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INTEGRATING STARLINK-POWERED FREE INTERNET WITH EDUCATIONAL APPLICATIONS TO ENHANCE DIGITAL LEARNING OUTCOMES AMONG NIGERIAN STUDENTS: A CASE STUDY OF FEDERAL COLLEGE OF EDUCATION (TECHNICAL), OMOKU

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Abstract
This study examined the potential of integrating free Starlink-powered internet access with educational applications to enhance digital learning outcomes among students at the Federal College of Education (Technical), Omoku, Rivers State, Nigeria. Adopting a descriptive survey design, data were collected from 86 randomly selected students using a 24-item structured online questionnaire administered between June and July 2026. Data were analysed using descriptive statistics (frequencies, percentages, means, standard deviations), Cronbach's alpha, Spearman's correlation, multiple linear regression, and chi-square tests of association. Results showed that while 100% of respondents had smartphone access, only 34.9% also had laptops, and 91.9% relied on mobile data as their primary internet source. Although 82.6% of students were already aware of Starlink, willingness to adopt it for academic purposes was exceptionally high (95.3%). A four-item perceived-impact/acceptance composite showed acceptable internal consistency ($\alpha = .63$). Willingness to use Starlink was the strongest predictor of perceived academic-performance benefit ($B = 0.46$, $p < .001$) in a regression model that explained 19.0% of variance ($R^2 = .190$, $p < .001$), and was significantly associated with level of study ($\chi^2 = 16.45$, $p = .012$). The study concludes that Starlink-powered free internet, if integrated with educational applications, holds strong potential to bridge connectivity gaps and improve digital learning outcomes in Nigerian tertiary institutions, and recommends institutional adoption alongside digital-literacy and device-access support.

Keywords: ***Starlink; satellite internet; digital learning outcomes; educational applications.***

1.0 Introduction
1.1 Background of the Study
Reliable internet access has become a foundational requirement for effective teaching and learning in the twenty-first century, enabling students to access digital libraries, learning management systems, and collaborative platforms that extend learning beyond the physical classroom. In Nigeria, however, tertiary institutions continue to grapple with inconsistent and costly internet connectivity, which limits the extent to which digital tools can be meaningfully integrated into instruction (Muraina et al., 2025). Colleges of education, many of which are located outside major urban centres, are particularly exposed to this infrastructural gap (Hassan, 2025).
Starlink, a low-Earth-orbit (LEO) satellite internet service operated by SpaceX, has recently emerged as a possible solution to Nigeria's connectivity challenges. Unlike terrestrial fibre or mobile networks that depend on extensive ground infrastructure, Starlink delivers broadband-grade internet directly to a compact user terminal, making it attractive for underserved and infrastructure-poor locations. Across Africa, education-focused Starlink deployments have already connected tens of thousands of students in Kenya through the CEMASTEA/Grow X Education partnership, and similar school-connectivity programmes are expanding through providers such as Paratus EduLINK in several other African countries. These developments signal a growing continental momentum toward using satellite connectivity to close educational digital divides. This study investigates whether such an

approach — Starlink-powered free internet integrated with educational applications — could similarly enhance digital learning outcomes at the Federal College of Education (Technical), Omoku.

1.2 Statement of the Problem

Despite growing recognition of the role of internet access in academic success, students at many Nigerian colleges of education continue to rely almost exclusively on costly mobile data, with limited access to laptops, campus Wi-Fi, or subsidised institutional bandwidth. This constrains their ability to use educational applications such as Google Classroom, e-library platforms, and video-conferencing tools that increasingly underpin modern instruction (Eze et al., 2020). While Starlink has attracted considerable public attention as a possible solution, there is limited empirical evidence — particularly from Nigerian colleges of education — on students' awareness of, willingness to adopt, and expected benefit from Starlink-powered internet for learning. This study addresses that gap by empirically assessing these factors among students of Federal College of Education (Technical), Omoku.

1.3 Objectives of the Study

The specific objectives of this study are to:

1. determine the level of access to digital devices and internet among students of FCE(T) Omoku;
2. assess the internet-related challenges experienced by students in their digital learning activities;
3. examine the extent of students' use of digital learning applications and their perceived effectiveness;
4. assess students' awareness of and perception towards Starlink-powered internet;
5. determine students' willingness to adopt Starlink-powered free internet for academic purposes; and
6. examine the relationship between internet accessibility/Starlink adoption willingness and digital learning outcomes (academic performance and understanding).

1.4 Research Questions

1. What is the level of access to digital devices and internet among students of FCE(T) Omoku?
2. What internet-related challenges do students encounter in their digital learning activities?
3. To what extent do students use digital learning applications, and how effective do they perceive them to be?
4. What is the level of students' awareness of and perception towards Starlink-powered internet?
5. How willing are students to adopt Starlink-powered free internet for academic purposes?
6. What is the relationship between internet accessibility/Starlink adoption willingness and digital learning outcomes?

1.5 Research Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

H01: There is no statistically significant relationship between internet quality/willingness to adopt Starlink and students' perceived academic-performance benefit.

H02: There is no statistically significant association between gender and willingness to adopt Starlink-powered internet.

H03: There is no statistically significant association between level of study and willingness to adopt Starlink-powered internet.

1.6 Significance of the Study
The findings of this study will be of value to institutional policymakers considering satellite-internet partnerships, to educational-technology providers designing applications for low-connectivity contexts, and to researchers seeking baseline empirical data on Starlink adoption readiness within Nigerian tertiary education. The study also contributes to the broader literature on bridging the digital divide in developing-country higher education.

1.7 Scope of the Study
The study is delimited to 86 students of the Federal College of Education (Technical), Omoku, Rivers State, and focuses specifically on internet access, digital-application usage, and Starlink awareness/adoption willingness as they relate to self-reported digital learning outcomes. It does not measure objective academic performance (e.g., examination scores) but relies on students' self-reported perceptions.

2.0 Literature Review
2.1 Conceptual Review
2.1.1 Digital Learning Outcomes
Digital learning outcomes refer to the measurable and perceived gains in students' knowledge, understanding, and academic performance that result from the use of internet-enabled tools and educational applications. These outcomes are shaped jointly by access (devices and connectivity), usage patterns, and the perceived quality of the digital tools employed (Adeoye & Adeoye, 2017).

2.1.2 Starlink-Powered Internet
Starlink is a satellite internet constellation that delivers broadband connectivity via low-Earth-orbit satellites, bypassing the need for terrestrial fibre or cell-tower infrastructure. Its capacity to reach remote and underserved areas has made it a focal point of several African education-connectivity initiatives, including a Kenyan deployment connecting over 32,000 students across 30 schools, and the multi-country Paratus EduLINK programme spanning several sub-Saharan African nations. In South Africa, Starlink has proposed connecting thousands of rural schools with free high-speed internet as part of broader market-access negotiations, underscoring the scale at which satellite connectivity is being considered as an educational-equity intervention on the continent.

2.2 Theoretical Framework
This study is anchored on the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2), proposed by Venkatesh, Thong, and Xu (2012) as a consumer-context extension of the original UTAUT. UTAUT2 explains behavioural intention and technology use through seven constructs: performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit, moderated by age, gender, and experience. The model is particularly well suited to this study for two reasons. First, its price value construct — defined as users' trade-off between perceived benefits and monetary cost — maps directly onto the central premise of this study, since Starlink is being considered specifically as a free, cost-removed intervention; UTAUT2 predicts that removing cost as a barrier should substantially raise adoption intention where perceived benefit is already high, exactly the pattern observed among respondents. Second, its facilitating conditions construct (the extent to which infrastructure and resources are believed to support technology use) directly parallels this study's device-access and connectivity findings, while habit captures respondents' existing, largely mobile-data-based, patterns of internet use.
Within this framework, students' willingness to adopt Starlink-powered internet is treated as a behavioural-intention outcome shaped jointly by performance expectancy (perceived benefit for academic performance and understanding), facilitating conditions (existing device and connectivity infrastructure), and price value (the removal of cost through free provision). UTAUT2 has

demonstrated stronger explanatory power than earlier acceptance models in consumer-technology contexts and has been applied in recent Nigerian e-learning research alongside TAM to explain adoption behaviour (Muraina et al., 2025), supporting its relevance to the present study of a still-emerging, consumer-facing connectivity technology.

2.3 Empirical Review

Several Nigerian studies have documented the infrastructural barriers confronting digital learning. Hassan (2025), studying college-of-education students in South-Western Nigeria, found that computer ownership was low and that internet access remained costly, though most students who did gain access reported favourable impacts on their learning. Similarly, Eze et al. (2020) reported that unreliable connectivity and epileptic power supply remained the dominant obstacles to e-learning delivery across Nigerian tertiary institutions. Muraina et al. (2025) found that only about a fifth of Nigerian undergraduates reported consistent digital access, while perceived usefulness and perceived ease of use were both significant positive correlates of e-learning adoption attitudes. Outside Nigeria, satellite-internet-in-education programmes such as Starlink's Kenyan school-connectivity partnership and the Paratus EduLINK initiative provide preliminary evidence that satellite broadband can materially expand access to online teaching materials and virtual learning resources in previously unconnected schools, though rigorous outcome evaluations of these programmes remain limited to date.

2.4 Gap in Literature

While prior Nigerian studies have extensively documented connectivity barriers and general e-learning adoption factors, few have specifically examined student readiness to adopt satellite-based internet solutions such as Starlink, and none, to the researcher's knowledge, has done so within a Federal College of Education (Technical) in Nigeria's South-South region. This study addresses that gap.

3.0 Methodology

3.1 Research Design

The study adopted a descriptive survey research design, considered appropriate for capturing the current status of students' internet access, digital-application usage, and attitudes toward Starlink adoption at a single point in time.

3.2 Population and Sample

The population comprised students of the Federal College of Education (Technical), Omoku. A sample of 86 students was drawn and completed a self-administered online questionnaire distributed via Google Forms between 11 June and 7 July 2026, using convenience sampling across departments and levels of study.

3.3 Research Instrument

Data were collected using a 24-item structured questionnaire titled "Assessment of Starlink-Powered Internet and Educational Applications on Digital Learning Outcomes Among Students," comprising items on respondents' demographic characteristics, device and internet access, internet challenges, digital-application usage, Google Classroom experience, Starlink awareness and perception, willingness to adopt Starlink, and perceived effects on academic performance and understanding.

3.4 Validity and Reliability

Face and content validity of the instrument were established through review of item wording and structure against the study's objectives and research questions. Internal consistency of the four-item perceived-impact/acceptance composite (covering Starlink's perceived institutional benefit, willingness to adopt, perceived academic-performance benefit, and perceived understanding benefit) was assessed using Cronbach's alpha, yielding α = .63, indicating acceptable-to-questionable reliability for this composite (Nunnally, 1978).

3.5 Method of Data Analysis

Data were analysed using descriptive statistics (frequency counts, percentages, means, and standard deviations) to address the research questions, and inferential statistics — Spearman rank-order correlation, multiple linear regression, and chi-square tests of independence — to test the stated hypotheses at the 0.05 significance level. Ordinal (Likert-type) items were numerically coded in ascending order of favourability prior to inferential analysis.

4.0 Results

This section presents the results of data analysis obtained from 86 respondents, organised in line with the study's research questions and hypotheses. Graphical illustrations are provided alongside the tables to aid interpretation.

4.1 Demographic Characteristics and Device Access

Table 1: Demographic Distribution and Device Access (N = 86)

Variable	Category	Freq.	%
Gender	Male	47	54.7
	Female	39	45.3
Age Range	Below 18 / 18–22	2 / 48	2.3 / 55.8
	23–27 / 28–32 / 33+	21 / 6 / 9	24.4 / 7.0 / 10.5
Level of Study	100L / 200L / 300L / 400L	26 / 18 / 28 / 14	30.2 / 20.9 / 32.6 / 16.3
Device Access	Smartphone only	56	65.1
	Smartphone and Laptop	30	34.9

Respondents were fairly balanced by gender (54.7% male, 45.3% female) and predominantly aged 18–22 (55.8%), with the largest single-level representation from 300-level students (32.6%). All respondents had at least smartphone access, but only 34.9% also had laptops, confirming mobile devices as the primary — and for most, the only — gateway to digital learning.

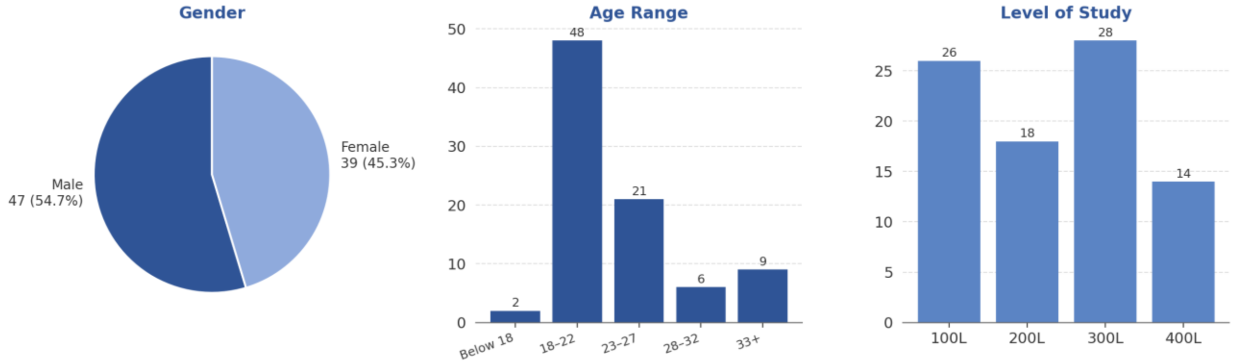


Figure 1: Demographic Distribution of Respondents by Gender, Age, and Level of Study

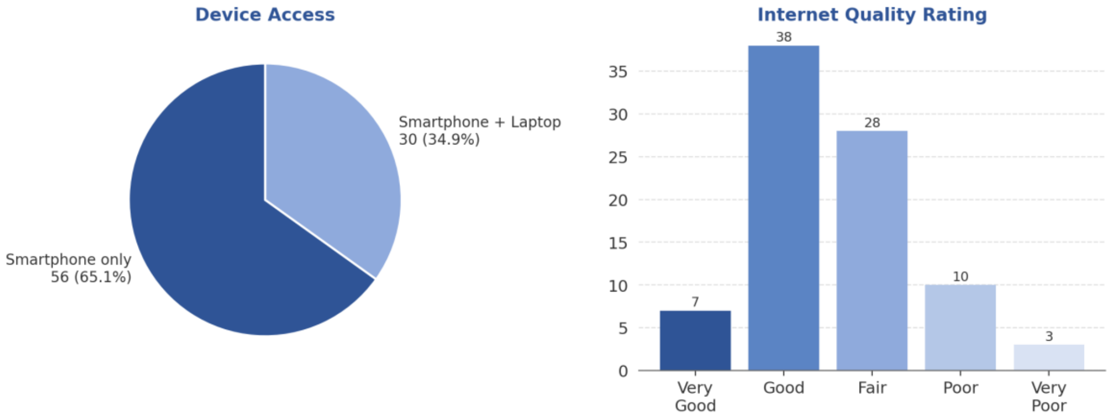


Figure 2: Device Access and Internet Quality Rating

4.2 Internet Accessibility and Challenges

Table 2: Internet Access Quality, Source, and Challenge Frequency (N = 86)

Indicator	Category	Freq.	%
Internet Quality	Very Good / Good	7 / 38	8.1 / 44.2
	Fair / Poor / Very Poor	28 / 10 / 3	32.6 / 11.6 / 3.5
Primary Source	Mobile Data	79	91.9
	Campus/Private Wi-Fi	6	7.0
	No regular access	1	1.1
Challenge Frequency	Very Often / Often	18 / 14	20.9 / 16.3
	Sometimes / Rarely / Never	47 / 6 / 1	54.7 / 7.0 / 1.1

While 52.3% rated their internet access as good or very good, 47.7% described it as fair to very poor. Mobile data was the dominant source (91.9%), and 98.9% of students reported experiencing connectivity challenges at some frequency — chiefly poor connection, high data cost, limited devices, unstable power supply, and limited ICT skills.

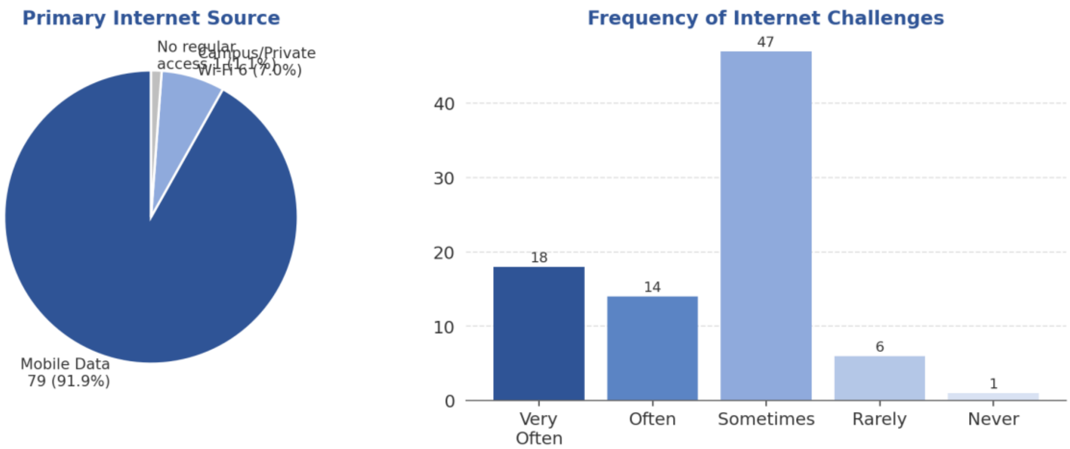


Figure 3: Primary Internet Source and Frequency of Internet Challenges

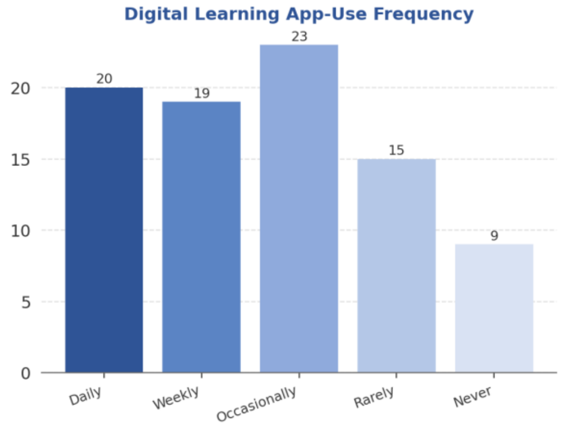
4.3 Digital Learning Application Usage

Table 3: Application Usage Frequency and Google Classroom Experience (N = 86)

Indicator	Category	Freq.	%
Usage Frequency	Daily / Weekly	20 / 19	23.3 / 22.1
	Occasionally / Rarely / Never	23 / 15 / 9	26.7 / 17.4 / 10.5
Used Google Classroom	Yes / No	35 / 51	40.7 / 59.3
GC Effectiveness (users)	Effective or Very Effective	34*	n/a

**Sub-category counts in the source data exceeded the reported n of 35 prior Google Classroom users, suggesting a form-logic inconsistency; figures are reported as collected and should be re-verified against raw responses.*

72.1% of students use digital learning applications at least occasionally, with YouTube, Google Classroom, WhatsApp, and Zoom/Google Meet the most popular platforms. Only 40.7% had previously used Google Classroom, though the majority of those users rated it positively.



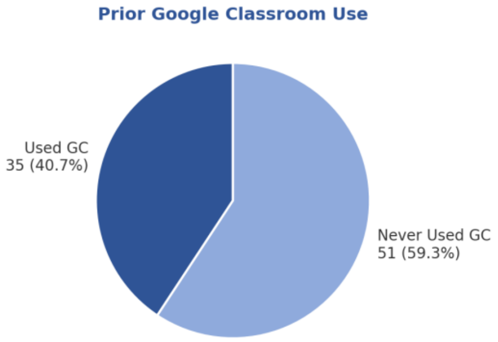


Figure 4: Digital Learning Application Usage Frequency and Prior Google Classroom Use

4.4 Starlink Awareness, Perception, and Willingness to Adopt

Table 4: Starlink Awareness, Perceived Institutional Benefit, and Adoption Willingness (N = 86)

Indicator	Category	Freq.	%
Awareness of Starlink	Yes / No	71 / 15	82.6 / 17.4
Perceived Institutional Benefit	Strongly Agree / Agree	41 / 32	47.7 / 37.2
	Neutral	13	15.1
Willingness to Adopt	Very Likely / Likely	50 / 32	58.1 / 37.2
	Not Sure	4	4.7

Most students (82.6%) were already aware of Starlink, and 84.9% agreed it could improve institutional internet access. Willingness to adopt Starlink for academic use was exceptionally high at 95.3%, with no respondent expressing unwillingness.

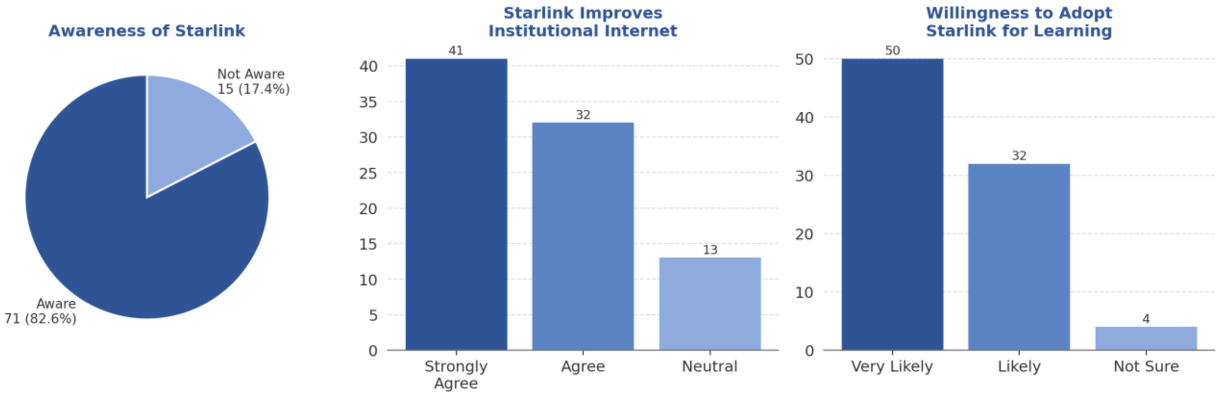


Figure 5: Starlink Awareness, Perceived Institutional Benefit, and Willingness to Adopt

4.5 Perceived Impact on Academic Performance and Understanding

Table 5: Perceived Effect of Internet Access on Academic Performance and Understanding (N = 86)

Indicator	Category	Freq.	%
Academic Performance	Strongly Agree / Agree	43 / 32	50.0 / 37.2
	Neutral / Disagree	9 / 2	10.5 / 2.3
Understanding of Lectures	Greatly Improve / Improve	47 / 36	54.7 / 41.9
	No Effect / Reduce	2 / 1	2.3 / 1.1

87.2% of students agreed that internet access improves academic performance, and 96.6% believe digital tools improve their understanding of lectures — among the most decisive findings in the dataset.

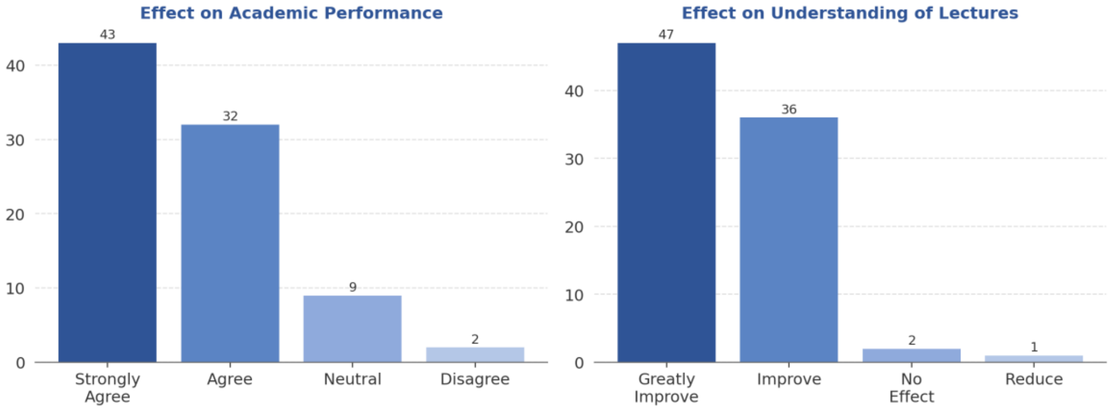


Figure 6: Perceived Effect of Internet Access on Academic Performance and Understanding

4.6 Reliability and Descriptive Statistics

A four-item "Perceived Impact and Acceptance" composite (Starlink institutional benefit, willingness to adopt, academic-performance benefit, understanding benefit) returned Cronbach's α = .63 (95% CI [.48, .74], n = 86), indicating acceptable-to-questionable internal consistency, likely reflecting the restricted (positively skewed) response ranges on several items.

Table 6: Means and Standard Deviations of Key Ordinal Variables (Coded 1–5, Higher = More Favourable)

Item	Mean	SD
Internet quality rating	3.42	0.93
Internet-challenge frequency (reverse-coded)	2.51	0.94
App-use frequency	3.30	1.29
Ease of accessing materials	3.31	0.99
Starlink perceived institutional benefit	4.33	0.73
Willingness to use Starlink	4.53	0.59
Effect on academic performance	4.35	0.76
Effect on understanding	4.47	0.73

4.7 Correlation Analysis (H01)

Table 7: Spearman Correlation Matrix Among Key Constructs (N = 86)

Variable	1	2	3	4	5	6
1. Internet quality	—					
2. Ease of access	.19	—				
3. Starlink institutional benefit	.05	.17	—			
4. Willingness to adopt Starlink	.04	.03	.42	—		
5. Effect on academic performance	.19	.12	.25	.34	—	
6. Effect on understanding	.09	.05	.25	.34	.37	—

$^{*}p < .05$, $^{**}p < .01$ (two-tailed).

Willingness to adopt Starlink correlated significantly and positively with perceived institutional benefit ($r_s = .42$, $p < .01$), perceived academic-performance benefit ($r_s = .34$, $p < .01$), and perceived understanding benefit ($r_s = .34$, $p < .01$). Internet quality showed only a weak, non-significant association with academic-performance benefit ($r_s = .19$, $p = .078$). On this basis, H01 is rejected with respect to willingness to adopt Starlink and retained with respect to internet quality alone.

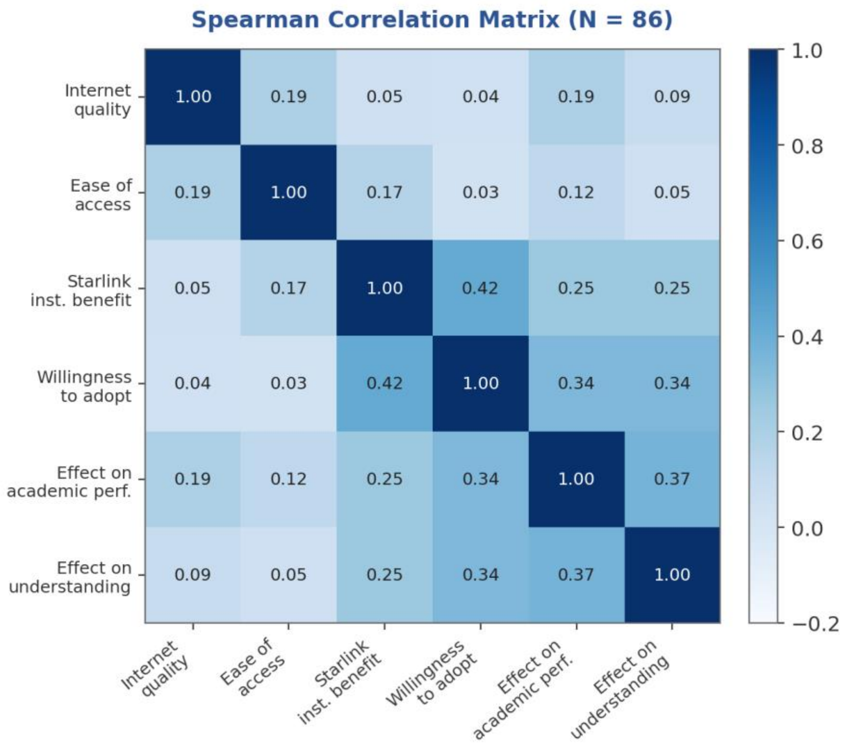


Figure 7: Spearman Correlation Heatmap Among Key Constructs

4.8 Regression Analysis

A multiple linear regression assessed whether internet quality, app-use frequency, and willingness to adopt Starlink jointly predict perceived academic-performance benefit. The model was significant, $F(3, 82) = 6.42$, $p < .001$, $R^2 = .190$, Adjusted $R^2 = .161$.

Table 8: Multiple Regression Predicting Perceived Academic-Performance Benefit

Predictor	B	SE	t	p
(Constant)	1.47	0.66	2.21	.030
Internet quality rating	0.17	0.08	2.10	.039
App-use frequency	0.07	0.06	1.12	.267
Willingness to use Starlink	0.46	0.13	3.54	<.001

Willingness to use Starlink was the strongest significant predictor ($B = 0.46$, $p < .001$), followed by internet quality ($B = 0.17$, $p = .039$); app-use frequency was not significant ($p = .267$).

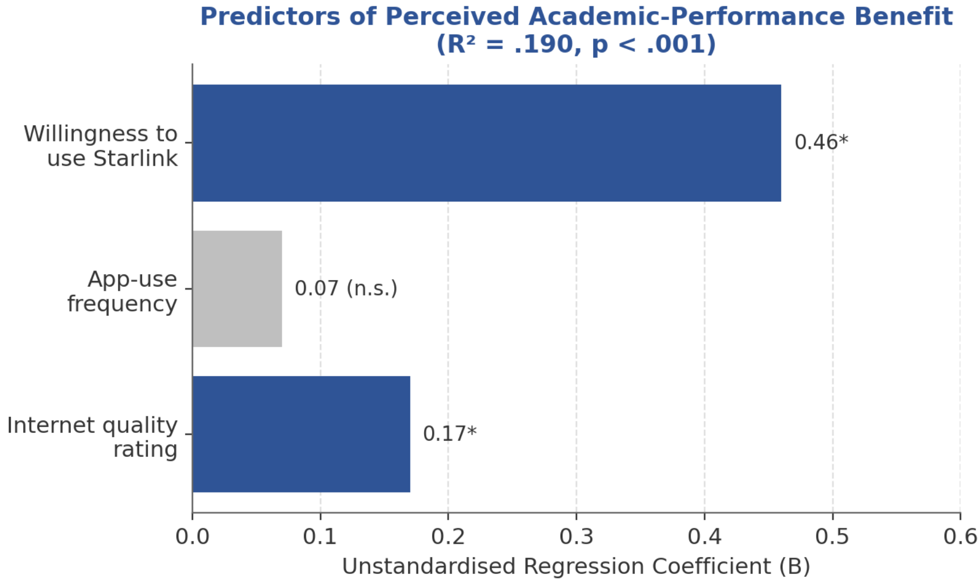


Figure 8: Standardised View of Regression Predictors of Perceived Academic-Performance Benefit

4.9 Chi-Square Tests (H02, H03)

Table 9: Chi-Square Tests of Association

Association Tested	χ^2	df	p	Decision
Gender × Willingness to adopt Starlink	2.66	2	.265	H02 retained
Level of study × Willingness to adopt Starlink	16.45	6	.012	H03 rejected
Gender × Awareness of Starlink	0.94	1	.333	Not significant
Device access × Internet quality	8.84	4	.065	Marginal, n.s.

Willingness to adopt Starlink was significantly associated with level of study ($\chi^2 = 16.45$, df = 6, p = .012), leading to rejection of H03. Gender showed no significant association with either willingness or awareness, so H02 is retained. Note that several cells in the level-of-study and device-access cross-tabulations had expected counts below 5; these results should ideally be corroborated with an exact test (e.g., Fisher–Freeman–Halton) in follow-up analysis.

5.0 Discussion of Findings

The findings reveal a student population that is device-ready at the smartphone level but connectivity-constrained: near-universal smartphone ownership contrasts with limited laptop access and overwhelming dependence on costly mobile data. This mirrors earlier Nigerian findings that computer/laptop ownership remains low among college-of-education students even where mobile access is comparatively strong (Hassan, 2025), and reinforces Eze et al.'s (2020) observation that unreliable connectivity remains a dominant barrier to e-learning delivery in Nigerian tertiary institutions.

The near-universal awareness of Starlink (82.6%) and exceptionally high willingness to adopt it (95.3%) suggest that students perceive Starlink as a credible solution to their connectivity constraints, consistent with the optimism reflected in ongoing Starlink education-connectivity deployments elsewhere in Africa, such as the Kenyan CEMASTEA partnership and the multi-country Paratus EduLINK programme. Within a UTAUT2 lens, this high adoption intention plausibly reflects the joint pull of strong performance expectancy — students already associate improved internet access with academic-performance and understanding gains — and high price value, since the free provision central to this study's premise removes the cost trade-off that ordinarily tempers adoption intention. Facilitating conditions and effort expectancy (e.g., installation logistics, institutional readiness, and technical support) were not directly measured in this study and warrant further investigation.

The correlation and regression results provide convergent evidence that willingness to adopt Starlink, more than current internet quality alone, is associated with perceived academic benefit. This is a subtle but important distinction: it suggests that expectation and attitude toward a prospective solution may currently be doing more explanatory work in students' self-reports than their actual present-day connection quality — plausible given that current connectivity is uniformly mediated through costly mobile data for the vast majority of respondents, leaving comparatively little variance in actual experienced quality to work with statistically. The significant association between willingness to adopt Starlink and level of study — with 400-level students showing the strongest enthusiasm relative to their numbers — may reflect final-year students' heightened awareness of how connectivity constraints have affected their academic work over time, though this interpretation should be tested in future longitudinal work.

The modest reliability of the perceived-impact composite ($\alpha = .63$) and the restricted response ranges observed across several perception items (e.g., no respondent selected the lowest categories for Starlink benefit, willingness, or academic effect) point to a strongly positively skewed attitude climate — students are, almost without exception, favourably disposed toward internet-enabled learning and toward Starlink specifically. While this indicates strong latent demand, it also limits the statistical power available to detect finer-grained relationships in a sample of this size, and future studies should consider larger and more heterogeneous samples, alongside behavioural (not just attitudinal) outcome measures, to validate these findings.

6.0 Conclusion and Recommendations

6.1 Conclusion

This study set out to assess the potential of integrating Starlink-powered free internet with educational applications to enhance digital learning outcomes among students of the Federal College of Education (Technical), Omoku. The findings show that students face persistent connectivity and device-access constraints under the current mobile-data-dependent regime, yet demonstrate very high awareness of, and willingness to adopt, Starlink-powered internet for academic purposes. Willingness to adopt Starlink was significantly associated with perceived academic-performance benefit and perceived understanding benefit, and differed significantly by level of study, while showing no significant gender difference. These findings support the study's central premise: that Starlink-powered free internet, integrated with existing and emerging educational applications, holds strong potential to improve digital learning outcomes in Nigerian tertiary institutions, provided that adoption barriers around cost, device access, and digital literacy are concurrently addressed.

6.2 Recommendations

1. The management of Federal College of Education (Technical), Omoku, and similar institutions should explore partnerships with Starlink resellers or education-focused connectivity programmes (e.g., models similar to Paratus EduLINK) to pilot subsidised or free campus-wide satellite internet access.
2. Institutions should complement improved connectivity with structured digital-literacy training, given that limited ICT skills remain a reported barrier even where connectivity exists.
3. Investment in shared computer/laptop facilities (e.g., ICT centres, libraries) is recommended to address the persistent laptop-access gap, since smartphone-only access constrains the range of educational applications students can meaningfully use.
4. Institutions should promote wider adoption of Google Classroom and similar platforms, given that fewer than half of students had prior experience with the tool despite generally positive reviews among those who had used it.

5. Given the significant relationship between level of study and willingness to adopt Starlink, sensitisation and onboarding campaigns should be tailored across academic levels rather than applied uniformly.
6. Future researchers should replicate this study with larger, multi-institutional samples and objective academic-performance measures (e.g., GPA) to validate and extend the present self-report-based findings.

6.3 Limitations of the Study

This study is limited by its relatively small, single-institution convenience sample (N = 86), its reliance on self-reported perceptions rather than objective academic performance data, and the cross-sectional design, which precludes causal inference. The moderate reliability of the perceived-impact composite (α = .63) and the positively skewed response distributions on several items also constrain the precision of the inferential estimates reported. Findings should therefore be interpreted as indicative of attitudes and associations within this specific student population rather than generalised to all Nigerian tertiary institutions.

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