



Bridging the Learning Divide in Pakistan: Educational Technology and the Pursuit of Educational Equity

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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 expand learning opportunities for illiterate 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 on 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 (World Bank, 2020). Within this context, educational technology (EdTech) refers to the use of technological processes and resources to facilitate learning and improve performance (TVET, 1974). However, research suggests that its effectiveness depends not simply on access to devices, but on how technology is introduced and integrated into learning environments (Rodriguez-Segura, 2021). 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.

With schools incorporating EdTech alongside traditional structures of learning, it has become an important component of modern educational systems worldwide. More than just expanding access to devices, research shows that these tools 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 (Xie et al., 2020). Furthermore, in several low-income countries, EdTech has improved foundational literacy skills (Silverman et al., 2024). 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 (Abrami et al., 2014). This suggests that for schools where foundational literacy gaps remain a persistent issue, well-implemented EdTech can be an effective strategy to improve learning outcomes. 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 (Putri et al., 2025). 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 (Rodriguez-Segura, 2021). This evidence illustrates that educational technology can enhance learning outcomes while offering a potentially more efficient alternative to traditional classroom structures, making it particularly promising in contexts where education resources and public funding 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 (Zubairi et al., 2021). 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. More particularly, this paper examines the extent to which EdTech can expand learning opportunities for illiterate children 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 critical case for understanding how institutional conditions shape the potential of technology to drive educational reform.

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 (IMF, 2025). Research attributes the underallocation of resources towards the educational sector to high levels of military funding (Luqman & Antonakakis, 2021). Pakistan faces several security challenges, which are reflected in the country's budget priorities, as defense spending continues to receive significantly higher allocations than education and other social sectors (Jamal, 2025). More particularly, Pakistan typically allocates only about 1.7–2.0% of its GDP to public education (IMF, 2025), falling to approximately 0.8% during the 2024–2025 fiscal year (IMF, 2025). This amount is far below the recommended benchmark of 4 to 6%, and it is one of the lowest in South Asia (World Bank, 2025). The consequences of this chronic underinvestment in Pakistan's education are reflected in the literacy rates of adults and children in the country, with a countrywide literacy rate of approximately 60–63%, and a youth literacy rate (ages 15–24) reported around 77% (World Bank, 2025). Furthermore, on average, a person in Pakistan completes roughly five years of formal education over their lifetime compared to neighboring nations such as India and Bangladesh, where the average person completes around seven years of education (World Bank, 2025). In essence, a driving force that restricts Pakistan's educational system from developing is underinvestment in this sector, which is reflected in the structure and performance of Pakistan's education system.

Overall State of Education in Pakistan

Behind these numerical literacy rates and schooling statistics are entrenched structural inefficiencies in the education system. Firstly, Pakistan's educational sector suffers from chronic underfunding. Under 2% of Pakistan's GDP is directed towards education, and of this small percentage, a majority of spending is skewed toward higher education (Thompson, 2025). This distribution tends to benefit upper-income groups and leaves educational levels in lower-income regions stagnant. Furthermore, this spending imbalance weakens foundational primary and secondary systems, exacerbating long-term literacy outcomes and limiting equal access to educational opportunities (Memon, 2007). The slim proportion of the GDP that is distributed to the educational sector favors higher education levels, inhibiting progress at the lower levels. This top-heavy allocation effectively creates an ongoing cycle of educational inequality, where underfunded primary schooling produces lower literacy rates that, in turn, reduce the pool of students who can access those higher education levels that disproportionately receive funding. Pakistan's underfunded education system has particularly produced deeply uneven outcomes at the primary and secondary levels. 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 (World Bank, 2024; UNICEF, 2024). This illustrates that while education opportunities are becoming increasingly available to students in Pakistan, literacy rates and learning outcomes remain relatively low, with schools not observing meaningful improvements in the quality of learning being delivered. This further emphasizes the system's inability to translate educational inputs into valuable learning outcomes. In addition, the systemic weaknesses in management further worsen these inefficiencies. Teacher appointments, particularly in primary schools, are frequently impacted by political interference and rent-seeking behavior, whereby individuals in positions of power exploit the system for personal financial gain. This weakens merit-based recruitment of teachers and

consequently contributes to high levels of teacher absenteeism (Memon, 2007). Additionally, the ability to evaluate the capacity of the educational system is limited, which reduces the state's ability to ensure quality assurance in the implementation of the new curriculum (Omer, 2021). These governance deficiencies further diminish the efficiency of an already economically constrained sector. 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.

A testament to the lack of management over the education system is reflected in the teacher qualification and training crisis. School teachers throughout different levels of education are often required to complete only minimal formal education and short certification programs, therefore limiting pedagogical preparation (Memon, 2007). These human capital constraints weaken the ability of teachers to provide meaningful guidance and instruction. Critically, these deficiencies extend beyond their immediate effect on literacy and access; they also directly undermine Pakistan's institutional capacity to integrate digital technology effectively. This is particularly consequential for EdTech integration, as teachers with limited pedagogical training 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.

Overall State of Digital Literacy in Pakistan

Although access to technology and awareness of digital tools have increased in Pakistan, these progressions have not been followed by significant gains in digital competencies and practical usage. At a national level, Pakistan has made visible strides in digital adoption, driven largely by mobile technology and government-led digital reforms. Smartphone penetration has reached roughly 30% of the population, up from approximately 11% in 2015, reflecting a significant expansion in access to digital devices and exposure to online platforms, particularly after COVID-19 (Noor, 2025; Pew Research Center, 2015). However, while basic digital access is expanding, the ability to use technology productively in schools remains limited across large segments of the population, especially in rural areas and public education systems. National assessments and policy reports show that while Pakistan is moving toward a digital society, digital literacy lags behind infrastructure expansion (Noor, 2025). The gap between tech access and digital literacy suggests that expanding device availability in and of itself is unlikely to improve educational outcomes because other components, like institutional barriers and a lack of human capital in this sector, also have a significant impact on this outcome. In this way, the uneven development of digital literacy across Pakistan mirrors the broader structural inequalities that shape its educational system, a sector where access to technological resources alone has consistently failed to translate into equitable or meaningful learning outcomes.

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 (Aslam, 2009a). As a result, rural communities and girls face disproportionately lower access to quality education (Aslam, 2009a). The uneven distribution of learning availability and resources in Pakistan illuminates the structural weakness within the

educational system and further emphasizes the need for more equitable policies that address this inequality. 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 technological learning 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 be illiterate than their urban peers (Javaid, 2011). 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 (Andrabi et al., 2006). 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 (Naveed, 2021). 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 (Mughal & Aldridge, 2017). Furthermore, rural schools are also more likely to face shortages of qualified teachers and a blend of grade levels in one classroom, all of which reduce educational quality for students in these areas (Nawab & Baig, 2011). 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 (Nawab & Baig, 2011). Furthermore, when many classrooms in rural areas are multigrade, it becomes difficult to meet the different learning needs of students across different grade levels (Akram, 2024). Taken together, these structural deficiencies reinforce one another in ways that make rural educational disadvantages particularly difficult to reverse. What emerges from across these sources is that rural students in Pakistan face compounding barriers at every stage, from access and enrollment through to the instructional quality they may receive. This convergence of evidence across infrastructure and teacher quality suggests that no single intervention can adequately address rural educational inequality in isolation, and that meaningful reform would need to simultaneously target all these dimensions. This disparity in resources has direct implications for EdTech implementation, because rural students who already have a lack of 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 digital learning tools (Jamil & Muschert, 2023). 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 (Nawab et al., 2025). Hence, the students who stand to benefit most from EdTech interventions are simultaneously the least equipped to access them, creating a compounding disadvantage that any EdTech initiative targeting rural Pakistan must directly 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 (Idrees & Shah, 2018). 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 (World Bank, 2023). However, these interventions have had uneven success due to several structural factors; for instance, logistical

constraints and weak incentive offerings have resulted in difficulties regarding teacher deployment in rural areas (Nawab et al., 2025). Furthermore, inadequate training and low retention rates also contribute to understaffed or poorly staffed schools (Nawab et al., 2025). Another limiting factor is the persistent underinvestment that limits the maintenance of school facilities and the supply of learning resources, therefore reducing the quality of education even where access has improved (World Bank, 2023). This suggests that Pakistan's rural education challenge is not solely a matter of physical access, since external institutional failures in resource allocation and implementation capacity can 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 (Aslam, 2009b; Mughal & Aldridge, 2017). 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 (Naveed, 2021). 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 (Idrees & Shah, 2018). 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 (Barón et al., 2024). Combined with this, curricula may often reinforce traditional gender roles and ideologies that support the perspective that women should stay at home as housewives (UNESCO, 2010). These systemic issues together further inhibit progression in the education system when it comes to male and female participation. 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 technological learning 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. 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 results in broader macroeconomic implications since educational gaps between genders reduce aggregate human capital accumulation and, therefore, limit long-run economic growth potential (Chaudhry, 2007). More specifically, gender gaps in education and employment reduce economic growth by between 0.9 and 1.7 percentage points annually in some regions (Klasen, 2009). Additionally, countries that close gender gaps in education can experience substantial gains in GDP due to a more skilled and inclusive labor force (Klasen, 2009). Essentially, in areas where women's literacy and enrollment

lag significantly behind those of men, intergenerational mobility is constrained, and labor force participation remains suppressed. Educational inequality in Pakistan, beyond being just a social equity issue, is a developmental constraint with real economic consequences.

EdTech Implementation in Pakistan

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 Kohat Division 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 (Suleman, 2011). In essence, EdTech was able to deliver significant learning gains and improvements to academic performance amongst students like those in this study in Pakistan. More than this, EdTech was able to keep students focused and motivated to learn during lessons, further strengthening their understanding of the material and allowing them to perform better on the tests. This suggests that when implemented smoothly, EdTech can be a beneficial tool to address illiteracy and improve learning outcomes 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.

Shortcomings in EdTech Implementation

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 digital learning requires 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 highlights that many students, particularly in rural and remote areas, did not have stable access to the internet as well as the digital skills necessary to effectively use virtual learning systems. On top of this, electricity load-shedding and a lack of institutional support from universities and the Higher Education Commission disrupted online learning further (Jamil & Muschert, 2023). Research in secondary schools in Pakistan also shows how successful Information and Communications Technology (ICT) integration relies heavily on teachers' understanding of applications of digital devices, meaning technology cannot be effectively used if teachers are underprepared in how to use it pedagogically. Technology is, therefore, often rolled out in schools and universities before the surrounding conditions that make it valuable educationally exist. Even when platforms or devices are in place, students and teachers often do not have consistent or adequate access to use them in ways that improve learning.

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. EdTech's growth is inextricably linked with existing structural imbalances in the education system. Although digital learning 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 (Malik, 2022). Yet access alone does not capture the full picture. These disparities are also indicators of larger systemic constraints in the classroom that limit the effectiveness of EdTech itself. 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 (Jamil & Muschert, 2023). 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 digital learning 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 educational technology. Government-led programs such as the Prime Minister's Laptop Scheme have targeted university students, where technology is already better-supplied, and institutional capabilities to facilitate use are stronger (Zubairi et al., 2021). At the school level, the roll-out of tablet-based learning has been more sporadic. Tablets have been floated in some areas to provide access to digital learning content services for students, particularly in resource-scarce areas (Ally et al., 2017). However, these devices are often not distributed to individual users; rather, they are controlled by teachers or shared among students, limiting their applied use (Ally et al., 2017). 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 (Rodriguez-Segura, 2021). By contrast, older students gradually become direct users of technology-based portals. In higher education, EdTech is much more heavily involved within the learning spaces occupied by students. In sum, while advances have been made in educational technology in Pakistan, its effective usage and implementation remain constrained by limitations in access.

Pakistan's Efforts to Address Illiteracy

Despite the underfunding of the education sector, Pakistan has taken various actions to address its uneducated population of children. Some forms of action include implementing policies to address the widespread illiteracy amongst the youth, particularly through constitutional commitments and national education reforms. The state of Pakistan is legally obligated to provide free and compulsory education to children between the ages of 5 and 16 under Article 25-A of the Constitution (Ashraf & Ismat, 2016). This highlights a binding commitment to ensuring universal education. Additionally, multiple National Education Policies (NEP), including the NEP 1998–2010 and NEP 2009, have aimed to increase enrollment rates and reduce illiteracy by setting targets such as achieving regional primary enrollment and raising literacy rates to approximately 86% (Ashraf & Ismat, 2016). Furthermore, Pakistan has engaged with organizations like the Education for All (EFA) initiative to commit to universal primary education and improved literacy outcomes (Ashraf et al., 2013). However, while these policies and commitments do demonstrate a clear recognition of the problem, they have not consistently translated into meaningful improvements on the ground. The persistence of learning poverty affecting 76-77% of children (World Bank, 2024; UNICEF, 2024), alongside chronically low literacy rates, suggests a significant gap between policy intention and implementation. This discrepancy can be partly attributed to the systemic issues discussed earlier, such as political

interference, undertrained teachers, weak governance structures, and insufficient funding. All of these factors can undermine the state's capacity to follow through on its commitments. In this sense, Pakistan's challenge hasn't necessarily been a lack of awareness towards this issue, but rather a lack of the institutional infrastructure needed to make these policies effective at addressing the deficiency in education. These implementation challenges are particularly relevant to EdTech initiatives, which similarly depend on institutional capacity, funding, and effective governance to produce meaningful educational improvements.

Targeted Programs

Beyond policy commitments, Pakistan has brought in several targeted programs to directly increase school participation. One of the most significant initiatives is the Benazir Income Support Programme, which provides cash transfers to low-income households to reduce financial barriers to education (Hussain & Schech, 2021). This programme has made it easier for low-income households to send their children to school, as it makes up for some of the forgone income their children could have made if they had worked instead. This initiative thereby encouraged investment in children's schooling. Along with this programme, the Benazir Taleemi Wazaif and Waseela-e-Taleem initiative requires children to maintain school attendance to receive financial support (Hussain & Schech, 2021). This additional strategy ensures that enrollment rates of these students are staying consistent, and it reduces the risk of financial assistance being misused or not directed toward children's education. Additionally, the government has attempted to diversify the options for educational pathways by including technical and vocational programs (Ashraf et al., 2013). These attempts aim at engaging youth who are excluded from traditional academic routes and, thereby, reduce long-term illiteracy within these groups of individuals. At the institutional level, reforms like the establishment of the Higher Education Commission expanded educational capacity and enrollment by opening new campuses across provinces, which introduced targeted scholarship and tuition waiver programmes, and integrated applied research and technology into higher education delivery. This eventually contributed to a rise in enrollment from 2% to 12.6% between 2003 and 2021 (Rind & Malin, 2024). This expansion demonstrates that when institutional reform is also simultaneously supported by dedicated funding and structural reorganization, measurable gains in access are achievable. However, this growth has not been distributed equally, as students from rural areas and high-poverty zones remain significantly underrepresented in higher education enrollment, which indicates that increases in overall capacity do not automatically translate into equitable access for the most marginalized populations. The uneven gains produced by these programs illustrate a broader principle with direct implications for EdTech, namely that expanding access, whether to schooling institutions or to digital tools, does not guarantee equitable outcomes when the structural conditions needed to convert that access into meaningful learning remain unevenly distributed.

Conclusion

This article explores the extent to which EdTech improves educational outcomes in Pakistan, and the structural conditions that enable or hinder its effectiveness. The literature reviewed throughout this paper suggests that EdTech holds meaningful potential as a tool to improve learning outcomes in Pakistan. Existing studies illustrate that EdTech in Pakistan has been able to strengthen learning outcomes by improving students' retention of the content while also strengthening students' engagement and motivation for learning (Suleman, 2011). These

positive learning outcomes demonstrate that EdTech can be an effective solution to combat the numerous illiterate students in Pakistan, as it also has proven to be a more cost-effective solution than traditional learning methods, particularly since the supply of teachers in Pakistan – especially in rural areas – is scarce (Nawab et al., 2025). However, the findings reviewed throughout this paper also suggest that the effectiveness of EdTech in Pakistan depends less on technological availability itself and more on the conditions surrounding implementation. When EdTech is implemented with adequate teacher support, curriculum alignment, and institutional structure, it can produce meaningful gains in student performance (Suleman, 2011). However, these instances of implementation that have resulted in positive outcomes remain relatively uncommon. The literature indicates that technology in Pakistan is often introduced into educational environments that lack the foundational conditions necessary to support its effective use (Jamil & Muschert, 2023). As such, while device access in Pakistan has increased over time, access alone does not necessarily translate into meaningful educational improvement if the surrounding educational systems are underdeveloped.

Addressing insufficiencies in the institutional conditions surrounding EdTech implementation will not only improve the effectiveness of digital learning tools but also reduce educational inequality rather than exacerbate it. As the literature illustrates, EdTech in its current form within Pakistan's educational system has disproportionately benefited higher-income students who already have some degree of digital literacy and access to reliable infrastructure, while schools in rural areas continue to lack the infrastructure and teacher pedagogy needed to make such tools beneficial to students' learning (Malik, 2022). This suggests that the path forward for EdTech in Pakistan is not simply one of expanding device access but also addressing the deeper institutional deficiencies that prevent technology from being used effectively. Until governance structures in relation to the educational sector are strengthened, teacher training is prioritized, and infrastructure gaps in schools are addressed, particularly in rural areas, EdTech will likely continue to reflect and reinforce existing educational inequalities rather than remedying them.

It is also important to situate Pakistan's EdTech challenges within a comparative global context. While the broader literature on EdTech in low-income countries demonstrates that digital tools can produce meaningful learning gains when well implemented, many of these studies draw on contexts where baseline institutional conditions, such as teacher training infrastructure and administrative capacity, are more developed than in Pakistan (Rodriguez-Segura, 2021). Pakistan's combination of exceptionally low education spending and systemic rural-urban and gender divides creates a constrained environment that goes beyond what the global evidence base typically accounts for. Furthermore, unlike many comparable countries where EdTech has been piloted under controlled conditions with dedicated institutional support, EdTech in Pakistan has largely been introduced without the surrounding infrastructure needed to support its functionality (Jamil & Muschert, 2023). This means that global findings on EdTech effectiveness cannot be directly applied to the Pakistani context, and that Pakistan requires a distinct policy approach in which institutional capacity and digital awareness from teachers are a prerequisite, rather than a byproduct of technological investment.

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. Considering that schools in more remote areas are increasingly gaining access to digital devices

and that these learning environments often face additional infrastructural challenges, this represents an important area for future research, as the effectiveness of EdTech interventions may differ substantially from that observed in 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 wanes. This is particularly relevant in Pakistan's context, where pilot programs often roll in EdTech under temporarily favorable conditions, with dedicated teacher training and monitoring, that are unlikely to be sustained once the program concludes. If learning gains documented in these studies erode after institutional support is withdrawn, then short-term outcome data may overstate the long-run effectiveness of EdTech in constrained environments, leading policymakers to invest in interventions that do not produce durable improvements.

Ultimately, the evidence reviewed in this paper does not suggest that EdTech is the wrong tool for Pakistan's educational challenges, but rather that it is being deployed without the necessary supporting elements. What the literature makes clear is that without first addressing the institutional and human capital gaps that surround its implementation, expanding access to technology alone will not be enough.

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