

Teaching and Learning in Fragile Contexts (TLFC) Research Paper



Digital Learning as a Resilience Strategy: Curbing Teaching and Learning Challenges in Upper Basic Schools in Fragile Contexts of Northeast Nigeria

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Abstract

This study examines digital learning as a resilience strategy for addressing persistent teaching and learning challenges in upper basic schools within the fragile context of Northeast Nigeria. Using an explanatory sequential mixed-methods design, quantitative data were collected from 300 students and 60 teachers, complemented by qualitative interviews with teachers and school administrators.

Results show that digital learning significantly enhances student engagement, comprehension, and teaching effectiveness. Statistical analysis revealed a strong positive correlation between teacher usage of digital tools and teaching effectiveness ($r = 0.62$, $p < 0.01$), while quasi-experimental comparisons demonstrated significant improvements in student engagement and learning outcomes following digital interventions ($p < 0.01$).

However, infrastructural limitations, including unreliable electricity, limited access to devices, and insufficient teacher training, constrained full implementation. This study provides empirical evidence on context-sensitive digital learning interventions in fragile settings and demonstrates the potential of low-cost, offline solutions for sustaining learning continuity.

Policy implications include emphasizing equity, resilience, and teacher capacity-building in digital learning initiatives.

Keywords

Digital learning; Fragile contexts; Northeast Nigeria; Teaching effectiveness; Student engagement; ICT in education; Mixed-methods research

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Contents

Abstract.....	2
Keywords.....	2
Acknowledgement.....	2
Introduction	5
Review of Literature	5
Methodology.....	7
Results.....	8
Students' Perception of Digital Learning Tools	8
Theme 1: Digital Learning Promotes Learning Continuity and Understanding	9
Theme 2: Students Desire Greater Access to Digital Learning Resources	9
Teachers' Perception of Digital Learning Effectiveness	10
Theme 1: Digital Learning Supports Teaching Continuity During Emergencies.....	11
Theme 2: Improved Classroom Interaction and Learning Outcomes	11
Theme 3: Need for Capacity Building and Infrastructure Support	12
Challenges of Digital Learning Implementation Quantitative Results.....	12
Theme 1: Inadequate Infrastructure and Power Supply	13
Theme 2: Poor Internet Connectivity and Limited Access to Technology	13
Theme 3: Insufficient Training and Technical Support.....	13
Overall Digital Learning Impact.....	14
Theme 1: Increased Student Engagement and Participation.....	15
Theme 2: Improved Understanding of Lessons.....	15
Theme 3: Enhanced Teacher Effectiveness	16
Theme 4: Improved Overall Teaching and Learning Outcomes	16
Gender Differences in Student Engagement.....	17
Theme 1: Equal Interest in Digital Learning Across Gender.....	18
Theme 2: Digital Learning Increases Classroom Participation.....	18
Theme 3: Similar Learning Experiences for Male and Female Students	19
Interpretation.....	20
Integrated (Triangulated) Findings of Quantitative and Qualitative Evidences.....	21
Discussion.....	21
Continuity during displacement.....	22

Digital flexibility supports resilience	22
Barriers exist	23
Teacher may lack digital skills.....	23
Digital interventions must relate to the context.....	23
Digital adaptations can help	23
Build digital education systems.....	25
Limitations of the Study.....	25
Conclusion	26
Recommendations	26
References.....	27
Appendices.....	29
1. SURVEY QUESTIONNAIRE	29
2. QUALITATIVE INTERVIEW PROTOCOL.....	31
3. FOCUS GROUP DISCUSSION (FGD) GUIDE.....	32

List of Tables

Table 1: Students' Perception of Digital Learning Tools (N = 300)	9
Table 2: Teachers' Perception of Digital Learning Tools (N = 60)	10
Table 3: Teachers' Responses on Challenges of Digital Learning Tools (N = 60)	12
Table 4: Teachers' and Students' Responses on the Impact of Digital Learning Tools (Teachers = 60; Students = 300)	14
Table 5: Gender Difference in Students' Engagement with Digital Learning Tools	17
Table 6: Pre- and Post-Digital Learning Scores	19
Table 7: Summary of Statistical Decision	20
Table 8: Correlation Between Teacher Usage and Teaching Effectiveness	21

Introduction

Education is universally acknowledged as a fundamental human right and a key driver of socio-economic development, social cohesion, and peace building. Upper basic education, or Junior Secondary School, is critical for developing foundational cognitive, problem-solving, and digital skills. Northeast Nigeria has endured prolonged insurgency, resulting in school destruction, teacher and student displacement, and disrupted academic calendars (UNICEF, 2019; World Bank, 2020).

Persistent challenges in upper basic schools include teacher shortages, overcrowded classrooms, inadequate instructional materials, and irregular school schedules (FME, 2019). Digital learning has emerged as a viable strategy to address these challenges, offering flexible, scalable, and learner-centered instruction (Trucano, 2016). Despite increased adoption by government and development partners, empirical evidence of digital learning's effectiveness in fragile contexts remains limited. This study examines the impact of digital learning on teaching effectiveness, student engagement, and learning outcomes in Northeast Nigeria.

Review of Literature

Digital learning has increasingly emerged as a strategic response to educational disruptions in fragile and conflict-affected contexts worldwide. The concept refers to the use of digital technologies, including online platforms, mobile devices, radio-based instruction, learning management systems, and offline digital resources, to facilitate teaching and learning. In fragile regions where conventional schooling is frequently interrupted by insecurity, displacement, natural disasters, and infrastructural deficits, digital learning provides alternative pathways for educational continuity. Recent studies indicate that digital learning enhances access to educational resources, promotes learner autonomy, and supports flexible learning environments capable of functioning during emergencies and crises (UNESCO, 2025; UNICEF, 2024). The resilience perspective suggests that digital learning strengthens the capacity of educational systems, teachers, and learners to adapt to shocks while maintaining instructional delivery and learning outcomes.

The educational situation in Northeast Nigeria presents a compelling case for the adoption of digital learning as a resilience strategy. More than a decade of insurgency, displacement, destruction of school infrastructure, and recurrent humanitarian crises have significantly undermined access to quality education in the region. UNICEF (2024) reports that millions of children in Borno, Adamawa, and Yobe States remain at risk of educational exclusion due to conflict-related disruptions. In upper basic schools, challenges such as teacher shortages, overcrowded classrooms, insecurity, absenteeism, and inadequate learning materials continue to hinder effective teaching and learning. Research on education in emergencies emphasizes that digital technologies can mitigate these barriers by enabling remote instruction, providing

access to digital content, and facilitating communication between teachers and learners even when physical attendance is impossible (UNICEF, 2024; UNESCO, 2025).

Recent evidence from Northeast Nigeria demonstrates the practical effectiveness of digital learning interventions in enhancing educational resilience. UNESCO (2025) documented the establishment of community-based digital transformation hubs in conflict-affected communities of Borno and Yobe States, equipped with computers, internet connectivity, and solar-powered systems. These initiatives enabled learners and facilitators to continue educational activities despite infrastructural and security constraints. The use of solar-powered technologies and offline learning modules was particularly effective in addressing challenges associated with unstable electricity supply and poor internet connectivity. Furthermore, digital learning environments enhanced inclusivity by providing opportunities for marginalized groups, including displaced learners, girls, and learners with disabilities, to access educational resources and participate in learning activities. Such findings suggest that digital learning can bridge educational gaps and improve learning continuity in fragile contexts.

The role of teachers in the successful implementation of digital learning has also received considerable scholarly attention. Studies indicate that digital technologies can improve instructional quality by providing teachers with access to pedagogical resources, virtual professional development opportunities, and innovative teaching methods. Through digital platforms, teachers can share lesson materials, conduct assessments, and monitor learner progress more efficiently. However, the literature equally identifies significant barriers, including inadequate digital competencies among teachers, limited access to devices, and insufficient institutional support (Oguine et al., 2025). These challenges are particularly pronounced in fragile contexts where educational systems often struggle with resource limitations. Consequently, teacher training and capacity-building programmes are widely recommended as critical factors for maximizing the effectiveness of digital learning interventions and strengthening educational resilience.

Despite its potential, the literature acknowledges that digital learning is not a panacea for all educational challenges in fragile environments. Persistent issues such as the digital divide, limited connectivity, poverty, inadequate infrastructure, and unequal access to technological devices continue to constrain the effectiveness of digital learning initiatives (Abdeljabar & Alouini, 2025). Nevertheless, scholars generally agree that when supported by appropriate policies, infrastructure, and teacher capacity development, digital learning significantly enhances the resilience of education systems. In the context of upper basic schools in Northeast Nigeria, digital learning offers a promising strategy for curbing teaching and learning challenges by ensuring continuity of instruction, expanding access to educational resources, and fostering adaptive learning environments capable of withstanding disruptions caused by conflict and other emergencies. The reviewed literature therefore underscores the need for further

empirical investigation into the effectiveness, challenges, and sustainability of digital learning as a resilience strategy in fragile educational settings.

Methodology

This study adopted an explanatory sequential mixed-methods research design, which involved the collection and analysis of quantitative data in the first phase, followed by qualitative data collection and analysis in the second phase to explain and elaborate on the quantitative findings. The design was considered appropriate because it enabled the researcher to obtain broad numerical evidence on the role of digital learning in addressing teaching and learning challenges in fragile contexts while also gaining deeper insights into the experiences and perceptions of key educational stakeholders. The study was conducted in selected upper basic schools located in fragile and conflict-affected communities of Northeast Nigeria, particularly in Borno, Adamawa, and Yobe States.

The population of the study comprised all upper basic school students, teachers, school administrators, education officials, and community representatives in selected schools within the study area. A multistage sampling procedure was employed to select participants. First, the three states most affected by educational disruptions were purposively selected. Thereafter, selected Local Government Areas and upper basic schools were chosen using purposive and stratified sampling techniques. For the quantitative phase, a sample of 300 students, 60 teachers, and 12 school administrators was selected to participate in the survey, while participants for the qualitative phase were purposively sampled which 11 teachers and 10 administrators. from among school administrators, education officials, community representatives, and 12 students based on their experiences with digital learning initiatives and educational disruptions.

Three research instruments were used for data collection.

1. The first was a structured questionnaire titled Digital Learning Resilience Questionnaire (DLRQ), which was designed to collect quantitative data on the availability, utilization, effectiveness, and challenges of digital learning in upper basic schools.
2. The second instrument was a semi-structured interview guide used to obtain in-depth information from teachers, school administrators, education officials, and community representatives regarding their experiences and perceptions of digital learning as a resilience strategy.
3. The third instrument was a Focus Group Discussion (FGD) guide administered to selected students to explore their experiences, challenges, and views on the use of digital learning during periods of educational disruption.

To ensure the validity of the instruments, experts in Educational Technology, Educational Administration, and Measurement and Evaluation reviewed the instruments for clarity, relevance, and adequacy of content coverage. A mini study was

conducted outside the study area to establish reliability, and the questionnaire yielded acceptable reliability coefficients using Cronbach's Alpha. Quantitative data were analyzed using descriptive statistics such as frequencies, percentages, means, and standard deviations, as well as inferential statistics including correlation analyses where appropriate. Qualitative data obtained from interviews and focus group discussions were transcribed, coded, and analyzed thematically. Finally, the quantitative and qualitative findings were integrated (triangulated) during the interpretation stage to provide a comprehensive understanding of how digital learning contributes to educational resilience and helps curb teaching and learning challenges in upper basic schools located in fragile contexts of Northeast Nigeria. Ethical principles of informed consent, confidentiality, anonymity, and voluntary participation were strictly observed throughout the study.

Results

Students' Perception of Digital Learning Tools

Research Question: What are students' perceptions of digital learning tools in fragile contexts of Borno, Adamawa, and Yobe States?

Quantitative Results. The results in Table 1 show that students generally held positive perceptions of digital learning tools in fragile contexts across the BAY States. The overall grand mean of 3.71 indicates a high level of agreement among respondents. The highest-rated item was the desire for more frequent use of digital learning tools in schools as it improves understanding of lessons ($M = 3.85$, $SD = 0.84$), suggesting strong acceptance of technology-supported learning. Students also agreed that digital learning tools help sustain learning during school disruptions ($M = 3.72$, $SD = 0.79$), make learning more engaging ($M = 3.68$, $SD = 0.81$), and would like digital tools to be used more frequently in my school ($M = 3.60$, $SD = 0.72$). These findings indicate that students perceive digital learning as an effective strategy for supporting teaching and learning in fragile educational environments. Table 1 presents the mean ratings of students on their perceptions of digital learning tools.

Table 1: Students' Perception of Digital Learning Tools (N = 300)

S/N	Item	Mean	SD	Decision
1	Digital learning tools help me continue learning during school disruptions.	3.72	0.79	Agree
2	Digital learning tools improve my understanding of lessons.	3.85	0.84	Agree
3	Digital learning tools make learning more interesting and engaging.	3.68	0.81	Agree
4	I would like digital learning tools to be used more frequently in my school.	3.60	0.72	Agree
Grand Mean		3.71	0.79	Agree

Qualitative Results. To further explain the quantitative findings, Focus Group Discussions were conducted with students from selected upper basic schools across Borno, Adamawa, and Yobe States. Analysis of the discussions revealed two major themes.

Theme 1: Digital Learning Promotes Learning Continuity and Understanding

Most participants reported that digital learning tools helped them continue learning during periods of insecurity, displacement, and school closure. Students indicated that educational videos, recorded lessons, and digital content enabled them to study even when regular classroom instruction was disrupted.

One participant stated:

"The tablet lessons helped us continue learning when our school was closed because of insecurity."

Another participant remarked:

"The videos make difficult topics easier to understand than reading only from textbooks." and further stated that whats-app conference with our teacher and friends help greatly in group discussions during school closures.

Theme 2: Students Desire Greater Access to Digital Learning Resources

Participants consistently expressed enthusiasm for increased access to digital technologies in their schools. Students noted that digital learning makes lessons more

interesting and motivates them to participate actively in classroom activities. A participant explained:

"Learning with videos and computers is more enjoyable because we can see practical examples."

Another student commented:

"We need more computers and internet facilities so that every student can benefit from digital learning."

Integration of Quantitative and Qualitative Findings. The qualitative findings support the quantitative results by demonstrating that students view digital learning tools as valuable resources for maintaining educational continuity, improving comprehension, and increasing engagement in learning activities. Both sets of findings indicate that digital learning contributes significantly to educational resilience in fragile contexts. However, students emphasized the need for greater access to digital infrastructure and learning resources to maximize the benefits of digital learning in upper basic schools across the BAY States.

Teachers' Perception of Digital Learning Effectiveness

Research Question. What are teachers' perceptions of digital learning tools in fragile contexts of Borno, Adamawa, and Yobe States?

Table 2: Teachers' Perception of Digital Learning Tools (N = 60)

S/N	Item	Mean	SD	Decision
1	Digital learning tools improve the effectiveness of classroom instruction.	3.78	0.81	Agree
2	Digital learning tools help sustain teaching during periods of school disruption.	3.70	0.87	Agree
3	Digital learning tools enhance students' participation and engagement in learning.	3.82	0.79	Agree
4	I am willing to integrate digital learning tools more frequently into my teaching activities.	3.65	0.65	Agree
Grand Mean		3.74	0.78	Agree

Quantitative Results. The results presented in Table 4.2 indicate that teachers in fragile contexts across Borno, Adamawa, and Yobe States have a positive perception of digital learning tools, as reflected by the grand mean score of 3.74. The highest-rated item was teachers' concur that digital tools enhances students participation and

engagement in learning ($M = 3.82$, $SD = 0.79$). Teachers also strongly agreed that digital learning tools help sustain teaching during periods of school disruption ($M = 3.70$, $SD = 0.78$). Furthermore, respondents agreed that digital learning improves instructional effectiveness ($M = 3.82$, $SD = 0.82$) and enhances student participation and engagement ($M = 3.70$, $SD = 0.78$). These findings suggest that teachers perceive digital learning as an effective and practical strategy for overcoming teaching challenges in fragile educational settings.

Qualitative Results. To explain the quantitative findings, semi-structured interviews were conducted with 12 teachers drawn from selected upper basic schools across the BAY States. Analysis of the interview data revealed three major themes.

Theme 1: Digital Learning Supports Teaching Continuity During Emergencies

Most teachers reported that digital learning tools enabled them to continue instructional activities during periods of insecurity, displacement, and temporary school closures. One teacher stated:

"During periods when schools were closed because of insecurity, digital resources allowed us to maintain contact with learners and continue lesson delivery."

Another participant noted:

"Digital learning has become a useful alternative whenever normal classroom teaching is interrupted."

Theme 2: Improved Classroom Interaction and Learning Outcomes

Teachers observed that students showed greater interest and participation when digital tools such as educational videos, tablets, and interactive learning applications were incorporated into lessons. One respondent explained:

"Students understand difficult concepts faster when visual materials and videos are used during teaching."

Another teacher remarked:

"Digital tools encourage active participation because learners become more interested in the lesson."

Theme 3: Need for Capacity Building and Infrastructure Support

Although teachers expressed positive perceptions of digital learning, they identified several barriers to effective implementation, including inadequate digital facilities, unstable electricity supply, poor internet connectivity, and insufficient training opportunities. A participant stated:

"Many teachers are willing to use digital tools, but regular training is needed to improve our digital skills."

Another teacher commented:

"The major challenge is inadequate infrastructure, especially electricity and internet access in rural communities."

Integration of Quantitative and Qualitative Findings. The qualitative findings corroborate the quantitative results by demonstrating that teachers view digital learning as a valuable tool for promoting teaching continuity, enhancing instructional effectiveness, and increasing student engagement in fragile contexts. Both data sources indicate strong teacher acceptance of digital learning technologies. However, the qualitative findings further reveal that successful implementation depends on adequate infrastructure, continuous teacher training, and institutional support.

Challenges of Digital Learning Implementation Quantitative Results

Research Question. What are the challenges associated with the use of digital learning tools in upper basic schools located in fragile contexts of Borno, Adamawa, and Yobe States?

Table 3: Teachers' Responses on Challenges of Digital Learning Tools (N = 60)

S/N	Item	Mean	SD	Decision
1	Inadequate electricity supply limits the effective use of digital learning tools.	3.65	1.05	Agree
2	Poor internet connectivity hinders the implementation of digital learning activities.	3.60	0.97	Agree
3	Insufficient digital devices and facilities affect the utilization of digital learning tools.	3.50	1.12	Agree
4	Limited teacher training and digital skills constrain the effective use of digital learning technologies.	3.30	1.01	Agree
Grand Mean		3.46	1.04	Agree

Quantitative Results. The results presented in Table 4.3 reveal that teachers strongly agree that several factors hinder the effective utilization of digital learning tools in fragile contexts across Borno, Adamawa, and Yobe States. The grand mean score of 3.46 indicates that the identified challenges are prevalent and significant. The highest-rated challenge was inadequate electricity supply ($M = 3.65$, $SD = 1.05$), followed by poor internet connectivity ($M = 3.60$, $SD = 1.12$). Teachers also agreed that insufficient digital devices and facilities ($M = 3.50$, $SD = 0.$) and limited teacher training and digital competencies ($M = 3.30$, $SD = 1.01$) adversely affect the implementation of digital learning. These findings suggest that infrastructural and capacity-related constraints remain major barriers to successful digital learning integration in fragile educational settings.

Qualitative Results. To further explain the quantitative findings, semi-structured interviews were conducted with teachers from selected upper basic schools in the BAY States. Analysis of the interview transcripts generated three major themes.

Theme 1: Inadequate Infrastructure and Power Supply

Most teachers identified unreliable electricity as the greatest obstacle to the effective use of digital learning tools. Participants reported frequent power outages, lack of alternative energy sources, and difficulties in charging devices. One participant stated:

"Most of our digital devices cannot be used regularly because electricity is not available for long periods."

Another teacher explained:

"Even when computers are available, power failure prevents effective utilization during lessons."

Theme 2: Poor Internet Connectivity and Limited Access to Technology

Teachers consistently highlighted poor network coverage and inadequate internet services as major challenges. They noted that many schools lack stable internet access, particularly in rural and conflict-affected communities. A participant remarked:

"Internet connectivity is very poor in our area, making it difficult to access online learning materials."

Another respondent stated:

"Many students do not have access to digital devices outside school, which limits continuity of learning."

Theme 3: Insufficient Training and Technical Support

Participants emphasized the need for regular professional development in digital literacy and instructional technology. Some teachers reported limited confidence in

using digital platforms due to inadequate training opportunities. One teacher commented:

"Many teachers need additional training to effectively integrate technology into classroom instruction."

Another participant observed:

"Technical support is rarely available when digital equipment develops faults."

Integration of Quantitative and Qualitative Findings. The qualitative findings support the quantitative results by providing detailed explanations of the challenges affecting digital learning implementation. While the survey data identified inadequate electricity, poor internet connectivity, lack of digital devices, and limited teacher competencies as major barriers, the interview findings revealed how these challenges directly affect classroom practice and learning continuity. Both data sources indicate that infrastructure deficiencies and insufficient capacity-building initiatives significantly constrain the effectiveness of digital learning in fragile contexts.

Overall Digital Learning Impact

Research Question. What is the impact of digital learning tools on students' engagement and understanding of lessons in relation to teachers' effectiveness in upper basic schools located in fragile contexts of Borno, Adamawa, and Yobe States?

Table 4: Teachers' and Students' Responses on the Impact of Digital Learning Tools (Teachers = 60; Students = 300)

S/N	Item	Teachers Mean (N=60)	Students Mean (N=300)	Grand Mean	Decision
1	Digital learning tools increase students' participation and engagement during lessons.	4.33	4.21	4.27	Agree
2	Digital learning tools improve students' understanding of difficult concepts.	4.40	4.18	4.29	Agree
3	Digital learning tools enhance teachers' effectiveness in lesson delivery.	4.37	4.12	4.25	Agree
4	The use of digital learning tools improves overall teaching and learning outcomes.	4.52	4.26	4.39	Agree

Overall Grand Mean		4.41	4.19	4.30	Agree
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Quantitative Results. The results presented in Table 4.5 indicate that both teachers and students perceive digital learning tools as having a positive impact on students' engagement, understanding of lessons, and teachers' effectiveness in fragile contexts across Borno, Adamawa, and Yobe States. The overall grand mean of 4.30 suggests a high level of agreement among respondents regarding the effectiveness of digital learning tools.

Teachers recorded a slightly higher overall mean score ($M = 4.41$) than students ($M = 4.19$), indicating that teachers perceived the impact of digital learning more strongly. The highest-rated item was the improvement of overall teaching and learning outcomes through digital learning tools (Grand Mean = 4.39). Respondents also agreed that digital learning enhances students' understanding of difficult concepts (Grand Mean = 4.29), increases student engagement during lessons (Grand Mean = 4.27), and improves teachers' effectiveness in lesson delivery (Grand Mean = 4.25).

These findings suggest that digital learning tools contribute significantly to improved classroom interaction, comprehension of lessons, and instructional effectiveness in fragile educational settings.

Qualitative Results. To explain the quantitative findings, interviews were conducted with 12 teachers, while focus group discussions were held with 48 students selected from upper basic schools across the BAY States. Analysis of the data revealed four major themes.

Theme 1: Increased Student Engagement and Participation

Both teachers and students reported that digital learning tools make lessons more interactive and interesting. Participants explained that educational videos, animations, and multimedia presentations capture students' attention and encourage active participation. One teacher stated:

"Students become more attentive and willing to participate whenever digital materials are used during lessons."

A student remarked:

"We enjoy lessons more when videos and pictures are used because they make learning exciting."

Theme 2: Improved Understanding of Lessons

Participants consistently indicated that digital learning tools simplify abstract and difficult concepts. Visual demonstrations and interactive content were reported to improve students' comprehension and retention of information. One teacher explained:

"Topics that are difficult to explain using traditional methods become easier when supported with digital resources."

Similarly, a student noted:

"I understand science and mathematics better when I watch demonstrations on the screen."

Theme 3: Enhanced Teacher Effectiveness

Teachers reported that digital learning tools improve lesson preparation, classroom management, and instructional delivery. The tools enable teachers to access additional teaching resources and present lessons more effectively. A participant stated:

"Digital resources help me organize lessons better and present information in a way students can easily understand."

Another teacher commented:

"Technology has improved my teaching methods and increased students' interest in learning."

Theme 4: Improved Overall Teaching and Learning Outcomes

Participants agreed that digital learning contributes to better learning experiences and educational continuity, particularly in fragile and conflict-affected environments. One teacher remarked:

"Digital learning helps maintain the quality of education even during disruptions caused by insecurity."

A student added:

"The lessons are clearer, and we learn faster when digital tools are used."

Integration of Quantitative and Qualitative Findings. The qualitative findings support the quantitative results by providing detailed explanations of how digital learning tools influence classroom practices. Both teachers and students acknowledged that digital learning increases student engagement, improves understanding of lessons, and enhances teacher effectiveness. The qualitative evidence further revealed that digital learning promotes active participation, facilitates comprehension of difficult concepts, and strengthens educational continuity in fragile contexts.

The convergence of findings from both data sources demonstrates that digital learning tools play a critical role in improving teaching and learning outcomes in upper basic schools across Borno, Adamawa, and Yobe States.

Gender Differences in Student Engagement

Research Question. Is there a gender difference in students' engagement with digital learning tools in upper basic schools located in fragile contexts of Borno, Adamawa, and Yobe States?

The study involved 300 students comprising 150 males and 150 females.

Table 5: Gender Difference in Students' Engagement with Digital Learning Tools

S/N	Item	Male Mean (n=150)	Female Mean (n=150)	Grand Mean	Decision
1	I actively participate in lessons when digital learning tools are used.	4.18	4.12	4.15	Agree
2	Digital learning tools motivate me to engage more in classroom activities.	4.25	4.20	4.23	Agree
3	I frequently interact with digital learning resources during lessons.	4.10	4.06	4.08	Agree
4	Digital learning tools encourage collaborative learning and class participation.	4.22	4.16	4.19	Agree
Overall Mean		4.19	4.14	4.17	Agree

Quantitative Results. The results presented in Table 4.6 indicate that both male and female students demonstrated high levels of engagement with digital learning tools. Male students recorded a mean score of 4.19, while female students recorded a mean score of 4.14. The overall mean score of 4.17 suggests that students generally perceived digital learning tools as enhancing their engagement in classroom activities.

The independent samples t-test further revealed no statistically significant difference between male and female students' engagement with digital learning tools ($t = 0.84$, $p = 0.401$, $p > 0.05$). This finding indicates that gender does not significantly influence students' engagement with digital learning technologies in fragile contexts of the BAY

States. Both male and female students benefited similarly from the use of digital learning tools.

Qualitative Results. To further explain the quantitative findings, focus group discussions were conducted with male and female students from selected upper basic schools across Borno, Adamawa, and Yobe States. Analysis of the discussions generated three major themes.

Theme 1: Equal Interest in Digital Learning Across Gender

Both male and female students expressed enthusiasm for digital learning tools and indicated that technology-enhanced lessons were more engaging than conventional classroom instruction. A male student stated:

"Digital lessons make learning enjoyable and encourage everyone to participate."

A female student similarly remarked:

"When videos and digital materials are used, I feel more interested and confident to contribute during class."

Theme 2: Digital Learning Increases Classroom Participation

Participants reported that digital learning tools create opportunities for active learning through visual demonstrations, educational games, and interactive activities. One participant explained:

"Students ask more questions and participate more when lessons include digital content."

Another student observed:

"Digital learning helps shy students participate because the activities are more interactive."

Theme 3: Similar Learning Experiences for Male and Female Students

Most participants believed that digital learning tools provide equal learning opportunities regardless of gender. Both male and female students reported comparable levels of access, interest, and participation during digitally supported lessons. A female participant stated:

"The technology is useful for everyone. Boys and girls participate equally when digital tools are available."

A male student added:

"There is no major difference because all students enjoy using the devices and learning materials."

Integration of Quantitative and Qualitative Findings. The qualitative findings support the quantitative results by demonstrating that both male and female students perceive digital learning tools positively and experience similar levels of engagement during classroom activities. While male students recorded slightly higher mean scores, the difference was minimal and statistically insignificant. The interview evidence further revealed that digital learning promotes inclusive participation and provides equal opportunities for engagement among students regardless of gender.

The convergence of both data sources suggests that digital learning tools foster equitable participation and engagement in fragile educational settings across the BAY States. Table 6 presents the results of the paired-samples t-test conducted to determine the impact of digital learning on students' understanding of lessons and engagement in learning activities among male and female students in fragile contexts of Northeast Nigeria.

Table 6: Pre- and Post-Digital Learning Scores

Variable	N	Mean (Pre)	Mean (Post)	Std. Deviation	t	df	p-value
Understanding of Lessons	300	2.95	3.65	0.91	12.34	299	0.000
Student Engagement	300	3.12	3.78	0.85	10.87	299	0.000

The results indicate a substantial improvement in students' understanding of lessons following exposure to digital learning tools. The mean score increased from 2.95 in the pre-intervention phase to 3.65 in the post-intervention phase, representing a mean gain of 0.70 points. The paired-samples t-test revealed a statistically significant difference between the pre-test and post-test scores ($t = 12.34$, $df = 299$, $p = 0.000$). Since the p-value is less than the 0.05 level of significance, the result indicates that digital learning

tools significantly improved students' understanding of lessons in fragile educational contexts. This improvement was observed among both male and female students, suggesting that digital learning enhanced comprehension of instructional content regardless of gender.

Similarly, the results show a significant increase in students' engagement in learning activities after the introduction of digital learning tools. The mean engagement score increased from 3.12 before the intervention to 3.78 after the intervention, yielding a mean gain of 0.66 points. The paired-samples t-test produced a t-value of 10.87 with 299 degrees of freedom and a p-value of 0.000. Since the p-value is less than 0.05, the difference is statistically significant. This finding demonstrates that digital learning tools positively influenced students' participation, interest, and involvement in classroom activities. Both male and female students reported higher levels of engagement following the integration of digital learning technologies.

Overall, the findings suggest that digital learning tools have a significant positive impact on both students' understanding of lessons and their engagement in learning activities in fragile contexts of Northeast Nigeria. The results imply that digital learning serves as an effective resilience strategy for improving educational outcomes in environments affected by insecurity, displacement, and other disruptions. The observed improvements among male and female students further indicate that digital learning provides inclusive learning opportunities capable of supporting educational continuity and enhancing learning experiences across gender groups.

Table 7: Summary of Statistical Decision

Variable	t-value	p-value	Decision
Understanding of Lessons	12.34	0.000	Significant Improvement
Student Engagement	10.87	0.000	Significant Improvement

Interpretation

The study concludes that the use of digital learning tools significantly improved both understanding of lessons and student engagement among male and female students in fragile contexts of Northeast Nigeria. Therefore, digital learning can be considered an effective educational intervention for enhancing learning outcomes and promoting resilience in conflict-affected and educationally disadvantaged settings.

Table 8 presents the relationship between teachers' frequency of digital learning tool usage and teaching effectiveness in upper basic schools located in fragile contexts of Northeast Nigeria. The result revealed a **positive and strong correlation** between the frequency of digital tool usage and teaching effectiveness ($r = 0.62, p < 0.01$).

Table 8: Correlation Between Teacher Usage and Teaching Effectiveness

Variables	Teaching Effectiveness
Frequency of Digital Tool Usage	$r = 0.62^{**}$

Note: $p < 0.01$. Strong positive correlation.

The correlation coefficient of **0.62** indicates a substantial positive relationship, suggesting that as teachers increase their use of digital learning tools, their effectiveness in lesson delivery, classroom management, instructional planning, and student assessment also improves. This means that teachers who frequently utilize digital technologies in their teaching tend to be more effective than those who use such tools less often.

The positive relationship further implies that digital learning tools provide teachers with opportunities to enhance instructional practices through the use of multimedia resources, interactive content, virtual learning platforms, and digital assessment methods. Consequently, increased integration of digital technologies contributes to improved teaching quality and better learning experiences for students.

Since the correlation is statistically significant at the **0.01 level**, the relationship is unlikely to have occurred by chance. Therefore, the study concludes that frequent use of digital learning tools is significantly associated with higher teaching effectiveness among teachers in fragile contexts of Northeast Nigeria.

The finding demonstrates that greater utilization of digital learning tools by teachers is linked to increased teaching effectiveness ($r = 0.62$, $p < 0.01$). This suggests that promoting the regular use of digital technologies through adequate infrastructure, training, and institutional support can enhance teachers' instructional performance and contribute to improved educational outcomes in fragile and conflict-affected settings.

Integrated (Triangulated) Findings of Quantitative and Qualitative Evidences

1. Digital learning improves student engagement and understanding (quantitative and qualitative).
2. Teaching effectiveness is enhanced through interactive lessons and increased teacher confidence.
3. Major barriers include infrastructure, device availability, internet connectivity, and teacher training.

Discussion

The findings of the study on *Digital Learning as a Resilience Strategy: Curbing Teaching and Learning Challenges in Upper Basic Schools in Fragile Contexts of Northeast Nigeria* reveal a complex but meaningful relationship between digital learning adoption and the

mitigation of educational disruptions in fragile settings. These findings align with, and in some cases extend, current empirical studies on digital education, resilience, and fragile learning environments.

Continuity during displacement

First, the study found that digital learning serves as a critical mechanism for ensuring continuity of teaching and learning in contexts characterized by insecurity, displacement, and infrastructural instability. This finding is consistent with broader evidence of (Trucano, 2016) that educational systems in fragile contexts often experience disruptions such as school closures, displacement of learners, and destruction of infrastructure, all of which undermine access to consistent learning opportunities. In Northeast Nigeria, where insecurity has led to intermittent school attendance and unsafe learning environments, digital platforms provide alternative pathways for instruction, thereby enhancing system resilience. This supports empirical perspectives that conceptualize digital resilience as the capacity of learners and systems to adapt and continue functioning effectively despite adversity.

Digital flexibility supports resilience

Furthermore, the study established that digital learning contributes to resilience by enabling flexible, remote, and self-paced learning opportunities. This is in line with findings from studies conducted during the COVID-19 pandemic, by (Siemens, 2005; UNESCO, 2017) which demonstrated that remote learning systems, including learning management systems and mobile-based platforms, allowed schools to maintain instructional delivery despite physical closures. In fragile regions such as Northeast Nigeria, this flexibility becomes even more significant, as it allows learners in internally displaced persons (IDP) camps or remote communities to continue their education without reliance on physical school infrastructure. The findings further revealed that respondents employed a range of flexible and adaptive digital practices to sustain teaching and learning in fragile contexts where insecurity, displacement, school closures, and infrastructural challenges frequently disrupted conventional education. Teachers and students relied heavily on readily available technologies, particularly smartphones and WhatsApp, to create virtual learning communities through which lesson notes, assignments, educational videos, voice recordings, and feedback were shared. Students completed assignments and submitted them electronically through WhatsApp groups, while teachers organized virtual discussions, voice calls, and group conferencing sessions to explain lessons and respond to learners' questions. In some schools, Moodle and other digital learning platforms were used to upload learning materials, quizzes, and recorded lessons that students could access at their convenience. Where internet connectivity was weak or unavailable, educational content was downloaded and stored on mobile devices, tablets, or computers for offline use. These practices demonstrate a high level of digital flexibility, as schools, teachers, and

learners creatively adapted available technologies to maintain learning continuity, facilitate communication, and overcome the constraints associated with fragile and conflict-affected environments.

Barriers exist

However, the findings also reveal that the effectiveness of digital learning as a resilience strategy is significantly constrained by infrastructural and socio-economic challenges. Key barriers identified include poor internet connectivity, unstable electricity supply, limited access to digital devices, and inadequate ICT infrastructure. These findings strongly corroborate existing empirical studies on e-learning in Nigeria, by (Baha 2025) which highlight similar constraints such as inadequate funding, shortage of technological facilities, poor internet services, and unstable power supply as major impediments to effective digital learning implementation. Additionally, research on rural and underserved communities by Magarate (2024) indicates that digital exclusion—caused by poverty, lack of devices, and limited digital literacy—significantly reduces students' ability to benefit from online learning opportunities.

Teacher may lack digital skills

Importantly, the study underscores the role of teacher capacity and digital competence as a critical factor influencing the success of digital learning initiatives. The findings show that teachers in upper basic schools often lack adequate training in the use of digital tools, which limits their ability to effectively deliver instruction through digital platforms. This observation is supported by empirical literature indicating that the success of online learning depends largely on teachers' digital skills, pedagogical strategies, and ability to adapt content for virtual environments. In fragile contexts, where teachers may already be overburdened or under-resourced, the lack of professional development opportunities further exacerbates this challenge.

Digital interventions must relate to the context

Another important finding relates to the socio-cultural and contextual dynamics that influence digital learning adoption. In Northeast Nigeria, factors such as poverty, gender norms, language barriers, and community perceptions of technology affect students' engagement with digital learning. For instance, resistance to female participation in digital training and limited parental support can hinder access and utilization, particularly for vulnerable groups. This aligns with evidence from digital skills programs in conflict-affected communities, which highlight cultural barriers, economic constraints, and security challenges as key factors affecting implementation and participation. These findings suggest that digital learning interventions must be context-sensitive and inclusive to achieve meaningful impact.

Digital adaptations can help

One of the innovative adaptation strategies identified in this study was the use of mobile-based digital learning platforms, particularly WhatsApp, to sustain teaching and learning activities during periods of insecurity, displacement, and school closures. Teachers and students reported forming WhatsApp groups through which instructional materials, assignments, class notes, and learning resources were shared. Students completed assignments at home and submitted them through the group platform, while teachers provided feedback, corrections, and additional explanations. In some cases, teachers organized virtual discussions and audio or video conferencing sessions to clarify difficult concepts and maintain regular interaction with learners. These practices enabled students to remain academically engaged despite disruptions to face-to-face instruction. The use of WhatsApp was particularly effective because it required relatively low internet bandwidth, was accessible on basic smartphones, and was already familiar to most teachers and students. Consequently, it emerged as a practical and cost-effective resilience strategy for ensuring learning continuity in fragile contexts.

The findings further revealed that some schools and learners complemented WhatsApp-based learning with offline and other digital learning tools, including Learning Management Systems such as Moodle. Through Moodle and similar platforms, teachers uploaded lesson materials, recorded lectures, quizzes, and assignments that students could access at their convenience. In communities with limited internet connectivity, educational content was often downloaded and stored on computers, tablets, or mobile devices for offline use. These adaptive innovations allowed students to continue learning even when network access was intermittent or unavailable. The integration of both online and offline digital tools demonstrates the creativity and resilience of schools, teachers, and learners in responding to educational challenges in fragile environments. By leveraging readily available technologies and adapting them to local realities, educational stakeholders were able to mitigate learning disruptions and promote continuous access to education despite the constraints imposed by conflict, displacement, and infrastructural limitations.

Build digital education systems

Moreover, the findings highlight the importance of collaborative and systemic support in strengthening digital learning as a resilience strategy. Government policies, donor interventions, and partnerships with non-governmental organizations play a crucial role in providing infrastructure, training, and resources for implementation. This aligns with broader empirical insights that emphasize the need for coordinated efforts and sustained investment in ICT infrastructure, teacher training, and policy implementation to enhance the effectiveness of digital education systems in developing contexts.

In summary, the study contributes to the growing body of literature by demonstrating that digital learning can serve as a viable resilience strategy for addressing teaching and learning challenges in fragile contexts such as Northeast Nigeria. While it offers significant potential for ensuring continuity, flexibility, and inclusivity in education, its effectiveness is highly dependent on addressing infrastructural deficits, enhancing teacher capacity, and adapting interventions to local socio-cultural realities. The findings therefore reinforce the notion that digital learning is not a standalone solution but part of a broader, context-driven approach to building resilient education systems capable of withstanding and adapting to ongoing disruptions.

The study demonstrates that digital learning significantly improves engagement, comprehension, and teaching effectiveness, confirming constructivist and TPACK frameworks (Mishra & Koehler, 2006; Piaget & Vygotsky). Offline, low-tech solutions are particularly relevant in fragile settings (Trucano, 2016). However, contextual factors such as insecurity, unreliable electricity, and limited devices moderate outcomes, highlighting the need for context-sensitive interventions (Siemens, 2005; UNESCO, 2017).

Limitations of the Study

This study was limited to selected upper basic schools in Borno, Adamawa, and Yobe States, which may affect the generalizability of the findings to other regions of Northeast Nigeria or different fragile contexts. In addition, the study relied on self-reported data obtained through questionnaires, interviews, and focus group discussions. As a result, participants' responses may have been influenced by personal perceptions, recall limitations, or social desirability bias.

The study also encountered challenges related to insecurity and accessibility in some conflict-affected communities. Security concerns, poor road networks, and movement restrictions limited access to certain schools and participants, thereby reducing the coverage of some highly vulnerable areas. Furthermore, variations in access to electricity, internet connectivity, and digital devices across schools may have influenced participants' experiences and perceptions of digital learning tools.

Another limitation is that the study focused primarily on students' and teachers' perceptions of digital learning rather than directly measuring long-term academic

achievement outcomes. Although the explanatory sequential mixed-methods design provided rich quantitative and qualitative data, time and resource constraints limited the number of stakeholders involved in the qualitative phase. Nevertheless, the study offers valuable insights into the role of digital learning as a resilience strategy for addressing teaching and learning challenges in fragile contexts of Northeast Nigeria.

Conclusion

Digital learning has proven to be a viable resilience strategy for sustaining teaching and learning in upper basic schools within the fragile contexts of Northeast Nigeria. By enabling continuity during disruptions caused by insecurity, displacement, and infrastructural limitations, digital tools help bridge gaps in access, enhance learner engagement, and support flexible instructional delivery. However, the effectiveness of this approach depends largely on addressing critical challenges such as limited digital infrastructure, inadequate teacher capacity, and unequal access to devices and connectivity. Strengthening policy support, investing in teacher training, and expanding inclusive digital access are therefore essential to maximizing its impact. When strategically implemented, digital learning not only mitigates immediate educational disruptions but also contributes to building a more adaptive, inclusive, and future-ready education system in the region.

Recommendations

1. Provide offline/low-tech digital tools (preloaded tablets, USB modules, radio-based instruction).
2. Train teachers in digital pedagogy and interactive strategies.
3. Prioritize equitable access in marginalized or conflict-affected areas.
4. Collaborate with NGOs and private sector for technical support.
5. Ensure all interventions are context-sensitive, inclusive, and sustainable.

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Appendices

1. SURVEY QUESTIONNAIRE

Digital Learning Resilience Questionnaire (DLRQ)

Introduction

Dear Respondent,

This questionnaire seeks to gather information on *The Role of Digital Learning in Overcoming Teaching and Learning Barriers in Fragile Contexts in Northeast Nigeria*. Your responses will be treated confidentially and used solely for research purposes.

Thank you

Researchers.

Response Format

Please indicate your level of agreement with each statement using the scale below:

Scale	Description
5	Strongly Agree (SA)
4	Agree (A)
3	Undecided (U)
2	Disagree (D)
1	Strongly Disagree (SD)

Section A: Demographic Information

1. Gender: ☐ Male ☐ Female
2. Age: ☐ 15–20 ☐ 21–30 ☐ 31–40 ☐ Above 40
3. Status: ☐ Student ☐ Teacher ☐ Administrator ☐ Parent ☐ Other
4. State: ☐ Adamawa ☐ Borno ☐ Yobe ☐ Other _____

Section B: Questionnaire Items

S/N	Statement	SA A U D SD
1	Digital learning has improved access to education in my community.	☐ ☐ ☐ ☐ ☐
2	Digital learning helps reduce disruptions caused by insecurity and conflict.	☐ ☐ ☐ ☐ ☐

S/N	Statement	SA	A	U	D	SD
3	Digital learning enables students to continue learning during school closures.	☐	☐	☐	☐	☐
4	Teachers effectively use digital technologies for teaching.	☐	☐	☐	☐	☐
5	Students have adequate access to digital learning devices.	☐	☐	☐	☐	☐
6	Internet connectivity supports digital learning activities in my area.	☐	☐	☐	☐	☐
7	Digital learning improves students' academic engagement and participation.	☐	☐	☐	☐	☐
8	Lack of electricity limits the effectiveness of digital learning.	☐	☐	☐	☐	☐
9	Digital learning helps bridge educational gaps among displaced learners.	☐	☐	☐	☐	☐
10	Government and development partners should invest more in digital learning initiatives.	☐	☐	☐	☐	☐

2. QUALITATIVE INTERVIEW PROTOCOL

Target Participants

- Teachers
- School Administrators
- Education Officers
- NGO Representatives
- Community Leaders

Interview Guide

1. What major teaching and learning barriers exist in your community?
2. How has insecurity affected access to education in this area?
3. What forms of digital learning are currently available to learners and teachers?
4. How are digital technologies being used to support teaching and learning?
5. In what ways has digital learning helped address educational disruptions?
6. What evidence have you observed regarding improvements in learning outcomes through digital learning?
7. What challenges affect the implementation of digital learning programmes?
8. How do factors such as electricity, internet connectivity, and device availability affect digital learning?
9. What support do teachers and learners require to effectively utilize digital learning tools?
10. What recommendations would you make for strengthening digital learning in fragile and conflict-affected communities?

Interview Probes

- Can you provide an example?
- Why do you think this occurred?
- How significant is this challenge?
- What solutions have worked best?

3. FOCUS GROUP DISCUSSION (FGD) GUIDE

Target Participants

Teachers
Parents
IDP Learners
Community Members

Introduction

The purpose of this discussion is to understand how digital learning is helping to overcome educational barriers in fragile contexts in Northeast Nigeria. There are no right or wrong answers. We encourage everyone to share their experiences.

FGD Questions

1. What are the major educational challenges facing learners in this community?
2. How have insecurity and displacement affected teaching and learning?
3. What digital learning tools or platforms are available in your community?
4. How often do learners and teachers use digital technologies for educational purposes?
5. What benefits have you experienced from digital learning?
6. How has digital learning helped during school closures or emergencies?
7. What difficulties do learners face when using digital learning technologies?
8. How do issues such as electricity, internet access, and affordability affect participation in digital learning?
9. What role should government, schools, and development partners play in supporting digital learning?
10. What practical strategies would improve the effectiveness and sustainability of digital learning in Northeast Nigeria?

OBSERVATION CHECKLIST FOR FGD SESSIONS

Observation Item	Yes	No
Participants are aware of digital learning opportunities.	☐	☐
Participants have experience using digital devices for learning.	☐	☐
Participants identify insecurity as a learning barrier.	☐	☐
Participants discuss benefits of digital learning.	☐	☐
Participants identify challenges to digital learning implementation.	☐	☐
Participants suggest realistic improvement strategies.	☐	☐