facilitating (or impeding) technology use in rural library settings. This study fills this gap by quantitatively measuring the digital competencies and AI awareness of these stakeholders alongside qualitative questioning based on the current state of these implementation barriers and potential insights for both capabilities and policy.

2. Problem Statement- Despite governmental digital literacy initiatives, rural India faces persistent challenges in meaningful digital participation (Soni, 2018; Strover, 2019). Rural public libraries encounter significant resource constraints including limited infrastructure, inadequate funding, and staff shortages that impede their role as digital inclusion intermediaries (Halder, 2021; Kulkarni et al., 2025). While smartphone penetration has increased, empirical evidence reveals a critical gap between device ownership and actual digital competency, with only 25% of rural households possessing functional digital literacy compared to 61% urban (Sharma, 2025). Gender-based disparities compound these challenges (Arinola & Oyewusi, 2024; Oyewusi, 2020). The emergence of AI technologies, particularly ChatGPT, introduces new dimensions to the digital divide (Baidoo-Anu & Owusu Ansah, 2023; Nehra & Bansode, 2024). Understanding digital literacy and AI awareness among rural library users remains critically under-researched (Iriabije, E. R. 2023). This study addresses this gap through empirical multi-state investigation.

3. Literature Review- Digital literacy, library services, and technology adoption are intertwined themes found throughout the relevant literature that can help us understand the digital transformation of rural libraries in developing contexts. Instead of reviewing studies in a chronological or by author fashion, this review thematically synthesizes existing research to delineate points of convergence between studies, contradictions between studies and gaps in knowledge providing the rationale for the present investigation. The literature presents five common themes: 1) theoretical basis of digital literacy in library environment; 2) digital divide and access barriers; 3) AI in information services; 4) socio-demographic differences in adoption of technology; and 5) issues surrounding Indian public Libraries.

3.1 Digital Literacy as Essential Competency: From Optional to Critical: This represents a shift in the way digital literacy is seen within library and information science that several scholars have documented. Martzoukou (2020) contends that the COVID-19 pandemic has partly fast-tracked the realization of the need for digital literacy as an essential competence rather than just an additional one, and that libraries' educational missions have shifted from being technology training providers in an optional space to designating essential infrastructure for social inclusion. This viewpoint relates to Smith (2020) analysis of public library roles in times of crisis, which placed support for digital literacy as core service dimension, as oppose to secondary one. Through this lens of digital equity, the shift outlined above is theoretically grounded as Strove (2019) has conceptualized public libraries as intermediary institutions and institutions which, by virtue of their role, can act to alleviate the digital divides. Strove stressed, though, that libraries can only play this role if they have the necessary conditions particularly in technological infrastructure and staffing expertise which are not uniformly present across library systems. This caveat is especially applicable to rural libraries in developing countries, where the scarcity of resources may hinder libraries from being digital inclusion intermediaries. All across these studies the convergence indicates a wide agreement that literacy in digital age is not desirable skill but rather an essential citizenry and market requisite. However, this literature largely focuses on developed-nation contexts which raises questions about the extent to which rural libraries in such countries as India, where digital infrastructure development occurs in different patterns, have undergone comparable conceptual transformations.

3.2 Infrastructure Deficits and the Urban-Rural Technology Gap: Infrastructure gaps are consistently pointed to by the research as major barriers to digital inclusion in other developing contexts around the world and are particularly severe in rural areas. Systematic differences in availability of digital materials and resource were reported by Soni (2018) based on type of library and geographical location, as rural libraries have considerably less access to computers, internet connectivity and digital collections when compared to urban libraries. These findings echo the recommendations of Sharma's (2025) recent assessment of Indian public libraries in the context of the digital age that highlighted inadequate technological preparedness of rural libraries as a reason for the failure of national level initiatives such as PMGDISHA that have provided digital skills to millions, but rarely provide adequate infrastructure to sustain the skills acquired during training. Extending this analysis through empirical investigation about the reading habits of public libraries users in the digital age, Halder (2021) shows that deficiency in infrastructure does not only lead to the gap in access but also creates a gap in psyche where users unable to

connect perceive digital resources negatively. It reveals an infrastructure problem where through the broken access domino effect the users feel less inclined and confident in practicing technology, and you cannot blame them, here we come back to vulnerability.

International comparisons provide useful context. Garner et al. Australian public libraries during the COVID-19 pandemic: adopting new delivery approaches and expanding digital services. The paper by DeWitt et al. (2021) documented the resilience of Australian public libraries during COVID-19, with remarkable agility to extend/expand digital services in record time a response made possible by the technological infrastructure that the Australian public libraries had already developed which largely absent in the rural libraries of India. Likewise, Temiz and Salelkar (2020), writing about Swedish university libraries, suggested that resource-rich institutions adjusted to the digital during the pandemic while libraries in other regions, specifically in the developing world, would not have the same resource advantages. There is a common thread in these papers: infrastructure gaps are not only technical challenges, but rather systemic obstacles that require continuous investments and policy momentum. Based on the literature, the experts contend that unless foundational infrastructure deficiencies are addressed, training initiatives and digital literacy programs will only have modest short-term success.

3.3 Artificial Intelligence in Libraries: Opportunities and Adoption Barriers: The combination of artificial intelligence and library services are in what some may refer to as an early research front, with a handful of studies investigating both transformative capacities and difficulties in the field. A systematic review of AI applications in academic libraries by Edam-Agbor et al., 2025 also revealed the main use cases of intelligent information retrieval, cataloging automation, personalized recommendation systems, and chat box reference Services. According to their analysis, AI can improve operational efficiency and user experience effective only when done right. However, Bawack et al. (2021) support represents research outside of library science, as 2021 warns about potential harms of AI adoption in library practice without thoughtful consideration of ethics and user privacy, and readiness factors. They highlight that impactful AI adoption isn't just about technical know-how but also about training library staff, building awareness among users of AI, and establishing governance frameworks all possible barriers for rural ones strapped on resources.

Iriabije, E. R. 2023 on acceptance of artificial intelligence (AI) in the context of the library, perceived usefulness, ease of use, and trust were found to be among the most significant factors influencing library professionals' intention to adopt AI. Of note, librarians were seen to have reservations around AI replacing human expertise and perspectives to get professional development and change strategies should accompany technological implementations (or librarians would reject the use of AI). Using empirical investigation of perceived ease of use and acceptability, Ali (2020) provides confirmation of this variability in attitudes, reporting fundamental differences in the attitudes of librarians toward AI based on previous technology experience and institutional support. It is striking that this literature reveals a significant elsewhere: nearly all studies of AI take explicitly or implicitly place in developed country university or other public library systems with advanced resources and services, with attention to how academically or otherwise well-resourced libraries in developing settings may (or may not) adopt and develop approaches to integrating AI deeply fundamentally missing. An empirical investigation of the generalizability of findings regarding the factors that predict adoption to settings where foundational digital infrastructure is still lacking is warranted, and we begin to investigate this question here.

3.4 Gender and Age Disparities in Digital Technology Adoption: In particular, studies demonstrate long-lasting demographic inequalities in access and use of technology, with gender and age being among the strongest predictors (Dutton and Blank 2013). Ahmed et al. A systematic literature review by Karlsson et al. (2021) highlighted three central mechanisms at play contributing to the gender gap in technology acceptance: structural barriers, socio-cultural factors, and confidence gaps that may sustain gender equality. The synthesis notes that women in the developing world are doubly disadvantaged by limited time and mobility, family responsibilities and norms that discourage engagement with technology. In the library context explicitly, Arinola & Oyewusi, 2024 and Oyewusi, (2020) detected inequality based on gender in the profession, especially in Nigeria, either as underrepresentation of women in leadership or as perceived obstacles to professional development such as on the use of technology. Although these studies look out at library professionals instead of users, it seems likely that gender-based technological inequality reflected more broadly in the library patron population, and other populations appropriate for investigation in the library literature. Petters et al. While Wu et al. (2024) add essential nuance by analyzing interactions between gender and age for technology use, showing behaviors are not just independent functions of

demographic factors, but work intersectionally. The results indicate that young women use technology in ways that may be more like young men than older women, reinforcing the need to incorporate more than one dimension of demographics, age or gender, into research rather than treating them as independent variables.

More to the point in the context of age, Ofem et al. (2024) multigroup analysis of AI awareness between students showed significant differences in awareness and usage patterns based on the age of the students. Respondents in younger cohorts were significantly more likely to have heard of AI tools, and yet, at least in this data-set, age gaps seem to be accounted for by cohort effects (differences in the opportunities for exposure during their formative years) rather than period effects (continued learning across the lifespan) a difference with ramifications for intervention design. Convergence across these studies makes demographic divides robust, requiring specific attention in digital inclusion efforts. This literature thus indicates that the current study should not only include the concept of gender but also the concept of ages in relation to digital literacy, AI awareness within the context of rural libraries as the possible moderators.

3.5 Indian Public Libraries: Context-Specific Challenges and Opportunities: However, limited studies on Indian public library research indicate context influenced variables determining digital inclusion initiatives. In their study on web-based community information services in public libraries, Joselin and Panneerselvam (2018) showed that using an open-source system such as Koha had enabled some resource-constrained libraries to offer digital services. However, through this case study approach they illustrated implementation challenges such as staff training needs and additional ongoing technical support needs, and argued that while technology may be easily deployed, sustainable institutional commitment to adoption is far more challenging than deployment of the technology itself (Evans-Agnew et al. 2015). Arindam (2019), for instance, has discussed various aspects of the role of public libraries in the Sundarban region which is economically a disadvantaged area and serves as a key source of information for rural libraries. His ethnographic studies found that rural libraries play an indispensable role in providing access to information in areas where outside points of access are few and far between, but that the libraries themselves are usually under-staffed, under-funded and under-resourced. It is particularly remarkable that Arindam found library utilisation differed significantly by sex, with much fewer women using library facilities as a consequence of mobility restrictions and domestic duties a result that foreshadows the gender inequalities detected in this study. Operational frameworks for academic and institutional libraries highlighting the importance of integrating strategic planning, staff development, and community engagement have been created (Sharma and Tarmali, 2023). Despite their emphases on academic libraries restricting direct generalizability to public library contexts, their views around librarian professional development which they see as a basic basis underpinning service quality align with core ideas from library transformation literature.

The study indicates that digital literacy is positively related with civic participation among rural women in China (Bai & Yang, 2025), thus, recent work by Bai and Yang includes relation of digital literacy and civic participation among rural women in China and suggests that digital competencies are significant predictors of community governance (CV) with political trust and self-efficacy mediating the path. Although not specific to library use, their findings indicate that there may be impacts beyond skill building for social and political participation from rural digital literacy interventions that could be relevant in the Indian context. This body of literature, specific to the context of India, suggests that rural public libraries are impeded, in ways that are broadly distinguishable, by issues related to resource availability, geographic isolation, and socio-cultural constraints. Importantly, existing research has primarily been focused on single sites or, at the most, regional examinations, with little comparative, multi-state work to date. The four-state design of the present investigation thus adds much needed empirical breadth to the understanding of variation and commonality across different rural Indian contexts.

3.6 Research Gaps and Study Justification: The present research fills in the gap in literature by examining an integrated approach towards digital literacy and awareness and use of emerging AI tools among rural library users where hardly any integrated area have been explored by researchers till date. It uses a mixed-methods approach and spans multiple states in India, making it different from the earlier studies that were single-site or single-method ones. Blending surveys of 847 users with interviews and focus groups in four socio-economically diverse states, the study examines gendered patterns, contextual influences, the adoption of generative AI tools, and provides evidence to inform policy and library service development.

4. Methodology- This study made use of a mixed method research methodology by combining quantitative survey with qualitative interviews to gain an in-depth understanding of digital literacy and AI tool awareness among rural public library patrons in India. The coverage population is in four states:



Madhya Pradesh, Bihar, Rajasthan and West Bengal, which were picked to represent geographical, economic and cultural diversity within rural India (Popenici et al., 2023).

4.1 Research Objectives: The study was guided by the following specific objectives:

1. To assess the current levels of digital literacy among rural public library users across the four selected Indian states and examine variations based on demographic characteristics including gender, age, and educational attainment.

2. To investigate the awareness, usage patterns, and perceptions of artificial intelligence tools, particularly generative AI platforms like ChatGPT, among rural public library users and library staff.

3. To identify and analyze the primary barriers hindering digital literacy development and AI tool adoption among rural library users, and to propose evidence-based recommendations for policy and practice.

4.2 Methods: This study was a mixed-methods sequential explanatory design, with an initial quantitative phase (phase 1) followed by a qualitative phase (phase 2) used to explain and obtain context of quantitative results. This design was deemed most appropriate to meet three primary objectives: (1) generate representatively sampled estimates of prevalence & distribution of digital literacy and AI awareness; (2) identify statistical patterns and variable-variable relationships; and (3) further explore underlying mechanisms and contextual factors that are less explicitly evidenced by quantitative data alone. A cross-sectional survey design is appropriate for quantifying current status and for examining the relationship among variables at a single point in time, and was used for this study. Six months (September 2024–January 2025) was chosen for data collection to accommodate seasonal differences in library visitation while controlling for time differences between sites.

4.3 Survey Instrument Design and Development: The digital literacy assessment utilized Ng's (2012) validated Digital Literacy Scale (DLS), a 15-item instrument measuring technical, cognitive, and socio-emotional competencies. We selected this framework over alternatives (DigComp 2.0, UNESCO Framework) because Ng's scale aligns with resource-constrained library contexts and demonstrates robust psychometric properties in Asian populations (Kumar & Sharma, 2020). The instrument underwent contextual adaptation: items were translated through forward-backward translation procedures, terminology was modified to reflect mobile-centric technology access patterns prevalent in rural India, and skill-level calibration was adjusted to capture the rural competency range. For AI awareness measurement, we developed novel recognition-based items due to absence of validated instruments for library contexts. Respondents identified AI tools (ChatGPT, Google Bard, etc.) and indicated usage frequency, informed by Technology Acceptance Model principles. The instrument achieved strong content validity (CVI=0.87) through expert review, demonstrated excellent internal consistency (Cronbach's $\alpha=0.82$) in pilot testing with 120 users, and confirmatory factor analysis validated the three-dimensional structure.

4.4 Study Setting and Sampling: The study targeted rural public libraries in four states of India namely Madhya Pradesh, Bihar, Rajasthan and West Bengal. We purposively selected these states to ensure geographical, socioeconomic, and linguistic diversity to provide better generalizability of findings to rural India. Within each state, a multi-stage probability sampling procedure was implemented:

- **Stage 1-** District Selection: Two districts per state were randomly selected from lists of predominantly rural districts, yielding eight districts total.

- **Stage 2-** Block Selection: Within each selected district, four administrative blocks were selected using probability proportional to size (PPS) sampling, where selection probability was proportional to block population.

- **Stage 3-** Library Selection: From each selected block, two functional public libraries were identified through consultation with district library officers, yielding 32 libraries total.

- **Stage 4-** Respondent Selection: Within each participating library, systematic random sampling was employed to select 26-27 adult users (18 years and above), with every kth user entering the library selected based on daily attendance patterns.

Using this sampling process, the final quantitative sample consisted of 847 library users. For the qualitative aspect, we used purposive sampling to identify one librarian from each of the 32 participating libraries to interview in a semi-structured format (32 librarians total). Along with that, 16 focus group discussions (4 per state) were also held with 6–8 library users per focus group.

4.5 Data Collection Instruments and Procedures: The quantitative and qualitative instruments facilitated comprehensive and reliable data collection. The quantitative aspect consisted of a structured questionnaire with five sections. Demographic details such as gender, age, education, and occupation were obtained in Section A. Digital device ownership and access were evaluated in Section B and digital literacy

was assessed via a 15-item validated scale with excellent internal consistency (Cronbachs $\alpha = 0.89$) in section C. The scale contained competencies in five defined domains, and utilized five-point Likert responses. In Section D, awareness and use of AI tools were assessed with recognition-based items for five topically common AI applications and indicators of use frequency. Perceived barriers to digital adoption were measured using three-point scales (Section E). As per mean scores, digital literacy levels were classified as basic (1.00–2.49), intermediate (2.50–3.74) or advanced (3.75–5.00). Standard back-translation procedures were employed to translate the questionnaire to Hindi and Bengali to ensure linguistic and conceptual equivalence.

For the qualitative aspect, a semi-structured interview guide was created for librarians, covering library infrastructure, access to digital materials, user engagement with digital offerings, staff digital competencies and training, familiarity with and attitudes toward AI tools, as well as barriers to digital literacy implementation. Interviews were approximately 45–60 min in length, conducted with informed consent, and audio-recorded and transcribed verbatim. Finally, focus group discussion guides were created to elicit user perspectives on 1) digital literacy needs; 2) barriers to accessing digital literacy; 3) experiences with library-based digital services; and 4) AI perceptions. Focus groups were 60–90 minutes long and were recorded and transcribed as previously described. Trained field investigators fluent in local tongues collected data. Surveys were conducted via face-to-face interview in one of the preferred language of the participant. Paper Questionnaires were filled for recording the responses which were subsequently entered in SPSS with double-entry verification. Interviews and focus groups with librarian participants were conducted in quiet library spaces and during off-peak hours whenever possible.

4.6 Data Analysis: For quantitative data, SPSS version 26.0 was used for the analysis. Descriptive statistics were employed to summarize demographic characteristics, digital literacy levels, awareness of AI tools, and perceived barriers to digital adoption. Chi-square tests of independence were used to examine associations between categorical variables but when expected cell frequencies were below five, Fisher’s exact test was applied. We analyzed multiple predictors on the same binary outcome with multiple logistic regression, and results were considered statistically significant at a p-value < 0.05. NVivo 12 was used for qualitative data analysis using thematic analysis with Braun and Clarke’s (2006) methods. The analysis progressed through six systematic phases: familiarity with the data, initial coding, theme identification, review, definition and reporting. The data were coded by two independent coders, and inter-coder reliability was substantial ($\kappa = 0.82$). There was integration of quantitative and qualitative findings at the stage of interpretation to identify convergence, divergence and expansion, with contextual explanations of the quantitative results through qualitative insights.

4.7 Ethical Considerations: Informed consent was obtained from all participants after a detailed explanation of the study aims, details of the methods, the voluntary nature of participation, and measures for maintaining confidentiality. Participants were assigned numeric codes; linking documents were stored separately from study data; audio recordings (if any) were destroyed after transcription; data files were stored on a password-protected computer accessible only to members of the research team.

5. Findings- 5.1 Demographic Profile and Digital Device Ownership

Table 1: Demographic Characteristics and Digital Device Ownership of Respondents (N=847)

Characteristic	Category	Frequency	Percentage
Gender	Male	523	61.7%
	Female	324	38.3%
Age Group	18-25 years	287	33.9%
	26-35 years	234	27.6%
	36-45 years	189	22.3%
	Above 45 years	137	16.2%
Education	Up to Primary	142	16.8%
	Secondary	298	35.2%
	Higher Secondary	246	29.0%

	Graduate and above	161	19.0%
Smartphone Ownership	Personal smartphone	412	48.6%
	Shared family device	289	34.1%
	No smartphone access	146	17.2%
Internet Access at Home	Yes	387	45.7%
	No	460	54.3%

Gender disparity is shown to be evident with males making up 61.7% of rural PL users as compared to females who comprised 38.3% of the sample (Table 1). This difference is consistent with the national distribution pattern in library usage studies, due to gendered sociocultural factors that create barriers for women to access public spaces such as libraries. Table 1 reveals that the age distribution of users indicates a higher percentage (61.5%) at rural library were younger adults (18 to 35 years) as compared to urban and city where the majority being age group of over 35, meaning that rural libraries mainly served educational and informational requirements of youth population. The data on educational levels provided in Table 1 are relatively dispersed and the highest proportion is of secondary (35.2%) and higher secondary (29.0%) level educated respondents. Concerning ownership of digital devices displayed in Table 1, while almost half the sample (48.6%) has access to a personal smartphone, a large percentage of this family-based sample (34.1%) uses a shared device which could limit independent encounters online.

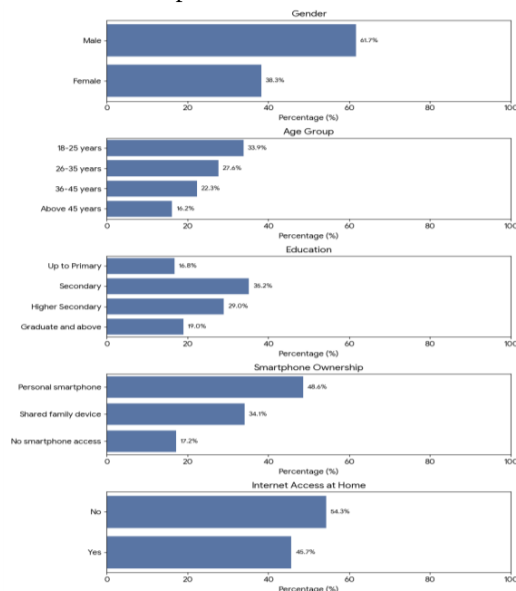


Figure 1: Combined Demographic Characteristics and Digital Device Ownership (N=847)

Figure 1 shows the distribution across these and other dimensions of 847 rural public library users (N = 847) in graphical form using horizontally oriented bar charts by percentage. Sample is predominantly Male (61.7%) and young (18-25 years: 33.9%), and mainly educated up to Secondary (35.2%). A strong digital divide is present as just 48.6% own their personal smartphone and a majority (54.3%) do not have Internet Access at Home, highlighting the vital role of the library.

5.2 Digital Literacy Assessment

Table 2: Digital Literacy Levels by State and Gender (N=847)

State/Category	Basic Level	Intermediate Level	Advanced Level	Mean Score (SD)
Madhya Pradesh	68.1%	24.7%	7.2%	2.18 (0.76)
Bihar	71.3%	21.4%	7.3%	2.09 (0.71)
Rajasthan	64.2%	27.8%	8.0%	2.24 (0.79)

West Bengal	58.6%	31.2%	10.2%	2.41 (0.82)
Overall	65.8%	26.1%	8.1%	2.23 (0.78)
Male	59.7%	29.4%	10.9%	2.38 (0.81)
Female	75.6%	20.7%	3.7%	1.98 (0.68)

Digital literacy assessment Table 2 shows the results of digital role studies, those users were ranked based on their level of literacy 11.1Digital literacy Almost three-fifths (65.8%) of rural public library users had elementary digital skills including phone calls and sending simple text messages, along with basic search abilities to browse the internet. There is a small percentage of women who were at the intermediate computer skills stage, which includes sending emails, filling out electronic forms on web sites and navigating through social media (26.1%), along with an even smaller percentage of them being in the advanced computer skills category that entails online transactions, making online content and awareness of cyber security issues (8%). Table 2 illustrates the significant inter-state differences, with West Bengal having relatively higher literacy levels (mean score = 2.41) than Bihar (mean score = 2.09). Table 2 further demonstrates that there are significant differences in gender with only 3.7% of women vs. 10.9% of men reaching the advanced digital literacy category, respectively.

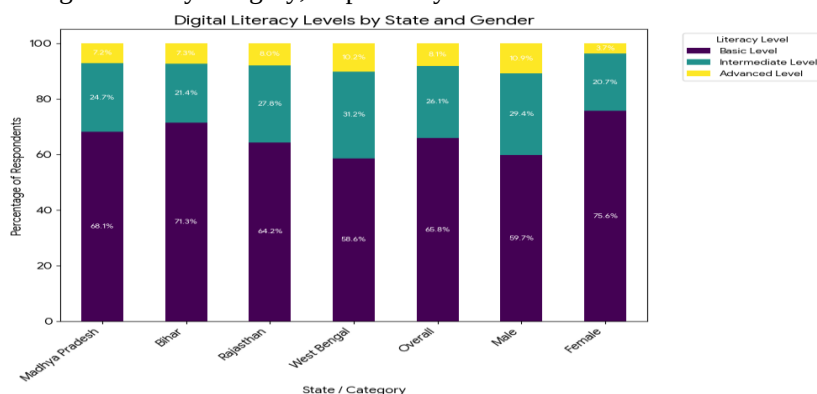


Figure 2: Digital Literacy Levels by State and Gender

The percentage distribution of Basic, Intermediate and Advanced digital literacy levels for the four states as well as overall groups is presented in figure 2. The Basic Level is the largest one in all groups (65.8%). There is a substantial gender gap, 75.6% of Female in the Basic level versus 59.7% of Male. In contrast, the Male group had a higher literacy level than the learners in that 29.4% and 10.9% of them are Intermediate and Advanced literates respectively, underscoring the digital gender divide. States-wise Maximum Advanced Level (10.2%) is observed in West Bengal.; among the States.

5.3 AI Tool Awareness and Usage:

Table 3: AI Tool Awareness and Usage Patterns among Respondents (N=847)

AI Tool/Metric	Aware (%)	Ever Used (%)	Regular Use (%)	Primary Purpose
ChatGPT	28.6%	12.4%	4.2%	Information search
Google Bard/Gemini	18.3%	7.8%	2.1%	Educational queries
Microsoft Copilot	8.7%	2.4%	0.6%	Document assistance
Any AI Tool	31.2%	14.8%	5.6%	Multiple purposes
Age 18-25 Awareness	47.8%	24.6%	9.1%	Educational/Social
Age 26-35 Awareness	32.1%	13.7%	4.8%	Work-related
Age 36-45 Awareness	18.5%	6.3%	2.1%	General information
Above 45 Awareness	9.5%	2.2%	0.7%	Limited use

The results in Table 3, which show the awareness and based on usage patterns of AI tools, demonstrate that generative AI is one of the less known among rural public library users. As seen in Table 3, ChatGPT was the AI assistant with the most recognition (28.6%) a number that is significantly lower than the 46% that urban Indians chose as word of choice according to surveys, which points towards an urban-rural divide in terms of AI awareness. Table 3 shows that only 12.4% of the participants have used ChatGPT ever and only 4.2% had regular usage experience. Age was the strongest predictor of AI awareness (Table 3), as 47.8% of respondents aged 18-25 answered affirmatively to ≥ 1 AI tool check compared to only 9.5% among those >45 years. Chi-square confirmed the significant relationship between age and AI awareness ($\chi^2=89.67$, $df=3$, $p<0.001$). Among those using AI tools, information search (42.3%) and educational queries were the most common purposes as listed in Table 3.

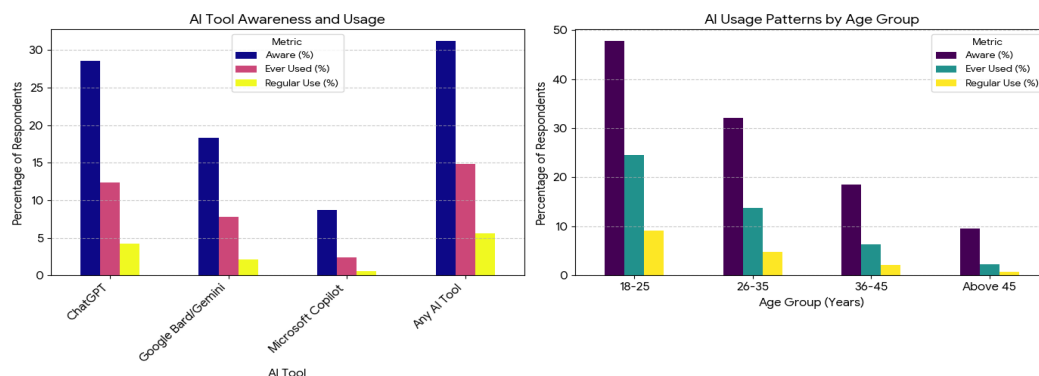


Figure 3: AI Tool Awareness and Usage Patterns (N=847)

Figure 3 AI Tool Awareness and Usage Patterns shows that the most recognized tool is ChatGPT, with 28.6% awareness and 4.2% regular usage, followed by Google Bard/Gemini. In general, 31.2% of the people have heard about Any AI Tool. The age-specific analysis shows a strong decrease of awareness and use with increasing age. The maximum awareness (47.8%) and regular use (9.1%) is visible for 18-25, whereas the Above 45+ group indicates a poor average of 9.5%,0.7%), leading to suggest that an age-based digital divide exists with respect to AI adaptation under study.

5.4 Barriers to Digital and AI Adoption:

Table 4: Perceived Barriers to Digital Literacy and AI Tool Adoption (N=847)

Barrier Category	Major Barrier (%)	Moderate Barrier (%)	Minor/No Barrier (%)	Rank
Lack of infrastructure	72.4%	18.6%	9.0%	1
Insufficient training	68.9%	21.2%	9.9%	2
Language barriers	64.3%	22.7%	13.0%	3
Cost of internet/data	61.8%	24.1%	14.1%	4
Low awareness of benefits	58.2%	26.4%	15.4%	5
Fear of technology	43.6%	28.7%	27.7%	6
Privacy/security concerns	41.2%	31.4%	27.4%	7
Lack of relevant content	38.7%	33.2%	28.1%	8

Regarding the barriers to digital and AI adoption explored in Table 4, infrastructure constraints were found to be the most salient barrier with 72.4% of respondents rating this as a major obstacle. Field survey findings also revealed that there were only 34.7% of the surveyed libraries having working computer terminals and 28.2% with reliable internet access available, which severely limited the provision of digital services. As the Table 4 illustrates, inadequate training opportunities ranked second (68.9) where respondents found that despite many of them having been trained under PMGDISHA initiative which has successfully secured the training of 6.39 crore persons across the nation, they didn't have access to organized digital literacy programs. (64.3%) in Table 4, which are symptomatic of the fact that English content/interface bias users who are more comfortable in Hindi or regional language usage. Cost (61.8%) of

Table 4 remains an issue despite lower data prices. See Section 5 especially for low-income families. Interestingly, as indicated in Table 4. Psychological barriers such as technophobia (43.6%) and concerns about privacy (41.2%) affect significant numbers of users suggesting that technology training alone may not be enough without complementary strategies to build confidence and address fears.

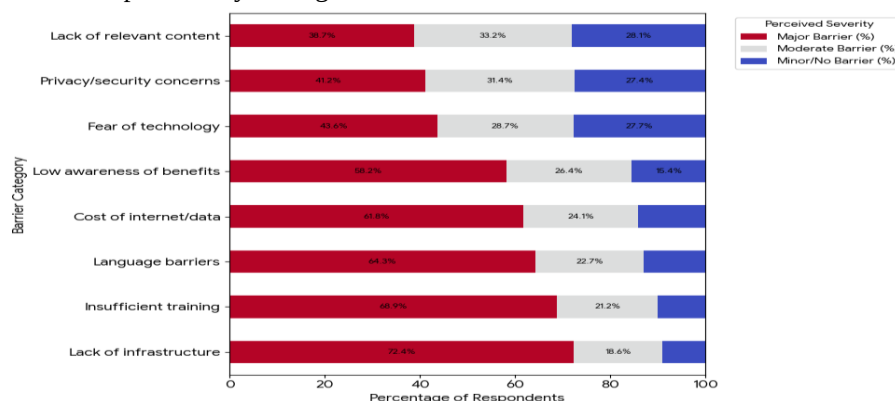


Figure 4: Perceived Barriers to Digital Literacy and AI Tool Adoption (N=847)

Perceived Barriers to Digital Literacy and AI Tool Adoption (Figure 4) shows that Lack of infrastructure (72.4%) and Insufficient training (68.9%) take up the top most challenges, highly reported as Major Barriers. Language barriers (64.3%) and Cost of internet/data (61.8%) are also substantial barriers. Perception-related barriers, namely Fear of technology (43.6%) and Privacy/security issues (41.2%), remain high but are less frequently perceived as Major Barriers than basic access and educational barriers being the primary impediment to adoption.

5.5 Qualitative Insights from Librarian Interviews and Focus Groups: Qualitative data from librarian interviews and focus group discussions provided rich contextual understanding of the quantitative patterns, revealing implementation challenges, user perspectives, and systemic barriers that survey data alone could not capture. Four major themes emerged from thematic analysis.

Theme 1: Infrastructure Inadequacy as Fundamental Barrier

Librarians consistently emphasized infrastructure deficits as the most significant constraint on digital service provision. A librarian from rural Bihar articulated this challenge:

"We received five computers through a government scheme three years ago, but we have had no stable internet connection for the past six months. The computers sit unused while users ask daily when internet will return. We cannot provide digital literacy training without reliable connectivity."

Similar narratives emerged across states, with librarians in Madhya Pradesh and Rajasthan describing intermittent electricity supply that rendered digital infrastructure unusable for significant periods. One Rajasthan librarian noted:

"Power cuts occur 4-5 hours daily during summer. Even when we have internet, frequent outages disrupt any training sessions we attempt. Users become frustrated and stop attending."

Infrastructure challenges extended beyond connectivity to encompass inadequate hardware. A West Bengal librarian explained:

"We have two working computers for a community of 15,000 people. Users must wait hours for brief access. This is not conducive to learning or skill development."

These qualitative accounts contextualize the quantitative finding that 72.4% of survey respondents identified infrastructure lack as a major barrier, revealing that infrastructure inadequacy encompasses unreliable connectivity, insufficient quantity, and outdated equipment.

Theme 2: The Digital Literacy Gap among Library Staff Themselves

A striking finding from librarian interviews was that many library staff themselves possessed limited digital competencies, creating a capacity constraint for user training. Several librarians candidly acknowledged their own skill gaps:

"I completed library science degree before computers were standard curriculum. I know basics email, internet search but I cannot teach advanced skills I do not myself possess. How can I guide users on AI tools when I barely understand what AI means?" (Bihar librarian)



This finding proved particularly salient regarding AI awareness. When asked about AI tools like ChatGPT, most librarians (26 of 32 interviewed) indicated they had heard the name but had never used the tools and could not explain their functions to users. One Madhya Pradesh librarian stated:

"Young users sometimes ask about ChatGPT because they see it on social media. I tell them I do not know enough to help. If the librarian cannot explain, where will they learn?"

Several librarians expressed interest in professional development but noted such training was rarely available:

"We receive no ongoing training. After initial appointment, you are on your own. Technology changes rapidly but our skills remain static. We need regular workshops but district authorities have no budget for librarian development." (West Bengal librarian)

These insights help explain why digital literacy and AI awareness remain low among users: libraries cannot effectively serve as digital learning hubs when staff lack necessary competencies and training support.

Theme 3: Gendered Barriers to Library Access and Technology Use

Both librarians and focus group participants identified gender-specific barriers affecting women's library access and technology engagement. Librarians across all states noted significantly lower female visitation:

"Women come much less frequently. Cultural norms discourage women from spending time in public spaces like libraries. Families question why a woman needs to visit library when she should focus on household duties." (Bihar librarian)

"Transportation is a barrier for women. Our library is 3-4 kilometers from some villages. Men come by bicycle or motorcycle, but women generally cannot travel alone such distances. Their mobility is restricted." (Rajasthan librarian)

Focus group discussions with female library users revealed additional layers to these barriers. Women described family responsibilities that limited library time:

"I must cook, clean, care for children and elderly. When would I find time to sit in library learning computer skills? My husband says it is unnecessary for housewife to know these things." (Focus group participant, Madhya Pradesh)

Some younger women reported experiencing discomfort in library spaces dominated by male users:

"When I come to library, I am often the only woman among many men. I feel self-conscious using computers when men are watching. I prefer to leave quickly rather than ask for help with technology." (Focus group participant, West Bengal)

These qualitative accounts provide crucial context for the quantitative finding of significant gender gaps in digital literacy (75.6% of females at basic level vs. 59.7% of males), revealing that gender disparities reflect systemic socio-cultural barriers limiting women's access to both libraries and technology learning opportunities.

Theme 4: Language as Technical and Psychological Barrier

The predominance of English-language interfaces emerged as both a technical obstacle and a source of psychological intimidation. Librarians described user reluctance to engage with digital resources due to language:

"Most users are comfortable only in Hindi or Bhojpuri. When they encounter English menus and instructions, they feel lost. Many give up immediately rather than struggle through." (Bihar librarian)

This observation was echoed in focus groups, where users described language barriers as generating feelings of inadequacy:

"I completed education in Hindi medium. Computer language is English. I feel like I am not smart enough for computers because I cannot understand the words. It makes me feel ashamed." (Focus group participant, Madhya Pradesh)

Interestingly, several librarians noted that AI tools like ChatGPT support multiple languages including Hindi, but users remained unaware of this capability:

"If users knew ChatGPT could respond in Hindi, perhaps more would try it. But they see it as English tool and assume it is not for them." (West Bengal librarian)

Synthesis: Convergence of Quantitative and Qualitative Findings- This consistency in findings through triangulation of methods is significant, with quantitative data revealed widespread low digital literacy (65.8% basic level) and limited awareness in relation to basic AI features (31.2%), while the qualitative data identified the underlying reasons for these patterns infrastructure inadequacy, staff capacity

constraints, gendered access barriers and the overwhelming size of learning required being a cruel cycle of reinforcing digital exclusion. This strong confidence in converging findings, combined with qualitative richness provides important context for the mechanisms which may underlie observed statistical associations.

6. Discussion- Findings from this multi-state survey generate detailed snapshots of the state of digital literacy and AI resource awareness among rural public library users in India, pointing to critical crevices as well as potential intervention paths.

6.1 Digital Literacy Disparities and Implications; The large majority of library users (65.8%) achieve only basic digital literacy levels a population which might be expected to be more information oriented even than the general rural public indicating that there could be an even higher level of digital skills that are required across the broader rural public. This discovery is consistent with information at the national level which shows that only 25% of rural residents have digital literacy and news sources, a finding that highlights the need for increased digital literacy efforts (Strover, 2019). The differences across states observed (where West Bengal had higher literacy rates compared to Bihar and Madhya Pradesh) likely reflect differential investments in educational and technological infrastructure among the state, indicating that policy interventions at the state level have a substantial impact on digital competency levels.

6.2 Gender Disparities in Digital Competencies: The marked differences between the sexes in their digital literacy skills mirror broader trends of technology inequality that affect women in rural India. As women were only 38.3% of library users and reported much lower DC scores, the implications derive that libraries have not effectively addressed gender related barriers for DI purposes. This is in line with the observation expressed by Nwokedi (2019) and Oyewusi, (2020) about continued gender inequality in access to information and engagement with technology across the spectrum of developing countries.

6.3 The Emerging AI Divide: In stark contrast to the low awareness of AI tools (31.2% overall), globally these trends are indicative of a rapidly increasing uptake by educated populations 46% use ChatGPT in India, for example. This gulf points to the continued underrepresentation of rural library users in the ongoing AI revolution shaping information access and creation. The steep age gradient of AI-awareness wherein younger generations enjoy a substantially higher level of awareness suggests that the general trends in technology exposure and adoption seen around the world are also at play within rural India (Ofem et al., 2024).

6.4 Infrastructure and Training Deficits: The barrier analysis yields practical implications for the design of interventions. Emphasis on infrastructure constraints reinforces the need for library technology resources to accompany digital literacy programs. The inadequate training barrier, which points out the disparity between national digital literacy efforts and library programming with relation to digital literacy, emphasises this space. Although PMGDISHA has successfully trained millions, the training seems to be divorced from library service contexts, as librarians themselves express lack of training for delivering digital services.

6.5 Language and Cultural Considerations: Language barriers are a special consideration, especially because of India's diversity and the use of English in the digital space. It's very important to build the vernacular digital literary materials and AI tools with regional language support." The advent of multilingual AI is a recent breakthrough that offers promise for overcoming this barrier, but such capacities are not well known to rural users or librarians (Baidoo-Anu & Owusu Ansah, 2023). Creation of linguistically-induced culturally-relevant content in regional languages could contribute to increase of digital translation among rural library users who perhaps feel disconnected from the digital world, which currently is English centric.

6.6 Methodological Contributions: In addition to substantive findings, this study offers methodological contributions to library and information science research. The multi-state design facilitates identification of both cross-site themes (e.g., common infrastructural constraints across all states) and contextual differences (e.g., maintain relatively high digital literacy levels in West Bengal), allowing for generalizability beyond single-site case studies that mainly characterize existing research on libraries in India. Postscript: The integrated mixed-methods approach shows the merit of blending quantitative measurement with qualitative interpretation. Quantitative data provided information about prevalence and statistical associations, while qualitative data uncovered causal mechanisms and contextual factors necessary for intervention design. The qualitative interviews confirmed this impression by showing that the gender gap is a poor proxy for digital literacy, since it reflects impediments from lack of mobility, domestic duties and cultural norms, insights indicating the necessity of gender-sensitive programs over courses, but rather addressing structural constraints.



6.7 Limitations: Several limitations warrant acknowledgment. First, the cross-sectional design reflects associations at only one point in time, and we are not able to infer causation. The second limitation is that the digital literacy had been assessed using self-reported data, which may not accurately align with behavioral skills. Third, this study used only four states, which might not be representative of other states in India, given the varying nature of states. Fourth, there might have been social desirability bias affecting responses. Fifth, because this study focused on rural libraries, comparisons to urban library users was not possible.

6.8 Future Research Directions: There are several possible directions for future work based on this study. For example, we need intervention research to test the efficacy of specific digital literacy and AI literacy programs that are tailored to rural library contexts. Second, longitudinal cohort studies of exposure to digital literacy interventions would show an enduring effect and long-lasting impact of skills learned. Third, similar comparative international research focused on rural library digital inclusion among developing nations would highlight challenges and approaches that libraries can share internationally. Fourth, research opportunity to examine potential of emerging technologies to bypass infrastructure hurdles. Finally, future research should consider how librarians' professional identity and institutional culture affect their willingness to adopt digital services.

7. Conclusion- This mixed-methods study fills a research gap by providing systematic empirical evidence on digital literacy levels and awareness of artificial intelligence (AI) tools among rural public library users in four states of India, highlighting significant divides that threaten to marginalize rural communities and deny them an opportunity to participate in India's continuing digital transitions. Although national initiatives have poured money into digital infrastructure and literacy training; results show that rural library users are still primarily basic digital users (65.8%) with severe gender imbalances (75.6% of females at basic level compared to 59.7% of males). Underutilization of generative AI tools that are increasingly becoming central to access to information, learning, and economic opportunity -- In particular, only 31.2% of rural public library users had ever heard of any AI tool while only 4.2% of them reported ever using such tools on regular basis. We established these patterns quantitatively among 847 library users, and our qualitative follow-up with 32 librarians and 16 focus groups revealed mechanisms: infrastructure inadequacy (patchy connectivity, fewer devices), staff capacity constraints (librarians themselves are untrained), gendered access barriers (mobility and family), and language intimidation (interfaces in English). The combination of the findings from the qualitative and the quantitative studies supports confidence in the findings while also providing insights for intervention design. The common comparative design across different states demonstrated both shared difficulties and variations attributable to context, with West Bengal generally showing greater levels of digital literacy than either Bihar or Madhya Pradesh differences that are likely a product of differential investments, state by state, in educational and technological infrastructure. The differences between these states indicate that rural digital inclusion varies considerably based on state-level policy and the quality of implementation.

Urgent Policy Implications- Findings demand urgent multi-pronged interventions:

- **Infrastructure Investment:** Sustained funding for reliable internet connectivity, sufficient modern computing devices, and stable electricity supply must be prioritized. One-time equipment donations prove insufficient without ongoing maintenance and upgrades.

- **Librarian Professional Development:** Mandatory continuing education programs should equip library staff with contemporary digital skills and AI literacy. Until librarians themselves become confident technology users, libraries cannot effectively serve as community digital learning hubs.

- **Gender-Responsive Programming:** Interventions must directly address gendered barriers through women-only training sessions, mobile library services reducing travel barriers, and community awareness campaigns challenging cultural norms that discourage female technology engagement.

- **Multilingual Digital Resources:** Development and promotion of AI tools and digital literacy materials in Hindi and regional languages would reduce language-based psychological barriers. Awareness campaigns should emphasize existing multilingual capabilities of tools like ChatGPT.

- **Integration with Existing Initiatives:** Rather than launching new standalone programs, AI literacy components should be integrated into existing schemes like PMGDISHA and National Mission on Libraries, leveraging established infrastructure and institutional relationships.

- **Evidence-Based Evaluation:** Interventions should include rigorous evaluation components to assess effectiveness and enable continuous improvement.

Broader Significance- More specifically, this study addresses the struggles and trends in the world largest rural population, contributing to an understanding of global digital inclusion, rural development and library transformation; With the ongoing transformation of information access and knowledge creation globally through artificial intelligence, leaving rural populations of developing countries behind is both an equity imperative and economic necessity. Libraries have always been democratic institutions, whose mission has been to provide universal access to knowledge, and they need to be empowered to continue this mission in the digital era. The blending of quantitative and qualitative provides an excellent demonstration of the benefits of methodological pluralism to comprehend complex socio-technical phenomena. Future research should build upon this tradition by following the spatial flow of transmission over time to track its spread seed, test the success of interventions for control and elimination with field experiments, and broaden comparisons to geographic and cross-national scales. Enabling the full coalescence of rural India in the digital economy and information society will require a targeted, sustained, and evidence-based intervention articulated at correcting not just skill gaps but structural impediments embedded in infrastructure deficits, institutional capacity constraints, and socio-cultural norms. While this study builds the evidence base for these types of interventions, translating evidence to implementation will take leadership, funding, and a real commitment to digital equity.

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