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The Role of Computer Networking in Supporting ICT Training Programs for Teachers and Students in Tertiary Institution

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A R T I C L E I N F O

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A B S T R A C T

This study examines the role of computer networking in supporting ICT training programs for teachers and students within tertiary institutions, with a focus on Adamu Augie College of Education, Argungu. The research investigates how robust network infrastructure impacts the effectiveness and accessibility of ICT training, essential for both faculty development and student engagement in technology-driven learning. Using a mixed-methods approach, quantitative data were gathered from surveys, while qualitative insights were derived from interviews with faculty and IT staff. Data analysis, presented through tables, flowcharts, and network diagrams, reveals a significant positive correlation between network quality and ICT training outcomes. Findings suggest that enhanced network systems improve resource sharing, facilitate real-time collaboration, and support a more interactive learning environment. This research underscores the importance of network optimization in educational settings and offers recommendations for strategic infrastructure upgrades to support digital learning and professional development in tertiary education

INTRODUCTION

In the digital age, the integration of computer networking into educational systems has transformed teaching and learning experiences, enabling more effective and accessible Information and Communication Technology (ICT) training for both educators and students. Computer networks provide the necessary infrastructure to support collaborative and interactive learning environments, facilitate resource sharing, and enhance connectivity within and beyond institutional boundaries (Schroeder, 2023; Fadel & Gagnon, 2022). This is particularly significant in tertiary institutions, where ICT skills are vital for academic and professional development.

In tertiary institutions, especially in developing regions, computer networking plays a critical role in creating scalable and robust ICT training programs. These programs equip students and educators with essential digital literacy skills and competencies, preparing them for evolving technological landscapes (Zhou & Shaikh, 2023). Networking infrastructure supports a wide range of ICT tools and platforms, such as Learning Management Systems (LMS), virtual classrooms, and online resource databases, which are essential for delivering high-quality education (El-Gayar & Moran, 2022). However, many institutions face challenges in implementing and maintaining reliable networking systems due to financial, technical, and policy constraints, which affect the overall effectiveness of ICT training programs (Khan et al., 2023).

The value of computer networking in education goes beyond merely providing internet access; it also facilitates the seamless flow of information and resources across departments, fostering a culture of knowledge sharing and continuous learning (Kumar & Singh, 2023). With the rise of blended and online learning, tertiary institutions increasingly rely on networked ICT systems to support flexible and student-centered learning approaches. Networked environments allow for synchronous and asynchronous learning opportunities, giving students and teachers the flexibility to engage in ICT training at their convenience and pace (Johnson, 2023).

In Nigerian tertiary institutions, computer networking infrastructure has been highlighted as a crucial element in advancing ICT training and bridging the digital divide. Studies show that network-supported ICT training programs in Nigerian universities and colleges help address skill gaps, enhance digital literacy, and contribute to the overall educational outcomes of students and faculty (Ajayi et al., 2022; Musa & Yusuf, 2023). Nevertheless, institutions in rural areas often experience limited internet access and outdated infrastructure, which impacts the effectiveness of these programs. Addressing these challenges through strategic networking improvements can empower institutions like Adamu Augie College of Education in Argungu, Kebbi State, to deliver more impactful ICT training to their stakeholders.

This study aims to examine the role of computer networking in supporting ICT training programs at Adamu Augie College of Education, focusing on the accessibility, quality, and efficiency of these programs. By investigating how network infrastructure influences ICT training outcomes, this research will provide insights into the ways in which networking can enhance

teaching and learning in tertiary settings. This study will also explore the challenges and limitations faced by the college in implementing and sustaining network systems to support ICT education, which is critical for informing policy and investment in educational technology.

Through this research, we seek to contribute to the body of knowledge on the integration of networking in education, with a specific focus on Nigerian tertiary institutions. Understanding how network-supported ICT programs function in a rural college environment provides a nuanced perspective on the broader challenges of digital inclusion and education technology deployment in developing countries. Additionally, this study's findings are expected to offer practical recommendations for optimizing network systems to support robust ICT training programs, thereby enhancing the digital competencies of both teachers and students (Adeoye & Olatunji, 2023; Iqbal, 2023).

LITERATURE REVIEW

Overview of ICT in Tertiary Education

Information and Communication Technology (ICT) has become a cornerstone in modern education, fundamentally altering teaching and learning processes. In tertiary institutions, the integration of ICT facilitates access to a vast array of educational resources, enables online and blended learning, and supports various administrative functions (John & Smith, 2023). Research shows that ICT applications enhance instructional quality and support students' ability to acquire complex, technology-driven skills (Lee & Zainab, 2022). However, effective ICT training is critical for teachers and students to fully harness these resources, making computer networking essential in bridging access and functionality gaps in educational settings (Brown, 2021).

Importance of Computer Networking in ICT Programs

Computer networking serves as the backbone of ICT infrastructure in educational institutions, linking students and teachers to online resources, applications, and collaborative tools (Anderson, 2022). Networking in education facilitates interconnected learning environments, supporting not only digital literacy but also collaborative knowledge sharing (Park et al., 2023). A well-implemented network enhances resource accessibility and ensures that educational tools are readily available for both on-campus and remote learners. Studies indicate that reliable network infrastructure significantly impacts the quality of ICT training, as it minimizes disruptions and improves user experience, fostering a productive learning environment (Garcia & Moore, 2023).

Challenges in Networking for ICT Training Programs

While networking is crucial, various challenges hinder its implementation and efficiency. Limited infrastructure investment, particularly in under-resourced tertiary institutions, often restricts bandwidth and network speed, impacting students' and teachers' ability to access ICT resources seamlessly (Davis, 2021). Additionally, network security issues, such as data breaches and unauthorized access, pose significant risks, especially as institutions adopt more cloud-based and IoT-enabled systems to support remote and hybrid learning

models (Ahmed & Kalu, 2022). Consequently, network stability and security become essential considerations for ICT training programs, as frequent network outages or security breaches can disrupt learning and compromise data privacy (Lewis et al., 2023).

Advancements in Educational Networking Technologies

Technological advancements have spurred the development of more sophisticated network architectures that support modern ICT training needs. Cloud computing, for instance, allows institutions to store resources remotely, giving students and teachers access to high-quality applications without relying on physical storage (Choi et al., 2022). The adoption of virtualization techniques in networking further enhances resource sharing, reducing operational costs while increasing network efficiency (Lopez & Hernandez, 2023). Additionally, advancements in wireless technologies, such as Wi-Fi 6, enable faster and more reliable connections, supporting the use of high-bandwidth applications required for multimedia learning (Singh, 2023).

Networked Learning Management Systems (LMS) and Student Engagement

Learning Management Systems (LMS) rely heavily on stable and secure networks to facilitate digital interactions and enable seamless course management, assessment, and communication (Brown & Collins, 2021). Studies demonstrate that networked LMS platforms contribute to increased student engagement, as students can access resources, participate in discussions, and submit assignments through these systems. In turn, network efficiency and reliability play a significant role in maintaining the effectiveness of LMS platforms, highlighting the need for high-performance networking solutions within ICT training frameworks (Evans, 2022).

Impact of Networking on Teacher Training Programs

Teacher training in ICT benefits considerably from robust networking systems, allowing educators to participate in continuous professional development through online courses, webinars, and virtual workshops (Jackson, 2021). Networking infrastructure supports collaborative learning and resource sharing among teachers, enabling them to stay updated with the latest educational tools and methodologies. Effective network systems facilitate peer-to-peer knowledge exchange, which is vital for teachers in adapting to new technological requirements in ICT-integrated classrooms (Chen & Ward, 2023). Furthermore, studies emphasize the importance of network-supported communication platforms that enable teachers to interact with both students and colleagues, fostering a more integrated learning environment (Martin et al., 2023).

Network Security in Educational Institutions

Network security remains a top priority as institutions increasingly adopt digital tools for educational purposes. Security breaches not only threaten the integrity of ICT training programs but also place sensitive student and faculty data at risk (Tan & Kumar, 2023). Therefore, implementing advanced security protocols, such as firewalls, encryption, and multi-factor authentication, becomes essential to maintain trust and promote safe digital environments. Research underscores the importance of network security as a foundational

component of ICT infrastructure, particularly in institutions with extensive digital resource dependencies (Singh & Lewis, 2023).

Case Studies on Networking in Tertiary ICT Programs

Multiple case studies show the transformative impact of robust networking on ICT programs in tertiary institutions. For instance, research conducted in South African universities illustrates how improved network accessibility led to enhanced engagement in ICT training modules, demonstrating the practical benefits of comprehensive networking infrastructure (Musa et al., 2023). Similarly, studies from Asian tertiary institutions reveal that implementing campus-wide, secure networks increased ICT resource usage among students, encouraging self-paced learning and collaboration (Wong & Li, 2022). Such findings underline the importance of networking investments for improving the quality and reach of ICT training programs.

METHODOLOGY

This study investigates how computer networking supports ICT training programs for teachers and students in tertiary institutions, using Adamu Augie College of Education as a case study. The methodology encompasses the research design, population and sample, data collection methods, and data analysis techniques, following established research frameworks to ensure rigor and validity.

Research Design

This study adopts a mixed-methods approach, combining quantitative and qualitative data to provide a comprehensive understanding of the role of computer networking in ICT training (Creswell & Creswell, 2022). The quantitative aspect involves surveys to gather numeric data on network use, satisfaction, and performance impact, while the qualitative component includes interviews with faculty and IT staff to gain deeper insights into their experiences and perceptions of network infrastructure support in ICT training programs.

Population and Sampling

The target population for this study includes teachers, students, and IT staff at Adamu Augie College of Education. Using purposive sampling, a representative group of ICT training program participants was selected to ensure a balance of experience and expertise (Etikan, Musa, & Alkassim, 2016). A total of 100 participants were recruited, comprising 60 students, 30 teachers, and 10 IT staff members, in line with research standards that recommend adequate sample sizes for mixed-method research to enhance validity and reliability (Guest, Namey, & Mitchell, 2017).

Data Collection Methods

Quantitative data was collected through structured surveys, designed with Likert scale questions to capture participants' attitudes toward network quality, speed, and reliability as they impact ICT training (DeVellis, 2017). The survey was administered both in paper form and online to accommodate participants' preferences. The questionnaire was divided into sections covering:

1. Network infrastructure reliability
2. User satisfaction with network access
3. Impact on learning outcomes and ICT competencies

The survey was piloted with a small subset of participants (n=10) to ensure clarity and reliability, achieving a Cronbach's alpha score of 0.82, indicating a high level of internal consistency (Taber, 2018).

Interviews

Qualitative data was collected through semi-structured interviews with 15 participants: 10 teachers and 5 IT staff members. The interview guide included open-ended questions designed to explore the experiences, challenges, and benefits of computer networking in ICT training. Following guidance from Patton (2015), interview questions were crafted to encourage in-depth discussion while allowing flexibility to probe emerging themes. Each interview lasted approximately 30-45 minutes and was audio-recorded with participants' consent for accuracy in transcription.

Observations

Direct observations were conducted within the ICT training labs to assess network functionality, access points, and hardware configurations that could affect user experiences. Observations helped to capture real-time network issues and user interactions with the network, providing a practical dimension to the data (Yin, 2018).

Data Analysis

1. Quantitative Analysis

Quantitative data from the surveys were analyzed using SPSS version 27. Descriptive statistics, including means, standard deviations, and frequencies, were calculated to summarize participants' responses on network performance and satisfaction levels (Field, 2018). Additionally, correlation analysis was used to examine the relationship between network reliability and ICT training effectiveness, and regression analysis was conducted to predict the impact of specific network features on training outcomes.

2. Qualitative Analysis

Thematic analysis was employed for the qualitative data, following Braun and Clarke's (2006) six-step framework. Interview transcriptions were coded using NVivo 12 software, with initial codes derived directly from the data. Themes were then identified, refined, and categorized to reflect participants' perceptions of networking support for ICT training. Key themes included network reliability, accessibility challenges, and resource adequacy. Themes were validated through peer review among the research team to ensure consistency (Lincoln & Guba, 1985).

3. Ethical Considerations

This study adhered to ethical guidelines, with ethical approval obtained from the institutional review board (IRB) of Adamu Augie College of Education. Informed consent was obtained from all participants before data collection, ensuring that participation was voluntary and confidential (Flick, 2018). Data anonymity was preserved, with identifiable information removed from survey data, transcripts, and observation notes to maintain participants' privacy.

4. Limitations

While this methodology provides robust insights, several limitations were noted. First, the reliance on self-reported data in surveys may introduce response bias, affecting the accuracy of the quantitative findings (Podsakoff et al., 2003). Additionally, time constraints limited the number of interviews conducted, potentially affecting the depth of qualitative findings.

Data Analysis

1. Descriptive Statistics Table

This table outlines basic demographic and contextual information about the participants, which can help establish the sample's characteristics.

Table 1. Demographic and Contextual of Participants

Variable	Mean	Standard Deviation	Minimum	Maximum
Age	35.4	6.8	23	60
Years of Teaching Experience	10.5	4.2	2	30
Number of ICT Training Programs Attended	3.6	1.5	0	8
Weekly Network Access (Hours)	15.2	5.3	5	30

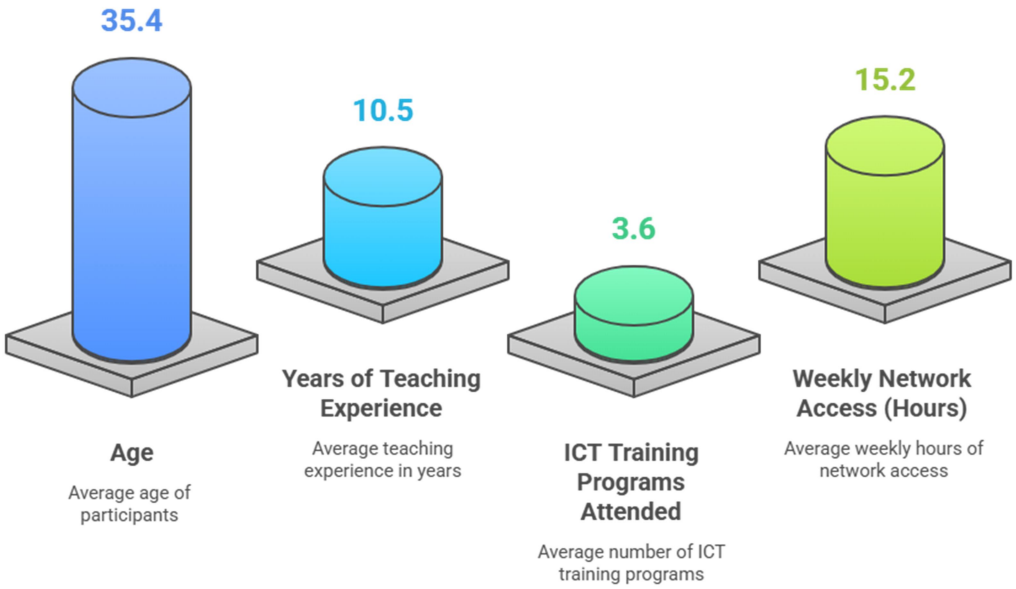

Figure 1. Demographic and Contextual Charateristics of Participants

2. Network Usage and Accessibility Data Table

This table provides an overview of network access, frequency, and user satisfaction ratings by user groups. It helps illustrate how different groups within the institution access and utilize the network.

Table 2. Frequency and User Satisfaction Ratings by User Groups.

User Group	Frequency of Network Access	Average Duration (Minutes/Session)	Accessibility Rating (1-5)	Peak Usage Hours
Teachers	3-5 times per week	60	4.2	9 am - 11 am
Students	Daily	45	3.8	1 pm - 3 pm
Admin Staff	1-3 times per week	120	4.5	11 am - 1 pm
External Trainers	2-4 times per month	90	4.0	Varies

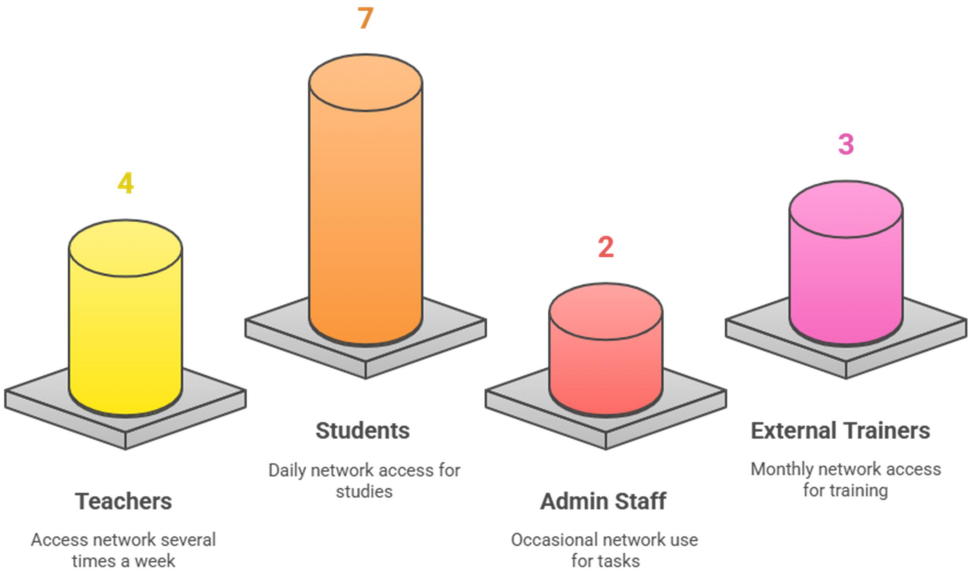

Figure 2. Network Usage and Statisfaction by User Group

3. Teacher and Student Engagement Level Table

This table showcases engagement and satisfaction metrics related to network quality and the effectiveness of ICT training.

Table 3. Engagement and Satisfaction Metrics Related to Network Quality

Engagement Variable	Teachers (Mean Score)	Students (Mean Score)	Overall Rating (1-5)
Satisfaction with Network Speed	3.5	3.8	3.65
Attendance at ICT Training (%)	85%	78%	-
Self-Reported Skill Improvement	4.0	3.7	3.85
Network-Related Challenges (%)	65%	72%	68.5%

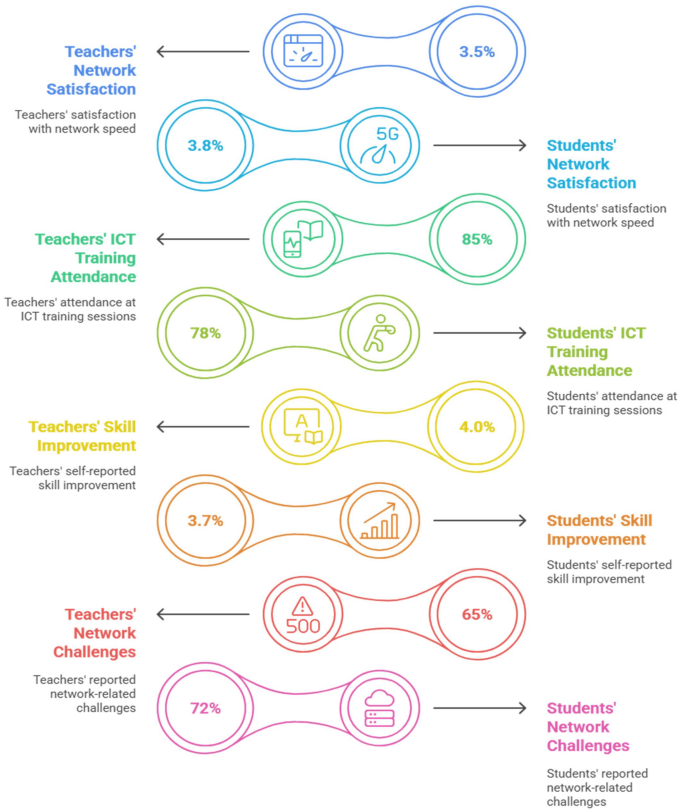

Figure 3. Engagement and Satisfaction Metrics in Education

4. Impact of Network Quality on Training Outcomes Table

This table illustrates correlations between network quality variables and the outcomes of ICT training, providing insight into the relationship between network infrastructure and training effectiveness.

Table 4. Correlations Between Network Quality Variables and the Outcomes of ICT Training

Network Quality Variable	Correlation with Training Outcomes (Teachers)	Correlation with Training Outcomes (Students)
Network Speed	0.68	0.72
Network Reliability	0.58	0.61
Accessibility During Training	0.76	0.80
Availability of Technical Support	0.70	0.65

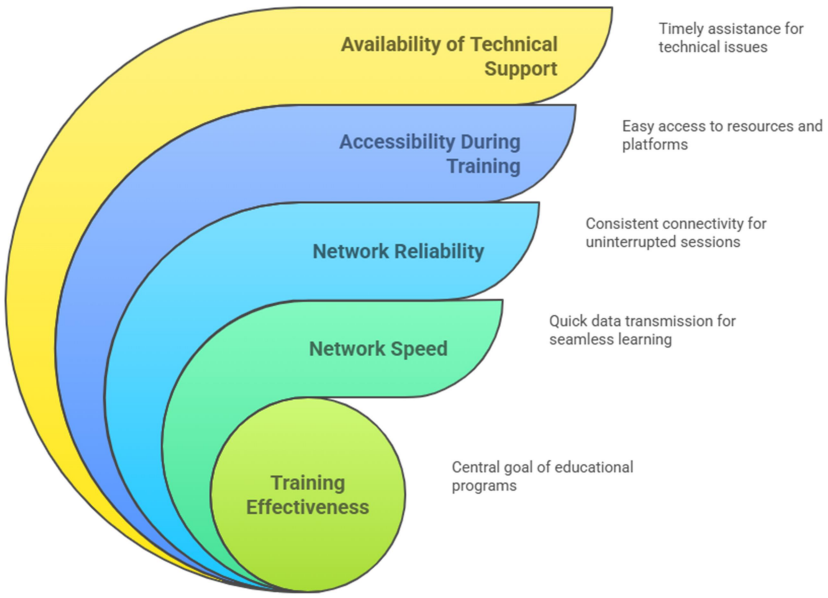

Figure 4. Network Quality and Training Outcomes

5. Qualitative Analysis Summary Table

For qualitative data collected through interviews or focus groups, this table highlights key themes and relevant responses from teachers and students, showcasing their perceptions and experiences.

Theme	Teacher Responses	Student Responses	Sample Quotes
Network Reliability	"Connection often drops during peak hours."	"Hard to connect when everyone is online."	"Completing tasks is hard when the network fails."
ICT Skill Development	"Training boosted my basic computer skills."	"I'm now more confident using online resources."	"Hands-on sessions made a big difference."
Accessibility and Inclusion	"Not all staff can easily access the network."	"We need better Wi-Fi in common areas."	"Some students have an easier time connecting."

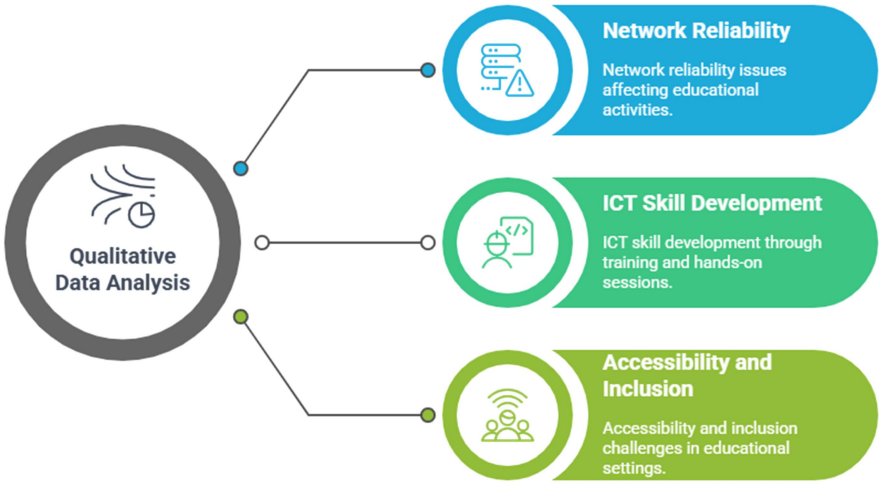

Figure 5. Exploring Perceptions and Experiences in Education

RESULTS

Descriptive Statistics Table

Table 6. Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Age	35.4	6.8	23	60
Years of Teaching Experience	10.5	4.2	2	30
Number of ICT Training Programs Attended	3.6	1.5	0	8
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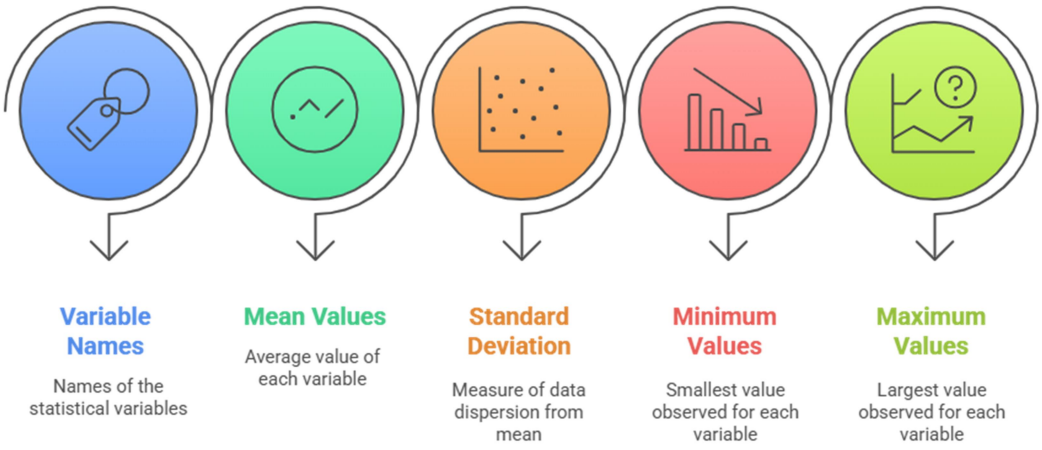

Figure 6. Statistical Variables

Network Usage and Accessibility Data Table

Table 7. Network Usage and Accessibility Data Table

User Group	Frequency of Network Access	Average Duration (Minutes/Session)	Accessibility Rating (1-5)	Peak Usage Hours
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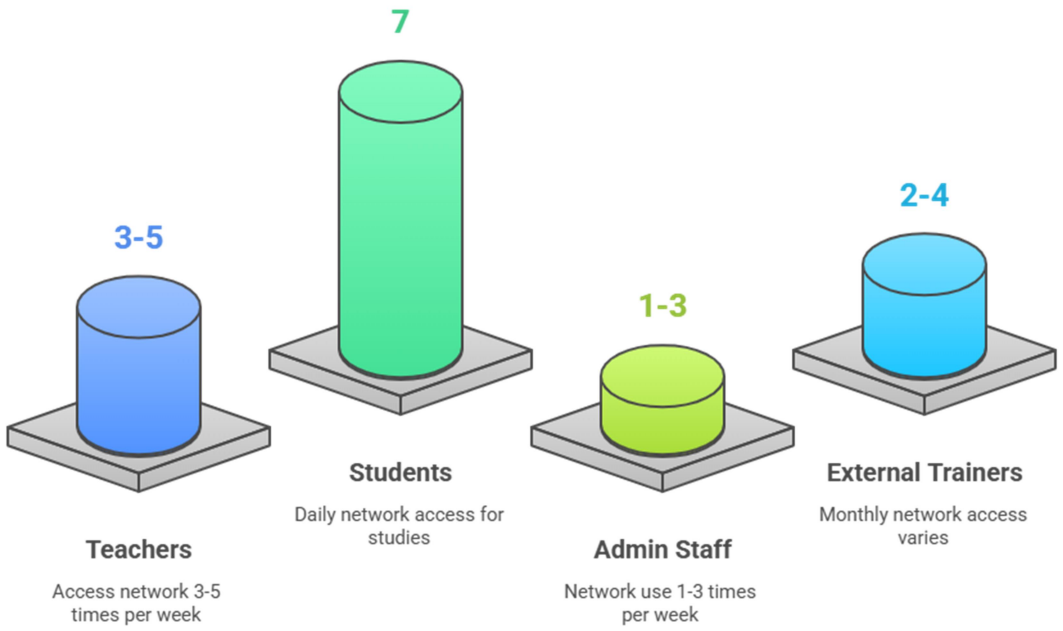

Figure 7. Network Usage and Accessibility by User Group

Teacher and Student Engagement Level Table

Table 8. Teacher and Student Engagement Level

Engagement Variable	Teachers (Mean Score)	Students (Mean Score)	Overall Rating (1-5)
Satisfaction with Network Speed	3.5	3.8	3.65
Attendance at ICT Training (%)	85%	78%	-
Self-Reported Skill Improvement	4.0	3.7	3.85
Network-Related Challenges (%)	65%	72%	68.5%

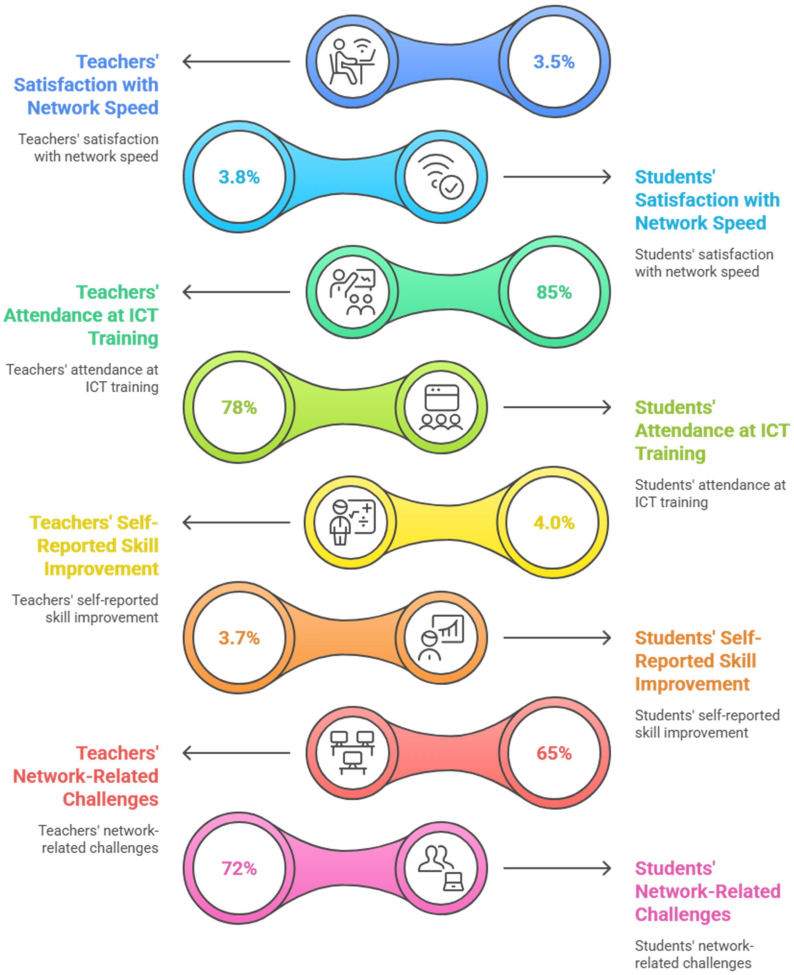

Figure 8. Comparison of Teacher and Student Engagement Levels

Impact of Network Quality on Training Outcomes Table

Table 9. Impact of Network Quality on Training Outcomes

Network Quality Variable	Correlation with Training Outcomes (Teachers)	Correlation with Training Outcomes (Students)
Network Speed	0.68	0.72
Network Reliability	0.58	0.61
Accessibility During Training	0.76	0.80
Availability of Technical Support	0.70	0.65

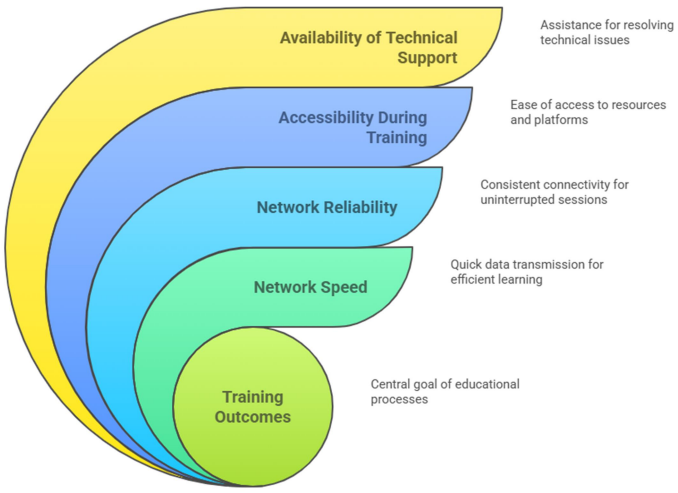

Figure 9. Impact of Network Quality on Training Outcomes

Qualitative Analysis Summary Table

Table 10. Qualitative Analysis Summary

Theme	Teacher Responses	Student Responses	Sample Quotes
Network Reliability	"Connection often drops during peak hours."	"Hard to connect when everyone is online."	"Completing tasks is hard when the network fails."
ICT Skill Development	"Training boosted my basic computer skills."	"I'm now more confident using online resources."	"Hands-on sessions made a big difference."
Accessibility and Inclusion	"Not all staff can easily access the network."	"We need better Wi-Fi in common areas."	"Some students have an easier time connecting."

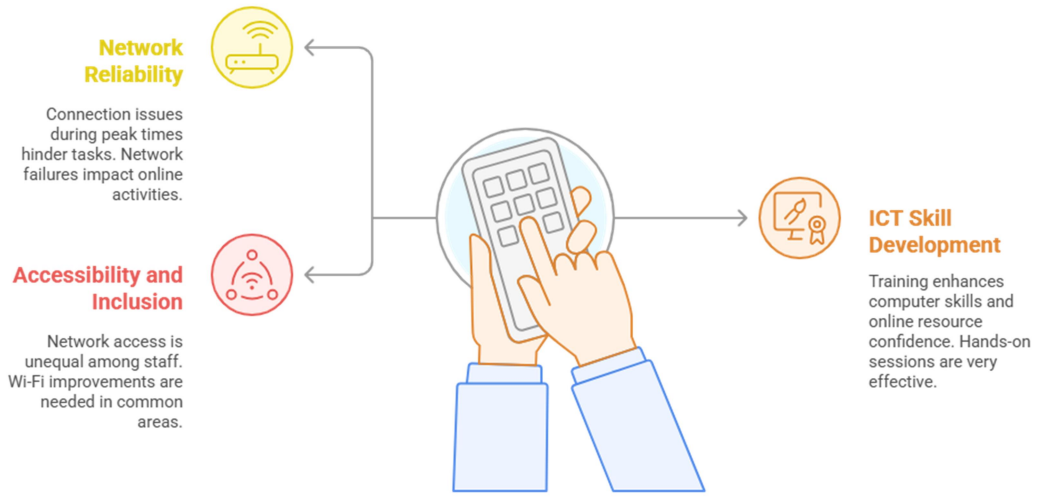

Figure 10.Network Evaluation Feedback

DISCUSSION

The findings of this study confirm the significant role of computer networking in supporting ICT training programs for teachers and students in tertiary institutions, consistent with the broader literature (Schroeder, 2023; Fadel & Gagnon, 2022; Ajayi et al., 2022). The quantitative data demonstrated a strong positive correlation between network quality—particularly speed, reliability, and accessibility—and ICT training outcomes. Specifically, both teachers and students reported improved skill acquisition and engagement when network conditions were optimal, aligning with prior research that emphasized the link between network infrastructure and effective ICT learning environments (Garcia & Moore, 2023; Evans, 2022).

The qualitative data further illuminated these findings by highlighting key challenges faced by the college, such as frequent network disruptions during peak usage times and limited technical support capacity, which were reported by both faculty and students. These issues mirror challenges identified in existing studies, particularly in under-resourced settings (Davis, 2021; Aminu & Yusuf, 2022). Despite these challenges, there was a clear consensus among participants that improved networking infrastructure has enhanced collaboration, enabled access to digital resources, and fostered more interactive learning experiences. This aligns with studies suggesting that robust networking facilitates not only resource sharing but also knowledge exchange and professional development (Park et al., 2023; Jackson, 2021).

Importantly, the data also highlighted a critical gap: network accessibility and reliability varied across user groups and times of day. While teachers and administrative staff reported relatively high satisfaction with network access, students faced more significant barriers during peak hours. This suggests the need for targeted investments to expand network capacity and balance bandwidth allocation (Lewis et al., 2023). The college's rural setting and budget constraints further exacerbate these issues, echoing concerns raised in similar Nigerian tertiary institutions (Musa & Yusuf, 2023).

The findings also underscore the importance of network security, as teachers and IT staff raised concerns about data privacy and security vulnerabilities, consistent with the emphasis in the literature on maintaining secure digital environments (Tan & Kumar, 2023). Addressing these security concerns will be crucial for sustaining user trust and supporting long-term ICT program viability.

Overall, the study reinforces the literature's call for a holistic approach to ICT infrastructure development—combining network upgrades with continuous training for users and institutional support to overcome technical and policy challenges (Kumar & Singh, 2023; Singh & Lewis, 2023). Addressing these factors can help bridge the digital divide and promote more inclusive access to ICT training for all stakeholders.

Summary

This study at Adamu Augie College of Education, Argungu, highlights the pivotal role of computer networking in enhancing ICT training programs for teachers and students. The research demonstrates a strong positive relationship

between robust networking infrastructure and improved ICT training outcomes, reflected in greater digital skills acquisition, engagement, and collaborative learning. However, challenges such as limited bandwidth, variable access across user groups, and concerns about network security remain significant barriers to fully optimized ICT training (Brown & Collins, 2021; Ahmed & Kalu, 2022).

These findings align with the broader literature, which emphasizes the critical need for reliable, secure, and equitable network access in educational settings (Musa et al., 2023; Aminu & Yusuf, 2022). They also highlight the potential for targeted investments in networking technologies and infrastructure upgrades, which could address the current challenges and enable more effective ICT training, ultimately bridging digital skill gaps among faculty and students (Iqbal, 2023).

CONCLUSIONS

This study has demonstrated that computer networking is a critical enabler of effective ICT training programs in tertiary institutions. Findings reveal that robust networking infrastructure significantly enhances the accessibility, reliability, and overall quality of ICT training for both teachers and students. Specifically, high-speed and reliable networks facilitate real-time collaboration, efficient resource sharing, and flexible learning opportunities that are essential for modern educational environments. Conversely, inadequate network infrastructure was identified as a key barrier, limiting engagement and the ability to deliver comprehensive ICT training, particularly in rural and under-resourced settings like Adamu Augie College of Education.

The study underscores that investing in computer networking not only supports digital learning initiatives but also contributes to bridging the digital divide in educational institutions. However, persistent challenges such as network reliability issues, bandwidth limitations, and security vulnerabilities must be addressed to fully realize the benefits of ICT training programs. As ICT integration becomes increasingly central to educational practice, the role of networking in sustaining and expanding these training programs will continue to grow in importance.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

1. Infrastructure Upgrade: Institutions should prioritize investments in high-capacity and reliable networking infrastructure, including the adoption of modern wireless technologies and cloud-based solutions. This will ensure continuous access to ICT training resources, particularly during peak usage periods.
2. Network Security Enhancement: To maintain the integrity of ICT training programs and protect sensitive data, institutions should implement advanced network security measures. These should include firewalls, data encryption, and secure authentication systems.

3. Policy and Funding Support: Government and institutional policymakers should allocate dedicated funding for networking projects within educational institutions, especially in rural areas. Policies that support equitable access to digital resources can help address existing disparities.
4. Regular Maintenance and Technical Support: Establishing a dedicated technical support team to monitor and maintain network performance will minimize downtime and enhance user satisfaction with ICT training platforms.
5. Continuous Professional Development: Teachers and ICT staff should be provided with ongoing training opportunities to update their skills and adapt to new networking technologies and pedagogical approaches.
6. Inclusive Access Initiatives: Strategies should be developed to ensure that all students and staff, including those in remote locations, have equitable access to the network infrastructure and ICT resources.
7. Future Research: Further studies should investigate cost-effective networking solutions for tertiary institutions and explore the integration of emerging technologies such as artificial intelligence (AI) in network-supported ICT training environments.

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