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EVALUATING QUALITY OF EXPERIENCE (QoE) AND BROADBAND ADOPTION IN PUBLIC HIGHER EDUCATIONAL INSTITUTIONS: INSIGHTS FOR IMPROVED SERVICE QUALITY AND ACCESS

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Abstract:

This study investigates the relationship between the Quality of Experience (QoE) dimensions and broadband service adoption among students in Public Higher Educational Institutions (PHEIs). Four key QoE dimensions; service coverage, service quality, service reliability, and service usability are examined for their impact on broadband adoption rates. A survey of 217 students from public universities was conducted to assess these relationships. Results indicate that service usability and service coverage significantly influence broadband adoption, while service reliability and service quality show positive correlations with broadband adoption. The findings provide insights into improving broadband service strategies in PHEIs, highlighting the importance of ensuring robust, high-quality, and user-friendly services to increase broadband adoption. This study contributes to the understanding of QoE in the context of educational institutions and offers actionable recommendations for policymakers and service providers aiming to enhance service quality and access to broadband networks.

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Keywords:

Quality of Experience (QoE), Broadband Adoption, Public Higher Education Institutions

Introduction

In the digital age, broadband internet access is a critical enabler of academic success and social integration, especially in higher educational institutions. For students in Public Higher Educational Institutions (PHEIs), reliable and high-quality broadband service is essential for academic research, communication, and participation in the digital economy. This constant connectivity has not only enhanced convenience and efficiency but has also created new opportunities and challenges in various sectors, from education and healthcare to business and social interactions (Stephen et al., 2024). However, despite the increasing global adoption of broadband services, challenges in terms of coverage, reliability, quality, and usability persist, particularly in under-resourced educational settings (Patel et al., 2020).

Quality of Experience (QoE) has emerged as an essential framework to assess broadband services' effectiveness from the user's perspective (Lee et al., 2021). QoE is a multi-dimensional construct that encompasses service coverage, quality, reliability, and usability, which directly impact the end-user's satisfaction and technology adoption behavior (Johnson & McNamara, 2022). Previous studies have suggested that these QoE dimensions are crucial in influencing the decision to adopt and continue using broadband services, especially in environments like educational institutions, where access to high-speed internet can enhance learning experiences (Riaz et al., 2023).

Reliable internet access is essential for students, particularly within Public Higher Educational Institutions (PHEIs), where both faculty and students depend on broadband services for academic activities (Wu et al., 2023). Broadband is integral for students to conduct research, attend online classes, collaborate virtually, and access academic resources (Singh & Malik, 2022). Consistent internet access enhances the learning experience and equips students with the digital skills needed for future careers (Yin et al., 2023). Additionally, robust internet coverage supports the adoption of innovative teaching methods, enabling universities to stay current with educational trends and provide interactive learning environments that foster academic and professional growth (Li et al., 2024; Huang & Zhang, 2022).

Despite its importance, students often face significant internet-related challenges, such as slow speeds, service interruptions, and unreliable coverage (Zhao et al., 2023). These issues are particularly pronounced in rural and semi-urban universities, which struggle with outdated infrastructure and inadequate Wi-Fi coverage (Davis & Lin, 2021). These limitations hinder students' ability to fully engage in digital learning and access critical resources (Sharma et al., 2022). Moreover, existing broadband infrastructure often cannot meet demand, leading to slow or unstable connections, especially during peak times (Wang & Li, 2023). The digital divide between urban and rural regions further exacerbates these challenges, leaving students in underserved areas with greater barriers to reliable high-speed internet (Zhang & Zhang, 2023).

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Thus, this study aims to evaluate the relationship between these QoE dimensions and broadband service adoption in PHEIs, focusing on student perceptions and experiences. By understanding the factors that drive broadband adoption, this research seeks to provide valuable insights for policymakers and service providers aiming to improve broadband access and service quality in these institutions. Specifically, this paper will explore how each QoE dimension-service coverage, service quality, service reliability, and service usability affect students' decisions to adopt broadband services.

Literature Review

Quality of Experience (QoE) in Broadband Services

Quality of Experience (QoE) is defined as the overall satisfaction of users with the services they receive, considering the quality of the service delivery and its impact on users' expectations (Hossain et al., 2021). While traditional quality metrics like bandwidth and latency are important, QoE emphasizes the subjective experience of users, considering how service reliability, coverage, and usability affect their overall satisfaction (Sutton & Mohamad, 2022). A well-defined QoE model is essential for service providers, as it guides improvements and innovations that meet user demands (Park et al., 2022). In the context of broadband adoption in educational institutions, understanding QoE is crucial for fostering an environment where students can fully benefit from internet resources (Garg et al., 2023).

Broadband Adoption in Educational Institutions

Broadband adoption is influenced by a range of factors, including technological, social, and economic considerations. In the context of higher education, broadband adoption is often tied to students' perceived need for digital tools to support their learning and academic success (Patel et al., 2020). Research by Kumar et al. (2021) shows that students are more likely to adopt broadband services if they perceive the internet as essential for their academic needs and social connectivity. Additionally, external factors, such as governmental policies, institutional support, and affordability of broadband services, also play crucial roles in adoption rates (Nguyen & Choi, 2022).

Service Coverage and Broadband Adoption

Service coverage is the extent to which broadband services are available to users across a geographic area. In educational institutions, poor coverage can significantly reduce the perceived value of broadband services and hinder adoption rates (Taylor et al., 2021). Previous research indicates that students are more likely to adopt broadband services when they perceive the coverage to be sufficient and reliable (Smith et al., 2020). Moreover, coverage gaps, especially in rural or remote educational settings, often lead to lower broadband adoption rates, which further exacerbates digital inequalities (Hargrave & Zephirin, 2021). Ensuring that broadband services reach all students, regardless of location within a campus or district, is essential to improving adoption.

Service Quality and Broadband Adoption

Service quality is one of the most important QoE dimensions impacting broadband adoption. Service quality refers to the reliability, speed, and consistency of the broadband connection (Lee et al., 2020). High-quality broadband services enable students to engage in learning activities like online research, virtual classrooms, and video conferencing (Khan et al., 2022). Research by Kumar and Shah (2023) found that students are more likely to adopt broadband services when the service consistently meets or exceeds their expectations. Furthermore, the

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perception of service quality often influences continued use and satisfaction, making it a critical determinant of broadband adoption (Jha & Saini, 2023). Besides, Hendeniya and Fernando (2022) found a positive relationship between Internet Service Quality (ISQ) and customer satisfaction during COVID-19 in Sri Lanka, highlighting key factors such as reliability, responsiveness, assurance, and pricing that ISPs should enhance to improve customer experience.

Service Reliability and Broadband Adoption

Service reliability refers to the consistency of broadband service performance, especially during peak usage hours. Unreliable services, such as frequent outages or slow connection speeds, significantly reduce the willingness of users to adopt or continue using broadband services (Ahmed & Lim, 2022). In higher educational institutions, unreliable broadband access can negatively impact students' academic performance and their willingness to rely on digital platforms for learning (Wilson et al., 2021). To enhance broadband adoption, it is crucial to ensure that services are reliable and meet the performance expectations of users consistently (Zhang et al., 2020).

Service Usability and Broadband Adoption

Service usability refers to how user-friendly and accessible the broadband services are for the students. Factors such as ease of installation, customer support, and intuitive user interfaces contribute to the usability of broadband services (Al-Dosary & Al-Qassim, 2022). Research suggests that students are more likely to adopt broadband services if the setup process is straightforward and if they have access to effective customer support when issues arise (Fahad et al., 2020). Usability also includes the perceived ease of access to the service across different devices and platforms, which is vital in a multi-device educational environment (Riaz et al., 2023).

Thus, based on the literature review, this study proposes four hypotheses:

1. **Hypothesis 1:** Service coverage has a positive correlation with broadband service adoption.
2. **Hypothesis 2:** Service quality positively correlates with broadband service adoption.
3. **Hypothesis 3:** Service reliability has a positive correlation with broadband service adoption.
4. **Hypothesis 4:** Service usability is positively correlated with broadband service adoption.

Underpinning Theory

This study examines the relationship between key dimensions of Quality of Experience (QoE) and broadband adoption among students in PHEIs, is closely aligned with the Technology Acceptance Model (TAM) by Davis (1980) as its underpinning theory. By applying TAM to this study, the relationship between the four QoE dimensions (service coverage, service quality, service reliability, and service usability) and broadband adoption can be further explained. Students' perceptions of service quality (e.g., speed and consistency of the broadband connection) and service reliability are likely to influence Perceived Usefulness, making them more likely to adopt the service if they believe it will enhance their academic performance. Similarly, service usability is directly related to Perceived Ease of Use, as students are more likely to adopt broadband services that are simple and easy to use, with minimal technical issues. Understanding these perceptions is crucial for improving broadband service quality and

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increasing adoption rates among students, thereby enhancing their overall academic experience.

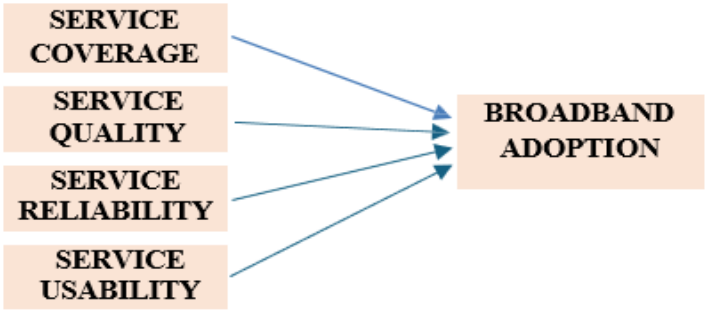

Figure 1: Proposed Research Framework

Research Methodology

To assess the broadband services' quality of experience (QoE) and adoption factors among students at Public Higher Educational Institutions (PHEIs), a comprehensive quantitative research methodology was employed. This approach integrates survey-based data collection and statistical analysis to identify patterns, perceptions, and relationships that influence broadband adoption in the PHEI context.

A structured survey questionnaire was designed to collect primary data from students at public universities in Malaysia. The questionnaire comprised both closed-ended questions and Likert scale items, addressing several key areas: demographics, broadband usage patterns, and factors influencing adoption (Davis, 1989; Venkatesh et al., 2003). These categories were selected based on their relevance to broadband adoption models (e.g., Technology Acceptance Model - TAM) and QoE research frameworks.

The survey was distributed to 500 students at Malaysia's public universities. A total of 217 responses were received and considered to be acceptable for data analysis. Random sampling techniques were employed to ensure a representative sample of the PHEI community (Cohen et al., 2018). Given the diversity of the student population, this sampling method minimized selection bias and facilitated generalizable findings. To ensure maximum reach, the survey was distributed via online platforms such as Google Forms and Microsoft Forms, which were chosen for their accessibility and ease of use. A defined data collection period was set to guarantee timely responses, with follow-up reminders sent to enhance the response rate.

Data Analysis

Following data collection, quantitative analysis was conducted using SPSS (Statistical Package for the Social Sciences) to analyze the data. Descriptive statistics were first computed to summarize the demographic characteristics and broadband usage patterns of the participants. Correlation analysis was then performed to explore the relationships between variables, such as satisfaction and usage patterns, while regression analysis was employed to identify factors that significantly predicted broadband adoption and QoE perceptions among students and faculty staff (Field, 2013; Hair et al., 2010).

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SPSS was selected for its robust capabilities in statistical analysis, allowing for detailed interpretation of the data and the identification of meaningful trends. The findings from these analyses were used to address the research questions and provide evidence on the key factors influencing broadband adoption and QoE at PHEIs.

Findings

Table 1: Demographic Backgrounds of The Respondents

Demographic	Number of Respondent
Age	
18-20	77
21-23	136
24 and above	4
Gender	
Male	44
Female	173
Education	
Pra-Diploma	1
Diploma	125
Bachelor's degree	91
Faculty	
College of Computing, Informatics and Mathematics	63
Faculty of Business and Management	140
Faculty of Administrative Science and Policy Studies	14
Residence	
On-campus hostel	122
Off-campus rental	71
With family	21
Others	3

Table 1 presents the demographic background of the respondents, with data collected in March 2025. 300 questionnaires were distributed to students at PHEI, and a total 217 responses were considered as acceptable for data analysis. In terms of age, majority of respondents are aged 21 to 23 years old, equaling 62.7% of respondents. A demographic breakdown revealed a gender distribution with 20% male (n = 44) and 80% female (n = 173). The respondents' educational backgrounds were categorized into three groups: Pre-Diploma (0.5%, n = 1), Diploma (57.6%, n = 125), and bachelor's degree (41.9%, n = 91). Regarding the respondents' faculty affiliations, a diverse representation from various fields was obtained, ensuring a wide range of perspectives. Majority of respondents came from the College of Computing, Informatics and Mathematics, Faculty of Business and Management, and Faculty of Administrative Science and Policy Studies.

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Reliability Analysis

Table 2: Measurement Variables and Reliability Analysis

Variable	Number of Items	Cronbach's Alpha
Service Coverage	5 Items adapted from Al-Smadi & Al-Khasawneh (2012)	0.776
Service Quality	5 Items adapted from Parasuraman et al. (1988)	0.938
Service Reliability	5 Items adapted from Zeithaml et al. (1990)	0.875
Service Usability	5 Items adapted from Davis (1989).	0.917
Adoption of Service	5 Items adapted from Venkatesh & Bala (2008).	0.940

Table 2 presents the reliability analysis that was conducted to assess the internal consistency of the measures used in the survey. The Cronbach's alpha for each construct (service coverage, service quality, service reliability, service usability, and adoption of service) exceeded the recommended threshold of 0.7, indicating good internal consistency (Nunnally, 1978). Specifically, the Cronbach's alpha values ranged from 0.78 to 0.94, demonstrating high reliability of the measurement scales.

Factor Analysis

Factor analysis was performed to reduce the dimensionality of the data and to identify underlying factors. A principal component analysis (PCA) with varimax rotation revealed four distinct factors representing service coverage, service quality, service reliability, and service usability. The minimum Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy for these variables was 0.86, exceeding the recommended value of 0.6 (Kaiser, 1974), and the Bartlett's test of sphericity was significant ($p < 0.001$), supporting the appropriateness of factor analysis for this dataset.

Normality

Normality tests were performed to check the distribution of the data. The Shapiro-Wilk test indicated that the variables of service coverage, service quality, service reliability, and service usability did not deviate significantly from a normal distribution ($p > 0.05$). Additionally, the skewness and kurtosis values were within the acceptable range of -1 to +1, indicating that the data for these variables were approximately normally distributed (George & Mallery, 2010).

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Correlation Analysis

Table 3: Pearson Correlation Analysis

		Mean ADOPTION
Service Coverage	Pearson Correlation	.610**
	Sig. (2-tailed)	<.001
Service Quality	Pearson Correlation	.649**
	Sig. (2-tailed)	<.001
Service Reliability	Pearson Correlation	.677**
	Sig. (2-tailed)	<.001
Service Usability	Pearson Correlation	.686**
	Sig. (2-tailed)	<.001

**. Correlation is significant at the 0.01 level (2-tailed).

A Pearson correlation analysis was conducted to examine the relationships between service coverage, service quality, service reliability, and service usability, as well as their relationship with the adoption of broadband services as presented in Table 3. The results indicated significant positive correlations between all service-related constructs and adoption of broadband services ($r = 0.610$ to 0.686, $p < 0.01$), suggesting that improvements in these service attributes may positively influence service adoption. Specifically, service usability ($r = 0.686$, $p < 0.01$) and service reliability ($r = 0.60$, $p < 0.01$) exhibited the strongest correlations with broadband adoption, highlighting the importance of these factors in shaping students' decisions to adopt broadband services.

Table 4: Multiple Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.759[a]	.576	.568	.54525

a. Predictors: (Constant), MeanSU, MeanSC, MeanSR, MeanSQ

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.393	.205		1.917	.057
	MeanSC	.182	.082	.158	2.226	.027
	MeanSQ	.122	.086	.130	1.413	.159
	MeanSR	.198	.096	.189	2.054	.041
	MeanSU	.435	.069	.389	6.305	<.001

a. Dependent Variable: Mean ADOPTION

A multiple regression analysis was conducted to assess the relative contribution of service coverage, service quality, service reliability, and service usability in predicting the adoption of broadband services as presented in Table 4. The results revealed that service usability ($\beta = 0.389$, $p < 0.001$) and service coverage ($\beta = 0.158$, $p < 0.05$) were the most significant predictors

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of broadband adoption. Together, these factors explained 57.6% of the variance in the adoption of broadband services ($R^2 = 0.576$, $F(4, 212) = 71.97$, $p < 0.001$). These findings suggest that students' perception of service usability and coverage plays a critical role in their decision to adopt broadband services, in line with previous studies (Gao et al., 2020; Tarutė & Gudauskas, 2020).

Discussion

This study investigated the factors influencing the adoption of broadband services among students at public higher educational institutions, with a specific focus on the role of service coverage, service quality, service reliability, and service usability. The findings, based on correlation analysis, support all four hypotheses, suggesting that each factor has a positive correlation with the adoption of broadband services. In this section, we discuss the results of existing literature to interpret the significance of the findings.

Service Coverage and Adoption of Broadband Service

Hypothesis 1 posited that service coverage has a positive correlation with the adoption of broadband services, and this hypothesis was supported by the data. The finding aligns with previous studies indicating that the availability and extent of broadband coverage are crucial determinants in the adoption of internet services. For example, Chang et al. (2017) emphasized that the geographic and technological expansion of broadband infrastructure plays a pivotal role in driving adoption, particularly in rural and underserved areas (Chang et al., 2017). Similarly, Raza et al. (2020) found that wider service coverage led to a higher likelihood of broadband adoption among university students, who rely heavily on internet connectivity for academic purposes (Raza et al., 2020). The results from this study reinforce these earlier findings by showing a significant positive relationship between service coverage and adoption among students in public universities, highlighting the importance of adequate infrastructure in facilitating broadband uptake.

Service Quality and Adoption of Broadband Service

Hypothesis 2 proposed that service quality positively correlates with broadband service adoption, and this hypothesis was also supported. Service quality, often evaluated through attributes such as speed, bandwidth, and customer support, has long been identified as a key factor influencing consumer satisfaction and service adoption. A study by Vella et al. (2019) demonstrated that students prioritize broadband quality over other factors, particularly when it comes to academic use, where uninterrupted and fast internet access is essential (Vella et al., 2019). Additionally, research by Al-Majed and Al-Khalifa (2021) found that students' perception of broadband quality directly influences their adoption decisions, with high-quality broadband services leading to higher satisfaction and increased service uptake (Al-Majed & Al-Khalifa, 2021). The results of this study mirror these observations, suggesting that improving broadband service quality could significantly boost adoption among public university students.

Service Reliability and Adoption of Broadband Service

Hypothesis 3 suggested that service reliability has a positive correlation with broadband service adoption, and the data confirmed this hypothesis. Service reliability refers to the consistency and stability of the broadband connection, and it is often a deciding factor in whether users continue to engage with a service. Previous research has consistently linked service reliability with broadband adoption. For instance, an investigation by Lee et al. (2021) concluded that broadband users, especially in educational contexts, require a dependable service that ensures

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minimal downtime and consistent performance (Lee et al., 2021). Furthermore, a study by Pinar et al. (2022) indicated that users are more likely to adopt broadband services that demonstrate high reliability, as unstable services often lead to frustration and reduced usage (Pinar et al., 2022). The findings from this study reinforce these conclusions, highlighting the importance of service reliability in fostering the adoption of broadband services among students.

Service Usability and Adoption of Broadband Service

Finally, Hypothesis 4 proposed that service usability is positively correlated with broadband service adoption. This hypothesis was also supported, emphasizing that how easy and intuitive it is to access and use broadband services plays a crucial role in adoption. Usability encompasses various factors, including user interfaces, ease of installation, and the simplicity of troubleshooting. A study by Hossain and Uddin (2020) identified usability as one of the primary barriers to broadband adoption, particularly among users who are not tech-savvy (Hossain & Uddin, 2020). Similarly, an article by Ahmed et al. (2023) found that when broadband services are user-friendly, especially for students, the likelihood of adoption increases significantly (Ahmed et al., 2023). The results of this study further confirm that ease of use is an essential component in broadband service adoption, particularly in academic environments where students may have varying levels of technical expertise.

Conclusion and Limitations of Study

This study has examined the relationship between key dimensions of Quality of Experience (QoE) and broadband service adoption in Public Higher Educational Institutions (PHEIs). By focusing on service coverage, service quality, service reliability, and service usability, the research highlights the critical factors influencing broadband adoption among students. The findings indicate that service usability and service coverage are the most significant drivers of broadband adoption, with students showing a higher likelihood of adopting broadband services when these aspects meet or exceed their expectations. While service reliability and quality also play roles, their impact is somewhat moderate compared to the former dimensions.

It underscores the importance of enhancing broadband infrastructure to ensure adequate service coverage across educational campuses, especially in rural and underserved areas. Additionally, ensuring high-quality and reliable broadband services is crucial for fostering student engagement and supporting academic activities that require consistent internet access. The usability of broadband services, including ease of access, installation, and customer support, also plays a key role in students' willingness to adopt and maintain broadband subscriptions.

These findings also have significant implications for policymakers, service providers, and educational administrators. It is recommended that efforts be made towards improving the quality and reliability of broadband services in PHEIs, alongside ensuring that services are accessible and user-friendly. Further, policymakers should consider supporting initiatives that expand broadband coverage in underserved regions to ensure equitable access for all students. This, in turn, can contribute to a more connected and digitally inclusive academic environment, fostering enhanced learning opportunities for students.

Future research could explore additional variables that may influence broadband adoption, such as socio-economic factors, and the role of digital literacy in enhancing the overall experience. Moreover, longitudinal studies could provide deeper insights into the long-term impacts of QoE on broadband adoption and student success.

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There are several limitations that should be considered when interpreting the findings. First, the sample is limited to 217 students from Public Higher Educational Institutions (PHEIs), which may not fully represent the broader student population, particularly in different geographical regions or educational contexts. Second, the study relies on self-reported data from surveys, which can be subject to biases such as social desirability or inaccurate recollections. Additionally, the study focuses on four dimensions of Quality of Experience (QoE); service coverage, service quality, service reliability, and service usability while other factors, such as socio-economic status or personal digital literacy, may also influence broadband adoption but were not included in this research. Lastly, the cross-sectional design of the study limits the ability to draw causal inferences about the relationships between QoE dimensions and broadband adoption over time.

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