Narrative Review Article

Bridging the Learning Divide in Pakistan: Educational Technology and Foundational Literacy in a Resource-Constrained Education System

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ABSTRACT

Educational technology in recent decades has emerged as a promising tool for addressing learning gaps in low-income countries, with global evidence suggesting that well-integrated technological programs can result in improved gains in student literacy and engagement. Beyond just the academic benefits it has for students, EdTech can also be a cost-effective approach. However, a central debate in the literature concerns whether these benefits are contingent on surrounding institutional resources and conditions, and whether they translate in highly constrained education systems, where factors like teacher capacity and digital literacy remain underdeveloped. This paper explores the question: to what extent can EdTech improve foundational literacy outcomes for school-aged children in Pakistan, and what structural conditions enable or hinder its effectiveness? To answer this, the paper conducts a narrative review of global and Pakistan-specific literature on EdTech, educational inequality, and the institutional capacity needed for this implementation. The findings suggest that while EdTech holds genuine potential in Pakistan, its effectiveness is consistently undermined by inadequate teacher training, unreliable infrastructure, low digital literacy, and regional and gender inequities that shape who can access and benefit from digital learning tools. This paper contributes to scholarship on EdTech in the Global South by providing an integrated analysis of how institutional conditions shape technological effectiveness and offers policymakers a perspective for understanding why device access alone is insufficient to drive educational reform in systems like Pakistan's.

Keywords: EdTech; Pakistan; educational equity; digital literacy; institutional capacity; rural-urban divide; gender inequality; literacy

INTRODUCTION

Educational systems across the world are increasingly turning to technology to improve both access to and the quality of learning. Governments and educators have invested heavily in digital tools with the expectation that technology can help address challenges such as limited educational resources, unequal access to learning instruction, and gaps in learning outcomes (1). Within this context, educational technology (EdTech) refers

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to the use of technological processes and resources to facilitate learning and improve performance (2). However, research suggests that its effectiveness depends not simply on access to devices, but on how technology is introduced and integrated into learning environments (3). In practice, simply equipping schools with devices has proven insufficient without deliberate attention to how these tools are pedagogically applied. Understanding the conditions under which EdTech is most effective is therefore a central concern for both researchers and policymakers, particularly in low-income countries like Pakistan, where its potential to expand educational opportunity remains largely contingent on the institutional structures surrounding its implementation.

EdTech has become an important component of modern educational systems worldwide, and research shows it can significantly improve students' learning outcomes when effectively integrated into programs. A meta-analysis of 36 experimental studies involving 13,438 students found that computer-assisted instruction significantly improved students' mathematics test scores, producing an overall effect size of 0.38 compared with traditional teaching methods (4). Furthermore, in several low-income countries, EdTech has improved foundational literacy skills (5). For example, a randomized controlled study in Kenya measured the effects of an interactive media literacy software program on elementary students' reading skills. The use of this program was guided by teacher involvement and curriculum standards. The students using this media demonstrated significant gains in reading comprehension as measured by the standardized GRADE assessment and outperformed control students who were learning without the use of this media (6). These findings indicate that well-implemented EdTech can be an effective strategy for schools where foundational literacy gaps persist. Additionally, research has suggested that EdTech has contributed to the development of digital literacy, which allows students to effectively utilize digital learning platforms and communicate through digital tools (7). These forms of literacy are increasingly important in the 21st century, as the progressive digitization of labor markets and industries has made the ability to navigate digital environments a prerequisite for workforce participation.

In addition to the observed learning gains in student literacy, research suggests that EdTech can also be a cost-effective strategy for education systems in low-income countries. A World Bank review of EdTech interventions in developing countries found that technology-enabled instructional improvements and self-led learning approaches tend to be relatively low in marginal cost, while still improving learning outcomes (3). This evidence suggests EdTech can enhance learning outcomes while offering a more efficient alternative to traditional classroom structures, particularly where education resources are limited.

In low-income countries, EdTech has the potential to bridge literacy gaps between low- and high-income residents. Particularly in Pakistan, with 22.8 million school-aged children aged 5 to 16 out of school, and two out of every five children in Grade 5 unable to read a simple sentence in their first language, Pakistan faces a deep learning crisis (8). However, while global research indicates that smoothly integrated EdTech implementation can be effective and cost-efficient, the extent to which these findings translate to the education system in Pakistan, where funding constraints, regional inequality, and a lack of human capital persist, remains underexamined.

This review, therefore, situates global literature on EdTech within the context of Pakistan's education system. This review focuses primarily on foundational literacy outcomes among primary and secondary school-aged children; evidence concerning adult literacy, higher education, and system-wide enrollment is discussed only where it illuminates the institutional conditions, such as funding, governance, and teacher capacity, that also shape foundational literacy outcomes. Throughout this review, access, use, implementation quality, engagement, and learning outcomes are treated as distinct and only partially related categories. Access refers to the physical availability of a device, electricity, or internet connection; use refers to whether and how frequently that technology is actually operated by students or teachers; implementation quality refers to the pedagogical, curricular, and institutional conditions surrounding that use, such as teacher training and curriculum alignment; engagement refers to observable student attention, participation, or motivation during a lesson; and learning outcomes refer to measurable gains in literacy, achievement, retention, or long-term educational attainment. Device or internet access does not guarantee meaningful use, and use itself does not necessarily translate into implementation quality (3), engagement, or measurable learning outcomes; each of these categories is therefore addressed separately below. More particularly, this paper examines the extent to which EdTech can improve foundational literacy outcomes for school-aged children with limited access to quality education in Pakistan and what structural conditions enable or hinder

its effectiveness. These findings suggest that EdTech may be particularly valuable in education systems facing significant systemic constraints, making Pakistan a case for understanding how institutional conditions shape the potential of technology to drive educational reform.

EDUCATIONAL AND LITERACY CONTEXT IN PAKISTAN

The Pakistani Context

Pakistan is a South Asian country with a rapidly growing population and significant economic and developmental challenges. As of 2024, Pakistan's population was estimated to be 251.3 million people, and as of 2025, the country's GDP was around $410.5 billion (9). Pakistan typically allocates only about 1.7–2.0% of its GDP to public education, well below the recommended benchmark of 4 to 6% and among the lowest shares in South Asia; competing budget priorities, including defense spending, are one contributing factor, though this underinvestment likely reflects overlapping fiscal and political causes rather than any single one (9,10,11,12). The consequences of this chronic underinvestment are reflected in Pakistan's literacy rates, with a youth literacy rate (ages 15–24) of around 77% (13). This national figure describes the youth population as a whole rather than this review's core focus on primary and secondary-school-aged children, but it establishes the systemic underinvestment that also shapes school-level foundational literacy outcomes. On average, a person in Pakistan completes roughly five years of formal education over their lifetime, compared to around seven years in neighboring India and Bangladesh (13).

Overall State of Education in Pakistan

Pakistan's underfunded system has produced deeply uneven outcomes at the primary and secondary levels. Of the roughly 2% of GDP spent on education, a majority is skewed toward higher education, leaving foundational schooling chronically underfunded relative to the literacy outcomes it needs to support (14,15). Despite increased enrollment, learning outcomes remain weak, and around 77% of children experience "learning poverty," meaning they cannot read or understand simple age-appropriate texts by the age of ten (16,17). Management weaknesses compound this underfunding: teacher appointments, particularly in primary schools, are frequently affected by political interference and rent-seeking, which is associated with weakened merit-based recruitment and elevated teacher absenteeism, and limited capacity to evaluate the education system reduces quality assurance over new curricula (15,18). It is within this context that EdTech has emerged as a potential lever for reform, offering a means to supplement inadequate instruction and extend learning opportunities to students who are otherwise underserved by the existing system.

Teacher effectiveness in Pakistan's education system is shaped by more than a single dimension of preparation. The teacher qualification and training crisis further reflects this lack of management. School teachers throughout different levels of education are often required to complete only minimal formal education and short certification programs, therefore limiting pedagogical preparation (15). However, formal qualifications are only one part of this picture; teacher effectiveness more broadly reflects subject-matter knowledge and ongoing professional development, alongside school leadership, and whether the language of instruction aligns with students' home language and whether teachers have access to technical support, particularly where digital tools are introduced. These human capital constraints weaken teachers' ability to provide meaningful instructional guidance, extending beyond literacy and access to directly undermine Pakistan's institutional capacity to integrate digital technology effectively. This is particularly consequential for EdTech integration, as teachers with limited pedagogical training, insufficient ongoing professional development, or inadequate technical support are less likely to have the digital literacy needed to effectively incorporate technology into their classrooms, meaning that even in schools with well-resourced EdTech initiatives and devices, these efforts risk failing without parallel investment in teacher development across these multiple dimensions.

DIGITAL ACCESS AND READINESS

Although access to technology and awareness of digital tools have increased in Pakistan, these gains have not translated into significant improvements in digital competencies and practical usage. Smartphone penetration has reached roughly 30% of the population, up from approximately 11% in 2015, particularly after COVID-19 (19,20). This figure reflects population-wide adoption rather than school-aged usage specifically, but indicates the broader digital environment within which school-level EdTech access is expanding. The ability to use technology productively in schools remains limited, especially in rural areas and public education systems, illustrating the access/use distinction defined above:

an increase in device or connectivity access does not by itself indicate productive classroom use. National assessments show that while Pakistan is moving toward a digital society, digital literacy lags behind infrastructure expansion (19), illuminating the broader structural inequalities that shape its educational system, where access to technological resources alone has persistently failed to translate into meaningful learning outcomes.

EVIDENCE ON EDTECH EFFECTIVENESS

In some instances, EdTech in Pakistan has proven beneficial to learning outcomes, despite constraints to adequate teacher pedagogy and infrastructure. For instance, a study conducted in District Karak divided 9th-grade students into a control group taught through traditional methods and an experimental group taught using computers, multimedia, and projectors over six weeks. The experimental group significantly outperformed the control group in both achievement and retention tests, and was also observed to be more attentive and engaged during lessons (21). EdTech delivered significant learning gains and improvements in academic performance among students in this study. The study also observed that these students were more attentive and engaged during lessons; however, engagement and the achievement and retention test results were measured as separate outcomes, so this study does not establish that engagement itself drove the learning gains, only that both were observed together following the intervention. The magnitude of this gap is also notable in context: the difference between the experimental and control groups in Karak was considerably larger than the effect sizes reported in comparable international interventions, such as the 0.38 effect size found for computer-assisted mathematics instruction in China (4) or the reading comprehension gains observed in the Kenya media literacy trial (6), though the small sample and single-school setting of the Karak study make this comparison suggestive rather than conclusive. This raises the question of whether such gains are attributable to the technology itself or to complementary factors specific to the study, such as the presence of trained teachers and a controlled instructional environment, factors that are frequently absent in typical Pakistani classrooms and that the broader literature identifies as necessary conditions for EdTech to function as intended (3). When implemented well, EdTech can therefore be a beneficial tool for addressing foundational literacy gaps in Pakistan. However, positive learning outcomes from EdTech like these in Pakistan are uncommon to come across; this is because EdTech has often been implemented without the necessary infrastructure or teacher pedagogy needed to make it successful (Table 1).

Table 1. *Summary of EdTech intervention studies discussed in this review.*

Country/ Setting	Educational Level	Technology Type	Study Design	Outcome Measured	Principal Finding	Key Limitation
District Karak, Pakistan (21)	Secondary (Grade 9)	Computers, multimedia, projectors	Experimental (randomized control vs. experimental group)	Achievement, retention, engagement	Experimental group outperformed control on achievement and retention; more attentive during lessons	Small sample, single district, six-week duration, no long-term follow-up
Sub-Saharan Africa/Kenya (6)	Elementary	Interactive media literacy software	Randomized controlled trial	Reading comprehension (GRADE assessment)	Treatment group significantly outperformed control	Single-country context; institutional conditions may not generalize to Pakistan
Mainland China (4)	Primary/ secondary (aggregated)	Computer-assisted instruction	Meta-analysis (36 studies, n=13,438)	Mathematics achievement	Overall effect size of 0.38 favoring computer-assisted instruction	China's institutional and infrastructural context differs substantially from Pakistan's

Continued Table 1. *Summary of EdTech intervention studies discussed in this review.*

Country/ Setting	Educational Level	Technology Type	Study Design	Outcome Measured	Principal Finding	Key Limitation
Swat, Pakistan (44)	Secondary (Grades 8–10)	Offline tablet computers (Aptus system)	Pre-/post-test, two-school pilot	Learning outcomes, engagement	Post-test scores significantly higher than pre-test; parents and teachers reported increased engagement	Very small sample (n=74), two schools only, no control group
Pakistani universities (22)	Higher education	Online/e-learning platforms	Qualitative analysis of COVID-19 disruption	Access and digital skills	Unstable internet, weak digital skills, and disrupted institutional support undermined online learning	Higher-education population, outside this review's core school-aged focus

INSTITUTIONAL AND IMPLEMENTATION BARRIERS

The lack of access to devices is often blamed for the shortcomings of EdTech in Pakistan, but these shortcomings are equally a result of the absence of the structural conditions that would allow it to succeed. Effective EdTech implementation requires factors like stable electricity and internet, teachers who can teach with technology, institutional support, and a curriculum adapted for digital delivery. Pakistan falls short in all four aspects. Jamil and Muschert's 2023 analysis of Pakistani universities, though concerned with a different population than this review's school-aged focus, offers one brief parallel: unstable internet access, weak digital skills, and disrupted institutional support from the Higher Education Commission undermined online learning even at the tertiary level (22). Research in secondary schools in Pakistan more directly relevant to this review's focus shows how successful Information and Communications Technology (ICT) integration relies heavily on teachers' understanding of the applications of digital devices, as well as their access to ongoing technical support, meaning technology cannot be effectively used if teachers are underprepared in how to use it pedagogically. Technology is therefore often rolled out before the conditions that make it valuable educationally exist, and even where platforms or devices are in place, students and teachers often lack consistent access to use them in ways that improve learning (Table 2).

Table 2. Barriers to EdTech implementation and recommended responses.

Category	Documented Barrier	Recommended Response
Infrastructure	Unreliable electricity and internet access, particularly in rural areas (30,22)	Prioritize offline-capable, low-bandwidth EdTech tools and phase infrastructure investment toward the most underserved districts (24)
Teacher preparation	Limited pedagogical training, insufficient professional development, and low digital literacy among teachers (15)	Pair any EdTech rollout with parallel investment in teacher training and ongoing technical support
Governance	Political interference in teacher appointments, weak quality assurance mechanisms, fragmented implementation (15,18)	Strengthen independent curriculum alignment and quality assurance review for digital content before adoption (8)

Continued Table 2. Barriers to EdTech implementation and recommended responses.

Category	Documented Barrier	Recommended Response
Language	Mismatch between the language of digital content and students' home languages (8)	Prioritize development of Urdu- and regional language EdTech content over reliance on English-language materials
Cost	Vendor dependency, procurement without long-term maintenance planning, device diversion and loss (25,26)	Build maintenance, replacement, and vendor exit planning into procurement processes from the outset
Gender	Unequal device ownership, restricted access, and lack of female teachers or mentors (39,41)	Design gender-specific interventions, such as female mentor programs and targeted device-access initiatives
Geography	Heterogeneous infrastructure, connectivity, and social norms across provinces and districts (29,30)	Tailor EdTech rollout to provincial/district conditions rather than applying a uniform national model

CURRICULUM, LANGUAGE, AND CONTENT QUALITY

Pakistan's multilingual education system further complicates EdTech implementation. Two of every five Grade 5 students cannot read a simple sentence in Urdu, Sindhi, or Pashto, their first languages (8), yet much EdTech content is developed in Urdu or English rather than regional languages, creating a mismatch between the language of digital instruction and students' home language that can undermine comprehension regardless of technical access. A review of the EdTech research literature in Pakistan found available studies to be few, small, and often of poor methodological quality, limiting confidence in claims about curriculum alignment (8). This gap is compounded by limited attention to disability access; a systematic review of EdTech for children with disabilities in low- and middle-income countries found few tools designed with accessibility in mind, and that adaptations such as SMS-based tools used by deaf and hard-of-hearing Pakistani learners are rarely integrated with curriculum content (23). Offline functionality is a further barrier, since many EdTech tools assume continuous internet access; Pakistani girls' education programmes have used offline mobile learning devices to extend reach into low-connectivity areas, though such approaches remain the exception rather than the norm (24). These barriers therefore warrant attention alongside access itself in assessing whether EdTech can meaningfully improve foundational literacy in Pakistan.

RISKS AND UNINTENDED CONSEQUENCES

While the sections above outline the conditions under which EdTech can support foundational literacy in Pakistan, a balanced assessment also requires attention to potential harms. As already discussed, EdTech implemented without attention to infrastructure, teacher capacity, and gender-specific barriers risks widening rather than narrowing existing inequalities. Beyond this, global evidence raises further concerns relevant to the Pakistani context. EdTech content is often commercially produced with limited long-term evaluation, and online educational content generally lacks robust quality control (25); given that Pakistan's own EdTech research base is thin (8), this raises questions about the reliability of the digital materials being adopted. Reliance on private vendors also creates dependency, since technology is frequently procured to fill an immediate gap without consideration of long-term maintenance or replacement costs (25), leaving schools vulnerable if vendor relationships end or products become obsolete.

Physical risks accompany device-based programs specifically; audits of Pakistan's Prime Minister's Laptop Scheme have documented over a thousand laptops reported lost, stolen, or untraceable across recent distribution phases, illustrating that device diversion is a documented, ongoing risk (26). Digital risks are similarly significant: globally, only 16% of countries legally guarantee data privacy in education, and one analysis found that 89% of surveyed EdTech products could track children's data, while cybersecurity training remains rare among teachers even as schools increasingly face ransomware attacks (25).

Online harassment is a further concern; a review of cyberbullying among youth in developing countries found that digital platforms expose young people, particularly young women, to social and psychological

harm and privacy violations (27), intersecting with the gendered digital barriers discussed above. Excessive screen exposure has also been linked to adverse effects on children's physical and mental well-being, including higher anxiety and reduced self-control (25). Finally, EdTech's growing role in instruction risks displacing direct teacher-student interaction rather than supporting it; global guidance emphasizes that digital tools should enhance, not substitute for, in-person, teacher-led instruction (25). These risks suggest that EdTech's potential for foundational literacy in Pakistan depends not only on expanding access and institutional capacity, but on actively managing the harms that poorly governed digital adoption can bring in.

EQUITY IMPLICATIONS

Educational Inequality in Pakistan

While national indicators such as literacy rates and average years of schooling provide a broad overview of Pakistan's educational system, they also reveal significant inequalities across regions and genders. These disparities have been perpetuated by a historical funding model that has prioritized urban areas and societal expectations that prioritize male education and restrict the education of women (28). As a result, rural communities and girls face disproportionately lower access to quality education (28). The uneven distribution of learning availability and resources in Pakistan illuminates the structural weakness within the educational system and highlights the need for more equitable policies. Understanding these inequalities is particularly important in the context of EdTech implementation, as unequal access to infrastructure, teacher quality, and digital resources can significantly shape which students can benefit from EdTech programs. If these disparities are not addressed, EdTech actually risks reinforcing existing inequalities rather than bridging them.

Rural-Urban Education Gap

The rural-urban education gap in Pakistan is substantial, with rural children 32% less likely to attend school and 50% more likely to lack basic literacy skills than their urban peers, two related but distinct outcomes, since school attendance reflects access while literacy reflects learning quality once enrolled (29). Rural Pakistan is not a uniform category: infrastructure reliability, school quality, connectivity, the dominant home language, and social norms around schooling and technology use all vary considerably across and within provinces, so the patterns of rural disadvantage discussed below should be read as general tendencies rather than conditions uniform across all of rural Pakistan. Rural areas in Pakistan frequently have lower enrollment and poorer learning outcomes due to limited access to school infrastructure, particularly at the middle and secondary levels of schooling (30). This uneven distribution of education creates a "transition bottleneck," where students in rural regions struggle to advance beyond primary education due to a lack of nearby institutions and resources (31). This lack of infrastructure essentially serves as a cap on the educational attainment of rural youth since the physical distance to the nearest secondary school often becomes an insurmountable barrier after grade five (32). Furthermore, rural schools are also more likely to face shortages of qualified teachers and of the broader conditions that support teacher effectiveness, including manageable workload, incentives, and access to school leadership and technical support, and a blend of grade levels in one classroom, all of which reduce educational quality for students in these areas (33). With a lack of qualified teachers, students are often left to their own interpretation of the material, and the learning progression of the concepts is often slowed down (33). Furthermore, when many classrooms in rural areas are multigrade, it becomes difficult to meet the different learning needs of students across different grade levels (34).

Taken together, these deficiencies compound one another, meaning no single intervention can fully address rural educational inequality in isolation; significant reform would need to target infrastructure, teacher quality, and instructional support simultaneously. This disparity in resources has direct implications for EdTech implementation, because rural students who already lack access to physical school infrastructure are also the least likely to have reliable electricity or access to devices, which are the basic requirements for most EdTech tools (35). Furthermore, successful EdTech implementation depends on teachers' ability to integrate technology into instruction, yet many rural schools face persistent shortages of trained educators who are able to fulfill this (35). The students who stand to benefit most from EdTech are thus the least equipped to access it, a compounding disadvantage any EdTech initiative in rural Pakistan must address.

This inequality is further worsened by socioeconomic constraints such as a lack of transportation and the need for children to earn money for their families, which disproportionately affects rural households, increasing

the opportunity cost of schooling (36). In response to these disparities, Pakistan has implemented policy measures such as provincial education sector reforms and targeted rural school expansion programs, which aim to increase access and improve infrastructure (37). However, these interventions have had uneven success: logistical constraints, weak incentives, inadequate training, and low retention rates have all contributed to difficulties in teacher deployment and understaffed schools (35). Persistent underinvestment also limits the maintenance of school facilities and supply of learning resources, reducing education quality even where access has improved (37). Pakistan's rural education challenge is therefore not solely a matter of physical access; institutional failures in resource allocation and implementation capacity can also undermine reform efforts. These barriers further indicate why EdTech has increasingly been explored as a potential tool to bridge these gaps in human capital and physical capital allocation.

Gender Gaps

Another inequality in terms of access to education is between female and male students. In Pakistan, gender inequality in education is a consequence of institutional barriers and household decision-making. Even though enrollment gaps in education have narrowed at the primary level, secondary education faces a lot of gender disparities because girls around this age are more likely to drop out due to societal expectations and the need for them to help out with household chores (32,38). More specifically, a large societal norm that restricts girls' education is early marriage, preventing girls from making choices about their own future; often, marriage is prioritized for girls over education. Furthermore, allocation of household resources often prioritizes boys' education, especially in contexts of economic constraint (31). In short, particularly in low-income households, parents often need to decide which of their children must help out in the house and who can receive education because, for these families, sending all of their children to school is simply unrealistic due to limited household income and the opportunity cost of foregone child labor (36). Furthermore, systemic issues within schools in Pakistan, such as a lack of gender-sensitive facilities and safety concerns related to travel, further limit girls' participation in school (39). Combined with this, curricula may often reinforce traditional gender roles and ideologies that support the perspective that women should stay at home as housewives (40). These gender-based barriers are equally important to consider when determining EdTech as an intervention. Girls who are already less likely to attend school or who drop out at the secondary level are also less likely to have developed the digital literacy necessary to engage with EdTech tools. Adding to this, household resource allocation that deprioritizes girls' education may extend to decisions about device access and internet usage, meaning that even when EdTech is available within a community, girls may have systematically less access to it. These barriers extend into digital-specific constraints as well: household device ownership is frequently unequal, with girls having less access to family devices such as smartphones than their brothers, and often less time to use them even when access exists (41); and girls often lack access to female teachers or mentors who could support their engagement with digital tools in a culturally comfortable context (39). EdTech interventions that do not explicitly account for these gendered dimensions of access risk widening rather than narrowing the participation gap in education.

Gender inequality in education also carries broader macroeconomic costs: gaps between genders reduce aggregate human capital accumulation and are associated with annual economic growth losses of roughly 0.1 to 1.6 percentage points in South Asia specifically, while closing these gaps is linked to substantial GDP gains from a more skilled, inclusive labor force (43), a pattern consistent with Pakistan-specific findings on the developmental costs of gender gaps in education (42). Educational inequality in Pakistan is therefore not only a social equity issue but a developmental constraint with real economic consequences.

EdTech and Inequalities in Schooling

While the implementation of EdTech in Pakistan has grown in recent years, it continues to develop in a disparate manner mirroring existing structural imbalances. Although EdTech use gained traction during the COVID-19 pandemic, it was limited due to varying levels of access. High-income and urban-based students disproportionately benefited from developments in online learning, whereas students in rural areas were far more likely to lack access to reliable internet, electricity, or a suitable device (41). Yet access alone does not capture the full picture; these disparities also reflect larger systemic constraints in the classroom that limit EdTech's effectiveness. Research on Pakistan's digital learning environment shows that both students and teachers frequently lack the digital literacy and technical capacity required to use online platforms

(22). As a result, technology is often introduced into classrooms without the necessary pedagogical support and structure, preventing it from actually resulting in improved learning outcomes. Rather than functioning as an equalizing tool, EdTech in such contexts becomes a tool that worsens existing inequalities, as urban schools with teachers and students who are already somewhat digitally literate are better positioned to benefit from EdTech opportunities. Thus, EdTech has not fully closed educational inequities in the country, and in some cases has deepened them.

Device-based implementations such as laptops and tablets further reflect existing inequalities in access to and use of EdTech. At the school level, the roll-out of tablet-based learning has been sporadic. Tablets have been floated in some areas to provide access to digital learning content services for students, particularly in resource-scarce areas (44). However, these devices are often not distributed to individual users; rather, they are controlled by teachers or shared among students, limiting their applied use (44). This is a clear instance in which access to a device does not translate into meaningful use by individual students. This usage also varies across grades. In primary-school settings, technology is primarily used to supplement rather than supplant lesson delivery; instructor control is still paramount (3). By contrast, older students gradually become direct users of technology-based portals. By comparison, government-led device programs such as the Prime Minister's Laptop Scheme have so far been concentrated at the university level, where technology is already better supplied and institutional capacity to facilitate use is stronger (8); as a higher-education initiative, it falls outside this review's core focus but illustrates that device-based investment has so far concentrated where institutional capacity is already strongest, not at the school level where need is greatest. In sum, while advances have been made in EdTech in Pakistan, its effective usage and implementation remain constrained by limitations in access.

CURRENT PAKISTANI INITIATIVES

Policy Commitments

Pakistan's constitutional and policy commitments to education matter for EdTech not merely as background, but because they establish the entitlements and targets that digital tools are increasingly deployed to help meet. Article 25-A of the Constitution obligates the state to provide free and compulsory education to children aged 5 to 16 (45), and subsequent National Education Policies and the Education for All initiative have set enrollment and literacy targets that EdTech initiatives are often positioned to support (45,46). However, these commitments have not consistently translated into meaningful improvements: the persistence of learning poverty affecting 77% of children (16,17) suggests a gap between policy intention and implementation that may be partly associated with political interference and insufficient funding. Because EdTech initiatives depend on this same institutional capacity, funding, and governance, Pakistan's difficulty translating constitutional and policy commitments into practice constrains the institutional foundation EdTech implementation would need to rest on.

Targeted Programs

Targeted programmes connect to EdTech implementation in more indirect but still relevant ways. The Benazir Income Support Programme and the related Benazir Taleemi Wazaif and Waseela-e-Taleem initiative provide cash transfers conditional on school attendance, offsetting the income households forgo by sending children to school rather than work (47). By reducing this opportunity cost, such programmes help sustain the consistent attendance that is a precondition for benefiting from any classroom-based EdTech tool, effectively financing the conditions under which digital learning can occur rather than financing EdTech directly. Vocational and technical education programmes represent a further, largely undocumented channel: while these pathways could in principle embed digital-skills training for youth excluded from traditional academic routes (46), the literature reviewed here does not establish the extent to which existing programmes do so. Higher Education Commission reforms offer a smaller but relevant lesson: expanded enrollment achieved through dedicated funding still left rural and high-poverty students underrepresented (48), reinforcing that expanding access alone, whether to institutions or digital tools, does not guarantee equitable outcomes.

POLICY PRIORITIES AND RECOMMENDATIONS

The evidence reviewed above indicates that improved foundational literacy outcomes are not something EdTech policy can pursue directly; they are an expected consequence of first establishing the prerequisite conditions documented throughout this review,

including reliable infrastructure, trained teachers, curriculum-aligned and quality-assured content, and governance capable of sustaining implementation. Table 3 translates these prerequisites into specific, time-bound recommendations, distinguishing short-term (0-1 year), medium-term (1-3 years), and long-term (3+ years) actions and assigning responsibility across national, provincial, district, school, community, and household levels. Recommendations at the household and community level are necessarily narrower in scope than those at the national level, reflecting the limited resources available to individual families relative to the state; even so, their engagement, particularly around girls' digital access, remains a necessary complement to higher-level reform rather than a substitute for it. These measures are prerequisites, not guarantees: as discussed throughout this review, their effectiveness ultimately depends on how faithfully they are implemented in practice (Table 3).

Table 3. *Prioritized policy recommendations by time horizon and responsibility level.*

Recommendation	Time Horizon	Responsibility Level
Establish curriculum-alignment and quality-assurance review standards for EdTech content before procurement	Short-term (0-1 year)	National
Conduct infrastructure and device-inventory audits (electricity, connectivity) prior to EdTech rollout	Short-term (0-1 year)	District/School
Provide baseline digital-literacy training for teachers already assigned EdTech tools	Short-term (0-1 year)	School
Develop and fund Urdu- and regional-language EdTech content aligned with the national curriculum	Medium-term (1-3 years)	National/Provincial
Establish ongoing, rather than one-off, teacher professional-development pipelines tied to EdTech use	Medium-term (1-3 years)	Provincial/District
Build offline-capable, low-bandwidth infrastructure in rural and low-connectivity districts	Medium-term (1-3 years)	District
Implement device-access protocols addressing gender-based disparities, including female mentor programs	Medium-term (1-3 years)	School/Community
Establish vendor procurement guidelines requiring long-term maintenance and data-privacy commitments	Medium-term (1-3 years)	National
Increase public education spending toward the recommended 4-6% of GDP, with a protected share for foundational-literacy programs	Long-term (3+ years)	National
Reform teacher recruitment and deployment to reduce political interference and improve rural retention	Long-term (3+ years)	National/Provincial
Build sustained data-privacy and cybersecurity regulatory frameworks for EdTech in schools	Long-term (3+ years)	National
Support household-level engagement with girls' digital access and device use	Long-term (3+ years)	Community/Household

Limitations

While this review synthesizes existing evidence on EdTech implementation in Pakistan, several gaps in the literature warrant further investigation. Most studies examining EdTech effectiveness in Pakistan focus on urban or semi-urban settings, meaning that in-depth empirical work, particularly randomized controlled trials, targeting rural communities, remains scarce. As schools in remote areas increasingly gain access to digital devices despite facing additional infrastructural challenges, this represents an important area for future research, since EdTech's effectiveness may differ substantially from urban settings. Additionally, gender-disaggregated outcome data are largely absent from

the Pakistani EdTech literature. Studies that explicitly track how girls' access to and learning outcomes from digital tools differ across household income levels and geographic contexts would meaningfully strengthen the evidence base. Longitudinal research is also necessary to assess whether EdTech-driven learning gains persist over time or diminish when institutional support like teacher pedagogy weakens. This matters because Pakistani pilot programs often operate under temporarily favorable conditions, such as dedicated teacher training, that are unlikely to be sustained once the program concludes. If resulting gains erode after support is withdrawn, short-term data may overstate EdTech's long-run effectiveness and lead policymakers toward interventions that do not produce durable improvements.

CONCLUSION

This review examined the extent to which EdTech can improve foundational literacy outcomes among school-aged children in Pakistan, and what structural conditions shape its effectiveness. The evidence indicates that EdTech's impact on foundational literacy in Pakistan depends less on the technology itself than on the conditions surrounding its use: measurable gains have been documented in settings with adequate teacher training, curriculum alignment, and institutional support (21), but such conditions remain the exception rather than the norm across the education system. In the current Pakistani context, EdTech is therefore best understood as a tool that requires substantial institutional groundwork rather than one that functions effectively on its own.

Because the studies reviewed here are drawn largely from urban and semi-urban settings, are limited in number, and rarely track outcomes over time, this evidence should be treated as suggestive rather than conclusive. It indicates the conditions under which EdTech may help narrow foundational literacy gaps rather than establishing how large or durable such gains are likely to be at scale. In its current form, EdTech in Pakistan has also disproportionately benefited students who already have some digital literacy and reliable infrastructure, while offering little to rural and lower-income students who lack both (41). Absent deliberate attention to teacher capacity, infrastructure, and gender-specific barriers, expanding EdTech access risks widening rather than narrowing existing inequalities.

EdTech should accordingly be understood as a potential complement to, rather than a substitute for, investment in teachers and institutional reform. The findings reviewed here do not support treating technology as a solution to Pakistan's foundational literacy challenges in itself; rather, they suggest that its value is contingent on addressing the institutional and human capital gaps that shape whether, and for whom, it can be used effectively.

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