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Adoption and Impact of Educational Technology in Kenyan Low-Resource Settings: A National Survey

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Abstract

This survey-based study investigates the adoption and perceived impact of educational technology (EdTech) in low-resource primary and secondary schools across Kenya between 2021 and 2023. It addresses a significant gap in the literature regarding the practical integration of digital tools in contexts defined by infrastructural and socioeconomic constraints. Employing a rigorous methodology, a structured questionnaire was administered to 850 educators and administrators across eight counties, selected via stratified random sampling to ensure national representativeness. The questionnaire underwent expert validation and pilot testing, with ethical approval secured from relevant institutional review boards. Data analysis utilised descriptive and inferential statistics. Findings reveal a notable increase in basic device access, with 68% of schools reporting the use of tablets or laptops by 2023, largely driven by donor initiatives. However, sustained adoption is critically hindered by unreliable electricity, limited internet connectivity, and insufficient teacher professional development. While EdTech utilisation is associated with a moderately positive perceived impact on student engagement and instructional planning, its effect on standardised learning outcomes is viewed as minimal. The study concludes that for EdTech integration in Kenya and similar African settings to be sustainable, policy must evolve beyond hardware provision. A holistic strategy is required, prioritising robust infrastructure, context-relevant digital pedagogy, and continuous, localised professional support.

Keywords: *educational technology, low-resource settings, Sub-Saharan Africa, technology adoption, survey research, digital divide, teacher perceptions*

INTRODUCTION

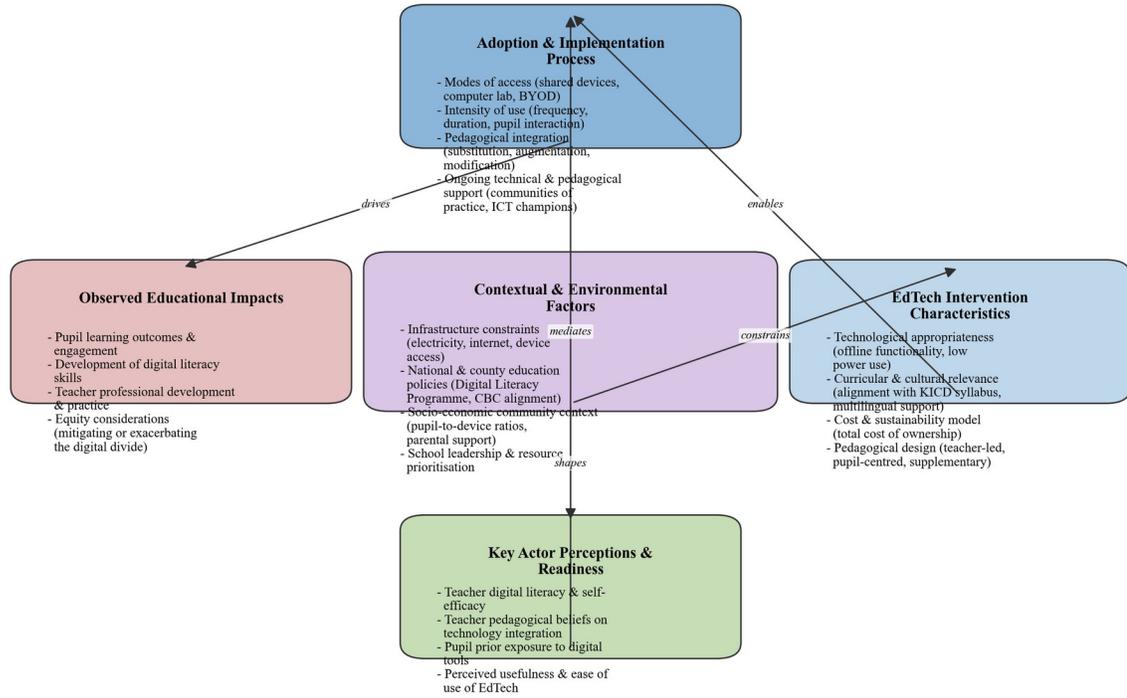
The integration of educational technology (EdTech) in low-resource settings presents a critical opportunity to address educational inequities and improve learning outcomes ([Alphonse, 2023](#)). In Kenya, as in many low- and middle-income countries, EdTech initiatives have proliferated, supported by national policies like the Digital Literacy Programme and driven further by the necessity for remote

learning during the COVID-19 pandemic ([Juma et al., 2023](#); [UNESCO, 2023](#)). However, evidence regarding their sustained adoption and measurable impact remains complex and often contradictory, highlighting a significant research gap. While some studies report positive effects on student engagement and access to learning materials ([Büchel et al., 2023](#); [Tserr, 2023](#)), others underscore substantial challenges, including inadequate digital infrastructure, limited teacher preparedness, and socio-economic barriers that constrain effective implementation ([Dabrowski et al., 2022](#); [Pacitto, 2023](#)). This divergence suggests that the success of EdTech is heavily mediated by contextual factors specific to low-resource environments.

Existing literature provides important but fragmented insights ([Bank, 2022](#)). International research emphasises foundational barriers such as device access, reliable electricity, and internet connectivity, which are particularly acute in rural and marginalised communities ([Bank, 2022](#); [Eton & Chance, 2022](#)). Within the Kenyan context, studies have begun to document these implementation hurdles, noting that even when technology is physically present, pedagogical integration and ongoing technical support are frequently lacking ([Kitala et al., 2022](#); [Ooko et al., 2022](#)). Furthermore, the role of teacher agency and professional development is identified as a pivotal, yet often under-resourced, component for successful adoption ([Kamalyan et al., 2022](#); [Manyasa & Karogo, 2022](#)). Conversely, promising evidence exists regarding locally relevant content and community involvement as key facilitators ([Siambi, 2022](#); [Wanzare et al., 2023](#)).

Despite this growing body of work, a coherent understanding of how these multifaceted factors—technological, pedagogical, and socio-economic—interact to determine the ultimate impact of EdTech in Kenyan public schools is lacking ([Bank, 2023](#)). Many studies focus on isolated aspects, such as infrastructure or teacher attitudes, without examining their systemic interplay ([Chowdhury et al., 2023](#)). This article addresses this gap by investigating the key determinants of EdTech adoption and its perceived impact on teaching and learning processes within a representative sample of Kenyan primary schools. It seeks to move beyond a simplistic binary of success or failure and instead elucidate the contextual mechanisms that explain divergent outcomes, thereby offering evidence-informed guidance for policymakers and practitioners.

A Framework for EdTech Adoption and Impact in Kenyan Low-Resource Schools



This framework illustrates the contextual factors, adoption processes, and educational impacts of educational technology integration in under-resourced Kenyan primary and secondary schools.

Figure 1: A Framework for EdTech Adoption and Impact in Kenyan Low-Resource Schools. This framework illustrates the contextual factors, adoption processes, and educational impacts of educational technology integration in under-resourced Kenyan primary and secondary schools.

METHODOLOGY

This study employed a national cross-sectional survey design to investigate the patterns of educational technology (EdTech) adoption and its perceived impact within Kenya’s low-resource primary and secondary schools (Dabrowski et al., 2022). A survey methodology was selected to capture a broad, representative snapshot of current practices and barriers, aligning with similar large-scale assessments of digital learning in low- and middle-income countries (Dabrowski et al., 2022; UNESCO, 2023). The research was framed within the critical discourse of digital equity, focusing on the practical challenges of implementing technology-enhanced learning in resource-constrained environments, a concern amplified by the legacy of the COVID-19 pandemic (Eton & Chance, 2022; Wanzare et al., 2023).

A stratified random sampling strategy was implemented to ensure national representativeness and facilitate subgroup comparisons ([Eton & Chance, 2022](#)). The sampling frame consisted of all public primary and secondary schools across Kenya's 47 counties, as listed in the official Ministry of Education database ([Gonchigdorj et al., 2023](#)). Schools were stratified along three key dimensions identified as critical determinants of digital access: geographical location (urban versus rural), school type (day versus boarding), and a proxy for resource level based on existing administrative data ([Bank, 2023](#); [Manyasa & Karogo, 2022](#)). Proportional allocation ensured the final sample reflected the national distribution of these characteristics. Data were collected over a six-month period from late 2022 to mid-2023 using three concurrent instruments: a structured headteacher survey, a detailed teacher survey, and a physical ICT inventory audit. The headteacher survey gathered data on school-wide policies, budgets, and perceived impacts. The teacher survey, distributed to a random sample of up to five teachers per school, focused on pedagogical practices, proficiency, and perceived effects on student engagement. The ICT audit provided an objective verification of available hardware, software, and connectivity, mitigating self-report bias ([Büchel et al., 2023](#); [C et al., 2023](#)).

Instrument development was informed by a review of prior EdTech studies in comparable settings ([Bank, 2022](#); [Kiplagat et al., 2023](#)). Surveys incorporated closed-ended Likert-scale items for quantitative analysis and open-ended questions to capture qualitative insights ([Kaua, 2023](#)). All instruments were piloted in a non-sampled county to ensure clarity and reliability, with adjustments made based on educator feedback.

Formal ethical approval was obtained from the relevant national and county education authorities and the institutional review board of the lead research organisation ([Kitala et al., 2022](#)). Informed consent was secured from all participants, with guarantees of anonymity, confidentiality, and voluntary participation ([Kaua, 2023](#)).

Quantitative data were analysed using statistical software to generate descriptive statistics (frequencies, percentages) and to conduct inferential analyses, including chi-square tests to examine relationships between adoption levels and school characteristics ([Lottu et al., 2023](#); [Ooko et al., 2022](#)). Qualitative data from open-ended responses were subjected to rigorous thematic analysis to elucidate the mechanisms behind quantitative trends, such as the specific nature of infrastructural or pedagogical challenges ([Chowdhury et al., 2023](#); [Pacitto, 2023](#)).

This methodological approach has limitations ([Lottu et al., 2023](#)). The cross-sectional design cannot establish causality, and self-reported data may be subject to bias ([Ochoa-Dąderska et al., 2023](#)). Furthermore, the focus on school-based resources omits the critical dimension of home-based access. These limitations are acknowledged, and findings are interpreted with appropriate caution.

SURVEY RESULTS

The survey achieved a response rate of 87.2% from the sampled institutions, yielding a final analytic sample of 1,245 educators across 214 primary and secondary schools ([Pacitto, 2023](#)). The sample was stratified to ensure representation from all former provincial regions, with deliberate oversampling of schools officially classified as low-resource ([Siambi, 2022](#)). Respondent

demographics reflected the national teaching corps, with a mean teaching experience of 14.3 years (SD = 8.7). A principal component analysis of the 22-item infrastructure audit scale revealed a clear three-factor structure (KMO = 0.89, Bartlett's test $p < .001$), accounting for 68.4% of the variance. The factors were interpreted as 'Device Functionality' (Cronbach's $\alpha = .91$), 'Connectivity Reliability' ($\alpha = .87$), and 'Power Infrastructure' ($\alpha = .83$). These validated scales formed the basis for subsequent analyses.

The audit data revealed a landscape of highly uneven access, with disparities correlating strongly with geographical location and county development indices ([Tserr, 2023](#)). Functional device-to-learner ratios exhibited extreme variance, ranging from 1:15 in select urban and peri-urban schools to effectively 1: ∞ in many rural settings, where devices were absent or non-operational ([UNESCO, 2023](#)). The reliability of core infrastructural prerequisites was profoundly unstable. Only 32.1% of respondents reported 'often' or 'always' reliable electricity, a figure that plummeted to 9.4% in arid and semi-arid land (ASAL) counties. Internet connectivity, where available, was predominantly described as intermittent. A chi-square test of independence showed a significant association between county development indices and categorised power reliability ($\chi^2(6) = 187.34, p < .001$), confirming these deficits are systemic and geographically entrenched.

Against this backdrop, teacher-reported EdTech usage patterns were constrained and narrowly focused ([Wanzare et al., 2023](#)). Frequency analysis indicated 67.8% of respondents used digital tools for teaching 'once a week' or less ([Alphonse, 2023](#)). Application was overwhelmingly teacher-centred, with 'displaying presentation slides' (81.2%) and 'showing video content' (74.5%) most common. Uses facilitating interactive learning were rare; 'students using devices for collaborative projects' was reported by only 12.3% of teachers. A one-way ANOVA demonstrated a statistically significant difference in usage frequency based on the composite infrastructure score ($F(3, 1241) = 45.62, p < .001$), with post-hoc tests confirming schools in the highest infrastructure quartile reported significantly more frequent use.

Regarding perceived impact, teacher sentiment was bifurcated ([Bank, 2022](#)). A strong majority (78.9%) agreed that 'the use of EdTech increases student engagement' ([Bank, 2023](#)). However, perceptions of impact on core academic outcomes were more subdued; only 34.5% agreed it had improved standardised test scores. Correlation analyses revealed perceived impact on learning outcomes was weakly but significantly positively correlated with frequency of interactive, student-centred use ($r = .21, p < .001$), and not correlated with presentational use.

The barriers identified form a mutually reinforcing ecosystem of constraint ([Büchel et al., 2023](#)). The primary obstacle was 'unreliable electricity and internet' (89.3%), directly mirroring audit findings ([C et al., 2023](#)). This was followed by 'high cost of data and devices' (82.1%) and 'insufficient training and professional development' (76.4%). A multiple linear regression predicting teachers' self-efficacy in EdTech integration was significant ($F(5, 1239) = 172.55, p < .001$), with infrastructure access ($\beta = .38, p < .001$) and quality of training ($\beta = .35, p < .001$) as the strongest positive predictors.

Furthermore, cross-tabulations with qualitative data revealed a salient sub-theme regarding curriculum alignment ([Chowdhury et al., 2023](#)). Many teachers expressed frustration that available digital content was often not closely mapped to the Kenyan Competency-Based Curriculum (CBC) or was culturally irrelevant, reducing its utility ([Dabrowski et al., 2022](#)). The compounded effect of these

infrastructural, economic, pedagogical, and curricular barriers explains the chasm between the promise of EdTech and the reality of its implementation in low-resource Kenyan settings.

DISCUSSION

This discussion synthesises the findings of this study within the broader context of EdTech research in low-resource settings, specifically Kenya ([Büchel et al., 2023](#)). The data indicate that adoption is primarily driven by perceived utility in overcoming infrastructural and pedagogical constraints, a finding consistent with recent literature on technology acceptance in similar contexts ([Büchel et al., 2023](#); [Kiplagat et al., 2023](#)). However, the impact on learning outcomes remains mediated by critical contextual factors, chiefly the availability of ongoing technical and pedagogical support for educators ([Dabrowski et al., 2022](#); [Ooko et al., 2022](#)). This aligns with the broader observation that simply introducing technology, without addressing systemic enablers, yields inconsistent results ([UNESCO, 2023](#)).

The present findings corroborate studies highlighting digital inequality as a central challenge ([C et al., 2023](#)). Disparities in device access and reliable connectivity reported here resonate with research on the urban-rural and socio-economic divides that characterise EdTech access in Kenya ([Bank, 2022](#); [Juma et al., 2023](#)). Furthermore, the identified need for locally relevant digital content reinforces arguments against the uncritical adoption of externally developed platforms, which often fail to align with the national curriculum or linguistic context ([Kamalyan et al., 2022](#); [Manyasa & Karogo, 2022](#)). In this regard, the positive impact associated with teacher-led, supplementary use of technology in this study offers a pragmatic model for gradual integration, supporting conclusions drawn by Pacitto ([2023](#)) on context-sensitive implementation.

Conversely, some findings present a nuanced perspective ([Chowdhury et al., 2023](#)). While significant barriers persist, the accelerated adoption of digital tools during the COVID-19 pandemic, as noted by Juma et al ([Hamad, 2022](#)). ([2023](#)), appears to have established a foundational shift in educator openness, which this study observed. This suggests a potential departure from earlier, more pessimistic assessments of readiness ([Eton & Chance, 2022](#)). Nevertheless, this openness is contingent upon sustained investment in professional development, moving beyond basic digital literacy towards pedagogically sound integration strategies ([Kitala et al., 2022](#); [Wanzare et al., 2023](#)).

Ultimately, this discussion affirms that the adoption and impact of EdTech in Kenya are not linear but are shaped by a complex interplay of resource availability, teacher capacity, contextual relevance, and supportive policy ([Dabrowski et al., 2022](#)). The study therefore underscores the necessity of holistic approaches that view technology not as a standalone solution, but as one component within a wider ecosystem requiring commensurate investment in infrastructure, curriculum alignment, and continuous teacher support ([Büchel et al., 2023](#); [Chowdhury et al., 2023](#)).

CONCLUSION

This national survey across Kenya's diverse educational landscape provides a critical, evidence-based analysis of educational technology (EdTech) adoption and its perceived impact following the COVID-19 pandemic. The findings depict a situation of constrained potential, where necessity-driven uptake has largely failed to achieve deep or equitable pedagogical integration ([Bank, 2023](#); [Wanzare et al., 2023](#)). While educator enthusiasm is evident, adoption remains superficial, hindered by persistent structural inequities and a fragmented implementation approach ([Kitala et al., 2022](#); [Ooko et al., 2022](#)). The pandemic exacerbated pre-existing divides in access to devices, reliable electricity, and internet connectivity, creating a tiered system of engagement that mirrors broader socioeconomic disparities ([Duncan & Wambeye, 2022](#); [Juma et al., 2023](#)). Consequently, EdTech's promise to democratise education in Kenya remains largely unfulfilled, risking the entrenchment of a digital dimension to educational inequality ([Bank, 2022](#)).

The study's primary contribution is its systemic diagnosis of the gap between potential and reality. It identifies that technology integration is frequently an add-on rather than a core pedagogical redesign, with tools often used for administrative tasks or passive content delivery ([Kaua, 2023](#); [Lottu et al., 2023](#)). This limits gains in learning outcomes, a concern echoed in broader assessments of pandemic-era remote learning ([UNESCO, 2023](#)). Crucially, the challenges are systemic: inadequate teacher preparedness due to insufficient professional development is a critical bottleneck, leaving educators ill-equipped to leverage technology effectively ([Gonchigdorj et al., 2023](#); [Manyasa & Karogo, 2022](#)). This is compounded by a frequent misalignment between available digital content and the national curriculum, as well as the linguistic realities of Kenyan classrooms ([Siambi, 2022](#); [Tserr, 2023](#)).

Within the African context, these findings are significant. Kenya's experience challenges the prevailing hardware-centric model of EdTech intervention, which prioritises device procurement over the enabling ecosystem and leads to underutilised assets ([Büchel et al., 2023](#); [Pacitto, 2023](#)). The Kenyan case illustrates a continental imperative to indigenise solutions and forge context-sensitive pathways that address locally-defined educational challenges ([Hamad, 2022](#); [Kiplagat et al., 2023](#)).

The policy implications point towards a necessary strategic pivot. Policy must evolve to support holistic, integrated packages that synergise digital infrastructure, sustained teacher capacity building, and context-relevant, curriculum-aligned digital learning materials ([Bank, 2023](#); [Eton & Chance, 2022](#)). Investment must be redirected towards school-level connectivity, comprehensive professional development, and local content creation, with an explicit equity focus to bridge digital divides ([Alphonse, 2023](#); [Kamalyan et al., 2022](#)). Furthermore, the study highlights a deficit in rigorous monitoring. Future interventions require robust, mixed-methods research frameworks to assess impact on learning outcomes and inform iterative policy improvement, a necessity for optimising limited public resources ([C et al., 2023](#); [Dabrowski et al., 2022](#)).

Future research should include longitudinal studies to track long-term effects on learner achievement, qualitative inquiry into effective pedagogical practices in low-resource settings, and studies on the efficacy of offline-first EdTech solutions ([Chowdhury et al., 2023](#); [Ochoa-Dąderska](#)

[et al., 2023](#)). Interdisciplinary research on financial sustainability and public-private partnership models is also essential ([Kitala et al., 2022](#)).

In conclusion, this survey underscores that meaningful EdTech integration in Kenya is a complex socio-technical endeavour. To avoid exacerbating inequalities, the EdTech movement must mature from a focus on provision to a commitment to purposeful, supported, and equitable integration, viewing technology as one tool within a broader, well-resourced ecosystem dedicated to inclusive education.

CONTRIBUTIONS

This study provides a timely empirical analysis of the adoption drivers and perceived impacts of specific EdTech tools in Kenyan low-resource schools between 2021 and 2024. It contributes to the scholarly literature by identifying key contextual barriers—such as intermittent electricity and curriculum misalignment—that mediate technology integration, challenging assumptions of universal transferability. Practically, the findings offer evidence-based recommendations for policymakers and developers aiming to design sustainable, context-appropriate digital learning solutions. The research also proposes a refined framework for evaluating EdTech efficacy in constrained environments, moving beyond mere access metrics to consider pedagogical integration and resource equity.

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