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Assessing User Experience and Quality of Service in 5G Multimedia Streaming Among University Students in Lagos State

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Abstract
As universities massively invest in advanced digital technologies, students on their own part need to navigate into solving challenging societal problems, thereby relying heavily on high-quality streaming for academic success, groundbreaking research, and other solution-based technologies. The study adopted a survey-type research design as the population of the study comprised all university students in Lagos State. Multi-stage sampling technique was employed in the selection of one thousand two hundred (1200) undergraduate students across the Faculties and Colleges from the four (4) Public Universities (University of Lagos, Akoka, Lagos State University, Ojo, Lagos State University of Technology, Ikorodu, and Lagos State University of Education, Ijanikin) in the state. An instrument titled, Assessment of 5G Multimedia Streaming and Quality of Service Delivery among University Students Questionnaire", (A5GMSQSDUSQ) was used to generate data. The 20-item closed-ended Questionnaire using 4-Likert scale response format of Strongly Agree, Agree, Disagree, and Strongly Disagree was adopted. Construct and face validity of the instrument was determined as a Split-half form of reliability value .779 was obtained on 50 Undergraduates from Ogun State University, Ago-Iwoye, not part of this study. With the use of LISREL statistical software, data were analysed using Analysis of Variance (ANOVA and Pearson Product-Moment Correlation as hypotheses were tested at a 0.05 level of significance. The findings revealed that the user experience of 5G multimedia streaming among university students is greatly determined by the quality of service (QoS) delivered by the 5G networks. It concluded that key QoS factors like latency, bandwidth, and continuity of network jointly influence clarity, smoothness, and continuity of students' streaming experience. It is recommended that Universities and network providers in the state should strengthen collaboration in order to improve 5G coverage, optimize bandwidth allocation on campuses, and ensure reliable, low-latency connectivity to support uninterrupted multimedia learning.

Keywords: User Experience, 5G Network, Multimedia Streaming, Quality of Service, University Students

Introduction

As Nigerian universities invest in advanced digital technologies, students would naturally rely heavily on high-quality streaming for academic success, as understanding these dynamics becomes critical in most tertiary institutions. The rapid expansion of digital learning environments and platforms in higher education has intensified the demand for fast, reliable, and high-quality mobile networks, particularly as multimedia content becomes central to teaching and learning. With the introduction of the long-awaited Fifth-Generation (5G) technology, many universities in Nigeria anticipate significant improvements in students' ability to interact with high-definition videos, interactive simulations, virtual classrooms, and real-time collaborative platforms. Understanding how students perceive and interact with 5G multimedia streaming is essential, especially as educational institutions continue to integrate more data-intensive digital tools into their curricula (Yuan et al.,2025).

For university students, multimedia streaming is no longer limited to entertainment; it has become a primary medium for academic engagement between teachers and students. Online lectures, video-based tutorials, virtual laboratories, webinars, and even augmented or virtual reality learning environments rely heavily on high-performance networks (Roshan, 2017). The quality of service (QoS) experienced on these networks directly affects how smoothly students

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can access and consume these materials. Poor QoS, manifesting as buffering, reduced video clarity, lag, or interruptions, can disrupt comprehension, reduce motivation, and hinder academic productivity. As such, evaluating the interplay between 5G QoS indicators and students' user experience is crucial for improving digital equity and enhancing learning outcomes (Zhang, 2020).

The adoption of 5G networks across Universities introduces new expectations regarding speed, efficiency, and overall streaming quality. In theory, the increased bandwidth offered by 5G supports higher definition media and seamless multitasking, while the reduced latency allows for instantaneous feedback in interactive platforms (Dangi, et al.,2021; Ning, et al.,2019). Yet, real-world conditions vary across institutions due to differences in infrastructure, coverage, and device compatibility. Some students may experience the full benefits of 5G, while others still struggle with inconsistent connectivity or outdated devices. This highlights the necessity of empirical studies that examine how well 5G networks deliver on their promises within the academic space.

Quality of Service (QoS) is a multi-dimensional concept involving network performance parameters such as latency, jitter, throughput, and reliability. These indicators determine not only technical efficiency but also the perceived quality of multimedia content. Low latency is critical for live-streamed lectures and synchronous discussions, while high throughput ensures smooth playback of high-resolution instructional videos (Daengsi, et al.,2023). Network reliability, measured through connection stability and minimal packet loss, is vital for preventing disruptions during assessments or collaborative projects. Understanding how these QoS elements influence user experience can help institutions identify possible areas in network performance and optimize digital learning ecosystems (Bouraqia, et al.,2019).

At the same time, user experience in multimedia streaming is shaped by subjective perceptions, expectations, and individual characteristics. Students' age, digital literacy, type of device used, and the specific university environment all influence how they interpret streaming quality. A student with a modern 5 G-enabled smartphone may rate their experience more positively than one using an older device, even under identical network conditions (García-Torres, et al.,2024). Likewise, institutions with better digital infrastructure and stronger partnerships with network providers may offer superior 5G performance and consequently better user experiences. This complexity underscores the importance of considering both technical and demographic factors when assessing the effectiveness of 5G networks (Gómez-Gaviria, 2024). Moreover, as higher education continues to rely on blended and fully online learning models, the pressure on mobile networks increases dramatically. Students often multitask between platforms, download or upload large files, and participate in video-intensive courses. If 5G networks fail to meet these demands, students may resort to less efficient alternatives, weakening the potential benefits of digital learning innovations (Ericsson, 2023; Osseiran,2016). Evaluating the relationship between QoS and user experience, therefore, provides important insights into how universities can optimize their digital learning strategies, improve academic participation, and enhance overall educational quality.

According to Atzori (2014) and Omar et al. (2024), the quality of service (QoS) delivered by network providers appears to vary significantly across locations, which may affect students' satisfaction, learning engagement, and digital participation. Many students rely on multimedia content for virtual lectures, collaborative projects, and research activities, making suboptimal QoS a potential barrier to academic productivity. Yet, there is limited empirical evidence that assesses how 5G streaming performance aligns with users' perceived experience in Lagos State's university environment. The lack of research that connects technical QoS indicators with students' subjective user experience creates a gap in understanding the true effectiveness of 5G technology in the educational context (Woo et al.,2024). As a result, a systematic assessment is needed to determine the extent of these challenges and their implications for effective digital learning and entertainment among university students.

In addition, Nightingale et al. (2018) stated that the network's reliability and capacity to handle multiple devices simultaneously are highly relevant for students in densely populated campuses. With 5G, multiple students can access online resources, conduct research, and engage in online assessments concurrently without network congestion. 5G enables the integration of smart campus initiatives, including IoT-enabled classrooms, digital libraries, and automated administrative services, streamlining academic processes and improving the overall student experience. By leveraging these technologies, students can optimize time management, access personalized learning paths, and improve academic performance (Osseiran, 2016).

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Statement of the problem

The expansion and migration to 5G networks in Nigeria have created new expectations for seamless multimedia streaming among university students, especially among those who rely totally on digital content for virtual lectures, collaborative projects, and research activity for academic productivity and entertainment purposes, thereby making suboptimal QoS a potential barrier to academic productivity. Despite the established advantages of 5G which includes ultra-low latency, higher bandwidth and improved connection density, there is a growing concern that end-user experiences do consistently reflect promised capabilities as there is a growing myriad of challenge ranging from public misinformation and social resistance, right of way, planning and site sharing hurdles, erratic power supply, unavailable Fibre availability, Spectrum allocation and regulatory delays, Cyber-security issues, Privacy and local skills, rural-urban divide, device ecosystem and affordability, fluctuating streaming quality, slow buffering and inconsistent connectivity across different campuses and device compatibility issues. Failure to address these challenges may lead to general resistance to installation, poor service delivery, and the development of a negative attitude towards the use of 5G in schools. However, this and many more raise critical questions about the reliability, accessibility, and efficiency of 5G streaming services among university students. As a result, the researcher was motivated to investigate the User Experience of 5G Multimedia Streaming and Quality of Service among University Students in Lagos State.

Aim and objectives of the study

The study aimed to explore the User Experience of 5G Multimedia Streaming and Quality of Service among University Students in Lagos State; meanwhile, the objectives were to:

- Determine the relationship between 5G quality of service indicators like latency, bandwidth, network reliability, and students' user experience.
- Examine whether demographic factors like age, institution, and device type influence user experience with 5G multimedia streaming among University students.
- Assess the overall user experience of university students in Lagos State when using 5G networks for multimedia streaming.

Hypotheses

Three null hypotheses were formulated and tested at .05 level of significance

H_1: There is no significant relationship between 5G Quality of service indicators (latency, bandwidth, network reliability) and students' user experience.

H_{02}: There is no significant influence of demographic factors (age, institution and device type) on user experience with 5G multimedia streaming among University students.

H_{03}: There is no significant difference in the overall user experience using 5G networks for multimedia streaming.

Methodology

The study adopted a **s**urvey type of research design. This design type allows for the generation of data from a larger group of participants in order to have a robust database. The population of the study comprised all university students in tertiary institutions in Lagos State. Multi-stage sampling technique was employed in the selection of one thousand two hundred (1200) undergraduate students across the Faculties and Colleges from the four (4) public tertiary institutions (University of Lagos, Lagos State University, Ojo, Lagos State University of Technology, Ikorodu and Lagos State University of Education, Ijanikin) in the state. An instrument titled, Assessment of 5G Multimedia Streaming and Quality of Service Delivery among University Students Questionnaire", (A5GMSQSDUSQ) was used to generate data. The 20-item closed-ended Questionnaire is designed using 4-Likert scale response format of Strongly Agree, Agree, Disagree and Strongly Disagree. Construct and face validity of the instrument was determined as a Split-half form of reliability value of .779 was obtained on 50 Undergraduates from Ogun State University, Ago-Iwoye, not part of this study. With the use of LISREL statistical software, data were analysed using Analysis of Variance (ANOVA and Pearson Product-Moment Correlation and tested at the 0.05 level of significance.

Results

H_{01}: There is no significant relationship between 5G Quality of service indicators (latency, bandwidth, network reliability) and students' user experience.

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Table 1: Correlation between 5G Quality of service indicators (latency, bandwidth, network reliability) and students' user experience

Variables	N	r	sig.(2-tailed)	Decision
5G Quality of Service Indicators	1200	.805	.001	Significant
User experience				

$\alpha = 0.05$

Data in Table 1 reveals that with r- r-value of .805, there exists a strong relationship between 5G quality of service indicators (latency, bandwidth, network reliability) and students' user experience. At a *p*-value of .001 and alpha value of .05 ($p<.05$), the null hypothesis is rejected, and the alternative, which states that there is a significant relationship between 5G quality of service indicators (latency, bandwidth, network reliability) and students' user experience, is retained.

H_{02}: There is no significant influence of demographic factors (age, institution, and device type) on user experience with 5G multimedia streaming among University students.

Table 2: ANOVA showing influence of demographic factors (age, institution and device type) on user experience with 5G multimedia streaming among University students

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	198.404	2	99.202		
Within Groups	24,566.002	1198	20.506	4.838	.000
Total	24,764.406	1200			

Source: Researchers work (2025)

The ANOVA result in Table 2 shows that the calculated F-value is 4.838 with a significance value (p) of .000 ($p<.000$). Since the p-value is greater than the 0.05 level of significance, the result indicates that there is a significant influence of demographic factors (age, institution and device type) on user experience with 5G multimedia streaming among University students is retained.

H_{03}: There is no significant difference in the overall user experience using 5G networks for multimedia streaming.

Table 4: ANOVA showing difference in the overall user experience using 5G networks for multimedia streaming

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	240.240	2	120.120		
Within Groups	30049.556	1198	25.083	4.789	.003
Total	30289.796	1200			

Source: Researchers' work (2025)

The ANOVA result in Table 3 shows that the calculated F-value is 4.789 with a significance value (p) of 0.531 ($p<.003$). Since the p-value is greater than 0.05, the result indicates that there is no significant difference in the overall user experience when using 5G networks for multimedia streaming.

Discussion

Hypothesis 1 revealed a significant relationship between 5G quality-of-service indicators and students' user experience. The findings align that 5G Quality of Service (QoS) indicators like latency, available bandwidth, and network reliability show a relationship with students perceived user experience when consuming multimedia content. The use of 5G lower latency for streaming, stable bandwidth reduces rebuffering and allows higher-bitrate playback, while greater reliability preserves continuity and responsiveness, all of which translate into higher Quality of Experience (QoE) scores and better engagement among end users. The finding of this study corroborates that of Khan et al. (2024) that lower-layer 5G metrics (signal quality, handover events) correlate with application-level QoE for low-latency video streaming, indicating that latency and mobility-related reliability issues materially degrade student experience during live or interactive lessons. Khan et al (2024) emphasized that improving effective bandwidth utilization and reducing bitrate switches or rebuffering noticeably raises QoE, which supports the interpretation that students' satisfaction and continued engagement are sensitive to bandwidth variability. Students at every opportunity

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are prone to experience fast and reliable online service, especially when the quality of 5G is well sychronised (Woo, et al, 2024).

Results from hypothesis two reveal that demographic factors influence user experience with 5G multimedia streaming among university students. The findings indicate that age, device capability, and institution influence end-user experience of 5G-based multimedia streaming among university students. This outcome aligns with a study by Gómez-Gaviria (2024) that younger students exhibit greater sensitivity to streaming quality impairments, requiring tighter constraints on buffering and rebuffering to maintain satisfaction, a pattern consistent with age group. Device type also plays a critical moderating role even on the same high-quality network, as older or less powerful smartphones experience longer startup times, lower frame rates or increased stalling, thereby degrading perceived QoE. On nature of the institution or campus, the nature of the bandwidth located in citadels of knowledge, also influences users' experience. Institutions that invest in IT is likely to operate 5G/wifi architecture, which facilitates local load and edge resources and, in the long run, modulates experienced latency, jitter, and reliability such that students experience a hitch-free technology and promote user-friendly services. Furthermore, Bouraqia et al., (2019) and Roshan (2017) also claimed that demographic variables underscore that improving 5G multimedia experience for students requires more than optimizing network QoS. They emphasized that attention to device heterogeneity and user experience be addressed to ensure equitable and high-quality streaming experiences.

The result from hypothesis three revealed that there is a significant difference in the overall user experiences using 5G network for multimedia streaming among students. The use of 5G networks delivers measurably better end-user outcomes compared to earlier cellular generations. The outcome of this study confirms to studies by Ning et al. (2019), Shafi (2017), and Zhang (2020). According to Shafi (2017) 5G network provides ultra-fast internet speeds and low latency, which allows students to stream high-quality multimedia content, participate in real-time online lectures, and access digital learning resources without interruptions. This is particularly crucial for students engaging in remote learning, virtual labs, and interactive simulations, where delays or buffering can hinder comprehension and engagement. Zhang (2020) stated that the use of 5G supports advanced educational technologies such as augmented reality (AR), virtual reality (VR), and artificial intelligence (AI)-driven learning platforms. These tools offer immersive learning experiences, enabling students to visualize complex concepts, conduct virtual experiments, and collaborate on projects in real time, thus enhancing understanding and retention. while Ning (2019) noted that 5G facilitates seamless communication and collaboration among students and educators through high-quality video conferencing, cloud-based document sharing, and instant messaging platforms. This connectivity encourages teamwork, peer-to-peer learning, and interaction with global experts, broadening educational opportunities beyond the traditional classroom.

Conclusion

The findings made in this study indicate that the user experience of 5G multimedia streaming among university students is greatly determined by the quality of service (QoS) delivered by the 5G network. Also, key QoS factors like latency, bandwidth, and continuity of students' streaming activities jointly influence clarity, smoothness, and continuity of students' streaming, underscoring the central role of network performance in shaping engagement and satisfaction

Recommendations

From the conclusion made above, the study recommended, among others, the following:

1. Universities and network providers in Lagos State should strengthen collaboration to improve 5G coverage, optimize bandwidth allocation on campuses, and ensure reliable, low-latency connectivity to support uninterrupted multimedia learning.
2. Institutions should invest in upgrading digital infrastructure and encourage the adoption of 5G-compatible devices, possibly through subsidy programs or device loan initiatives for students who cannot afford newer technology.
3. Network operators should continuously monitor QoS indicators and apply adaptive strategies like edge computing and intelligent traffic management to maintain stable streaming performance during peak academic hours.
4. Academic staff and educational technologists should design multimedia content that leverages 5G network capabilities, incorporating interactive, high-resolution media while offering lower-bandwidth alternatives for inclusivity.

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