The International Journal of Learning Spaces Studies (IJLSS)

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ORIGINAL RESEARCH ARTICLE

Determinants of Students' LMS Use Behaviour Post-COVID in an ODL-Based Institution in Nigeria: A Multi-Theoretical Framework Approach

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ARTICLE INFO

Article History:
Received: 2025-07-24
Revised: 2025-08-24
Accepted: 2025-08-28
Published Online: 2025-09-01

Keywords:
Learning management systems, Attitudes, Behavioural intention, Use behaviour, post-COVID-19

Number of Reference: 93
Number of Figures:
Number of Tables:

DOI:

ABSTRACT

This study investigated the determinants of students' use of LMS within the distinctive context of an ODL-based university post-COVID-19 in Nigeria. The Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB), and Unified Theory of Acceptance and Use of Technology (UTAUT) were integrated as the theoretical framework for the study. A quantitative research design was adopted, and 120 students participated in the study. Data were collected using an e-survey, and a Structural Equation Modelling (SEM) technique was used to analyse the data. The results of the study indicate that perceived usefulness (slope = 0.79, $p < 0.001$), perceived ease of use (slope = 0.86, $p < 0.001$), and digital literacy (slope = 0.81, $p < 0.001$) significantly influenced attitudes toward LMS use. Also, performance expectancy (slope = 0.37, $p<0.00$), effort expectancy (slope = 0.60, $p<0.00$), social influence (slope = 0.62, $p<0.00$) and facilitating conditions (slope = 0.70, $p<0.00$) significantly predicted students' intention. Further, facilitating conditions (slope = 0.59, $p<0.00$) and intention (slope = 0.57, $p<0.00$) significantly influence LMS use behaviour. Based on these results, it was recommended that LMS design and implementation in the university should focus on creating an LMS that is intuitive, user-friendly and aligns with students' academic needs. This will make navigation of the platform easy for the students. Thus, enhancing their attitude, intention and use of the LMS for learning post-COVID. **©authors**

►**Citation:** Abidemi Itasanmi, S., & Mampane, J. (2025). Determinants of Students' LMS Use Behaviour Post-COVID in an ODL-Based Institution in Nigeria: A Multi-Theoretical Framework Approach. *The International Journal of Learning Space Studies (IJLSS), 3(3): 16-35.*

Introduction

The advent and continual advancements in Information Communication Technologies (ICTs) have significantly transformed education delivery across the world, especially during the post-COVID-19 era (Kant et al., 2021; Castiello-Gutiérrez et al., 2022). Integrating technologies in instructional delivery has become a defining feature of 21st-century education (Vivekanandan, 2019). The COVID-19 pandemic acted as a catalyst, accelerating technology adoption and pushing higher education institutions toward an era of ubiquitous learning (Alturki & Aldraiweesh, 2021). ICTs now offer students access to high-quality educational resources, flexible learning opportunities, and seamless communication (Swart, 2015; Sarsekeyev & Sarsenova, 2023), redefining education beyond the confines of the traditional classroom (Palaming, 2022; Itasanmi, 2022).

Learning Management Systems (LMS) have emerged as powerful tools in this digital transformation, providing an online environment to manage, deliver, and track educational content and performance (Turnbull et al., 2020; Mthethwa-Kunene & Maphosa, 2020). LMS adoption is especially important in African universities, where it supports flexible and cost-effective learning while increasing access to education (Dampson, 2021). In Open Distance Learning (ODL) contexts, where students are geographically dispersed and require adaptable modes of engagement, LMS play an even greater role (Kumar et al., 2021). ODL institutions across Sub-Saharan Africa have embraced LMS to provide accessible learning materials, improve instruction, and reduce costs, with LMS usage growing at an estimated rate of 5% annually since 2011 (Bervell & Umar, 2017; Yakubu et al., 2020).

In Nigeria, the National Open University of Nigeria (NOUN) has significantly leveraged LMS to achieve its mandate of providing accessible and affordable education nationwide (National Open University of Nigeria, n.d.). Before the COVID-19 pandemic, increasing student enrollment and the need for scalable solutions propelled LMS adoption in NOUN and other ODL institutions (Adamu & Adesina, 2021). The pandemic further accelerated this adoption, ensuring instructional continuity and enabling remote learning (Itasanmi et al., 2022; Nannim et al., 2023).

Despite these advances, the effective use of LMS in ODL institutions in Nigeria has not met expectations. Studies have revealed that LMS usage remains limited, with high rejection rates compared to developed countries (Eberendu, 2015; Cavus et al., 2021). Students often underutilise LMS or fail to persist in using it after initial exposure (Salloum & Shaalan, 2018). Additionally, key barriers such as initial acceptance failures have been identified (Bervell & Umar, 2017), raising concerns over LMS adoption in developing contexts, particularly within the post-COVID-19 educational environment (Ajijola et al., 2021).

Existing studies have examined various factors influencing LMS adoption, including perceived usefulness, perceived ease of use, trust, satisfaction, social influence, system quality, and behavioural intention (Mthethwa-Kunene & Maphosa, 2020; Joo et al., 2016; Bervell & Umar, 2017; Yakubu et al., 2020). However, most of these studies focus on students in conventional higher education settings rather than in ODL environments. Furthermore, few have considered the post-COVID-19 context or incorporated other critical factors such as digital literacy, which research suggests is a key determinant of technology adoption (Mabila et al., 2014; Suryawidjaja, 2023).

This gap highlights the need to examine the determinants of LMS use among ODL students in Nigeria in the post-COVID-19 era. By integrating constructs from the Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB), and Unified Theory of Acceptance and Use of Technology (UTAUT), this study seeks to identify the factors that influence ODL students' attitudes, intentions, and actual LMS usage behaviour post-OVID-19. Addressing this gap is crucial for improving LMS adoption, enhancing student learning experiences, and maximising the potential of LMS in expanding access to quality education in Nigeria's ODL system.

Research Objectives

Generally, this study aims to examine the determinants of LMS use among ODL students in Nigeria in the post-COVID-19 era. Specifically, the study seeks to:

1. Examine the influence of perceived usefulness (PU) and perceived ease of use (PEOU) on students' attitudes towards LMS in an ODL institution post-COVID-19.
2. Determine the effect of digital literacy on students' attitudes, intention, and actual use behaviour of LMS post-COVID-19.
3. Investigate the effect of subjective norms and perceived behavioural control on students' intention to use LMS post-COVID-19.
4. Assess the influence of performance expectancy, effort expectancy, social influence, and facilitating conditions on students' intention to use LMS post-COVID-19.
5. Evaluate the influence of facilitating conditions, attitude, and behavioural intention on students' actual use of LMS post-COVID-19.
6. Analyse the moderating effects of age and gender on the relationships between digital literacy, attitude, intention, and LMS use behaviour, as well as between selected technology acceptance constructs and intention.

Literature Review

Research on Learning Management System (LMS) adoption has primarily focused on identifying factors influencing user acceptance and usage, yet significant gaps remain in understanding these dynamics within Nigeria's Open and Distance Learning (ODL) context. This study critically integrates the Technology Acceptance Model (TAM) (Davies, 1989), Theory of Planned Behaviour (TPB) (Ajzen, 1991), and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) to highlight their strengths, limitations, and applicability in explaining LMS adoption among Nigerian ODL students. It is believed that an integrated TAM-TPB-UTAUT framework, incorporating digital literacy, is essential to address the unique socio-technical challenges in this setting.

TAM posits that perceived usefulness (PU) and perceived ease of use (PEOU) drive users' attitudes and intentions toward LMS adoption (Davies, 1989). Studies such as (Fathema et al., 2015; Radif et al., 2016) demonstrate TAM's efficacy in predicting LMS acceptance by emphasising PU's role in enhancing learning outcomes and PEOU's reduction of effort barriers. However, TAM's narrow focus on PU and PEOU limits its explanatory power, as it excludes external variables like social influence and contextual factors such as Nigeria's infrastructural constraints (Ajibade, 2018). This limitation is particularly critical in the Nigerian ODL context, where access to technology and digital proficiency vary widely.

TPB extends TAM by incorporating attitude, subjective norms (SN), and perceived behavioural control (PBC) to predict behavioural intention (Ajzen, 1991). Research applying TPB to LMS adoption (Habibi et al., 2021; Mouloudj, et al., 2021; Hayford et al., 2022; Ngafeeson et al., 2024) underscores PBC's relevance in capturing users' perceived control in resource-limited settings. However, TPB's emphasis on intention over actual use restricts its ability to explain sustained LMS engagement (Ngafeeson & Gautam, 2021). Additionally, TPB fails to account for system-specific factors (e.g., LMS quality) and individual characteristics like digital literacy, which are critical in Nigeria's diverse ODL landscape.

UTAUT integrates TAM and TPB constructs, proposing that performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) predict behavioural intention and actual use, moderated by age, gender, experience, and voluntariness (Venkatesh et al., 2003). Studies such as (Budiman et al., 2017; Garone et al., 2019; Sezer & Yilmaz, 2019; Yakubu et al., 2019; Tussardi et al., 2021; Pagán & Medina, 2021; Al-Mamary, 2022) validate UTAUT's applicability to LMS adoption. Extensions incorporating self-efficacy, anxiety, and attitude (Liebenberg et al., 2018) or integrating TAM constructs (Buabeng-Andoh & Baah, 2020b) enhance its scope. However, UTAUT's

broad constructs may overlook Nigeria-specific barriers, such as limited infrastructure and cultural influences on SI (Njenga, 2011; Yakubu & Dasuki, 2018).

LMS adoption in Nigeria's ODL setting is complicated by infrastructural limitations, inconsistent internet access, and varying digital literacy levels (Yakubu & Dasuki, 2018; Govender & Moonsamy, 2018; Yakubu, 2019; Petersen, 2020; Matarirano et al., 2021). While studies like (Buabeng-Andoh Baah, 2020b) apply TAM and UTAUT to highlight PU, PEOU, PE, and FC, they neglect digital literacy's mediating role and fail to integrate multiple theoretical perspectives, limiting their ability to capture the post-COVID-19 ODL dynamics.

To the best of the researchers' knowledge, no Nigerian ODL study has integrated TAM, TPB, and UTAUT to holistically examine LMS adoption, nor has digital literacy's influence been assessed. An integrated model combining TAM's PU and PEOU, TPB's SN and PBC, and UTAUT's PE, EE, SI, FC, and moderators (age, sex, digital literacy) addresses these gaps by capturing attitudinal, social, and contextual determinants. It is expected that this framework will enhance predictive validity by accounting for Nigeria's unique socio-technical constraints, such as limited FC and cultural influences on SN. Incorporating digital literacy as a moderator responds to the heterogeneous technological proficiency among ODL students, a factor unaddressed in prior studies. This model will therefore provide a nuanced analysis of LMS adoption drivers, facilitating targeted interventions to enhance engagement and optimise learning outcomes in Nigerian ODL universities post-COVID-19.

The study utilised a multi-framework approach that involves integrating 3 theories to investigate LMS use behaviour post-COVID-19 among students in an ODL-based institution in Nigeria. The constructs of the various theories were used to develop the proposed research model. Figure 1 shows the proposed research model. Each of the constructs in the proposed research model is defined, and the associated relationships are explained below:

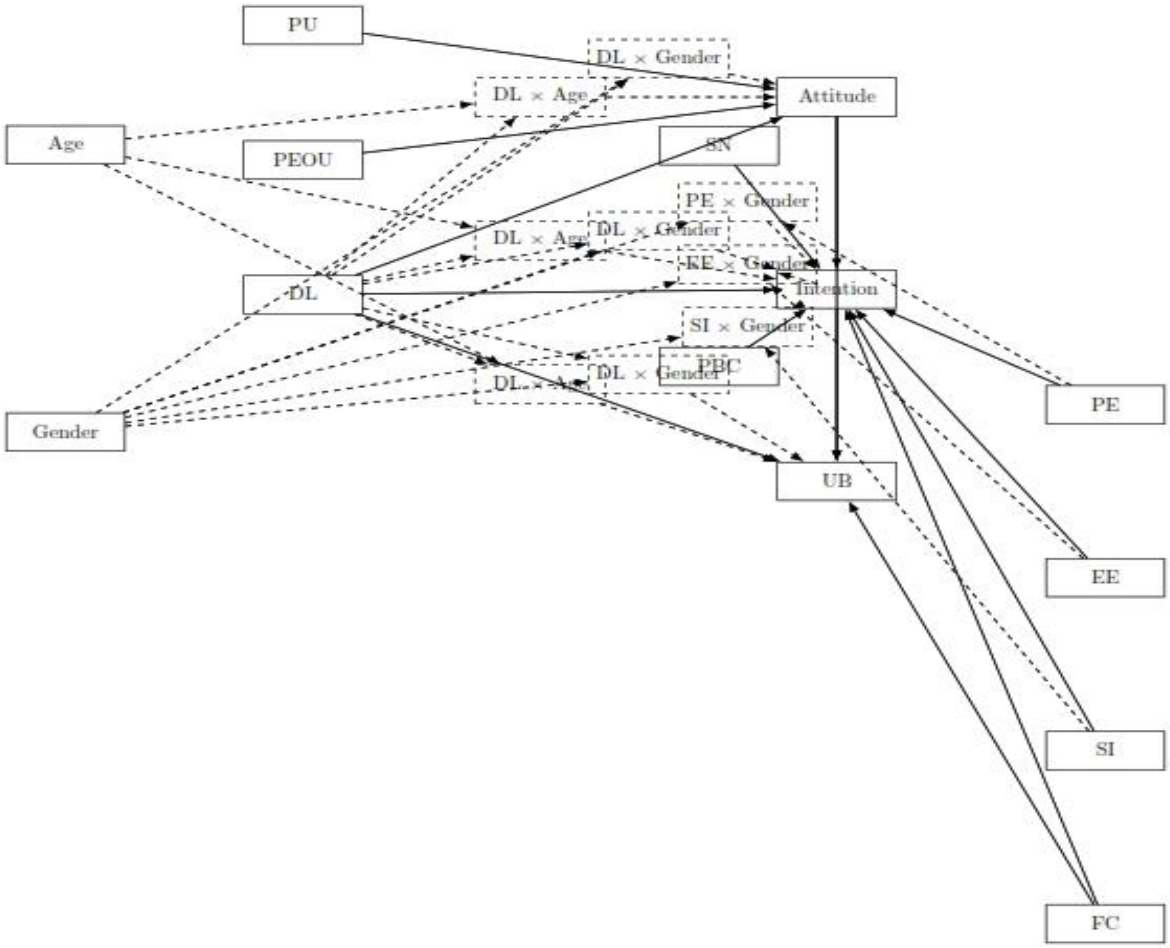

Figure 1. *Proposed research model*

Perceived usefulness (PU) is derived from TAM and refers to the degree to which an individual believes that using a particular system (LMS)would enhance his or her academic outcomes (Worthington & Burgess, 2021). PU is expected to influence students' attitudes towards LMS post-COVID-19. Therefore, the research posits that:

- PU will significantly influence students' attitudes towards LMS post-COVID-19

Perceived Ease of Use (PEOU) is another TAM construct that refers to the extent to which an individual believes that using a particular technological tool would require little effort (Worthington & Burgess, 2021). The researcher believes that PEOU is expected to influence students' attitudes towards LMS post-COVID-19. Thus:

- PEOU will significantly influence students' attitudes towards LMS post-COVID-19

Digital literacy refers to an individual's ability to access, understand, evaluate and communicate information using technology (Itasanmi & Ajani, 2023). Digital literacy is an important learning influence and has been associated with learner autonomy within the context of distance education (Prior et al., 2016). Navigating the LMS platform requires students to have digital literacy skills that will make them more comfortable accessing course materials, using various LMS functionalities and participating in online discussions (Mabila et al., 2014). It is believed that students who possess strong digital literacy skills are more likely to perceive LMS as a valuable tool, which might influence their intention and actual use of it post-COVID-19. Thus, it is posited that:

- Digital literacy will significantly influence students' attitudes towards LMS post-COVID-19
- Digital literacy will significantly influence students' intention to use LMS post-COVID-19
- Digital literacy will significantly influence students' LMS use behaviour post-COVID-19

Subjective norms are one of the constructs of TPB, and they refer to an individual's perception that important others (friends, family, peers, instructor) expect him or her to adopt a particular behaviour (Peters & Templin, 2010). ODL Students who perceive their instructors and peers valuing and emphasising the importance of using LMS for learning are more likely to develop a positive intention to use it for learning post-COVID-19 (Almarashdeh et al., 2011). Therefore:

- Subjective norms will significantly influence students' intention to use LMS post-COVID-19

Perceived Behavioural control is another concept within the TPB that refers to an individual's belief in their ability to perform a particular behaviour (Ajzen, 1991). Students' confidence in his or her ability to navigate the LMS platform, including using its various functionalities and surmounting all technical challenges that may arise using it (Ngafeeson & Gautam, 2021). This could potentially influence their intention to engage with the LMS post-COVID-19. Therefore:

- Perceived behavioural control will significantly influence students' intention to use LMS post-COVID-19

Performance expectancy (PE) is a core term in the UTAUT model developed by Venkatesh et al. (2003). According to them, PE refers to an individual's belief that using a certain technological tool will enhance his or her performance in achieving a goal. ODL Students' belief that using LMS will help them to improve learning outcomes, understand the course material and achieve better grades may influence their intention to use it post-COVID-19 (Yuen et al., 2019). Therefore:

- Performance expectancy will influence students' intention to use LMS post-COVID-19

Effort expectancy (EE) is another construct of the UTAUT model that measures the degree of ease associated with the use of an information system (Venkatesh et al., 2003). Within the context of LMS use, effort expectancy is the degree of expectation of students that the use

of LMS will not be characterised by physical and mental efforts (Onaolapo & Oyewole, 2018). According to Ghalandari (2012), EE is based on the notion that there are connections between the effort exerted in work, the resulting performance, and the rewards obtained from that effort. ODL Students who perceive the LMS as user-friendly and easy to learn are more likely to have a strong intention to use it post-COVID-19. Thus,

- Effort expectancy will influence students' intention to use LMS post-COVID-19

Social influence (SI) is defined as the extent to which an individual perceives that people who are important to him or her think he or he should use the information system (Venkatesh et al., 2012). SI captures the influence of people important to the students to use the LMS for learning. Among those that could be important to the ODL students are instructors and classmates (Yakubu et al., 2019). UTAUT model specifically indicated that SI exerts a significant influence on behavioural intention. Thus:

- Social influence will significantly influence ODL students' behavioural intention to use LMS post-COVID-19

Facilitating Conditions (FC) is among the four UTAUT constructs that refer to the resources and support structures required for using a particular information system (Venkatesh et al., 2012). Within the context of LMS use in ODL universities, students need reliable internet access, digital tools, training opportunities, technical support and others to seamlessly navigate the LMS platform (Onaolapo & Oyewole, 2018). Having adequate resources and support structures will influence students' willingness to use the LMS, and this may translate into them actively engaging with it to access course contents, participate in discussions and complete learning activities post-COVID-19. Therefore:

- Facilitating conditions will significantly influence ODL students' behavioural intention to use LMS post-COVID-19
- Facilitating conditions will significantly influence ODL students' actual usage of LMS post-COVID-19

Attitude toward use refers to the positive or negative feelings individuals have about performing a particular behaviour and how these feelings can influence their use behaviour (A.trayek & Hassan, 2013). Within the context of LMS, it is the students' beliefs, feelings and overall disposition towards using LMS for learning. Attitude towards the use of technology has been found to directly influence willingness to use and frequency of use (Kiraz & Ozdemir, 2006; Teo, 2009; Itasanmi, 2022). The research, therefore, posits that:

- Attitude towards LMS will significantly influence ODL students' intention to use LMS for learning post-COVID-19
- Attitude towards LMS will significantly influence ODL students' actual use of LMS post-COVID-19

Behavioural intention refers to the likelihood of a person performing or carrying out a specific behaviour. It is also defined as an individual's planned behaviour, which can be explained by their intention regarding their personal decision to engage in certain future behaviours (Tey & Moses, 2018). Several scholars have argued that behavioural intention is the most significant predictor of actual usage behaviour. According to Ajzen (1991), the motivational factor that influences behaviour is considered to be the intention. Within the context of LMS use, BI captures the ODL students' intention to use the LMS for learning. Therefore, it is expected that:

- Behavioural intention will significantly influence LMS use post-COVID-19

LMS use behaviour refers to the frequency with which ODL students utilise the LMS platform for academic activities (Yakubu et al., 2019). The proposed research model (Fig. 1) indicates that digital literacy, facilitating conditions, attitude and behavioural intention are the only direct determinants of LMS use behaviour post-COVID-19 among ODL students.

Studies have shown that certain demographic factors, particularly age and gender, have been deemed significant moderators in technology acceptance models (Venkatesh et al., 2003;

Khechine et al., 2014; Acheampomg & Boateng, 2018). The researcher, therefore, posits that:

- Age will significantly influence the relationships between digital literacy and attitude, digital literacy and intention and digital literacy and use behaviour of LMS
- Gender will significantly influence the relationships between digital literacy and attitude, digital literacy and intention, digital literacy and use behaviour of LMS, performance expectancy and intention, effort expectancy and intention and social influence and intention.

Method

Research Design

The study adopted a quantitative research design to gain an understanding of factors that determine and influence LMS use post-COVID-19 among students in an ODL-based university in Nigeria. This design is considered appropriate because it allows the researchers to collect large amounts of data that can be quantitatively analysed. This will help to identify structural patterns and levels of association among the model constructs.

Research Population and Sampling

The population for this study consisted of students studying to obtain a bachelor's degree (first degree) in the selected ODL-based university in Nigeria. The ODL-based institution chosen for this research is the National Open University of Nigeria (NOUN), being the foremost ODL institution in the country. The institution is established and funded by the Federal Government of Nigeria; it is purely ODL-based and offers academic programmes leading to the award of bachelor's degrees. A multistage sampling technique was employed to select participants from NOUN study centres across the six geopolitical zones. At first, NOUN study centres were divided into six strata based on the Nigerian six geopolitical zones (North-West, North-East, North-Central, South-West, South-South, and South-East). Within each geopolitical zone, one study centre was purposively selected for the study. 20 students in each of the selected study centres across the country participated in the study using simple random sampling techniques.

A detailed breakdown of the participants' demographic information indicates that the majority are young adults (54.2%), with the remaining 45.8% being older adults. Gender representation is balanced, with equal proportions of males and females (50% each). Also, the majority of them are married (55.8%), followed by singles (38.3%), while the least represented groups are widowed (3.3%) and divorced (0.8%). Employment status indicates that most respondents are employed (65.8%), with 19.2% self-employed and 15% unemployed. Their programme level shows a gradual increase in representation from lower to higher levels, with the highest percentage of respondents in their 500L (31.7%) and the least in 100L (12.5%).

Table 1. *Demographic Information*

Parameter	Choices	Frequency	Percent
Age	Old Adult	55	45.8
	Young Adult	65	54.2
Gender	Female	60	50
	Male	60	50
Marital Status	Divorced	1	0.8
	Married	67	55.8
	Separated	2	1.7
	Single	46	38.3
	Widowed	4	3.3

Employment Status	Employed	79	65.8
	Self-Employed	23	19.2
	Unemployed	18	15
Programme Level	100L	15	12.5
	200L	19	15.8
	300L	19	15.8
	400L	29	24.2
	500L	38	31.7

Instrumentation

The study utilised an anonymised online questionnaire to collect data from the students. The questionnaire was divided into 2 domains. The first domain contains questions on the demographic characteristics of the participants, namely, age group, gender, marital status, employment status, level of study, and regions of residence. The second domain contained items adapted from existing studies (Weng et al., 2018; Ngafeeson & Gautam, 2021; Humida et al., 2021; Abbad, 2021; Itasanmi, 2022) to measure various constructs in the proposed model for the study. The items were anchored on a five (5 Likert rating scale. The questionnaire was pilot-tested among thirty (30) students of the University of Ibadan Distance Learning Centre who are in the category of the study's population but not part of the main study. The Cronbach alpha coefficient of 0.72 obtained revealed that the questionnaire was reliable.

Ethics Approval

Ethics approval for the study was obtained from the UNISA College of Education Ethics Review Committee (Ref: 2024/07/12/00000077/02/RB), and permission to conduct the research in NOUN was granted. Participants were informed about the study's purpose and use of their data, assured of confidentiality, and their anonymity was maintained by not collecting personal information. Informed consent was obtained from all participants before their involvement.

Data Analysis

The data analysis for the study was conducted in several stages based on the general SEM model of analysis stages. The analysis started with the reliability and validity assessment of the study's constructs, followed by cross-loadings, model fit indices, and finally, the evaluation of path coefficients for the study constructs using Python 3.8.

Findings

Reliability Analysis of the Study's Constructs

The reliability analysis presented in Table 2 illustrates the internal consistency of various parameters related to the study's constructs. Notably, the highest Cronbach's Alpha values are observed for digital literacy (0.890), Performance Expectancy (0.882), and Perceived Usefulness (0.856), indicating strong reliability and suggesting that these constructs are measured consistently across the sample. However, most parameters exhibit satisfactory reliability with a Cronbach alpha value greater than 0.70. except for use behaviour

Table 2. *Reliability Analysis*

Parameter	Cronbach's Alpha
Digital Literacy	0.890
Perceived Usefulness	0.856
Perceived ease of use	0.843
Digital Literacy	0.892
Subjective Norms	0.680
Behavioural Control	0.769
Performance Expectancy	0.882
Effort Expectancy	0.799
Social Influence	0.738

Facilitating Condition	0.795
Behavioural Intention	0.855
Use Behaviour	0.390

Inter-Item Correlation Matrix for the Study's Construct

The inter-item correlation matrix in Table 3 shows the relationships among various constructs related to behavioural intention and LMS use behaviour. Each construct reflects a different aspect of user engagement, from digital literacy to behavioural intention and use behaviour. **Digital Literacy** shows moderate positive correlations with constructs such as **Perceived Usefulness** (0.383) and **Attitude towards Use** (0.356). This suggests that individuals with higher digital literacy tend to find technology more useful and hold a more favourable attitude towards its use. The correlation with **Behavioural Control** (0.286) indicates that those who are digitally literate feel more empowered to engage with technology effectively. **Perceived Usefulness** demonstrates the strongest correlations with several constructs, particularly **Perceived Ease of Use** (0.606) and **Attitude towards Use** (0.614). These findings suggest that users who perceive technology as useful are most likely to view it as easy to use and develop a positive attitude towards its application. Furthermore, the correlation with **Behavioural Intention** (0.483) reinforces that perceived usefulness significantly influences students' intentions to use the LMS for learning.

The correlation between **Perceived Ease of Use** and **Attitude towards Use** (0.701) is notably high, indicating that ease of use is a critical factor in shaping users' attitudes. Additionally, it has a moderate correlation with **Behavioural Intention** (0.417). This underscores its role in influencing future LMS use. **Subjective Norms**, reflecting social influences on behaviour, show a substantial correlation with **Behavioural Intention** (0.677). This indicates that the opinions and behaviours of others significantly impact students' intentions to use the LMS for learning. The correlation with **Social Influence** (0.616) further emphasises the importance of social context in shaping user behaviour. **Behavioural Control** reveals a strong correlation with both **Performance Expectancy** (0.610) and **Effort Expectancy** (0.661), suggesting that users who feel in control of their technology interactions are more likely to expect positive performance outcomes and perceive less effort in usage. Interestingly, the correlation between **Use Behaviour** and other constructs is notably lower, particularly with values such as 0.097 for **Digital Literacy** and 0.124 for **Perceived Usefulness**. This indicates that while various factors may influence users' intentions and attitudes, the actual behaviour of using LMS may not be as strongly related to these constructs, suggesting that other external factors or personal motivations may also play a significant role in determining actual LMS usage.

***Table 3**. Inter-Item Correlation*

	Digital Literacy	**Perceived Usefulness**	**Perceived ease of use**	**Attitude towards use**	**Subjective Norms**	**Behavioural Control**
Digital Literacy	1	0.383	0.313	0.356	0.279	0.286
Perceived Usefulness	0.383	1	0.606	0.614	0.414	0.446
Perceived ease of use	0.313	0.606	1	0.701	0.441	0.485
Attitude towards use	0.356	0.614	0.701	1	0.521	0.433
Subjective Norms	0.279	0.414	0.441	0.521	1	0.53
Behavioural Control	0.286	0.446	0.485	0.433	0.53	1
Performance Expectancy	0.281	0.544	0.637	0.612	0.469	0.61
Effort Expectancy	0.256	0.484	0.512	0.478	0.589	0.661
Social Influence	0.288	0.404	0.49	0.535	0.616	0.533
Facilitating Condition	0.296	0.47	0.459	0.448	0.598	0.661
Behavioural Intention	0.327	0.483	0.417	0.484	0.677	0.568
Use Behaviour	0.097	0.124	0.087	0.028	0.249	0.24
	Performance Expectancy	**Effort Expectancy**	**Social Influence**	**Facilitating Condition**	**Behavioural Intention**	**Use Behaviour**
Digital Literacy	0.281	0.256	0.288	0.296	0.327	0.097
Perceived Usefulness	0.544	0.484	0.404	0.47	0.483	0.124
Perceived ease of use	0.637	0.512	0.49	0.459	0.417	0.087
Attitude towards use	0.612	0.478	0.535	0.448	0.484	0.028
Subjective Norms	0.469	0.589	0.616	0.598	0.677	0.249
Behavioural Control	0.61	0.661	0.533	0.661	0.568	0.24

Performance Expectancy	1	0.537	0.56	0.505	0.582	0.141
Effort Expectancy	0.537	1	0.686	0.705	0.578	0.139
Social Influence	0.56	0.686	1	0.693	0.577	0.194
Facilitating Condition	0.505	0.705	0.693	1	0.642	0.253
Behavioural Intention	0.582	0.578	0.577	0.642	1	0.308
Use Behaviour	0.141	0.139	0.194	0.253	0.308	1

Cross-Loading Analysis of the Study's Constructs

The cross-loading analysis presented in Table 4 reveals a significant perception of the factor structure of the constructs under study. The results indicate that items such as "Attitude towards use" (0.840), "Perceived ease of use" (0.816), and "Perceived Usefulness" (0.751) demonstrate strong loadings on Component 1, suggesting they are well aligned with their intended factor and exhibit high validity in measuring the underlying construct of user attitudes. Conversely, the loading for "Digital Literacy" (0.491) indicates a weaker relationship with Component 1, suggesting it may not be as strongly associated with the attitudes of students as other items.

Notably, "Facilitating Condition" displays a dual loading, with a value of 0.403 on Component 1 and 0.748 on Component 2, indicating it may represent two distinct but related constructs. Similarly, "Behavioural Intention" (0.406) and "Subjective Norms" (0.402) also show substantial loadings on Component 2 (0.717 and 0.683, respectively), indicating potential overlaps with the factors of intention and norms in behavioural contexts. Items such as "Use Behaviour" (0.658) and "Behavioural Control" (0.655) also exhibit meaningful loadings on Component 2, further emphasising the complexity of the relationships between these constructs.

Table 4. *Cross-Loading Analysis*

	Component	
	1	2
Attitude towards use	.840	
Perceived ease of use	.816	
Perceived Usefulness	.751	
Performance Expectancy	.693	
Digital Literacy	.491	
Facilitating Condition	.403	.748
Behavioural Intention	.406	.717
Subjective Norms	.402	.683
Use Behaviour		.658
Behavioural Control	.442	.655
Social Influence	.475	.650
Effort Expectancy	.496	.646

Sampling Adequacy Analysis

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity, as presented in Table 5, provide strong evidence supporting the appropriateness of conducting factor loading analysis on the dataset. The KMO value of 0.907 indicates a high level of sampling adequacy, suggesting that the correlations among the variables are sufficiently strong for the analysis.

Generally, a KMO value above 0.6 is considered acceptable, with values closer to 1 indicating that the variables are highly correlated. Additionally, Bartlett's Test of Sphericity yields an approximate chi-square value of 789.372 with 66 degrees of freedom, and a significance level (Sig.) of 0.000. This result demonstrates that the correlation matrix significantly differs from an identity matrix, confirming the presence of relationships among the variables.

The combination of a high KMO value and a significant Bartlett's test strongly supports the conclusion that the data is suitable for the analysis, allowing the researcher to proceed with confidence in exploring the underlying factor structures of the constructs being studied.

Table 52. *KMO and Bartlett's Test*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.907
Bartlett's Test of Sphericity	Approx. Chi-Square	789.372
	df	66
	Sig.	.000

Model Fit Indices

The model was tested using multiple fit indices. Based on the value obtained in Table 6, the model showed mixed results. While some indices indicated an acceptable fit, others indicated a need for improvement. However, the researchers believe that due to the small sample size of the study, the chances of detecting true model fit are reduced. Thus, the fit indices presented below may not accurately reflect the model's performance.

Table 6. *Model Fit Results*

Fit Index	Results	Cutoff Criteria	Comment
Chi-Square (χ^2)	287.914	p > 0.05 (non-sig.)	Acceptable fit.
χ^2/df	2.11	< 3 (good)	Good fit
CFI	0.875	≥ 0.90 (good)	Below cutoff
SRMR	0.848	< 0.08 (good)	Good fit
GFI	0.060	≥ 0.90 (good)	Below cutoff
RMSEA	0.094	≤ 0.08 (acceptable)	Moderate fit

Hypotheses Testing

Table 7 presents the results of the proposed model for the study based on the TAM, TPB and UTAUT models and the inclusion of digital literacy (DL). The results show that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) demonstrate significant positive relationships with attitude (slope = 0.79, p<0.00 and slope = 0.86, p<0.00, respectively). This suggests that users' perception of the utility and simplicity of a digital system significantly shapes their attitude toward its use. Similarly, Digital Literacy significantly impacts attitude (slope = 0.81, p<0.00), emphasising that individuals' skills and comfort with digital tools positively influence their attitudes. In terms of intention, several significant predictors emerge. Performance Expectancy (slope = 0.37, p<0.00), Effort Expectancy (slope = 0.60, p<0.00), and Social Influence (slope = 0.62, p<0.00) all play a crucial role in shaping students' intention to use LMS for learning post-COVID-19.

Facilitating Conditions also demonstrate significant relationships, both with intention (slope = 0.70, p<0.00) and use behaviour (slope = 0.59, p<0.00). This suggests that the availability of resources, support, and infrastructure has a significant impact on students' intentions and eventual use of LMS for learning after the COVID-19 pandemic. Additionally, the strong relationship between intention and use behaviour (slope = 0.57, p<0.00) underscores the critical role of intention as a mediator in converting attitudes and expectations into actual usage. When examining the role of Digital Literacy moderated by Age and Gender, significant relationships persist with attitude and intention. For example, Digital Literacy (Age) significantly influences attitude (slope = 0.77, p<0.00) and intention (slope = -0.21, p<0.02), highlighting age-related variations in the impact of digital skills. Similarly, Digital Literacy (Gender) also significantly affects attitude (slope = 0.74, p<0.00). These results suggest that demographic factors like age and gender play a role in moderating the effects of digital literacy on LMS usage.

Table 7. *Hypothesis testing for the proposed model for the study*

Predictor (Path)	Slope	Intercept	MSE	P-value	Remarks
PU → Attitude	0.79	-0.00	0.3691	0.00	Sig.
PEOU→ Attitude	0.86	-0.00	0.2585	0.00	Sig.
DL → Attitude	0.81	-0.00	0.3380	0.00	Sig.
DL → Intention	-0.18	0.00	0.9693	0.06	Non-Sig.
DL → UB/	0.07	-0.00	0.9950	0.45	Non-Sig.
SN→ Intention	-0.12	0.00	0.9850	0.19	Non-Sig
PBC→ Intention	0.01	0.00	1.0000	0.94	Non-Sig

PE→ Intention	0.37	-0.00	0.8624	0.00	Sig.
EE→ Intention	0.60	-0.00	0.6424	0.00	Sig.
SI→ Intention	0.62	0.00	0.6209	0.00	Sig.
FC→ Intention	0.70	0.00	0.5155	0.00	Sig.
FC→ UB	0.59	-0.00	0.6505	0.00	Sig.
Attitude→ Intention	-0.11	0.00	0.9885	0.25	Non-Sig
Attitude→ UB	0.03	-0.00	0.9992	0.77	Non-Sig
Intention→ UB	0.57	0.00	0.6746	0.00	Sig.
DL→ Age → Attitude	0.77	0.00	0.4048	0.00	Sig.
DL → Age → Intention	-0.21	-0.00	0.9562	0.02	Sig.
DL → Age → UB	0.04	-0.00	0.9981	0.64	Non-Sig
DL → Gender → Attitude	0.74	0.00	0.4466	0.00	Sig.
DL → Gender → Intention	-0.15	-0.00	0.9772	0.10	Non-Sig
DL → Gender → UB	0.05	-0.00	0.9977	0.60	Non-Sig
PE → Gender → Intention	-0.15	-0.00	0.9770	0.10	Non-Sig
EE→ Gender → Intention	-0.10	0.00	0.9908	0.30	Non-Sig
SI → Gender → Intention	-0.05	-0.00	0.9977	0.60	Non-Sig

Figure 4 visualises PU, PEU, DL, PE, EE, SI, and FC linked to attitude and behavioural intention, respectively. The figure also highlights the significant pathway from FC and Intention to UB. Furthermore, while age and gender moderate the relationships between DL and attitude, only age moderates the relationship between DL and intention. This visual aid clarifies the interplay between digital literacy and the other constructs in the model. Below is the diagram showing SEM with its path coefficient.

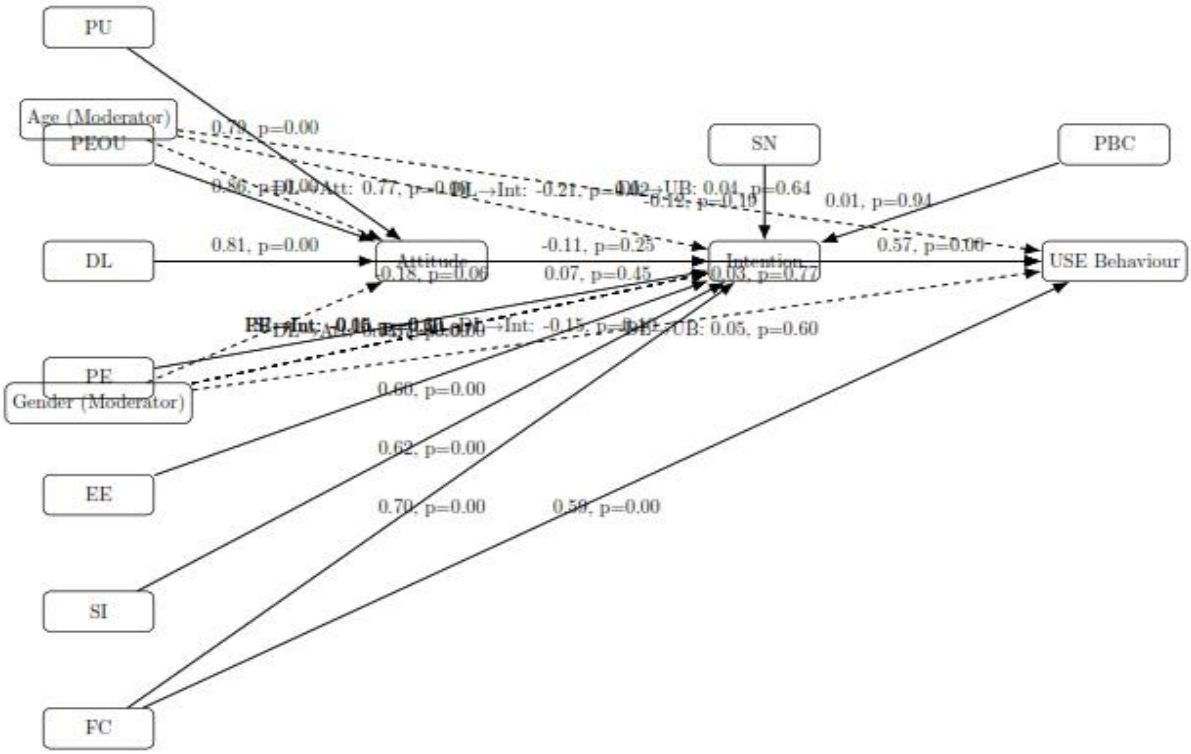

Figure 2. *SEM with its coefficient.*

Discussion

This study attempted to investigate factors influencing students' attitudes, intentions and actual use behaviour of LMS for learning in the post-COVID era. The SEM results indicated that perceived usefulness and ease of use significantly and positively influence students' attitudes towards LMS use post-COVID. This result is consistent with previous research findings (A.trayek & Hassan, 2013; Wichadee, 2015; Kyzy, Ismailova, & Dündar, 2018; Husin et al., 2024). This result also aligns with the technology acceptance model (TAM), which posits that users' attitudes towards technology adoption are primarily determined by perceived usefulness and ease of use (Granić & Marangunić, 2019).

It was also revealed that digital literacy significantly influences students' attitudes towards LMS use post-COVID. This result aligns with similar studies (Prior et al., 2016; Suryawidjaja, 2023) that observed digital literacy to significantly help students enhance their confidence and reduce anxiety regarding perceived efforts to use the LMS platform for learning, thus, improving their overall attitude towards LMS use for learning especially in the post-COVID period. This result implies that the higher the digital literacy skills of the ODL students, the more likely they are to have a positive attitude towards LMS use post-COVID (Adegbore et al., 2023).

Further, the result indicated that performance expectancy, effort expectancy, social influence and facilitating conditions significantly predict students' intention to use LMS post-COVID. This result is consistent with previous research findings (Govender & Moonsamy, 2018; Raza et al., 2020; Özkan et al., 2020; Buabeng-Andoh & Baah, 2020a; Samaila et al., 2022; Alharbi et al., 2023). However, the result is inconsistent with the research findings of Alharbi et al. (2019) and Kabir (2021), who found effort expectancy and social influence to be insignificant predictors of students' behavioural intention to use LMS for learning. This result aligns with the UTAUT model that identifies performance expectancy, effort expectancy, social influence and facilitating conditions as major predictors of the behavioural intention of individuals to adopt technology (Marikyan & Papagiannidis, 2021). This result suggests that ODL students are more likely to intend to use LMS for learning post-COVID if they believe that it will enhance their academic performance and the LMS platform is easy to use (Chaudhry et al., 2023). Also, students are likely to intend to use the LMS platform for learning when lecturers and peers reinforce the need to use the platform for learning, and there is the availability of resources and technical support for its use (Zacharis & Nikolopoulou, 2022).

Results revealed that facilitating conditions and behavioural intention to use LMS significantly predict ODL students' actual LMS usage for learning post-COVID. This result is consistent with previous research findings (Bervell & Arkorful, 2020; Yakubu et al., 2020; Musa et al., 2022; Ikhsan et al., 2021; Alharbi et al., 2023). This result is, however, inconsistent with the research finding of Samaila et al. (2022), who found that facilitating conditions insignificantly influence students' LMS use. This result suggests that the availability of technological infrastructure and support, and the desire to use the LMS platform for learning are critical factors for LMS actual usage among ODL students post-COVID (Alshammari, 2020). ODL institutions should therefore focus on strategies that foster good facilitating conditions and strengthen students' intention to use LMS for learning. This will ensure equitable access to LMS platforms and increase their actual usage.

Moreover, the results revealed that age and gender moderate the relationship between digital literacy and attitude and digital literacy and intention. This result is consistent with the findings of similar studies (Al-Azawei, 2019; Alshehri et al., 2020; Jamalova & Bálint, 2022). This result could be related to the fact that older students tend to have a lower level of digital literacy compared to younger students who are usually more technologically savvy (Eshet-Alkalai & Chajut, 2009). Thus, negatively affecting their attitudes and intentions towards LMS use post-COVID. It behoves the ODL institution to develop age-specific digital literacy training programmes to address the varying needs of students. Similarly, the result indicated that gender moderates the relationship between digital literacy and ODL students' intention to use LMS for learning post-COVID. This result contradicts previous similar research findings of Itasanmi and Ajani (2023). This result could be attributed to the fact that female students in Nigeria face certain socio-economic barriers, which include limited access to technology or cultural factors (Umar, 2022). This may affect their digital literacy skills and, subsequently, their intentions to use LMS for learning post-COVID. There is a need for ODL-based institutions to implement gender-sensitive strategies to address disparities in digital literacy and LMS adoption.

Conclusion

The current study provides a great insight into the factors influencing students' LMS use post-COVID in an ODL-based university in Nigeria. The results of the study highlight the relationships among the modified UTAUT constructs, emphasising that perceived usefulness, ease of use and digital literacy significantly influence students' attitudes towards LMS use post-COVID. Also, the study established that students' intention to use LMS post-COVID is significantly influenced by performance expectancy, effort expectancy, social influence and facilitating conditions. Further, the result indicated that facilitating conditions and behavioural intention to use LMS significantly predict students' actual LMS usage for learning post-COVID. Lastly, the study results revealed that while age and gender moderate the relationship between digital literacy and attitude and digital literacy and intention, the relationship between digital literacy and intention to use LMS for learning post-COVID was moderated by gender.

Based on these results, the following are recommended:

1. LMS design and implementation in the university should focus on creating an LMS that is intuitive, user-friendly and aligns with students' academic needs. This will make navigation of the platform easy for the students. Thus, enhancing their attitude towards the LMS for learning post-COVID.
2. The ODL-based university should implement a mandatory digital literacy assessment for incoming students during admission or orientation. They should also provide tiered training modules (beginner, intermediate, and advanced) based on assessment results.
3. ODL institutions should upload high-quality, multimedia-rich learning materials (videos, infographics, interactive quizzes) to enhance engagement. They should also implement a 24/7 live chat or helpdesk for technical support and academic guidance.
4. Instructors should provide personalised guidance and encouragement in the form of one-on-one mentorship to support ODL students with varying digital skills.
5. The ODL-based institution should strengthen the available digital infrastructure, improve LMS usability and accessibility and offer consistent technical support to help students navigate the challenges that may arise in using the LMS platform for learning post-COVID
6. ODL-based institutions should design gender- and age-specific training programs (e.g., workshops for older students or female-only tech sessions to boost confidence).

Limitations

This study has several limitations. First, the model's fit indices (CFI = 0.875, RMSEA = 0.094, GFI = 0.060) fell below recommended thresholds, suggesting inadequate alignment with the data. This may stem from the small sample size (N=120). Small sample size reduces power to detect true effects, or measurement issues (e.g., low reliability for "Use Behaviour," α = 0.390). Second, key hypotheses (e.g., H13/H14: Attitude → Intention/Use Behaviour) were non-significant, potentially due to contextual factors (e.g., ODL students prioritising pragmatic concerns like facilitating conditions over attitudes) or construct overlap. Third, self-reported data risks social desirability bias, and the single-institution focus limits generalizability to other Nigerian universities or conventional settings.

Suggestions for Further Studies

To address these gaps, future studies should:

1. Employ longitudinal designs to track LMS adoption over time.
2. Compare results across institutions (e.g., NOUN vs. conventional universities) to assess contextual variability.
3. Refine measurement scales (e.g., for "attitude" and "use behaviour") and test extended models (e.g., UTAUT2 with moderators like experience).

Acknowledgement and Sponsoring Information

This article is part of the achievements of a research project that was carried out in the Institute of Cultural Studies.

Declaration of Competing Interest

The author declares that he has no competing financial interests or known personal relationships that would influence the report presented in this article.

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