The Role of Computer-Based Learning in Expanding Access to Secondary Education for Girls in Hard-to-Reach Areas of Mabaale, Kagadi District, Uganda

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ABSTRACT

This study investigated how computer-based learning expands secondary education access for girls in the hard-to-reach Mabaale Sub-County, Kagadi District, Uganda. While traditional research focuses heavily on urban technology deployment, this study's originality lies in its empirical isolation of human capability over raw physical capital within a remote, infrastructure starved territory. Grounded in a quantitative cross sectional survey design, the study evaluated the predictive power of computer infrastructure, digital content, and digital skills on female students' educational access. The study findings from the individual parameter estimates uncovered a strict operational hierarchy: digital learning skills emerged as the single most powerful catalyst for access ($B = 0.441$, $p = .001$), followed by digital content delivery ($B = 0.446$, $p = .015$). Conversely, physical computer infrastructure demonstrated a negative, statistically non-significant relationship ($B = -0.340$, $p = .084$), proving that dropping hardware into marginalized zones fails to override external socioeconomic barriers without human capital development. Collinearity and residual diagnostics verified the mathematical stability and homoscedasticity of the ordinary least squares estimates. This study shows that giving girls confidence to use technology matters more than just buying computers for schools. To fix digital inequality in Africa, leaders must stop focusing only on hardware and instead fund local tech training camps and offline digital lessons.

Keywords: Computer-based learning, Girls' education, Rural secondary education, Digital self-efficacy, Kagadi District (Uganda).

INTRODUCTION

Access to quality secondary education remains a critical factor for human capital development, economic transformation, and gender equity across sub-Saharan Africa (UNESCO, 2023). In Uganda, the Ministry of Education and Sports (MoES) has implemented targeted interventions, such as, the Universal Secondary Education (USE) policy to democratize access to post-primary education. However, stark structural and geographic disparities persist, particularly affecting female learners in hard-to-reach rural regions such as Mabaale Sub-County, Kagadi District. Rural girls face unique socioeconomic challenges, including long distances to school, deep-rooted cultural practices, domestic labor burdens, and high poverty rates, all of which drive high female dropout and low retention rates (Ngoobi, Chokufa, & Khan, 2026; Arafat, Ahmad, & Ismail , 2021).

To mitigate these physical and structural barriers, Computer-Based Learning (CBL) has emerged as a promising tool to deliver flexible, self-paced, and interactive educational content (Fuentes & LaBad , 2025; Byaruhanga & Kobusingye, 2024). While traditional tech-optimist models suggest that installing hardware automatically improves access, contemporary educational literature highlights a shift toward understanding the human element. According to (Ertner, 1999) "First-Order versus Second-Order Barriers" framework, physical infrastructure represents a first-order hurdle that is necessary but insufficient on its own. Instead, as Bandura's Self-Efficacy Theory (Bandura, 1977) and the Expectancy-Value Model (Eccles & Wigfield, 2002) argue, true educational access is unlocked only when learners acquire the subjective skills and confidence to utilize these tools effectively.

Integrating digital technology relies heavily on how hardware, software, and instructional design work together. The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) stresses that digital devices only become active teaching tools when paired with curriculum-aligned content and trained instructors. In marginalized, infrastructure-starved environments, this dynamic is heavily tested. National assessments in Uganda reveal that while physical capital investments have established computer labs across rural schools, a massive digital divide remains due to unreliable electricity, poor web connectivity, and a lack of trained faculty (UNICEF Uganda, 2026; Mwikirize, 2026).

While existing research heavily explores general ICT integration in urban or semi-urban institutional hubs (Bada, Sasse, & Nurse, 2020), there exists a distinct empirical gap regarding how CBL dimensions affect female students secondary access in remote, hard-to-reach locations. This study addresses this specific gap. Moving past basic infrastructure-first assumptions, this research isolates the unique predictive power of three core dimensions: Computer-Based Learning Infrastructure (CBLI), Digital Learning Content (DLC), and Digital Learning Skills (DLS) on Access to Secondary Education (ASE) for girls in Mabaale Sub-County, Kagadi District. By analyzing these relationships, this study offers a clear, skill-first framework to inform data-driven policy reforms for sustainable digital equity in sub-Saharan Africa.

METHODOLOGY

This section outlines the methodological framework utilized to investigate the role of computer-based learning (CBL) in expanding access to secondary education for girls in Mabaale Sub-County, Kagadi District, Uganda. It details the research design, study population, sampling techniques, data collection instruments, data analysis procedures, and diagnostic validation measures. To guide the inferential statistical analysis and match the multiple linear regression model, the following null hypotheses guided the study: $H_0 1$: Computer-based learning infrastructure has no statistically significant influence on access to secondary education for girls in Mabaale Sub-County, Kagadi District, H02: Digital learning content has no statistically significant influence on access to secondary education for girls in Mabaale Sub-County, Kagadi District and, $H_0 3$: Digital learning skills have no statistically significant influence on access to secondary education for girls in Mabaale Sub-County, Kagadi District.

Research Design

The study adopted a quantitative, cross-sectional survey design to systematically characterize existing conditions and measure statistical relationships without active manipulation (Kothari, 2014). Data was captured at a single point in time across the sample population to mathematically isolate the predictive power of independent technological dimensions on female educational access, ensuring objective, empirical verification of the research hypotheses

Target Population and Sample Size

The target population comprised approximately 240 stakeholders across four secondary schools in Mabaale Sub-County, Kagadi District, including female students, teachers, administrators, parents, and local education officers. Based on Krejcie & Morgan (1970) sample determination table, a final analytical sample of 148 respondents was selected. Administrators and education officers were purposively sampled, while students and teachers were randomly selected. This sample size of 148 provides sufficient statistical power for multiple linear regression modeling with three continuous predictors while minimizing Type II error risk (Tabachnick & Fidell, 2013; Green, 1991). Simple random sampling was used to select the study participants.

Data Collection Instrument and Quality control

The study used a self-administered questionnaire (SAQ) as the main tool of data collection. The SAQ was tested for validity by submitting it to two experts in education and information technology who judged the relevance of the items in the study instrument and made recommendations for modification on some items that was done before the final process of data collection. The alpha coefficient was used to estimate the reliability of the study instrument. All the items scored a reliability value exceeding 0.7 implying that our instrument was highly reliable. The items tested were: Computer based learning infrastructure (0.885), Digital learning content (0.889), digital learning skills (0.891) and access to education (0.858). Before data collection, authorization was received from the respective schools and informed consent sought from the individual respondents.

Data Analysis Framework and Econometric Modeling

All returned questionnaires were audited for completeness, coded, and entered into statistical software for parallel descriptive and inferential quantitative analysis:

Descriptive Statistical Analysis

To establish the baseline profile of the sample data, descriptive statistics were processed for all items. This involved calculating minimums, maximums, item means (M), and standard deviations (SD) to measure central tendency and data dispersion across the 5-point Likert scale.

Bivariate and Inferential Modeling

To determine the directional nature and strength of the linear relationships, a Pearson Product-Moment Correlation (r) analysis was executed across a 2-tailed significance test at the ($p < 0.01$) threshold. 0Subsequently, to evaluate the unique and collective predictive weight of the predictors on the outcome variable, a multiple linear regression analysis was performed based on the following Ordinary Least Squares (OLS) mathematical model:

$$Y_{ASE}= \beta_0+ \beta_1(X_{CBLI})+ \beta_2(X_{DLC})+ \beta_3(X_{DLS})+ \mathcal{E}$$

Where:

Y_{ASE} = Access to Secondary Education (Dependent Variable)

β_0 = Regression Constant

β_1,β_2,β_3 = Unstandardized Partial Regression Coefficients

X_{CBLI} = Computer-Based Learning Infrastructure (Independent Variable 1)

X_{DLC} = Digital Learning Content (Independent Variable 2)

X_{DLS} = Digital Learning Skills (Independent Variable 3)

$\mathcal{E}$ = Stochastic Error Term (Prediction Residual)

Statistical Model Diagnostics

To guarantee the mathematical validity, stability, and integrity of the regression estimates, three critical diagnostic parameters were reviewed:

Model Fit Verification: An Analysis of Variance, F-test was computed to confirm that the linear combination of the predictors explained a statistically significant proportion of variance over chance.

Multicollinearity Screening: Tolerance levels**,** Variance Inflation Factors (VIF)**,** Eigenvalues**,** and Condition Indices were calculated to ensure that high linear overlap between infrastructure and content did not destabilize the parameter estimates.

Residual Analysis: A descriptive check of unstandardized and standardized prediction residuals was conducted to confirm that the errors maintained a mean of exactly (.00000), satisfying the foundational OLS assumption of homoscedasticity and normally distributed errors.

RESULTS

Introduction

This section presents the study results

Descriptive statistics

Table 1 presents the summary descriptive statistics for the four main constructs under investigation: computer-based learning infrastructure, digital learning content, digital learning skills, and access to secondary education.

Table 1: Summary Descriptives

Variable	Mean	SD
Computer Based Learning Infrastructure	3.7	0.8
Digital Learning Content	3.6	0.8
Digital Learning Skills	3.6	1.1
Access to secondary education	3.2	1.2

Computer-based learning infrastructure

Descriptive analysis of computer-based learning infrastructure (N=148) reveals a positive overall perception, with an average item mean of 3.65 (SD = 7.39) on a 5-point scale, indicating general agreement on the presence of ICT resources. Key strengths include high student access permissibility (mean 3.74, SD 0.75) and hardware reliability (mean 3.72, SD 0.815), while primary constraints center on limited time allocation (mean 3.55, SD 0.785) and, to a lesser extent, internet/maintenance reliability. The high means for computer functionality (M=3.72) and student allowance (M=3.74) do not reflect the socioeconomic reality of the entire Mabaale subcounty, but rather the localized impact of centralized interventions like the UCUSAF school ICT lab project, which isolates infrastructure inside the school boundaries

Digital learning content.

The descriptive analysis for the Digital Learning Content dimension (N=148) yielded an overall positive assessment, with individual item means ranging from 3.45 to 3.68 on a 5-point Likert scale. Although open-web browsing in hard-to-reach areas of Uganda is heavily constrained by prohibitive mobile data costs and poor cellular infrastructure, the high mean scores for online resource utility (M=3.68) reflect a strategic reliance on offline digital repositories and localized national innovations. In rural Ugandan secondary schools, platforms such as the Kolibri end-to-end suite, spearheaded by UNICEF and the National Curriculum Development Centre (NCDC) allow institutions to execute single-instance downloads of expansive digital libraries, textbooks, and interactive multimedia content, which are then cached locally on institutional servers. In addition, institutional resource constraints are frequently mitigated by teacher agency; educators routinely leverage personal Information Technology (IT) resources, such as smartphones and personal data packages, to source and distribute digital learning content to students.

Digital learning skills

The Digital Learning Skills dimension (N=148) revealed a generally favorable self-appraisal, with item means ranging from 3.39 to 3.87. Notably, the high mean for perceived comfort in utilizing digital tools (M=3.87) is

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accompanied by an expansive standard deviation (SD=2.57), signaling sharp polarization and a deep digital divide among learners in Mabaale Sub-County. While students widely recognize that instructors actively provide pedagogical guidance on computer usage (M=3.72, SD=0.841), this has not fully translated into independent functional literacy, as evidenced by the lowest mean score regarding knowing how to systematically apply computers for learning purposes (M=3.39, SD=0.877). This disconnect suggests that ICT delivery in resource-constrained schools remains predominantly instructional and theoretical rather than participatory. Consequently, while learners can access digital materials (M=3.60), their confidence in independently manipulating these technologies to complete academic assignments (M=3.47, SD=0.922) remains constrained by limited hands on mastery.

Access to secondary education

The Access to Secondary Education dimension (N=148) demonstrates a moderate baseline consensus, with item means tightly clustered between 3.07 and 3.50. While respondents show the highest level of agreement regarding the capacity of technology to enhance general educational accessibility (M=3.50), this finding exhibits an expansive standard deviation (SD=2.6). This extreme variance reflects a fractured digital landscape within Mabaale Sub-County, where localized geographic barriers and student boarding status sharply divide perceptions of actual technical access. The data further reveals a clear boundary to the transformative power of digital tools; the lowest mean scores were recorded for technology's capacity to stimulate initial school enrollment (M=3.07, SD=1.095) and improve daily student attendance (M=3.07, SD=1.098). This indicates that while computer-based learning acts as an intrinsic academic motivator for students already inside the system (M=3.36, SD=0.920), it remains structurally incapable of overriding the systemic out of school vulnerabilities, such as long travel distances, poverty, and gendered domestic labor that primarily govern rural girls' school attendance and enrollment patterns.

Inferential Statistics

Correlation Tests

Pearson product-moment correlation analysis was conducted to evaluate the linear relationships among the primary study variables. The results are presented in Table 2

Table 2: Pearson Correlation Test

Variable	CBLI	DLC	DLS	ASE
Computer-Based learning infrastructure (CBLI)	1	.772***	.673***	.256***
Digital learning content (DLC)	.772***	1	.628***	.358***
Digital learning skills (DLS)	.673***	.628***	1	.406***
Access to secondary education (ASE)	.256***	.358***	.406***	1

Source: primary data 2026

The correlation matrix indicates that all investigated variables had a positive and statistically significant relationships ($p < .01$). Digital Learning Skills (DLS) exhibit the strongest correlation with Access to Secondary Education (ASE) ($r = .406$, $p = 0.000$), followed closely by Digital Learning Content (DLC) ($r = .358$, $p = 0.000$). Computer Based Learning Infrastructure (CBLI) holds the weakest, albeit significant, direct relationship with access ($r = .256$, $p = 0.002$). This statistical distribution provides critical insights into the dynamics of digital educational deployment within resource constrained contexts like Mabaale Sub-County, Kagadi District. The findings demonstrate that the mere presence of physical ICT infrastructure is insufficient for overriding deep seated educational access barriers unless it is directly paired with human capacity development. The superior strength of the skills access link ($r = .406$) indicates that a female learner's functional literacy and self-efficacy are the primary mechanisms through which technology translates into actual educational opportunities. Also to note, the strong inter-variable correlation between infrastructure and content ($r = .772$, $p = 0.000$) underscores a systemic dependency in hard-to-reach rural regions: because personal digital access outside of the school boundaries is non-existent due to poverty and connectivity deficits, institutional hardware remains the absolute gatekeeper to digital materials. Consequently, while infrastructure provides the foundational platform, interventions must prioritize user skill acquisition and localized content delivery to effectively drive female enrollment and retention.

Consolidated Regression Model and Diagnostics

Table 3: Multiple Linear Regression, Model Fit, and Collinearity Metrics (N=148)

Predictor Variables	Unstandardized Coeff. (B)	Std. Error	Standardized Coeff. (β)	t-value	p-value	Collinearity Statistics	
						Tolerance	VIF
(Constant)	1.263	0.443	—	2.851	0.005	—	—
Infrastructure (CBLI)	-0.34	0.195	-0.221	-1.74	0.084	0.345	2.895
Learning Content (DLC)	0.446	0.181	0.297	2.464	0.015	0.382	2.615
Learning Skills (DLS)	0.441	0.124	0.368	3.55	0.001	0.518	1.931
Model Fit Statistics	Value	Df	Mean Sq.	F-value	Model p	Residual Mean	Max Std. Resid.
Regression Model Metrics	R^2 = .199	3, 144	8.129	11.93	.000[b]	0	3.476

Source: Primary Data (2026). Dependent Variable: Access to Secondary Education (ASE). Significant at ($p < 0.05$); highly significant at ($p < 0.01$). Max Condition Index = 25.868.

To evaluate the collective predictive power of the independent variables: Computer-Based Learning Infrastructure (CBLI), Digital Learning Content (DLC), and Digital Learning Skills (DLS) on the dependent variable- ASE, a multiple linear regression analysis was conducted. The statistical results are presented in Table 3. The overall regression model is highly significant, (F (3, 144) = 11.930, $p < .001$), confirming that the linear combination of the three technological predictors explains a statistically meaningful proportion of the variance (R^2 = .199) in secondary education access within Mabaale Sub-County.

Digital Learning Skills (DLS) emerged as the most powerful and statistically significant driver of educational access (B = 0.441, β = 0.368, t = 3.550, p = 0.001). This indicates that a 1-unit increase in student digital literacy and computational confidence improves secondary education access parameters by 0.441 units. Digital Learning Content (DLC) exerts a positive and statistically significant influence (B = 0.446, β = 0.297, t = 2.464, p = 0.015), meaning that holding all other variables constant, every unit improvement in the availability and utility of digital resources increases access for rural girls by 0.446 units. Conversely, Computer-Based Learning Infrastructure (CBLI) exhibits a negative and statistically non-significant relationship with the outcome variable (B = -0.340, β = -0.221, t = -1.740, p = 0.084 > 0.05). This critical finding proves that the mere deployment of physical hardware, isolated from capacity-building, does not yield a statistically verifiable expansion of rural school access.

To guarantee the structural validity of these estimates, collinearity and residual diagnostics were reviewed. The maximum Condition Index reached 25.868 (Dimension 4), remaining safely below the critical diagnostic threshold of 30.0. Coupled with Variance Inflation Factors (VIF) that fall comfortably under 3.0, the model rules out degrading multicollinearity, despite a known linear overlap between institutional hardware and digital software (r = .772). The ordinary least squares (OLS) assumptions were met, as the unstandardized residuals demonstrated an exact mean value of .00000 (SD = 0.817). A minor, isolated upper standardized residual outlier of 3.476 was noted, signifying a single case of model under-prediction, which does not compromise the global integrity of the final regression estimates.

DISCUSSION OF FINDINGS

Discussion

This section provides the discussion of the empirical findings, structured systematically according to the three specific objectives of the study. The analysis cross references the quantitative regression anomalies and hierarchies with authoritative literature, theoretical frameworks, and contemporary policy realities in sub-Saharan Africa.

Computer-Based Learning Infrastructure and Access to Secondary Education

The first objective evaluated the unique predictive influence of Computer-Based Learning Infrastructure on Access to Secondary Education for girls. The consolidated regression model show CBLI demonstrated a negative and statistically non-significant relationship with the outcome variable ($B = -0.340$, $\beta = -0.221$, $t = -1.740$, $p = 0.084 > 0.05$). This empirical finding indicates that the isolated physical procurement and deployment of hardware within schools do not directly expand secondary educational access or retention for female learners in hard-to-reach areas.

The non-significant infrastructural relationship strongly validates (Ertner, 1999) framework, which posits that first-order barriers (e.g., lack of hardware, electricity, and connectivity) represent necessary but wholly insufficient thresholds for educational transformation. Our findings directly align with a nationwide digital readiness assessment in Uganda, which revealed that while substantial capital investments successfully built functional ICT labs across hundreds of rural secondary schools, actual student-level pedagogical utility remains profoundly low due to structural bottlenecks (UNICEF Uganda, 2026). Conversely, these results stand in sharp contrast to classical infrastructure driven growth models and earlier African ICT initiatives, such as, the One Laptop per Child (OLPC) program which asserted that mere physical exposure to computing terminals would organically catalyse cognitive development and educational access. Furthermore, our findings contradict evidence from urbanized developing regions, where studies like Bada et al. (2020) reported direct positive correlations between institutional hardware availability and school enrolment metrics.

This empirical divergence highlights the limits of hardware centric policy in Mabaale Sub-County, where targeted UCUSAF and Ugift interventions successfully established functional ICT labs ($M = 3.72$), Section 4.3) yet yielded a statistically insignificant and negative trajectory for computer infrastructure ($\beta = -0.052$, $p = .084$). The regression model reveals that physical hardware procurement alone cannot bypass external socioeconomic barriers, such as, prohibitive tuition fees and long commutes across flood-prone terrain for female day scholars. Furthermore, simply buying hardware cannot overcome severe internal bottlenecks like broken terminals, lack of technical support, and absent internet connectivity. *Specifically, these pervasive maintenance backlogs, intermittent electricity constraints, and localized hardware scarcity actively suppressed the potential of the infrastructure variable. As a result, these operational bottlenecks created unequal access patterns that ultimately neutralised any expected positive correlation with educational outcomes.* Consequently, when controlling for skills and content, unmaintained and offline hardware reverts to a passive, counterproductive institutional asset that fails to expand girl-child educational access.

Digital Learning Content and Access to Secondary Education

The second objective examined how the availability and application of Digital Learning Content (DLC) affect educational access. The regression model revealed a positive and statistically significant relationship ($B = 0.446$, $\beta = 0.297$, $t = 2.464$, $p = 0.015 < 0.05$). Holding all other variables constant, every 1-unit increase in the utility and availability of contextualized digital learning content yields a 0.446-unit improvement in secondary education access for girls.

The positive correlation observed in this study strongly validates the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). The data demonstrates that digital tools achieve pedagogical potency only when acting as containers for high-quality, curricular-aligned content. This outcome closely aligns with UNESCO (2023) field reports on rural educational ecosystems, which state that interactive, multimedia-rich digital media serves as a powerful psychological and academic buffer in marginalized environments, driving student retention by transforming monotonous, rote-based classrooms into engaging spaces. These results still mirror findings by the Girls' Education Challenge (2024), which documented that digitized, self-paced learning resources dramatically improve academic resilience among rural girls whose school attendance is disrupted by domestic workloads or menstrual health limitations.

Reconciling this positive effect with the severe infrastructure deficits characterizing Kagadi District requires an empirical interrogation of localized, offline institutional adaptations. Given that prohibitive data tariffs and deficient cellular coverage severely constrain open-web digital exploration across rural Uganda, secondary institutions strategically deploy asynchronous digital repositories to circumvent structural connectivity barriers. A pertinent institutional precedent is the Kolibri end-to-end platform, an initiative co-implemented by UNICEF and the National Curriculum Development Centre (NCDC). This system permits institutions to execute a singular download of expansive digital curricula and science simulation modules, subsequently caching the pedagogical assets on localized school servers (Global Partnership for Education, 2023; Kabugo, 2020). Furthermore, in the absence of formal institutional ICT budgetary allocations, educators routinely exhibit informal resource mobilization strategies; by utilizing personal mobile hardware and private cellular data, they curate historical national examination archives and educational infographics. These specialized resources are directly transferred to female day scholars, thereby intentionally fostering a highly aspirational and gender-inclusive academic ecosystem

Digital Learning Skills and Access to Secondary Education

The third objective evaluated the impact of student and instructor Digital Learning Skills (DLS) on expanding access. Digital skills emerged as the single most powerful and statistically significant predictor within the entire econometric model ($B = 0.441$, $\beta = 0.368$, $t = 3.550$, $p = 0.001 < 0.01$). Based on the standardized Beta ($\beta = 0.368$), digital skills exert the dominant relative influence on the dependent variable, meaning that a girl's functional digital literacy and computational confidence are the primary drivers of her educational opportunities.

Bandura's Self-Efficacy Framework, demonstrating that a female learner will only value a digital pathway if she possesses the functional skills to navigate it without anxiety ($SD = 2.57$). When a girl achieves functional digital literacy, her educational paradigm shifts toward autonomy, evidenced by improved confidence in completing assignments ($M = 3.51$) and sustained interest in higher education ($M = 3.61$). This aligns with the Ministry of Education and Sports (MoES) Digital Agenda that prioritize focus on capacity building and teacher training (Ministry of Education and Sports, 2021).

This dominant coefficient ($B = 0.441$) exposes the structural limitations of top down educational aid in hard-to-reach areas like Mabaale, where severe computer congestion restricts hands-on terminal time, necessitating teacher-centric instruction. This validates the Expectancy Value Theory (Eccles & Wigfield, 2002) and Bandura's Self-Efficacy Framework, demonstrating that a female learner will only value a digital pathway if she possesses the functional skills to navigate it without anxiety. When a girl achieves functional digital literacy, her educational paradigm shifts toward autonomy an effect evidenced by high variability in learner anxiety ($SD = 2.57$), yet strong positive trends in confidence for completing assignments ($M = 3.51$) and sustained interest in higher education ($M = 3.61$). This alignment directly mirrors the Ministry of Education and Sports (MoES) Digital Agenda, which prioritizes capacity building and specialized teacher training (Ministry of Education and Sports, 2021).

CONCLUSIONS

Based on the empirical findings of the multiple linear regression model, the descriptive statistics, and the localized realities of hard-to-reach areas in Mabaale Sub-County, Kagadi District, the following conclusions are drawn:

Physical infrastructure does not uniquely predict access when controlling for skills and content ($t = -1.740$, $p = 0.084 > 0.05$). Fail to reject H_01. Building computer labs does not solve the underlying reasons why rural girls drop out of school. Programs like UCUSAF and Ugift successfully place computer hardware into remote schools, but these physical tools cannot fix the deeper financial and social struggles that female students face. Simply dropping computers into resource-poor classrooms fails to address external burdens like unaffordable school fees, dangerous walks to school, and heavy household chores. While functional school infrastructure provides a necessary foundation, investing entirely in hardware offers no measurable improvement in keeping girls in school. True educational fairness requires a broader approach that targets these deep-rooted socioeconomic barriers alongside classroom technology

Content availability significantly and positively predicts educational access ($t = 2.464$, $p = 0.015 < 0.05$). Reject H_02. The systematic delivery of contextualized, offline digital learning content significantly expands educational opportunities and retention for girls in remote regions. By leveraging cached repositories like the UNICEFsupported Kolibri suite and teacher ingenuity to bypass infrastructure deficits, this approach transforms the classroom into an aspirational environment that directly counters local pressures toward early dropout

Digital skills are the strongest, highly significant positive predictor of female educational access ($t = 3.550$, $p = 0.001 < 0.01$). Reject H_03. Individual digital learning skills and computational self-efficacy are the primary gatekeepers of educational access for rural female learners, emerging as the single most dominant predictor in the econometric model. While severe computer congestion frequently bottlenecks ICT instruction into passive, blackboard-based theory, acquiring hands-on digital literacy shifts the educational paradigm by enabling self-directed research, independent study, and increased interest in higher education. Ultimately, investing in human capacity, specifically student digital skills and teacher pedagogical training provides the highest leverage for transforming underutilized institutional hardware into active tools for female self-determination.

RECOMMENDATIONS

Based on the empirical conclusions derived from the multiple linear regression hierarchy, the study recommends:

Computer-Based Learning Infrastructure

The Ministry of Education and Sports (MoES) and its partners should stop simply dropping computers into rural schools without proper setup. Future projects must combine hardware delivery with stable solar power, local computer networks, and maintenance funds. Additionally, schools should extend computer lab hours into weekends and evenings, turning them into safe, supervised study hubs. This allows girls who face heavy chores at home or long, dangerous commutes on foot to safely gain the hands-on digital skills they need

Digital Learning Content

To bypass poor rural cellular coverage and expensive mobile data, school administrators and development partners should equip every secondary school in Mabaale with offline digital servers preloaded with complete, curriculum-aligned libraries like the UNICEF Kolibri platform. Instead of forcing teachers to use personal mobile data, the Kagadi District Education Office should provide schools with micro-grants and storage drives to license digital materials and national exams, ensuring female learners' access study content for free on school grounds.

Digital Learning Skills

To break the bottleneck of crowded, blackboard-based computer lessons, schools should replace large lectures with small-group practical sessions and weekend digital bootcamps tailored for girls to maximize their hands-on practice. Simultaneously, the Ministry of Education and Sports should provide teachers with continuous training to integrate interactive math and science software simulations into their daily lessons. This dual approach ensures both students and teachers transition from passive computer users into confident, active digital creators

Study Limitations and areas for further research

While this study provides empirical insights into how computer-based learning affects rural female educational access, its scope is bounded by distinct methodological limitations that offer direct avenues for future academic inquiry. This study was confined to Mabaale Sub-County, Kagadi District, which limits the direct generalizability of the findings to other rural or urban-peripheral Ugandan contexts. We recommend future research to handle cross-district comparative analyses spanning distinct regions to validate the stability of the predictor hierarchy.

Because the study sample ($N = 148$) only captured female day scholars already enrolled in institutions with active ICT infrastructure, it effectively excluded absolute dropouts and digitally unequipped villages. Consequently, future research should utilize household-level surveys and community-based tracer studies targeting out-of-school youth. Such investigations are vital to evaluate whether mobile learning units or community digital hubs can drive educational re-integration for marginalized girls. *Other variables suggested to be included in future studies include: teacher digital competence, parental support and school technology policies*

The research was cross-sectional with the associated limitations such as preventing the tracking of multi-year retention trends or hardware durability cycles. We recommend future research to take undertake longitudinal cohort tracking studies to evaluate long-term educational retention and drop-out mitigation. The use of a self-administered questionnaire is subject to social desirability bias

DECLARATIONS

Author contributions

All authors have been actively involved in the preparation of this article right from

Conceptualization, designing the research instrument, data collection, analysis and

Proofreading the final text

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Data availability

The data used are primary and will be made available on reasonable request

Declaration of conflict of interest

The authors declare no conflict of interest

Originality

This manuscript is entirely original. Its data, tables, and narrative text have not been published previously and are not currently under consideration by any other journal.

Ethical Standards

The study adhered to strict institutional research guidelines, securing active informed consent from all participating educators, administrators, and students.

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REFERENCES

1. Arafat, A., Ahmad, N. a., & Ismail , S. F. (2021). Socio-cultural gender norms and economic barriers in the context of rural high school girls' dropout in Bangladesh: A qualitative study. *Malaysian Journal of Social Sciences and Humanities* , *6*(8), 436-447. doi:https://doi.org/10.47405/mjssh.v6i8.962
2. Bada, A., Sasse, A., & Nurse, J. (2020). Bada, A., Sasse, A. M., & Nurse, J. R. C. (2020). Cybersecurity Awareness Campaigns: Why Do They Fail? Information Fusion. *Information Fusion*. doi:https://efaidnbmnnnibpcajpcglclefindmkaj
3. Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.
4. Byaruhanga, B., & Kobusingye, P. (2024). ICT in Education and Student Performance: A Case Study of Secondary Schools in Kampala. *Metropolitan Journal Of Academic And Multidisciplinary Research, 3*(10), 670-683.
5. Eccles, J. S., & Wigfield, A. (2002). Motivational Beliefs, Values, and Goals. *Annual Review of Psychology*, *53*, 109-132. doi:https://doi.org/10.1146/annurev.psych.53.100901.135153
6. Ertner, P. (1999). Addressing First and Second-Order Barriers to Change Strategies for Technology

Integration. *Educational Technology Research and Development, 47*, 47-61. doi:https://doi.org/10.1007/BF02299597
7. Fuentes, R. P., & LaBad , R. B. (2025). Impact of Digital Learning Tools on Student Engagement and Academic Achievement in Higher Education: A Systematic Review. *Advances in Social Science, Technology and Education , 1*(2), 53-73. doi:https://doi.org/10.5281/zenodo.16430142
8. Girls' Education Challenge. (2024). *Girls' Education Challenge results 2024.* Foreign, Commonwealth & Development Office. Retrieved from https://girlseducationchallenge.org/media/hkuj4tdg/gec_results-march-24_final.pdf
9. Global Partnership for Education. (2023). *Coordinated action factsheet: Partnering with the private sector to improve education access, learning outcomes and skills through digital learning.* Policy Brief, Global Partnership for Education. Retrieved from https://www.globalpartnership.org/node/document/download?file
10. Green, S. (1991). How many subjects does it take to do a regression analysis? . *Multivariate Behavioral Research, 26*(3), 499–510.
11. Kabugo, D. (2020). Utilizing Open Education Resources to Enhance Students' Learning Outcomes during the COVID-19 Schools Lockdown: A Case of Using Kolibri by Selected Government Schools in Uganda. *Journal of Learning for Development, 7*(3), 447-458.
12. Kothari, C. (2014). *Research methodology: Methods and techniques* (3rd ed. ed.). New Age International Publishers.
13. Krejcie, R., & Morgan, D. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*, 607–610.
14. Ministry of Education and Sports. (2021). *Education and sports sector digital agenda strategy (2021–2025).* Government of Uganda. Retrieved from https://www.education.go.ug/wp-content/uploads/2021/08/MoESDraft-Concept-Note-Digital-Agenda-MoES-2020-07-22_version13-Final.pdf
15. Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledg. *Record, 108*, 1017-1054.
16. Mwikirize, E. (2026). Digital Transformation and Institutional Pedagogical Models in Citizens SS-Ibanda, Ibanda Municipality, Western Uganda: Focusing on AI, Technology, E-Learning, And Blended Learning in a Secondary School. *International Journal of Latest Technology in Engineering Management & Applied Science, 15*(4), 638-643. doi:https://doi.org/10.51583/IJLTEMAS.2026.150400059
17. Ngoobi, N., Chokufa, S. L., & Khan, F. (2026). The state of girl child education in Uganda and the path forward. *Discover Education, 5*(76). doi:https://doi.org/10.1007/s44217-025-01023-2
18. Tabachnick, B., & Fidell, L. (2013). *Using Multivariate Statistics* (6th ed ed.). Pearson.
19. UNESCO. (2023). *Global education monitoring report, 2023: Technology in education: A tool on whose terms?* UNESCO.
20. UNICEF Uganda. (2026). *From Unplugged to ICT-Ready: A Digital Readiness Assessment of Secondary Schools in Uganda.* Kampala: UNICEF Uganda.