EXPLORING HOW DIGITAL LEARNING TOOLS CAN BE USED TO ENHANCE ACCESS TO EDUCATION AMONG VULNERABLE TEENAGE MOTHERS IN KENYA

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ABSTRACT

Vulnerable teenage mothers in Kenya face significant barriers to accessing education, including stigma, socioeconomic challenges, and limited institutional support. These barriers often hinder their ability to engage in formal educational systems, perpetuating cycles of poverty and exclusion. Digital learning tools, such as mobile applications, online courses, and e-learning platforms, present a promising solution to bridge this gap by offering flexible, accessible, and cost-effective learning opportunities. This study explored how digital tools can enhance access to education among this marginalised group. The research examined the impact of digital learning tools on educational access and engagement through a mixed-methods approach, including surveys, interviews, and focus group discussions with teenage mothers and educators. Findings revealed that while digital tools significantly improved enrolment, participation, and learning outcomes, challenges such as digital literacy, internet connectivity, and inadequate infrastructure remain persistent. Additionally, cultural attitudes toward teenage mothers and their education hindered effective implementation. This paper provides actionable recommendations for policymakers, educators, and technology developers to address these challenges, including increased investment in digital infrastructure, tailored training programs for users, and integrating digital tools into existing educational frameworks. By scaling these interventions, stakeholders can create more inclusive and equitable educational opportunities for vulnerable teenage mothers, fostering long-term social and economic empowerment.

PROJECT SUMMARY

The right to basic education is enshrined in Kenya's 2010 Constitution. Kenya's Basic Education Act of 2013 provides all children with free and compulsory basic education. The Children Act of 2022 defines a child as anyone under the age of 18, with a right to be in school regardless of ethnicity, religion, sex, disability, or culture. Despite such provisions, teenage pregnancies among school-going girls in Kenya have led to their dropping out of school, hindering their realisation of the right to education. Teenage pregnancies deny girls opportunities to access education, as they must remain out of school for an extended period. In 2020, the Ministry of Education in Kenya introduced the National School Re-entry Guidelines to help manage the reintegration of teenage mothers back to school after delivery. However, these teenage mothers still require support to catch

up on learning missed during their absence from school. In Kenya, Information and Communication Technologies (ICTs) have been identified as tools that enhance equitable and accessible education. However, the government acknowledges the challenges of implementing these technologies in and beyond the school environment. The challenges include significant infrastructure and equipment requirements and ensuring school connectivity. Therefore, if children who cannot access education due to geographical factors (such as informal settlements) or other issues like teenage pregnancy are to receive education, it is essential to consider the available and accessible technology that can be utilised. The government of Kenya also recognises Alternative Providers of Basic Education and Training (APBET) as a means of increasing access to education for learners outside the traditional school setting, often called informal learning. This study sought to identify technologies available to teenage mothers outside the school environment, examine the challenges they face in their efforts to access education through such technologies, and explore how tools like video recordings by teachers can facilitate educational access for these teenage mothers. Restrictions associated with the COVID-19 pandemic created opportunities to review how technology can enhance teaching and learning, thereby reaching students both in school and beyond. This study focused on how video recordings by teachers can enhance learning among teenage mothers, enabling them to cover syllabus content outside the school environment. The research explored how digital learning tools can enhance educational access for vulnerable teenage mothers in Kenya.

The objectives of this research were as follows:

1. To determine digital learning tools for teenage mothers to access education.
2. To establish ICT-related challenges that teenage mothers face in accessing education.
3. To explore using available ICTs to create and deliver lessons to teenage mothers for enhanced access to education.

The research was conducted in the urban slums of Nairobi County, Kenya. Qualitative and quantitative methods were utilised for data collection and analysis. Purposive sampling of rescue centres with cases of teenage pregnancies was employed for the study. Data was gathered through interviews and evaluations of students' experiences and performance in two subjects. It was hoped that the research would enhance learning outcomes for teenage mothers.

The study will guide policymakers in addressing the gaps in implementing the 1994 School Re-entry Policy for Girls and the 2020 National School Re-entry guidelines.

Background

Kenya recognises the crucial role that quality education plays in fostering an inclusive and equitable society. Consequently, it has implemented several initiatives, including the launch of a Free Primary Education (FPE) programme and ensuring a 100% transition rate from primary to high school. The government also acknowledges the significance of informal schools through the Alternative Provision of Basic Education and Training (APBET) guidelines. Additionally, it has incorporated digital learning tools to improve access to education for all. (UNESCO, 2021)

Research has identified numerous benefits of utilising ICT in education. These benefits include, among others, enhancing the learning process, leveraging students' potential for active learning, and improving the quality and accessibility of instructional delivery

To support the integration of ICT in teaching, the government of Kenya has increased funding for developing suitable ICT infrastructure, acquiring learning materials, and training teachers, tutors, and lecturers in ICT integration skills. Furthermore, it has promoted Open Distance Learning (ODL) through local radio stations and mobile phones, as outlined in Session Paper 14 of 2012 (Government of Kenya 2012).

Furthermore, the government has provided APBET guidelines for establishing informal schools. These guidelines play a crucial role in enhancing access to education for individuals who cannot participate in standard government programmes, especially in informal settlements and marginalized areas. The majority of such schools are located in larger cities in Kenya, including Nairobi, Mombasa, and Kisumu. APBET schools can follow a curriculum accommodating lesser standard facilities (UNESCO, 2021). Additionally, the guidelines permit alternative methods of curriculum delivery. This study will examine how technology can serve as an alternative to improve access to education for teenage mothers.

Acknowledging education as a fundamental right to which every child is entitled, the Ministry of Education does not allow expectant learners to be expelled from school. It further, allows them

back to school after delivery under the National School Re-entry guidelines. However, the teenage mothers have to be out of school for a period of time before delivery. In addition, they have to breastfeed the baby for six or more months before they go back to school. While the teenage mothers stay away from school all these months their peers continue learning. Although re-entry guidelines give them an opportunity to continue schooling, the education they miss leaves substantial gaps in their learning that need to be filled. The majority of girls who drop out of school due to pregnancy are unlikely to return. This has an effect on the girls' social, economic and health outcomes. It is through education that teenage mothers can be given an opportunity to realize their dreams.

Use of technology in education has the potential to provide new learning and teaching opportunities within available infrastructure, both at home and in school, to address identified learning challenges, such as those faced by teenage mothers. Despite the efforts that the government has made on digital learning tools integration in education, there is no sufficient evidence of their impact (Murithi & Yoo, 4). In addition, through Sessional Paper No.1 of 2019, the Ministry of Education has acknowledged a lack of or poor connectivity, unreliable power, online safety and security for learners and inadequate and outdated digital content as some of the challenges it is facing (Ministry of Education 45). Video recordings, being one of the digital learning tools that can be used in teaching, were used in the study. This is because it may not require a huge investment on the infrastructure and connectivity. Further, video use in education provides both audio and visual information, besides providing an opportunity to record classroom lessons for future use

Given the need for teenage mothers to attain learning for sessions missed while unable to attend school, the research project seeks to explore how teachers can use video-recorded lessons to provide teenage mothers – beyond the school environment - with relevant learning materials for enhanced education access.

Research Questions

1. What digital learning tools are available to teenage mothers to access education?

2. What digital learning tools -related challenges do teenage mothers face in their effort to access education?
3. In what ways can video-recorded lessons be used to create and deliver lessons to teenage mothers for enhanced access to education?

Justification

Carrying out research on use of video in teaching teenage mothers in slums in Nairobi revealed how technology can be used in enhancing learning among teenage mothers. The study acts as a platform for revealing how technology may be used in improving learning outcomes both at school and beyond the school environment. Despite the effort made by the government in implementing use digital learning tools in schools to make education accessible to all, infrastructure remains a major challenge. The study used video recorded lessons to show how digital learning tools can be used to give access to education for students who have no internet connectivity. Further, use of video- recorded lessons may be better because it may limit distractions in learning like it happens where there is internet connectivity.

The study will assist education policymakers in reviewing ways of assisting teenage mothers and other disadvantaged groups forced by circumstances to be out of school. This will enable them to achieve optimum performance in school. Also, findings will be disseminated to the key stakeholders through planned meetings. The findings will also be presented to organised literacy conferences in the country and submitted to a recognised peer-reviewed journal. Conferences in the country, as well as submitted to a recognised peer-reviewed journal

Limitations of the Study

Many reasons cause learners to leave school, while the rest continue learning. Some of these include lack of school fees, drug addiction, child marriages and teenage pregnancy. This study focused on teenage mothers. The teenage mothers are accommodated in rescue homes where they cannot interact with their families through the phone. In addition, they have no access to laptops or computers. To address this limitation, the researcher acquired phones and refurbished laptops for teenage mothers to record and watch lessons.

Significance of the Research Project

The research intended to give hope to the teenage mothers by providing catch-up classes during the time they are not in school, especially after delivery, through digital platforms. The project hoped to be an eye-opener to stakeholders on how digital learning tools may be incorporated in offering alternative ways of learning to disadvantaged and vulnerable groups to ensure the realization of free basic compulsory education to all, as enshrined in our constitution.

Key Terms

Catch up lessons – Video recorded lessons organized to cover syllabus that might have been missed when teenage mothers are unable to attend school due their responsibilities as new mothers.
Rescue Centre – is a safe haven that provides vulnerable girls with a protective and nurturing environment with food, shelter, clothing and sometimes both formal and informal education. Additionally, some centres provide psychosocial support and mentorship as well as organising for the girls to enrol back to formal schooling after delivery.
Rescue Centre Managers – The people in charge of day today activities in the rescue centres.
Information Communication Technology – Any communication device or application encompassing radio, television, cellular phones, computer, and computer network hardware, network satellite systems, as well as various services and application associated with them like video conferencing and distance learning.
Teenage Mothers – These are adolescents aged 13 to 19 years that give birth to children conceived through unintended pregnancies

METHODOLOGY

Research Design

The research project adopted a case study research design since the focus was on a specific group of teenage mothers. A case study involves a careful and complete observation of a unit, be that unit a person, a family, an institution, a cultural group or even the entire community (Kothari 113-116). The study focused on how video recordings by teachers can enhance learning among teenage mothers to cover content in the syllabus beyond the school environment. According to Gillham, the study employed the principle of triangulation, which involves approaching the same questions from different data sources (12-13). The study employed methodological triangulation using data from focused group discussions involving students; semi-structured interviews with selected

teachers, Ministry of Education officials, Children Officers, and rescue centres' management teams, and written results from tests taken by teenage mothers. The study was primarily qualitative, although quantitative techniques, such as frequency tables, were employed, particularly for data presentation. Morgan states combining qualitative and quantitative approaches offers a more comprehensive view of reality.

Target Group and Population sample

According to Mugenda and Mugenda, a target population is the entire group of individuals or objects to which researchers are interested in generalising the conclusions (41). Further, every population must have characteristics the researcher wants the sample to have. The study aimed to collect data for this research from teenage mothers facing challenges in accessing education. There are about 15 rescue centres in Kasarani Sub County that accommodate destitute children who experience challenges in accessing education. Each of the homes accommodates between 1 and 40 children. In Kasarani Sub-County, only three rescue homes accommodate teenage mothers. Therefore, a purposive sampling was used to select the two rescue centres. One of the centers allows the girls to attend day school while the other rescue centre takes them to boarding schools. A sample size of 25 students was used in the study. This is about 10% of the estimated population, approximately 250 children. Mills & Gay argue that 10% of the accessible population is enough (155-157). Further, Milroy & Gordon observe that much data may not be necessary in research as it is only repetitive. With the views of Milroy& Gordon and Mills & Gay, a sample size of 25 students in the two homes was selected, because they learn at home while the rest of their peers continue learning at school (29-30).

In Kenyan High schools, a student is expected to pass in seven subjects, three of which are compulsory and four of which are optional. The study focused on two compulsory subjects: English Language and Mathematics. This is because all students are taught these subjects at all levels, and hence, the content covers a larger group as opposed to optional subjects such as History or Religious Studies, which would benefit only those who have selected the subject.

Location of Study

The study was conducted in the Kasarani Sub-County in Nairobi County, Kenya. This is one of the 17 sub-counties that make up Nairobi, and it has five wards: Kasarani, Clay City, Njiru, Mwiki, and Ruai. See below the map of Kasarani. The study was carried out in Kasarani and Ruai Wards within the sub-county. Non-probability sampling was used to select the area of study: Ruai and Kasarani. In non-probability sampling, the researcher uses their judgment to select subjects to be included in their study based on their knowledge of the phenomenon (Babbie). Although there are many rescue centres in Kenya, most are found in Nairobi County. The rescue centres host different categories of vulnerable communities. However, in Kasarani Sub-County only three rescue centres accommodate teenage mothers. Therefore, two rescue centres were selected for the study.

Figure 1: Map of Kasarani Sub-County in Nairobi County

Data Collection

Both quantitative and qualitative data were collected. Questionnaires, interview schedules, focus group discussions (FGDs) and video-recorded lessons were used to collect data. On the one hand,

both quantitative and qualitative data were collected from learners. To assess the effectiveness of video-recorded lessons used for teaching and learning, students were required to sit for a written exam before and after catch-up classes to evaluate the impact of digital learning aids on education. The data is presented using descriptive statistics. On the other hand, qualitative data was collected by interviewing teachers, students, education officers, and rescue centre managers. Teenage mothers filled out questionnaires. In addition, qualitative data were collected from FGDs, which solicited views from teenage mother participants on opportunities and the challenges they identified in their quest to achieve equal education opportunities to those of their peers.

Ethical Clearance

Before commencing the research, the principal investigator formally obtained the ethical approval required to conduct it from the designated national government body.

Ethical Consideration

The researcher assured the participants (teenage mothers) of confidentiality, and this was done using pseudonyms when disseminating the lessons and compiling the reports to ensure that the respondents were not exposed. Informed consent was sought from all the teenage mothers sampled to participate in this study, and only those willing to participate proceeded. The teenage mothers were also informed that they would have the right to drop out of the study if uncomfortable, and no punitive actions would be taken. Their guardians and/or management of the rescue centres signed the consent forms for those under the age of consent. The research team, including the research assistant, went through safeguarding procedures and committed to signing a contract that they would not harm the research project participants. Teenage mothers were sensitised about children's rights and informed on the relevant reporting procedures in case they encountered any form of abuse.

Data Analysis

This study employed a mixed-methods approach, combining quantitative (statistical) and qualitative (thematic) analysis to assess how digital learning tools enhance education access among vulnerable teenage mothers in Nairobi’s urban slums. Data was collected from 25 participants across rescue centres via interviews, performance tests, and usage logs.

SPSS and Excel were the tools used for quantitative analysis. Thematic Coding was used for the qualitative analysis of interview responses. The data analysis is based on the three objectives as presented below.

Digital Learning Tools Accessible to Teenage Mothers for Educational Advancement.

The findings revealed that the school has an ICT lab with 28 computers, internet connectivity, a smart TV, an LCD projector, and grid electricity. Teachers utilise WhatsApp, Google Meet, Zoom, and YouTube to enhance learning. Notably, some educators independently create and upload video content. Integrating digital tools within the school's infrastructure demonstrates a proactive approach to modernising education. Various platforms indicate adaptability and a commitment to improving learning experiences. Studies have shown that digital tools can enhance learning outcomes by providing rich, interactive, and personalised educational experiences (Mwangi).

Table 1: ICT Tools in Learning

	Item	**Available**	**Available and Inadequate**	**Not Available**
1	Radio	x		
2	Television set	x		
3	Mobile phone *(kababe)*	x		
4	Mobile phone *(smartphone)*	x		
5	Cassette recorder	x		
6	Computer	x		
7	Printer	x		
8	Tape-recorder			x
9	Overhead projector			x
10	Film projector (TV)	x		
11	Internet facilities	x		
12	Tablet?		x	

Data was collected through interviews, revealing that radio, television, and mobile phones were the most commonly available tools. Quantitative data indicated that mobile phones were the most accessible (86%, n=19), followed by TV (64%, n=14) and radio (59%, n=13). Despite high mobile phone ownership, smartphone penetration remained limited, with only 9 out of 25 having internet-enabled devices. Interviews showed that most relied on basic feature phones for SMS and calls, while a few accessed educational content via WhatsApp and YouTube when data was available.

The usage patterns for learning indicated that, while mobile phones are primarily used for communication, some mothers (36%, n=8) reported utilising them for SMS-based lessons, recorded audio lectures, or WhatsApp study groups. The challenges encountered included high data costs and limited storage space. Educational programs on television, such as Edu-TV (a Kenyan broadcasting initiative), were accessed by 64% (n=14); however, inconsistent electricity and scheduling conflicts due to childcare responsibilities hindered regular use. Regarding radio, 59% (n=13) tuned into school broadcast programs, but only 27% (n=6) did so consistently. Interviews revealed that radio was preferred for its low cost and portability, although the content was often not tailored to their literacy levels.

Challenges Teenage Mothers Face in Accessing Education through Digital Learning Tools

Furthermore, the study conducted focus group discussions (FGDs) and interviews with teenage mothers, teachers, and education officers to identify the challenges faced in adopting and using digital learning tools. It was observed that despite the transformative potential of these tools in enhancing educational access for marginalized groups, their integration into learning environments, especially for vulnerable learners such as teenage mothers, encounters several structural and systemic barriers.

Table 2: ICT-Related Challenges are Hindering Teenage Mothers' Access to Education.

	Challenge(s)	Not a challenge	Minor challenge	Major challenge
1	Time		x	
2	Availability of equipment			x
3	Poor quality of technology?			x
4	Lack of technical skills			x
5	Lack of Internet facilities			x
6	Frequent power failure			x
7	Students' low morale to continue schooling			x

Performance tests showed that 45% (n=10) struggled with basic digital skills, such as downloading study materials or navigating educational apps. Interviews revealed that some students feared “breaking" devices, which led to deterred experimentation. Most students depended on peers or centre staff for tech support, delaying independent learning. There is significant misinformation about data-saving techniques (e.g., disabling updates), which often worsens usability. Teacher

respondents noted that challenges included lacking ICT support staff, limited formal training, shared devices, and inconsistent network connectivity. For students, restricted computer access, low technical proficiency, frequent power outages, monotony of the videos, lack of one-on-one interaction with the teacher for clarification or follow-up, and a lack of parental support remain pressing issues. These reflect systemic barriers that can hinder the effective adoption of digital education. Research indicates that many Kenyan schools lack sufficient digital devices and technical personnel, further delaying implementation.

The findings demonstrate that access to necessary devices and reliable internet connectivity remains a significant barrier. A systematic review highlighted that students from economically disadvantaged backgrounds and rural areas often struggle with limited access to digital devices and stable internet connections, hindering their ability to engage effectively in online learning (Alikhan and Sritharan). In addition, the pervasive presence of digital devices can lead to distractions that impede learning. A study on digital distractions among higher education students revealed that multitasking with digital technologies negatively affects academic performance. The study emphasised the need for strategies to raise awareness about these adverse effects and to develop students' self-control skills (Pérez-Juárez, González-Ortega, and Aguiar-Pérez).

Moreover, technical issues such as unstable internet connections and platform unavailability can disrupt the learning process. An integrative review in medical education identified technological and logistical problems, including internet connectivity issues leading to video buffering and periodic unavailability of e-learning platforms, as barriers to online learning (Forde and OBrien) .

Therefore, tackling these challenges demands a multifaceted approach, which includes enhancing technological infrastructure, boosting digital literacy, implementing strategies to minimise distractions, and creating effective online teaching practices to promote engagement.

Use of Digital Learning Tools to Create and Deliver Lessons to Teenage Mothers

To achieve this objective, video-recorded lessons were used in this study. Two experienced teachers were selected to develop written academic assessment tools in Mathematics and English Language, along with a video for the research. During the initial stage, two video lessons for each subject were created and utilised in the piloting process. The teenage mothers took exams in both English and Mathematics. The initial exams enabled the teachers to identify academic performance

gaps among adolescent mothers, which guided the creation of catch-up lessons. Lesson plans, notes, and references for both subjects were developed to address the identified gaps among participants in the research project. The teenage mothers watched 12 lessons in both English and Mathematics under supervision, but were also allowed to view the videos during their free time. The analysis below compares the performance improvements in the two subjects.

Impact of Digital Tools on Mathematics Performance

The study assessed the performance of 25 learners in mathematics through two assessments: CAT 1 and CAT 2. Between the two evaluations, digital learning tools (e.g., instructional videos, virtual whiteboards, interactive platforms) were introduced.

Table 3: Statistical Summaries for the Mathematics CAT Scores

Metric	CAT 1 (Before)	CAT 2 (After)	Deviation
Mean	11.68	16.04	4.36
Std Dev	6.22	7.83	2.50
Min	3.00	3.00	0.00
Max	23.00	29.00	10.00

As shown in the table above, the results indicate that the average score in CAT 1 (before digital tool use) was 11.68, while the average in CAT 2 (after intervention) rose to 16.04. This reflects a mean improvement of 4.36 marks, suggesting a notable positive shift in performance. The standard deviation increased from 6.22 (CAT 1) to 7.83 (CAT 2), indicating greater score variability after the intervention. This may reflect differing levels of adaptability or access to digital tools among students. The results also show that the minimum and maximum scores for CAT 1 ranged from 3 to 23, while for CAT 2, they ranged from 3 to 29. Furthermore, the deviation ranged from 0 to 10, demonstrating that all students either maintained or improved their performance.

Paired Sample T-Test

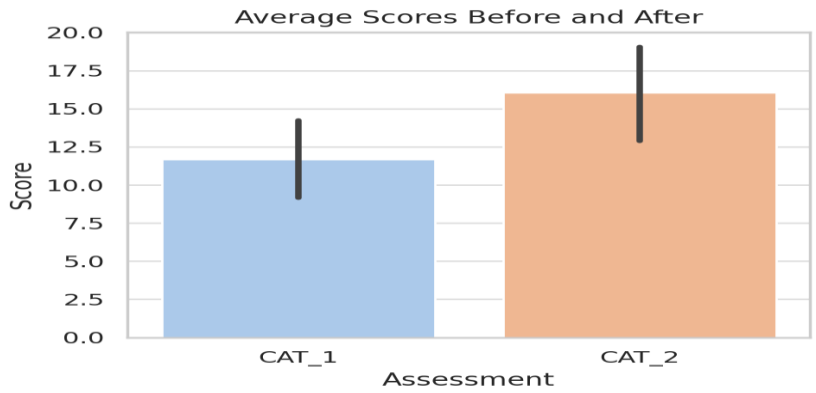
To determine whether the observed difference was statistically significant, a paired sample t-test was conducted.

T-Statistic: 8.73

P-Value: 6.54×10^{9}

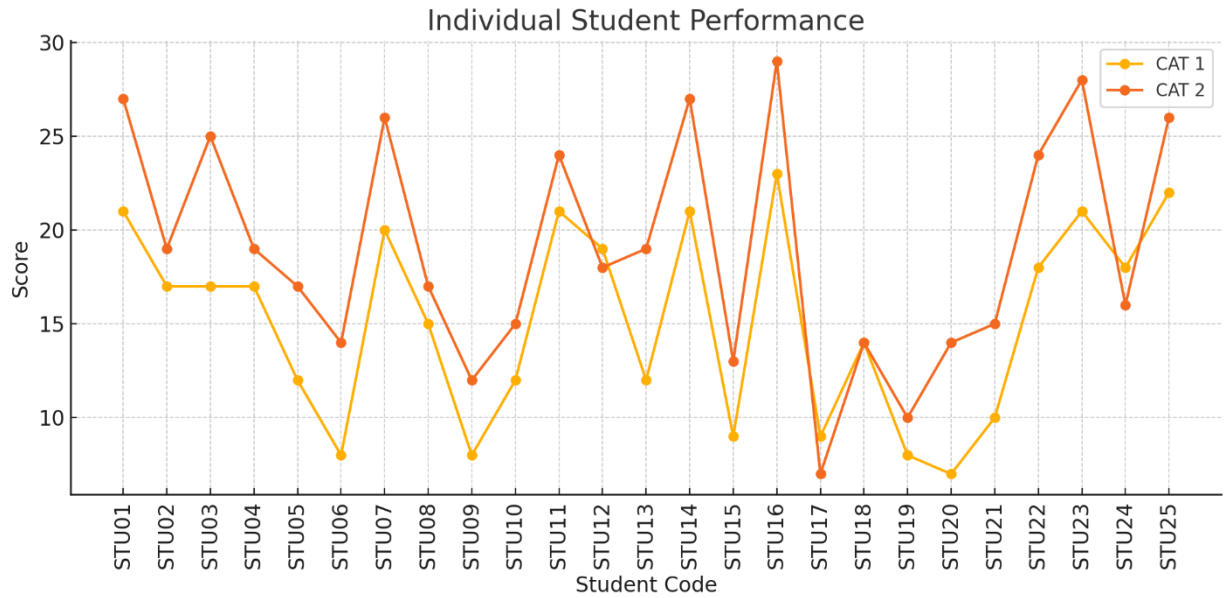
The results indicate that the p-value is significantly lower than the conventional alpha level 0.05. This suggests that the improvement in scores was not due to random chance. Consequently, the null hypothesis (which states that there is no difference in performance before and after using digital tools) was rejected. This finding provides strong statistical evidence that the introduction of digital learning tools positively and significantly impacted student achievement in mathematics.

Figure 2: **Mathematics Average Scores Before and After DLT Intervention**



This chart compares the mean scores of CATS 1 and CAT 2, clearly highlighting the average increase in scores after the digital learning intervention.

Figure 3: Individual Student Performance



The above line graph was drawn to indicate individual student progress in performance in CAT 1 and CAT 2. Nearly all lines trend upwards, affirming that most students experienced improvement post-intervention. Most students improved between 3 and 6 marks, with a few recordings higher improvements. This demonstrates an overall positive shift across the student population.

The analysis provides strong evidence that integrating digital learning tools improves students' mathematics performance statistically significantly. These results support the continued adoption of digital resources to enhance engagement and learning outcomes in STEM subjects. The literature indicates that using digital learning tools in teaching benefits learners. For instance, McLaren et al. developed the "Decimal Point" digital learning game to teach decimal concepts. Studies show that students using the game achieved significantly better learning gains than those using traditional methods, with the game proving particularly effective for female students (36-56).

A study evaluating the impact of "Rori," an AI-powered conversational math tutor accessible via WhatsApp, found that students who used Rori had significantly higher math growth scores, with an effect size of 0.37. Additionally, the results were statistically significant ($p < 0.001$) (Henkel et al.).

Impact of Digital Learning Tools on English Performance

Table 4: Statistical Summaries for the English CAT Scores

Statistic	CAT1 (Before)	CAT2 (After)	Deviation
Mean	15.16	19.00	4.36
Std Dev	5.26	6.22	2.14
Min	7.00	7.00	0.00
Median	17.00	18.00	5.00
Max	23.00	29.00	7.00

This analysis compares students' performance in CAT 1 (before exposure to digital learning tools) and CAT 2 (after exposure). The deviation represents the individual difference in scores, providing insight into the effectiveness of digital interventions.

The average improvement of 4.36 marks strongly indicates a positive impact of digital learning tools. Students performed significantly better, on average, after being exposed to tools such as

instructional videos, digital apps, and remote learning platforms. The slightly higher standard deviation in CAT 2 suggests more variation in how students benefited from the intervention — some showed more significant improvements than others. However, the relatively low standard deviation (2.14) implies that most students improved within a similar range, reflecting consistency in the effectiveness of the digital tools across learners. Additionally, the lowest-performing students maintained their scores at a minimum but did not decline. This suggests there was no negative impact from the digital intervention, even for students who may struggle academically.

Top-performing students also demonstrated significant gains, with some increasing their scores by as much as seven points. This indicates that the tools were beneficial for all ability levels, not just those who were initially struggling. The median deviation of 5 points reveals that at least half of the students improved by five points or more. This indicates a strong central trend toward performance improvement and confirms that only a small number of high performers did not skew the positive shift in scores.

Therefore, the data demonstrate that digital learning tools significantly enhanced student performance in English. The improvement is consistent across the entire class, with no student showing a decline and many making substantial gains. Both high and low performers benefited, and the intervention appears to have levelled the playing field by addressing diverse learning needs. This outcome aligns with educational research indicating that interactive, multimedia, and flexible digital resources foster engagement, motivation, and academic progress, particularly when implemented thoughtfully.

Paired t-test

A paired t-test was performed to assess whether there is a significant difference between scores before (CAT1) and after (CAT2) the implementation of digital tools.
t-statistic: -6.6617
p-value: 0.00000069
Significant difference at $\alpha=0.05$: Yes

The extremely low p-value ($p < 0.001$) indicates a statistically significant difference between the scores of CAT1 and CAT2. The negative t-statistic suggests that scores in CAT2 are significantly higher than those in CAT1.

To assess the significance of integrating digital learning tools, a Pearson correlation analysis was conducted on the data, as shown below:

Correlation between CAT1 and CAT2

Pearson correlation coefficient: 0.8871

p-value: < 0.00000001

Significant correlation at α=0.05: Yes

The strong positive correlation indicates that students who performed well in CAT1 also tended to excel in CAT2. This suggests that digital tools enhanced performance overall but did not significantly change students' relative standing.

The relationship between initial performance (CAT1) and improvement (deviation) was also assessed.

Pearson correlation coefficient: 0.1651

p-value: 0.43019430

Significant correlation at α=0.05: No

The absence of a significant correlation between CAT1 scores and improvement indicates that the advantages of digital tools were independent of students' initial performance levels. Students from all initial performance levels experienced similar relative enhancements.

Figure 4: English Average Scores Before and After DLT Intervention

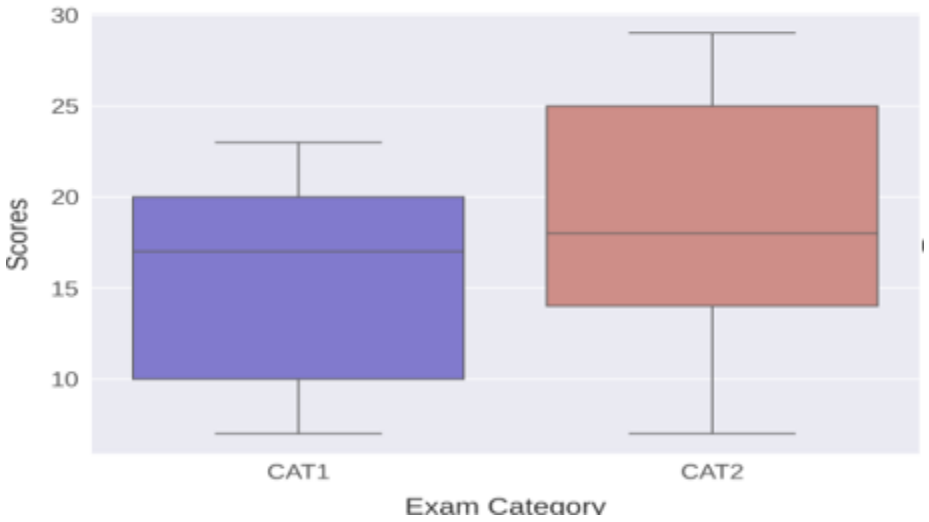


Figure 3: Boxplot comparison of scores before (CAT1) and after (CAT2) the implementation of digital tools.

In summary, the results highlighted by the paired t-test indicate that the DLT intervention (i.e., digital tool usage) is associated with a significant improvement in exam scores. Second, despite this noteworthy difference, the medium effect size suggests that the improvement, while apparent, is moderate. Additionally, the strong correlation between initial and later scores implies that students' overall abilities do not change, even though they achieve higher scores after exposure to digital tools.

Furthermore, as there is no direct correlation between initial performance and the extent of improvement, the benefits of the intervention do not depend on how well a student performed initially. The percentage improvement scores indicate different impacts on individual students, suggesting a need for qualitative follow-up investigation into why some students benefit greatly while others do not.

Considerable research on the use of digital tools in education has been conducted over the past two decades. Scholars have debated the effectiveness of digital tools in enhancing students' performance, particularly in language learning. Digital tools have transformed language instruction through interactive, personalised learning. Golonka et al. theorise that certain technologies, specifically automatic speech recognition and chat software, significantly enhance language learning (70).

It is also suggested that computer-mediated communication tools offer the potential for genuine language use and purposeful interaction, which are vital to language learning (Blake). Research on the effectiveness of digital tools in enhancing academic performance presents mixed, though predominantly positive, results. A meta-analysis by Cheung and Slavin indicates a moderate positive effect on language learning achievement (Cheung and Slavin). The findings of our study show that vocabulary learning mobile apps can yield significant improvements in English language acquisition. Macaro et al. found that teacher training, technology infrastructure, and pedagogical integration are essential prerequisites for effective technology-enhanced learning (1-43). Huang et al. demonstrated that digital tools support learners at all proficiency levels through different mechanisms, emphasising the subtle role of prior knowledge in learning outcomes (623).

Despite the positive findings, gaps remain in the long-term evaluation of the impact of digital tools on language proficiency, particularly concerning distinct language skills. Longitudinal and broader-scale studies are necessary to substantiate these early findings (Burston). Computer-

mediated communication tools create opportunities for authentic language use and meaningful interaction, which are essential for language acquisition (Blake). Similarly, Stockwell (2012) notes that mobile-assisted language learning (MALL) offers flexibility and accessibility that traditional classroom settings cannot provide.

Research on the effectiveness of digital tools in improving academic performance shows mixed but generally positive results. A meta-analysis examining the impact of educational technology applications on reading outcomes for K-12 students found a positive, moderate effect size of 0.16, indicating that technology can enhance reading achievement (Cheung and Slavin 198).

Interestingly, Huang et al. found that the relationship between prior knowledge and learning gains with digital tools is complex. Their study demonstrated that digital tools can benefit both high and low performers, albeit through different mechanisms, supporting our finding that improvement was not significantly correlated with initial performance.

Despite extensive research, gaps remain in understanding the long-term effects of digital tools on language proficiency and how these tools impact various aspects of language learning, including reading, writing, speaking, and listening. Most studies, including ours, focus on relatively short-term outcomes and often do not break down results by specific language skills. Furthermore, Burston points out in his review of MALL research that many studies suffer from small sample sizes and limited implementation periods, which restrict their generalizability (4-20). While providing valuable insights, our study shares these limitations and emphasises the need for longitudinal research with larger samples.

During FGDs, it was noted that video-recorded lessons effectively help learners catch up on material they missed in class. The majority of respondents affirmed that recorded video lessons can enhance classwork. Reviewing content during free time can aid in retention, while its flexibility allows learners to pause and continue lessons later.

It was further noted that some students have varying levels and paces of mastering and retaining content, particularly when a teacher presents material quickly to complete the syllabus, which can disadvantage slower learners. Therefore, the respondents observed that recorded content would be invaluable for these students. It is especially beneficial for those who learn slower, as they can rewind, replay, and pause the video; thus, this format can be considered user-friendly.

Some of the student respondents pointed out that mathematics was the best subject, as they enjoyed watching videos, particularly for learning about numbers, fractions, and linear equations. Conversely, those who preferred the English videos noted they learned about intonation, functional writing, letters, memos, and telephone etiquette.

Teenage mothers often encounter significant obstacles to continuing their education due to responsibilities related to early motherhood, social stigma, and limited access to flexible learning environments. However, existing Information and Communication Technology (ICT) tools offer a promising opportunity to bridge the educational gap for this group. Utilising mobile devices, radio, television, and internet-based platforms can provide teenage mothers with the flexibility and accessibility needed to pursue their education while managing their parental responsibilities. This approach aligns with the goal of inclusive education and supports Sustainable Development Goal 4, which emphasises equitable quality education for all.

One of the most accessible ICT tools is the mobile phone, which is widely used in urban and rural settings. Through SMS-based learning, WhatsApp groups, and mobile learning applications, teenage mothers can access educational materials, engage in peer discussions, and receive support from teachers without being physically present in a classroom. Mobile phones facilitate asynchronous learning, allowing students to study at their own pace and time, a critical feature for teenage mothers who may need to balance childcare and household tasks. Apps like Eneza Education, used in Kenya, have already demonstrated promise in reaching underserved learners using basic mobile phones (Eneza Education).

Additionally, radio and television have long been utilised to provide educational content, particularly in rural areas with limited internet access. Educational radio programs can offer curriculum-aligned materials, language lessons, and life skills training. These platforms can be enhanced by scheduling broadcasts when teenage mothers are more likely to be available, such as after typical caregiving hours. For example, the Kenya Institute of Curriculum Development (KICD) has employed radio and TV programming to facilitate distance learning, especially during the COVID-19 pandemic (KICD).

Web-based learning platforms provide teenage mothers with a more organised and interactive learning experience. With internet access, learners can engage with online courses, e-books, video tutorials, and interactive assessments. Platforms like Google Classroom, Moodle, and even

YouTube educational channels can be tailored to include content that addresses the unique needs of teenage mothers, such as parenting education, mental health support, and vocational training. Community-based digital hubs and public schools with internet-connected computers can serve as local access points, assisting those without personal devices in online learning.

Collaborating between government agencies, non-governmental organisations (NGOs), and the private sector is essential for effectively implementing these strategies. Policies should support the provision of subsidised data bundles, affordable smartphones, and free access to educational content. Furthermore, training teachers to deliver inclusive digital learning will ensure that the content is not only accessible but also engaging and supportive of teenage mothers' circumstances. With targeted interventions and the strategic use of existing ICT tools, education can become a transformative pathway for teenage mothers, empowering them to achieve academic and personal growth.

SUMMARY AND CONCLUSION

This study explored how digital learning tools—specifically video-recorded lessons and ICT platforms—can enhance access to education for vulnerable teenage mothers in Kenya, particularly in urban slum settings like Nairobi's Kasarani Sub-County. Teenage pregnancy remains a significant barrier to education, often forcing girls to leave school for months without sufficient learning support.

Using a mixed-methods approach, including interviews, tests, and focus groups, the research assessed the availability of digital tools, such as phones, radios, and TVS, and their impact on academic performance in English and Mathematics. The study also identified the barriers these mothers face in accessing digital learning, including limited devices, poor infrastructure, low digital literacy, and societal stigma. Performance data revealed statistically significant improvements in learners' test scores after the digital tool intervention. The research demonstrates the potential of digital interventions, such as mobile learning, SMS-based lessons, and educational video content, for bridging learning gaps in marginalised groups.

The findings of this study confirm that digital learning tools significantly enhance access to education and improve outcomes for teenage mothers in rescue centres. Despite systemic challenges—such as limited connectivity, high data costs, and inadequate teacher training—

learners demonstrated measurable academic gains when provided with targeted digital content. Importantly, video-recorded lessons proved to be a user-friendly and flexible learning method, particularly beneficial for slower learners and those who need to balance studies with childcare responsibilities. These tools offer a practical approach to supporting catch-up education and compensating for the time lost outside the traditional classroom.

While the benefits were evident, the study acknowledged that digital equity gaps persist. Not all learners have access to smartphones or a reliable power supply, and educational content may not always align with students' literacy levels or learning needs. Nevertheless, the research confirms that digital learning tools—when thoughtfully implemented—are practical for inclusive education and support Sustainable Development Goal 4, which emphasises quality education for all.

Recommendations

Several strategic recommendations are proposed to improve the effectiveness and accessibility of digital learning tools for adolescent mothers in educational rescue centers.

First, improving infrastructure and access is essential. This includes distributing low-cost smartphones or tablets to rescue centers to ensure learners have the necessary hardware. Providing solar-powered radios and DVD players would facilitate consistent access to educational content in areas with unreliable electricity. Furthermore, expanding zero-rated educational platforms and offering subsidized data packages for low-income users would help eliminate financial barriers to connectivity.

Regarding content development, the study recommends scaling up the production and distribution of video-recorded lessons aligned with Kenya’s national curriculum. The content should be inclusive, multilingual, and available in offline-compatible formats to accommodate learners from diverse linguistic and technological backgrounds. Additionally, content should be designed with attention to literacy-level appropriateness, particularly for foundational subjects such as English and Mathematics.

Effective implementation also requires training for teachers and staff. Continuous digital literacy workshops should be offered for learners and educators to enhance their capacity to use technology effectively. Staff in rescue centers should also be trained to serve as learning facilitators, guiding students through digital content and providing academic support.

From a policy and partnership perspective, the study encourages the formation of strong alliances with telecommunications companies, NGOs, and edtech startups to support digital learning initiatives. Digital learning should be integrated into national policies, including the School Re-entry Guidelines and the Alternative Provision of Basic Education and Training (APBET) framework. Furthermore, incentivizing teachers to create localized, high-quality digital content can enhance relevance and adoption.

Lastly, effective monitoring and evaluation systems are essential. These systems should track learner engagement and performance on digital platforms. Feedback mechanisms—such as SMS-based surveys and WhatsApp check-ins—should be utilized to collect learner insights and continuously enhance content delivery.

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