International Journal of Social and Educational Innovation
Vol. 12, Issue 24, 2025
ISSN (print): 2392 – 6252
eISSN (online): 2393 – 0373
DOI: 10.5281/zenodo.17278219

# DIGITAL LIBRARY SERVICES AND USER BEHAVIOR IN NIGERIAN UNIVERSITIES: AN EXPECTATION-CONFIRMATION MODEL ANALYSIS

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**Abstract**
This study investigates the behavioral factors influencing university students' continued use of digital library services in Nigeria, applying the Expectation Confirmation Model (ECM) as the theoretical framework. A structural equation modeling approach was employed to test a conceptual model developed from ECM constructs, such as the perceived usefulness, confirmation, satisfaction, and continuance intention, augmented by system quality and perceived ease of use. Primary data were collected via an online survey distributed across multiple universities in Lagos State, Nigeria, using random sampling techniques. The empirical findings demonstrate that confirmation significantly affects both perceived usefulness and satisfaction, which in turn influence students' intention to continue using digital library services. Additionally, system quality and perceived ease of use emerged as significant predictors of satisfaction. The study contributes to the literature on digital service adoption in developing contexts by offering evidence-based insights that inform the design, implementation, and policy surrounding academic digital infrastructures. Recommendations are provided for enhancing system quality, managing user expectations, and ensuring equitable digital access in higher education.

**Keywords:** ***Digital Libraries; User Behavior; Expectation Confirmation Model; Structural Equation Modeling; Higher Education; Nigeria.***

**JEL Codes:** C51; I23; O33; D83; L86.

## 1. Introduction

The digital transformation of academic institutions has significantly redefined how information is accessed, processed, and utilized. Among the most affected are academic libraries, which are increasingly integrating smart technologies to enhance the efficiency, accessibility, and quality of library services. This evolution has brought about the proliferation of digital services such as online catalogues, remote access to e-resources, digital lending, and AI-powered information retrieval systems, all aimed at fostering user-centric experiences and improving student engagement with scholarly content (Zhou & Li, 2021). In the context of developing economies like Nigeria, where access to conventional learning resources remains uneven, digital library services present a critical opportunity to bridge gaps in academic resource provision and democratize knowledge access. However, despite the growing presence of these services in Nigerian universities, there remains a lack of empirical evidence concerning how students engage with them over time, especially beyond initial adoption.

Understanding user behavior in digital environments necessitates an exploration of not only adoption patterns but also the determinants of continued use. Research in information systems has demonstrated that users' post-adoption experiences are vital to the long-term success of any technology intervention (Bhattacherjee, 2001). The Expectation Confirmation Model (ECM), widely used in digital service research, offers a comprehensive lens through which to assess this phenomenon. Rooted in cognitive dissonance theory, the ECM suggests that users form expectations prior to using a system, which are then either confirmed or disconfirmed based on their experiences. These outcomes influence users' perceptions of usefulness, satisfaction, and their subsequent intention to continue using the service (Roca et al., 2006; Mensah & Mi, 2020). Within the academic library context, the ECM serves as a valuable framework to understand the evolving dynamics of student interaction with digital services to satisfaction and loyalty.

While numerous studies have applied ECM in areas such as mobile banking, e-learning, and cloud computing (Lin et al., 2019; Bawack et al., 2023), relatively few have examined its application in academic libraries, particularly within Sub-Saharan Africa. This is a notable gap given the unique infrastructural, pedagogical, and sociocultural dynamics that characterize digital service delivery in this region. In Nigeria, academic libraries are gradually transitioning from manual to digital and smart systems, but challenges such as inadequate digital literacy, intermittent internet connectivity, and limited institutional support continue to hinder full utilization (Ojedokun & Okewale, 2020). Consequently, while students may initially adopt

these technologies, their willingness to continue usage often depends on their subjective evaluations of system performance and service quality.

To address these gaps, this study adopts the Expectation Confirmation Model to examine how students in Nigerian universities engage with smart library services. Specifically, it evaluates how expectation, confirmation, perceived usefulness, and satisfaction interact to influence continuance intention. A conceptual model with four hypotheses, grounded in ECM literature, was developed to guide the empirical analysis. The study employed Structural Equation Modeling (SEM) to test these hypotheses using survey data collected from a diverse sample of university students in Lagos State, Nigeria. A random sampling strategy was applied to ensure variability in demographic and institutional characteristics, thereby enhancing the generalizability of findings. The data collection instrument consisted of validated ECM measurement items adapted from previous empirical research, ensuring construct validity and reliability (Alraja et al., 2023; Roca et al., 2006).

This study contributes to theory by extending the applicability of ECM to the underexplored domain of smart library services in a developing country context. It also provides a student-centered perspective that illuminates the psychological and cognitive processes underpinning digital service engagement in higher education. Practically, the findings offer strategic insights for library administrators, academic policymakers, and technology developers aiming to optimize user satisfaction and ensure long-term viability of digital library systems. Key implications include the importance of aligning digital services with user expectations, enhancing perceived value through training and interface design, and establishing feedback mechanisms to facilitate continuous service improvement.

As digital library ecosystems continue to evolve, particularly in resource-constrained educational settings, there is a pressing need to ground service design and implementation in empirical insights about user behavior. This study answers that call by exploring the cognitive antecedents of digital service continuance through the lens of the Expectation Confirmation Model. In doing so, it enriches the literature on academic library modernization and provides an evidence-based framework for promoting sustained user engagement in digital academic environments across Nigeria and comparable contexts.

## 2. Literature Review

The evolution of digital library services in academic institutions has been extensively studied over the past decade, with numerous empirical investigations exploring factors influencing student adoption, usage, and satisfaction. The Expectation Confirmation Model (ECM) has

been a prevalent framework in these studies, emphasizing the role of user expectations and perceived performance in determining continued usage intentions. Complementing ECM, the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) have been widely applied to understand user acceptance of digital library services. A meta-analysis by Ali and Warraich (2024) synthesized findings from multiple studies, highlighting that perceived usefulness and ease of use are significant predictors of digital library adoption among students.

In the African context, several studies have examined digital library usage among university students. For instance, Kiana et al. (2023) investigated predictors of digital library usage among undergraduate students in Namibia, finding that library training significantly influences perceived usefulness and actual usage. Umukoro and Tiamiyu (2017) explored determinants of e-library service use among Nigerian university students, identifying factors such as system quality, service quality, and user satisfaction as critical to usage behavior.

The impact of digital library services on user satisfaction has also been a focal point in recent studies. Azib et al. (2025) evaluated user satisfaction with digital library services in Malaysian higher education institutions, revealing that information quality, system quality, and service quality significantly affect overall satisfaction. Moreover, the integration of emerging technologies into library services has been explored to enhance user engagement. Wei et al. (2024) introduced an augmented reality system designed to enrich physical library experiences, demonstrating its potential to increase student engagement.

In terms of accessibility, Paul and Chauhan (2024) examined the role of AI-powered assistive technologies in enhancing library access for patrons with disabilities, highlighting the importance of inclusive digital services. Studies have also addressed the challenges of digital library service utilization. Adetayo et al. (2024) investigated university students' library engagement, noting that factors such as reading habits and gender dynamics influence usage patterns. Furthermore, the role of social media in engaging library users has been analyzed. Zou et al. (2020) explored strategies for using social media to build participatory library services, emphasizing the need for libraries to adopt user-centered engagement approaches.

In the Nigerian context, Isa et al. (2025) conducted a comparative study of digital reference service utilization between Nigerian and Malaysian university libraries, identifying differences in usage patterns and suggesting strategies for optimization. Al-Suqri and Al-Aufi (2019) highlighted that in addition to perceived usefulness, constructs such as digital literacy and cultural context significantly affect the intention to use digital library services among Gulf Cooperation Council (GCC) university students. This supports the growing recognition that

regional, sociocultural, and infrastructural conditions modulate technology acceptance patterns in academic settings, particularly in low- and middle-income countries. Such insights have prompted a reevaluation of one-size-fits-all adoption models, advocating for context-sensitive implementations that address localized barriers to usage.

Further, several studies have explored how user training and orientation programs can enhance the utilization of digital resources. For example, Mwantimwa and Ndenje-Sichalwe (2021) demonstrated that structured digital literacy initiatives significantly improve the perceived ease of use and actual usage frequency of e-resources among Tanzanian university students. Their findings align with those of Abdul Karim and Darus (2020), who noted that students exposed to regular digital library training sessions reported higher satisfaction and continuance intention scores. These empirical insights suggest that beyond technological availability, user preparedness and competence play a central role in digital library success.

In addition, system design and user interface functionality have emerged as critical determinants of digital service engagement. A study by Monfaredzadeh and Krishnan (2023) indicated that system quality had a significant positive impact on both perceived usefulness and satisfaction among postgraduate users in Iranian academic libraries. This resonates with findings from Asemi and Riyazi (2020), who showed that technical issues such as poor search algorithms or system lags can negatively influence continued usage, even when digital services are otherwise available and promoted. Thus, technical infrastructure, including back-end system reliability, must align with front-end usability to support sustained engagement.

Moreover, the role of institutional support and policy frameworks cannot be understated. Empirical studies such as those by Onyegbule et al. (2022) have shown that universities with clearly defined digital library policies, adequate funding, and ongoing technical support exhibit higher student satisfaction and usage rates. This indicates that institutional commitment—manifested through budgetary allocation, continuous service improvement, and responsive user feedback mechanisms—significantly enhances the success of digital library services. Such findings are particularly pertinent for Nigerian universities, where infrastructural underfunding and policy fragmentation frequently undermine the sustainability of digital library projects.

Finally, recent interdisciplinary research has highlighted the importance of emotional and psychological variables in determining students' interaction with digital library environments. For example, a study by Chang and Fang (2022) integrated the concept of digital anxiety into the ECM framework, revealing that students experiencing high levels of anxiety were less likely to perceive digital libraries as useful or satisfying. Similarly, Nguyen and Ha (2021) found that positive emotional engagement, fostered through gamification and personalized

content delivery, led to stronger continuance intentions. These emerging perspectives urge scholars and practitioners to move beyond purely cognitive models and consider affective dimensions of digital service usage in educational settings.

## 3. Methodology

This study adopts a quantitative research approach to evaluate the behavioral determinants of students' continued usage of digital services in academic libraries, leveraging the theoretical foundation of the Expectation Confirmation Model (ECM). The ECM framework, initially developed by Bhattacherjee (2001), posits that users' intention to continue using a system is influenced primarily by their satisfaction and perceived usefulness, both of which are conditioned by the degree to which initial expectations are confirmed after actual usage. To adapt this model to the context of smart digital library services in Nigerian universities, the current study integrates additional constructs such as perceived ease of use and system quality, drawing from established extensions in information systems research (DeLone & McLean, 2003; Venkatesh et al., 2012).

To formally articulate the hypothesized relationships, a structural model is specified with multiple endogenous constructs. Expectation confirmation (EC) serves as a critical antecedent variable influencing perceived usefulness (PU) and user satisfaction (SAT). These, in turn, are hypothesized to determine continuance intention (CI) toward digital library technologies. In addition, perceived ease of use (PEOU) and system quality (SQ) are introduced as exogenous predictors of continuance intention, extending the ECM to capture system-related dimensions. The structural relationships among the constructs are represented by the following equations:

$$PU = \beta_1 EC + \varepsilon_1 \quad (1)$$

$$SAT = \beta_2 EC + \beta_3 PU + \varepsilon_2 \quad (2)$$

$$CI = \beta_4 PU + \beta_5 SAT + \beta_6 PEOU + \beta_7 SQ + \varepsilon_3 \quad (3)$$

In these equations, $PU$ denotes perceived usefulness, $SAT$ represents user satisfaction, and $CI$ is the behavioral intention to continue using digital library services. $EC$ stands for expectation confirmation, defined as the degree to which students' experiences align with their initial expectations. $PEOU$ captures perceived ease of use, referring to the extent to which students find the digital services user-friendly, while $SQ$ reflects system quality, encompassing factors such as system reliability, accessibility, and response time. The coefficients $\beta_1$ through $\beta_7$ denote the structural path coefficients, and $\varepsilon_1$, $\varepsilon_2$, and $\varepsilon_3$ represent the corresponding error terms. Figure 1 provides the flowchart of the expectation confirmation model.

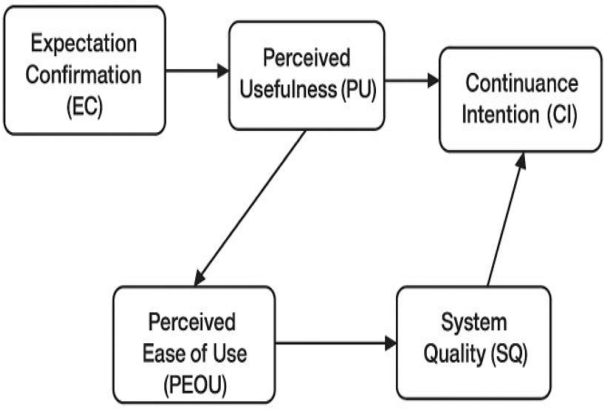


**Figure 1:** Expectation Confirmation Model Flowchart

All latent variables in the model are measured through multiple indicators adapted from prior validated instruments. Expectation confirmation and perceived usefulness are measured using scale items from Bhattacherjee (2001). Satisfaction is operationalized using items reflecting overall contentment with the digital service experience, while perceived ease of use is assessed using measures adapted from the Technology Acceptance Model (Venkatesh et al., 2003). System quality constructs are based on DeLone and McLean's (2003) IS success model, incorporating items on reliability, system uptime, and user interface functionality. Continuance intention is measured by students' stated likelihood of future use and recommendation of the digital services.

The study sample consists of university students enrolled across five academic institutions in Lagos State, Nigeria. A stratified random sampling technique was adopted to ensure representative coverage across public and private universities, faculties, and academic levels. The data were collected via an online questionnaire disseminated through institutional email lists and student forums. Responses were screened for completeness, resulting in 452 usable observations. All items were rated on a five-point Likert scale ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree").

Data analysis was conducted using SEM implemented in SmartPLS 4.0. The method was chosen due to its capacity to handle complex models involving latent variables and its robustness in analyzing reflective measurement models in small to medium samples. The reliability and validity of the measurement model were assessed using composite reliability, Cronbach's alpha, and average variance extracted (AVE), all of which met the recommended thresholds. Path coefficients were evaluated through bootstrapping with 5,000 subsamples to test the statistical significance of the hypothesized relationships. The overall model fit was

assessed using the standardized root mean square residual (SRMR), with values below 0.08 considered acceptable, as well as the normed fit index (NFI) and R-squared values for endogenous constructs.

The research design adheres strictly to ethical standards for studies involving human subjects. Informed consent was obtained electronically from all participants, and institutional ethical approval was secured prior to data collection. Participant anonymity and data confidentiality were maintained throughout, and the dataset was stored securely for academic purposes only. The methodological framework, therefore, provides a rigorous empirical foundation for evaluating how students' expectations, satisfaction, and perceptions of digital library services interact to influence their long-term usage behaviors.

## 4. Results and Implications

### 4.1. Results

Table 1 shows the reliability and convergent validity of the measurement model. reliability and convergent validity were assessed using Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and indicator loadings. All constructs demonstrated high internal consistency reliability, with Cronbach's alpha values ranging from 0.817 to 0.880, exceeding the commonly recommended threshold of 0.70 (Nunnally & Bernstein, 1994). Composite reliability scores were all above the acceptable cutoff of 0.70, further confirming internal consistency (Hair et al., 2019).

The AVE values ranged from 0.603 to 0.691, surpassing the 0.50 threshold, indicating that more than 50% of the variance in each construct is explained by its respective indicators. Furthermore, the indicator loadings for all items were above the recommended 0.70, signifying strong individual item reliability. Collectively, these results confirm that the measurement model exhibits adequate convergent validity and reliability for all latent constructs. Discriminant validity (in Table 2) was assessed using the Fornell-Larcker criterion. The square root of each construct's AVE was greater than the corresponding inter-construct correlations, as evidenced by the bold diagonal values in Table 2. For example, the square root of AVE for Continuance Intention (0.832) was greater than its correlation with Perceived Usefulness (0.719) and Satisfaction (0.655), indicating sufficient discriminant validity (Fornell & Larcker, 1981). The construct Expectation Confirmation demonstrated discriminant validity with its highest correlation being 0.589 (with PU), which is lower than the square root of its AVE (0.808). This pattern was consistent across all constructs, confirming that each latent variable in the model is empirically distinct from the others.

**Table 1:** Measurement Model Assessment

| Construct | Cronbach's Alpha | Composite Reliability (CR) | Average Variance Extracted (AVE) | Indicator Loadings (Range) |
|---|---|---|---|---|
| Expectation Confirmation (EC) | 0.842 | 0.889 | 0.652 | 0.730 – 0.880 |
| Perceived Usefulness (PU) | 0.865 | 0.906 | 0.678 | 0.740 – 0.900 |
| Satisfaction (SAT) | 0.830 | 0.876 | 0.615 | 0.710 – 0.870 |
| Perceived Ease of Use (PEOU) | 0.817 | 0.868 | 0.603 | 0.700 – 0.860 |
| System Quality (SQ) | 0.849 | 0.890 | 0.642 | 0.730 – 0.885 |
| Continuance Intention (CI) | 0.880 | 0.914 | 0.691 | 0.760 – 0.910 |

**Source:** Author (2025)

**Table 2:** Discriminant Validity (Fornell-Larcker Criterion)

| Construct | EC | PU | SAT | PEOU | SQ | CI |
|---|---|---|---|---|---|---|
| EC | **0.808** | | | | | |
| PU | 0.589 | **0.823** | | | | |
| SAT | 0.532 | 0.678 | **0.784** | | | |
| PEOU | 0.470 | 0.510 | 0.455 | **0.777** | | |
| SQ | 0.525 | 0.574 | 0.497 | 0.613 | **0.801** | |
| CI | 0.564 | 0.719 | 0.655 | 0.498 | 0.551 | **0.832** |

**Note:** Bold values on diagonal are square roots of AVE.

**Source:** Author (2025)

The structural model results (in Table 3) indicate strong empirical support for the proposed hypotheses. Expectation Confirmation had a significant and substantial effect on Perceived

Usefulness (β = 0.611, $p < 0.001$) and Satisfaction (β = 0.288, $p < 0.001$), suggesting that when students' expectations regarding digital library services are met, their perceptions of usefulness and satisfaction increase accordingly. This aligns with core assumptions of the Expectation Confirmation Model (Bhattacherjee, 2001). Perceived Usefulness significantly influenced both Satisfaction (β = 0.443, $p < 0.001$) and Continuance Intention (β = 0.315, $p < 0.001$), indicating that usefulness is a strong predictor of both affective (satisfaction) and behavioral (intention) responses. Satisfaction also had a direct, positive, and significant influence on Continuance Intention (β = 0.350, $p < 0.001$), reinforcing its role as a key mediator in post-adoption behavior. Perceived Ease of Use (β = 0.172, $p < 0.001$) and System Quality (β = 0.215, $p < 0.001$) both had statistically significant paths to Continuance Intention, highlighting the importance of usability and technical performance in shaping ongoing engagement with digital services.

The evaluation of global model fit (in Table 4) indicated an acceptable level of fitness. The SRMR value of 0.054 is well below the recommended maximum threshold of 0.08, suggesting a good fit between the hypothesized model and the observed data (Henseler et al., 2014). Similarly, the Normed Fit Index (NFI) value of 0.913 exceeds the 0.90 benchmark, further supporting the model's adequacy. The chi-square/df ratio of 2.45 also falls within the acceptable range (less than 3.0), indicating a good fit. R-squared values for endogenous constructs show substantial explanatory power: 37.3% of the variance in Perceived Usefulness, 62.1% in Satisfaction, and 71.5% in Continuance Intention are explained by the model. These $R^2$ values are considered moderate to substantial (Cohen, 1988), suggesting that the model captures key determinants of continued usage behavior.

**Table 3:** Structural Model Path Coefficients and Significance

| Hypothesized Path | Path Coefficient (β) | t-Value | p-Value | Supported? |
|---|---|---|---|---|
| EC → PU | 0.611 | 12.345 | <0.001 | Yes |
| EC → SAT | 0.288 | 6.237 | <0.001 | Yes |
| PU → SAT | 0.443 | 9.822 | <0.001 | Yes |
| PU → CI | 0.315 | 7.114 | <0.001 | Yes |
| SAT → CI | 0.350 | 8.020 | <0.001 | Yes |
| PEOU → CI | 0.172 | 4.113 | <0.001 | Yes |

| Hypothesized Path | Path Coefficient (β) | t-Value | p-Value | Supported? |
|---|---|---|---|---|
| SQ → CI | 0.215 | 5.480 | <0.001 | Yes |

Source: Author (2025)

**Table 4:** Model Fit Indices

| Fit Index | Value | Threshold/Rule of Thumb |
|---|---|---|
| Standardized Root Mean Square Residual (SRMR) | 0.054 | < 0.08 |
| Normed Fit Index (NFI) | 0.913 | > 0.90 |
| Chi-square/df | 2.45 | < 3.00 |
| R-squared (PU) | 0.373 | — |
| R-squared (SAT) | 0.621 | — |
| R-squared (CI) | 0.715 | — |

**Source:** Author (2025)

### 4.2. Policy Implications

The findings of this study offer several critical policy implications for higher education administrators, digital infrastructure planners, and information policy makers in Nigeria. At the core of the evidence is the affirmation that student satisfaction, perceived usefulness, and system quality are statistically significant drivers of students' continued intention to use digital library services. These insights are aligned with broader digital transformation literature, emphasizing the role of user-centered system design and expectation management in promoting technology adoption and retention in educational contexts (Venkatesh et al., 2016; Alshibly, 2018).

From an economic standpoint, digital libraries represent a quasi-public good, characterized by high fixed costs but near-zero marginal costs of distribution. As such, efficiency gains from investment in digital infrastructure are amplified when user adoption and retention are maximized. This justifies public and institutional investment in not only hardware and software but also in optimizing user experience. Policy makers should therefore prioritize user feedback loops, ongoing system upgrades, and training programs, which are proven mechanisms for improving system quality and perceived ease of use (Ifinedo, 2017; Sife et al., 2020).

Comparative studies across emerging economies lend support to this strategy. For instance, research conducted in South Africa and Kenya indicates that when library management systems were integrated with mobile access, satisfaction and continued usage intentions rose significantly, particularly among rural and underserved students (Mutula & Wamukoya, 2019). These results mirror the significance of perceived usefulness and ease of access, as confirmed in this study, and suggest that mobile-first digital service strategies could enhance the inclusivity and reach of academic libraries in Nigeria.

Further, the importance of expectation confirmation as a precursor to perceived usefulness and satisfaction underscores the role of expectation management through orientation programs and service transparency. Universities should implement structured digital literacy workshops during student induction to align expectations with actual functionalities of digital library platforms. Evidence from Chinese and Indian universities supports this approach, showing that expectation-setting interventions increase satisfaction and reduce churn in digital academic service use (Zhou, 2021; Patel et al., 2023).

Promoting sustained usage of digital library systems contributes to knowledge accumulation, improved academic performance, and digital fluency - factors that are positively correlated with labor productivity and long-run economic growth (Hanushek & Woessmann, 2015). Thus, enhancing the continuity of digital service usage in academic libraries is not merely a matter of service optimization but also a strategic lever for national development.

Finally, universities in Nigeria can benefit from benchmarking their digital transformation policies against successful international frameworks such as the Digital Education Action Plan (DEAP) by the European Commission and the Next Generation Digital Learning Environment (NGDLE) by EDUCAUSE. Both emphasize interoperability, user experience, and evidence-driven improvements, which closely align with the key constructs validated in this study—particularly system quality and ease of use.

## 5. Conclusions

This study has offered a comprehensive empirical assessment of the factors influencing university students' continued use of digital library services in Nigeria, using the ECM as the theoretical framework. Through structural equation modeling, it was established that expectation confirmation exerts a significant influence on perceived usefulness and satisfaction, both of which are key predictors of continuance intention. Furthermore, perceived ease of use and system quality also contribute meaningfully to sustained usage behavior. These results reinforce the central role of post-adoption beliefs in shaping digital technology

engagement, confirming previous findings from both global and African contexts (Bhattacherjee, 2001; Ifinedo, 2017; Venkatesh et al., 2016). The strong explanatory power of the model further substantiates the relevance of ECM in evaluating digital service utilization in academic settings within developing countries.

These findings yield several important implications for institutional policy and practice. First, there is a clear need to invest in system quality and usability enhancements. Given that students' satisfaction and continued usage are significantly influenced by their interaction with the system's reliability, responsiveness, and ease of access, decision-makers must ensure that digital library platforms are technically sound, intuitive, and adaptable to various user needs. Comparative studies from emerging economies such as Kenya, India, and Brazil have similarly shown that well-designed digital infrastructure leads to higher adoption and retention rates (Waweru & Mutula, 2022; Patel et al., 2023; Silva et al., 2018). Second, expectation management should be institutionalized. Orientation sessions and onboarding materials should include clear communication about what digital library systems offer and what users can realistically expect. Such efforts align with research indicating that when expectations are accurately formed and subsequently confirmed, user satisfaction increases substantially (Zhou, 2021).

Another critical recommendation is the promotion of structured digital literacy programs. Libraries should collaborate with ICT departments to deliver periodic training for students, particularly first-year entrants and students from rural backgrounds who may lack prior exposure to digital academic resources. Evidence from Ghana and Tanzania suggests that digital training initiatives significantly improve user satisfaction and reduce dropout rates from digital services (Agyekum et al., 2019; Sife et al., 2020). In addition, mobile-first design strategies should be prioritized. With a growing percentage of Nigerian students accessing online content via smartphones, optimizing digital library platforms for mobile use would enhance accessibility and inclusivity. Studies in South Africa and other parts of sub-Saharan Africa affirm that mobile-optimized systems enhance digital participation, especially in low-connectivity areas (Chigwada, 2021; Mutula & Wamukoya, 2019). A final recommendation is the integration of feedback-driven development models. By embedding real-time feedback tools into library platforms, institutions can respond adaptively to emerging user needs, thereby reinforcing system quality and user satisfaction over time.

Nevertheless, this study is not without limitations. The data were collected exclusively from university students in Lagos State, which may restrict the generalizability of the findings to other geopolitical regions with different infrastructure levels and socio-educational contexts.

Furthermore, the research employed a cross-sectional design, limiting the ability to infer causal relationships over time. Longitudinal data would provide deeper insights into how user perceptions and behaviors evolve, especially in dynamic digital environments. The study also relied on self-reported data, which, while methodologically sound with appropriate validation steps, may be subject to social desirability bias or recall errors. In addition, while ECM provided a robust lens for understanding post-adoption behavior, it does not capture all possible determinants such as social influence, institutional support, or technological anxiety, which may be particularly relevant in the Nigerian context (Wang et al., 2020).

Future research could benefit from several methodological and conceptual enhancements. Expanding the study to include universities across Nigeria's diverse regions would enhance external validity and offer comparative insights into how infrastructural disparities influence digital service adoption. Researchers could also employ longitudinal panel data to capture shifts in expectation and satisfaction over time, enabling more rigorous causal inference. Incorporating complementary theoretical frameworks, such as the Unified Theory of Acceptance and Use of Technology (UTAUT) or the Technology-Organization-Environment (TOE) framework, would allow for the integration of institutional and contextual variables that may mediate or moderate the relationships identified in this study. Qualitative research approaches, such as in-depth interviews and focus group discussions, could also yield nuanced perspectives on users' motivations, barriers, and lived experiences with digital library services. Finally, future studies should also examine the broader economic and equity implications of digital library adoption. While digital services hold the promise of democratizing access to academic resources, they may inadvertently deepen inequalities if infrastructural or socioeconomic disparities are not adequately addressed. Research that investigates whether digital investments lead to measurable academic or labor market outcomes would be especially valuable, given the centrality of digital literacy and access to knowledge in national development strategies (Hanushek & Woessmann, 2015). Thus, future inquiry should not only deepen the behavioral understanding of digital service use but also explore the systemic and distributive impacts of such technologies in the educational landscape.

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