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RESEARCH ARTICLE

Students' Acceptance of Learning Management Systems at the Peak of Covid-19 Pandemic by Employing a Modified Technology Acceptance Model

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Abstract

Objectives: This study aimed to investigate the motivating variables that affect students' attitudes toward using Learning Management Systems (LMS) during the Covid-19 pandemic and beyond by extending the Technology Acceptance Model (TAM) to include perceived enjoyment and perceived trustworthiness. **Methods:** Data were collected from 599 tertiary students from across five public universities in Ghana using online questionnaires to measure Perceived Usefulness (PU), Perceived Ease of Use (PEU), Attitude Towards Use (ATU), and Behavioural Intention (BI). The collected data were analyzed using PLS-SMART. **Findings:** The study's findings suggest that perceived usefulness and perceived ease of use affect students' attitudes toward LMS use (That is, PEU — > ATU [O = 0.227, t = 4.747, p = 0.000] and PU — > ATU [O = 0.430, t = 8.993, p = 0.000]), which affects students' behavioural intention to use IT (That is, ATU — > BI [O = 0.314, t = 6.828, p = 0.000]). In addition, the most vital relationship was "perceived ease of use" as a predictor of "perceived usefulness" (That is, PEU — > PU [O = 0.440, t = 10.025, p = 0.000]). Furthermore, contrary to expectations, perceived enjoyment and perceived trustworthiness, also considered critical predictors, did not affect students' attitudes toward LMS use (That is, PE — > ATU [O = 0.085, t = 1.776, p = 0.076] and PT — > ATU [O = 0.033, t = 0.744, p = 0.457]). **Novelty:** These findings provide valuable insights which can enhance education quality and students' acceptance of LMS during mandated environments such as the COVID-19 pandemic. The framework of the study is an extension of the original TAM model, including new constructs, perceived enjoyment, and perceived trustworthiness.

Keywords: Covid19; TAM; User acceptance; Tertiary institutions; LMS; Perceived enjoyment; Perceived trustworthiness

1 Introduction

The use of the Learning Management System (LMS) has become necessary, not only as an online tool for distance and virtual learning but as a tool for mandated environments, such as at the peak of Covid-19, where it became necessary for traditional (face-to-face) tertiary students to stay at home to ensure social distancing and avoid contact entirely. As a learning management tool forced on the students, it became necessary to investigate its acceptance using a modified Technology Acceptance Model (TAM) to inform policy direction going forward. To situate the study well in the e-learning environment, we define the LMS, referred to in this study, as a software system developed for teaching and learning and used by both instructors and learners[(1)]. It can also be referred to as a software suite or collection of software tools that enables the management and delivery of learning content and materials to learners[(2)]. According to Gasaymeh[(3)], there are two main types of LMS: commercial and free or open-source systems. Commercial or vendor LMSs include the Blackboard Learning System, Desire2Learn, and eCollege. Free or open-source LMSs include Moodle, ATutor, Google Classroom, Eliademy, and Forma LMS. This study's LMS is free, open-source, and customized like Moodle and Google Classroom.

At the peak of Covid-19 and beyond, there have been quite a several research activities around the globe trying to predict the adoption of LMSs using the TAM model. We restrict ourselves to the situation in Ghana since studies on this subject matter in Africa, and for that matter, Ghana, is still on the low side, as evidenced in the literature[(4,5)]. The response to the Covid-19 pandemic in Ghanaian universities was slow but picked up later when it was clear that the pandemic was not going anytime soon. Even though most universities had virtual systems for learning in place, no university was in full virtual mode for learning and exams. The traditional face-to-face was in full swing. The pandemic forced universities to go entirely online for teaching, learning and assessment. The change was quick and sharp, necessitating the research to find students' reactions to the new normal of LMS usage. Quansah and Essiam[(6)] were one of the researchers who worked on students' perspectives on using the learning management system (LMS) Moodle amid the covid-19 pandemic. They found a considerably high acceptance of the LMS Moodle by students. Despite issues such as poor internet connectivity and a lack of timely feedback from lecturers, students found the LMS Moodle convenient and user-friendly. Regardless of how good their findings may be, the method used could have been scaled from just descriptive analysis to inferential analysis to relate well with the causal relationships of the various constructs considered. Ordinal data could be better suited for ordinal regression and inferential analysis, which are catered for in the structural equation model (SEM). Again, only one university was considered, limiting the generalization of the research output. This work employs a structural equation model (SEM), which brings out the output well regarding the relationships between constructs. Again, this work employs five Ghana universities as its study object.

Amankwa and Asiedu[(5)] also researched this space but focused on second-cycle institutions. No wonder they proposed the inclusion of technology infrastructure against the overemphasis on attitudes and intentions. Ghanaian university students' IT skills are expected to improve from secondary school to university, so the inclusion of technology infrastructure in the parameters becomes less critical. Generally, they found that students' attitudes and intentions to use e-learning are the main determinants that will influence the student's acceptance of the e-learning system of education in second-cycle institutions in Ghana after the COVID-19 emergency.

By employing a mixed method approach on the University of Education, Winneba (UEW) students, Dampson [7] established moderate adoption of the LMS among UEW students. The study further established that perceived usefulness, perceived ease of use and attitude towards the LMS were significant predictors of students' adoption of the LMS. They used Means and Standard Deviations and Stepwise Regression analysis for quantitative and qualitative content analysis to analyze TAM parameters with some mediation parameters. In their findings, age, faculty and level of ICT skills mediated the level of adoption of LMS. This study does not do mediation and moderation analysis; it introduces two additional constructs (Perceived Trustworthiness and Perceived enjoyment), which deviate from the traditional TAM.

One recent study in Ghana employed perceived trust in its model [8] and found it positively influenced lecturers' continuous usage intention. Their study focused on lecturers, but this study focuses on the perceived trustworthiness of students' attitude towards using LMS and, subsequently, the behavioural intention to use, which is a research gap in the LMS adoption studies in Ghana. Again, using Artificial Intelligence (AI) models to predict LMS determinants, nonlinear sensitivity analysis was employed by Cavus et al. [9] to select the critical parameters of the LMS determinants in Nigerian students during Covid-19. They found perceived enjoyment as one of the most significant factors affecting Nigeria's educational sustainability. This study pioneers the use of perceived enjoyment as one of the parameters intended to predict attitudes towards using LMS and behavioural intention to use in the Ghanaian context.

Therefore, this study intends to investigate the adoption of LMS by students in Ghana during the Covid-19 pandemic and beyond, considering additional constructs by building on the model of Masrom [10], which is the LMS version of the TAM.

This study makes the following contributions. First, we extend existing knowledge on technology acceptance by examining the explanatory power of TAM from the perspective of students in tertiary institutions in Ghana. Thus, we identify significant factors in explaining students' attitudes toward IT use amidst the Covid-19 crisis. Second, we extend the TAM by including two variables, namely perceived enjoyment and perceived trustworthiness, to understand better the attitude and beliefs towards IT use in an educational context. Hence, this study is among the notable studies investigating TAM's explanatory power from the perspective of students in tertiary institutions in Ghana in the era of Covid-19.

This paper is organized as follows. We discuss TAM and extend the model by including two variables: perceived enjoyment and perceived trustworthiness. A discussion of the research methodology follows this. Results and discussion are presented in the fourth section. The fifth section presents the implications of the study and the conclusion.

2 Materials and Methods

2.1 Research Design

2.1.1 TAM

The study employs a modified TAM as the research design. TAM suggests that external elements (e.g., system design characteristics) drive cognitive reactions (i.e., perceived ease of use and perceived usefulness), which, in turn, produce an emotive response (attitude toward utilizing technology/intention), impacting use behaviour [11,12]. TAM denotes that behaviour results from perceived ease of use, perceived usefulness, and behavioural intention (Figure 1).

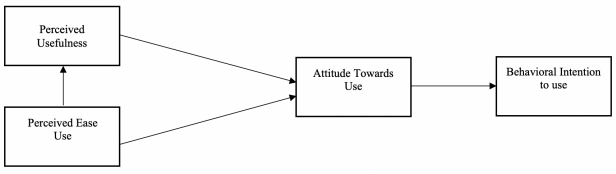

Fig 1. Technology acceptance model (11)

There have been several revisions of the original model by Davis depending on the type of Information System in question. For a typical e-learning system, Masrom [10] developed a variant of TAM, as seen in Figure 2.

Perceived ease of use (PEU) relates to how simple a person thinks utilizing technology will be [10]. More formally, Davis [11] defined PEU as "the degree to which an individual believes that using a particular system would be free of physical and mental effort." Davis [11] also proposed that an individual's perception of the effort necessary to utilize a system can directly impact how that system is used (PEU). Matute-Vallejo and Melero-Polo [13] suggest that perceived ease of use (PEU) has a direct, positive, and substantial impact on students' perceived usefulness (PU) of IT. Similarly, Cavus et al. [9] suggest that PEU affects the desire

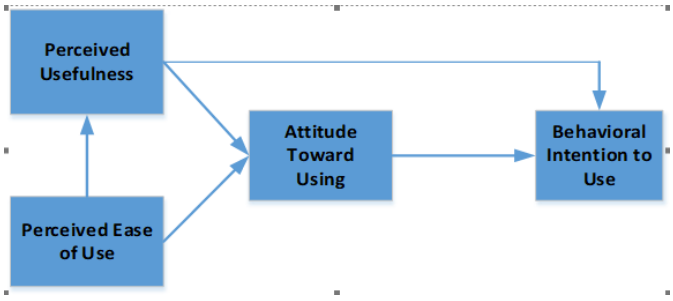

Fig 2. LMS TAM by Masrom (10)

of users to utilize technology. TAM suggests that PEU affects PU, and an increase in PEU leads to better performance.

Perceived usefulness (PU) refers to the degree to which a person believes using a particular system would enhance job performance[10]. The degree to which students feel that using IT would improve their academic performance represents PU[11]. PU of IT has proven beneficial in delivering timely and relevant information to enhance and improve students' activities in tertiary institutions[14]. Several studies have approved the strength of PU as a significant factor in determining users' behavioural intentions to accept technology[11,14]. Dampson[7] applied TAM to explore the determinants of e-learning adoption and concluded that PU significantly affects behavioural intention to adopt e-learning platforms.

Attitude towards use (ATU) can be described as a bodily propensity that manifests in favouring or disfavoring a sure thing. ATU directly impacts a person's desire to utilize technology[11,15]. That is, ATU directly affects behavioural intention (BI). Davis[11] defined BI as the strength of a prospective adopter's intention to make or support an adoption choice in their organization. BI is concerned with the chance that a user will do an intended activity, in this case, students' use of IT[16]. The degree to which a person is willing to put out an effort to complete a task or the amount of effort an individual would put forth to carry out the desired conduct is referred to as BI[16]. Ajzen and Fishbein[15] suggest that BI is a vital indicator of an individual's desire to act.

Based on the discussions above, the following hypotheses were developed:

H1: Perceived ease of use (PEU) has a significant effect on the perceived usefulness (PU) of users towards the use of LMS.

H2: Perceived ease of use (PEU) has a significant effect on the attitude toward the use (ATU) of LMS.

H3: Perceived usefulness (PU) has a significant effect on the attitude toward the use (ATU) of LMS.

H4: Perceived usefulness (PU) has a significant effect on the behavioural intention (BI) of users towards LMS use.

H5: Attitude towards using (ATU) has a significant effect on the behavioural intention (BI) of users towards LMS use.

2.1.2 External Variables

For this paper, we introduce two additional constructs to the model of Masrom[10], which are much related to students' use of a learning management system (LMS). They are Perceived Trustworthiness (PT) and Perceived Enjoyment (PE) of using the LMS. This is seen in Figure 3. We argue that with the use of LMS by students, students have no option but to use it since, at the peak of Covid-19, LMS usage was non-negotiable, and the student's performance was dependent solely on it. The attitude of the students to continue to use the LMS even after the pandemic, however, largely depends on the Perceived Trustworthiness (PT) and Perceived Enjoyment (PE) of the usage, which will determine the behavioural intention to use. The focus of this work is students' acceptance of the LMS during and beyond the pandemic, hence the introduction of the constructs "Perceived Trustworthiness" and "Perceived Enjoyment".

Perceived enjoyment refers to the "degree to which the activity of using technology is perceived to be enjoyable in its own right apart from any performance consequences that may be anticipated" (p. 1113)[17]. Also, unlike perceived ease of use and perceived usefulness, regarded as extrinsic motivation variables, perceived enjoyment is considered an intrinsic motivation variable that describes an individual's motivation to use technology[18,19]. Initially, van der Heijden[20] extended TAM to include the perceived enjoyment construct in a survey that investigated the use of websites. Yu[21] also extended TAM with perceived enjoyment and two psychological constructs, conformity behaviour and self-esteem, to test the acceptance of WeChat use in language learning. Perceived enjoyment represents the level of pleasure that students perceive they will feel whenever they interact with IT; it emphasizes the pleasure, satisfaction, or enjoyment related to system use[22]. However, this variable has yet to be included in studies examining technology use in educational contexts[13]. Perceived enjoyment is an essential factor influencing users' attitudes toward technology use[4]. When students perceive that using the LMS is fun and gives them

joy, they tend to have a positive attitude towards its use which significantly increases their behavioural intention to use IT [9]. Recent studies reveal that constructs such as perceived enjoyment, perceived playfulness, anxiety, and social influence, are included in the TAM model to increase its predictive validity [18]. Empirical studies reveal opposing results of the relationship between perceived enjoyment and behavioural intention to use LMS. For example, while Navarro et al. [23] report that perceived enjoyment has no significant effect on the behavioural intention to use LMS, Khalid [24] and Munabi et al., [25] reported that perceived enjoyment a key driver for the adoption and usage of LMS. From the above examples, even in the Covid-19 era, the results of Navarro et al., [23] and Munabi et al., [25] were at variance. We, however, propose the following hypothesis:

H6: Perceived enjoyment (PE) has a significant effect on students' attitudes toward the use of LMS.

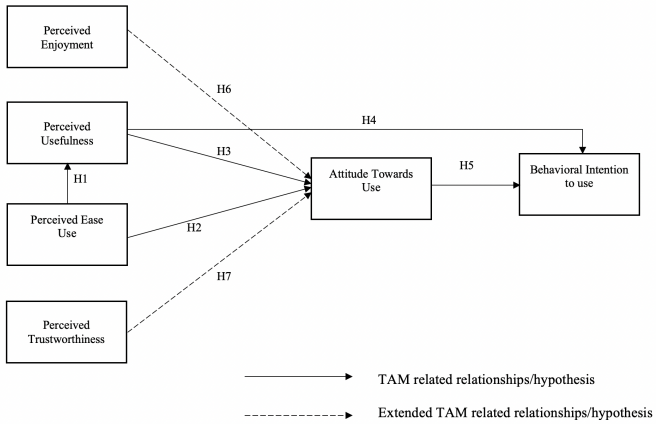

Fig 3. Research model

The influence of perceived trustworthiness on an individual's action must be considered. Trustworthiness describes a set of beliefs that leads to an individual's willingness to trust [26]. Perceived trustworthiness comprises three dimensions: ability, integrity, and benevolence [27,28]. Ability describes students' judgment of the educational service and competencies IT provides within the educational context [27] . Integrity refers to students' perception that the educational services provided by IT conform to pedagogical principles acceptable in the tertiary educational context. Benevolence describes students' perception that is providing IT as an e-learning platform motivates them to seek joint gain, with student performance as a priority. Thus, IT is not instituted as an e-learning platform to "behave opportunistically" [26]. One of the most critical factors in successful online exam participation is perceived trust [29]. Arpaci [30] discovered that perceived trust influences mobile cloud services, and Liu et al. [31] discovered that perceived trust influences students' participation in an online exam. Perceived Trust and Perceived Usefulness have a significant relationship [32], consistent with previous research on the role of trust in online exams [29]. Overall, we expect perceived trustworthiness to have a significant effect on students' attitudes toward the use of LMS from the backdrop of having to deal with scanty information from the literature concerning perceived trustworthiness and attitude towards the use of LMS. Therefore, we propose the following hypothesis.

H7: Perceived trustworthiness (PT) has a significant effect on students' attitudes toward the use of LMS**.**

A pilot study was conducted to determine the parameters of Perceived Trustworthiness (PT) and Perceived Enjoyment (PE). Out of 20 factors presented, the students chose five that they perceived as factors of enjoyment/displeasure and five for trust worthiness/untrust worthiness, depending on how the questions were framed. These factors formed the basis for the question items in this research work's PT and PE constructs (see Table 2).

2.2 Study Participants

The data collection tool consisting of close-ended and five-point Likert-type questions was delivered online to the participants of the study, who were students at public universities in Ghana. A Google form survey was prepared and sent to the student community via their group WhatsApp platforms and e-mails controlled by the management of the student bodies of 5 universities in Ghana. In all, 599 responses were obtained. Of the 599 students, 53.9% were male, while 46.1% were female. The profile of the group of study respondents is presented in Table 1.

2.3 Data Collection

The data collection tool comprises two sections. The first section comprises questions that reveal the demographic characteristics of the respondents, for instance, gender and study programmes. Section two consists of 22 items of five-point Likert scale questions (where 1 represents strongly disagree and 5 represents strongly agree). This was to help the researchers to measure the study variables. We adapted studies from the literature to measure the study constructs of the research model represented in Figure 3. The criteria for inclusion in the study were students in tertiary institutions who use IT as an e-learning platform for teaching and learning. Study participants from 5 universities across Ghana were contacted via e-mail and WhatsApp groups. In addition, it was clearly stated that data obtained from study participants would be used for scientific research purposes only and that participation was entirely voluntary. We used the Google forms restriction, allowing one response per person on a particular device or Gmail account. Besides, there was no monetary motivation for one to make multiple responses. Again, the researchers used well-structured data-cleaning techniques to validate all the responses from the questionnaire. As a result, students participated in the study by filling out the tool for data collection in the Google survey form. The first section of the data collection tool was designed to solicit demographic information from the respondents, while the second section was designed to measure the study constructs.

Consequently, items of the data collection tool were adapted from measurement tools that adopted the same theoretical underpinning as the study and verified with respondents with similar characteristics in the educational context. To measure perceived usefulness (PU), perceived ease of use (PEU), attitude towards use (ATU), and behavioural intention (BI), we adapted items from Masrom [10]. The items used to measure perceived enjoyment (PE) and perceived trustworthiness (PT) were adapted from van der Heijden [20] and Hallikainen et al. [26], respectively.

Table 1. Demographic characteristics of participants

Students		*f*	**%**
Program	Degree	508	84.8
	Diploma	91	15.2
Gender	Male	323	53.9
	Female	276	46.1

2.4 Data Analysis

The PLS-Smart analytical tool was used to analyze data obtained from the respondents. This is because it is considered an appropriate tool for studies where the models are complex [33]. Also, PLS is deemed effective in predicting target variables [34]. Furthermore, PLS's applicability in explanatory models and its compatibility in determining existing and the power of tested relationships make it appropriate for analysis in this study [35]. To begin, validity and reliability analysis were conducted. Discriminant and convergent validity of the measurement model was conducted. Also, relationships between the external models, as well as their indicators, were assessed. This was followed by an analysis of whether the relationships were significant. In addition, the variance values of the variables and their predictive power were investigated [33]. Table 2 below shows the constructs, the items under each construct, and the source of the items from the literature.

Table 2. Constructs and items under each construct

No.	**Constructs**	**Items under constructs**	**Nomenclature**	Source
1	Perceived Usefulness (PU)	LMS improves my learning	IMPIMPROVES	Edumadze [36]
		Course content is accessible anytime and anywhere, anyhow.	IMPACCESS	Edumadze [36]
		I found the LMS useful.	IMPUSEFUL	Masrom [10]
2	Perceived Ease of Use (PEU)	LMS is easy to use	IMPEASY	Edumadze [36]
		Learning online is stressful and difficult.	IMPONLINE	Edumadze [36], Masrom [10]
		My interaction with the LMS was clear and understandable.	IMPINTERACT	Masrom [10]
3	Attitude Toward Using (ATU)	I have a positive overall experience using the LMS	IMPEXPERIENCE	Edumadze [36]
		I prefer LMS to face-to-face examinations.	IMPPREFER	Edumadze [36]

Continued on next page

Table 2 continued

		I believe it is (would be) a good idea to use this E-learning for my course work.	IMPCOURSEW	Masrom [10]
4	Perceived Enjoyment (PE)	The LMS does not perform well and creates problems	FREQLRETL	Featherman and Pavlou [37]
		I experience long system downtimes.	FREQLSYSD	Field data
		I tend to have poor network connectivity using the LMS	FREQPOORN	Field data
		Scores are displayed incorrectly.	FREQSYSINT	Field data
		I experience short time-out sessions.	FREQTOUT	Field data
5	Perceived trustworthiness (PT)	My personal information is used without my knowledge	SEVELRETL	Featherman and Pavlou [37] and Field data
		My student account goes off periodically because of malicious activities online.	SEVELSYSD	Field data
		I can easily recover lost data.	SEVEPOORN	Field data
		The security controls of the system are not adequate	SEVESYSINT	Field data
		Unauthorized users can easily access my information	SEVETOUT	Field data
6	Behavioral Intention to Use	I would like to take courses with the LMS	IMPTAKEC	Edumadze [36]
		One has to be an IT expert to use the LMS	IMPEXPERT	Edumadze [36]
		I will use the LMS often.	IMPOFTEN	Masrom [10]

3 Results and Discussion

3.1 Measurement Model

3.1.1 Indicator loadings

The recommended loading values should be greater than (>) 0.708, and hence loadings below 0.708 should be dropped [35]. All the indicators (as shown in Table 3) had at least one recording above 0.708 (recommended) across the constructs and were retained for the analysis. According to cross-loadings, a specific component should have more significant loadings on its parent construct than on any other study construct. There are problems with discriminant validity if an item loads well onto another construct compared to its parent construct. The item may be cross-loading onto the other construct and pose a danger to discriminant validity if the difference in loading is less than 0.10. The evaluation techniques for determining the measurements' reliability and validity describe the measurement model. Hair et al. [33] presented three measurement models: indicator loadings, convergent validity, and discriminant validity.

3.1.2 Convergent validity (internal consistency reliability)

The examination for statistical consistency across indicators is called internal consistency reliability. Internal consistency reliability should be reported using Cronbach's alpha (α) and Composite Reliability (CR). Hair et al. [33] suggest a threshold of $\alpha > 0.700$ and CR of > 0.708. Table 4 shows that the reliability of all variables was above 0.7, depicting a high level of reliability or dependability among the variables. Average variance Extracted (AVE) values were also higher than 0.5. The α and Composite Reliability (CR) values for all constructs have good internal consistencies, the reliability ranging from 0.862 to 0.954 for the α and 0.913 to 0.971 for the CR. As a result, there were no convergent validity issues [33].

Table 3. Cross-loading

Constructs	Nomenclature	ATU	PE	PEU	PU	PT	BI
PE	FREQLRETL	0.235	0.844	0.189	0.214	0.542	0.189
	FREQLSYSD	0.22	0.844	0.178	0.213	0.562	0.196
	FREQPOORN	0.212	0.807	0.207	0.151	0.527	0.159

Continued on next page

Table 3 continued

	FREQSYSINT	0.234	0.834	0.224	0.229	0.512	0.218
	FREQTOUT	0.159	0.782	0.215	0.129	0.511	0.136
PU	IMPACCESS	0.378	0.176	0.395	0.762	0.15	0.466
	IMPIMPROVES	0.546	0.228	0.409	0.95	0.158	0.59
	IMPUSEFUL	0.546	0.216	0.379	0.953	0.152	0.56
ATU	IMPCOURSEW	0.956	0.261	0.428	0.536	0.187	0.508
	IMPEXPERIENCE	0.956	0.277	0.456	0.553	0.192	0.54
	IMPPREFER	0.735	0.139	0.268	0.366	0.137	0.42
PEU	IMPEASY	0.465	0.257	0.971	0.471	0.158	0.427
	IMPINTERACT	0.416	0.256	0.969	0.445	0.165	0.407
	IMPONLINE	0.271	0.108	0.731	0.2	0.055	0.17
BI	IMPEXPERT	0.468	0.186	0.331	0.524	0.147	0.913
	IMPOFTEN	0.538	0.22	0.398	0.595	0.174	0.979
	IMPTAKEC	0.577	0.229	0.408	0.618	0.182	0.979
PT	SEVELRETL	0.179	0.582	0.145	0.168	0.864	0.145
	SEVELSYSD	0.178	0.586	0.161	0.187	0.874	0.159
	SEVEPOORN	0.175	0.534	0.128	0.15	0.866	0.151
	SEVESYSINT	0.149	0.546	0.126	0.138	0.873	0.192
	SEVETOUT	0.166	0.552	0.093	0.096	0.873	0.122

Table 4. Convergent validity (internal consistency reliability)

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Attitude toward use (ATU)	0.861	0.917	0.789
Perceived enjoyment (PE)	0.881	0.913	0.677
Perceived ease of use (PEU)	0.878	0.924	0.805
Perceived usefulness (PU)	0.868	0.921	0.797
Perceived trustworthiness (PT)	0.92	0.94	0.757
Behavioural intention (BI)	0.954	0.971	0.917

3.1.3 Discriminant validity

The heterotrait–monotrait (HTMT) method[38] was employed to test discriminant validity for this study. The HTMT is a measure of similarity between latent variables. When HTMT is less than one, discriminant validity can be regarded as established. The acceptable levels of discriminant validity should be less than (<) 0.90[38] . The results in Table 5 demonstrate that all values were less than one, indicating that all constructs were distinct.

Table 5. Discriminant validity using HTMT ratio

	ATU	PE	PEU	PU	PT	BI
ATU						
PE	0.288					
PEU	0.485	0.263				
PU	0.631	0.26	0.48			
PT	0.218	0.715	0.155	0.192		
BI	0.608	0.237	0.406	0.664	0.188	

3.2 Structural Model Assessment

We examined the path analysis and the various relationships between constructs, including hypothesis testing, about the research model (Figure 3) adopted for the study. These include the structural model relationship, the coefficient of determination (R^2), and the predictive relevance (Q^2).

3.2.1 Structural model relationship

Figure 4 illustrates the path analysis for the study. We were interested in examining the relationships between nodes. Node-to-node path analysis aligned with the objective of the study, as well as the hypotheses developed. Table 6 outlines the original sample (coefficients), T stats, and the p-value columns for the various paths. For a 2-tailed test, with a 95 % confidence level or 5% significance level ($p<0.05$), a z (T Stats) below -1.96 or above 1.96 is required before arguing that the difference is significant. From Table 5, we realize that only two paths were not significant (T stats for them are below 1.96, and $p>0.05$); Perceived enjoyment -> Attitude toward use, and Perceived trustworthiness -> Attitude toward use.

Table 6. Node-to-node path analysis

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Attitude toward use -> Behavioural intention	0.314	0.313	0.046	6.828	0.000
Perceived enjoyment -> Attitude toward use	0.085	0.085	0.048	1.776	0.076
Perceived ease of use -> Attitude toward use	0.227	0.227	0.048	4.747	0.000
Perceived ease of use -> Perceived usefulness	0.440	0.437	0.044	10.025	0.000
Perceived usefulness -> Attitude toward use	0.430	0.430	0.048	8.993	0.000
Perceived usefulness -> Behavioural intention	0.432	0.433	0.043	10.023	0.000
Perceived trustworthiness -> Attitude Toward Use	0.033	0.037	0.045	0.744	0.457

In Table 7, we deduced that perceived enjoyment and perceived trustworthiness were not significant predictors of students' attitudes toward IT use. This suggests that no matter the perceived enjoyment and perceived trustworthiness students experience when using IT, it does not affect their attitude toward using IT. This can be explained by IT being a "must" (non-negotiable) to ensure academic progress, irrespective of the student's experience. The most vital relationship occurred supporting H1; "Perceived Ease of Use" predicted "Perceived Usefulness" ($O = 0.440$, $t = 10.025$, $p = 0.000$). This implies that the students are of the view that using IT is simple and that using it will enhance their performance. This result is in line with the study conducted by Matute-Vallejo and Melero-Polo[13]. The second strongest relationship occurred supporting H4; "Perceived Usefulness" predicted, "Behavioural Intention to Use" ($O = 0.432$, $t = 10.023$, $p = 0.000$). Once the students know that using IT enhances or improves their academic performance, they will strongly stick to using IT without coercion. This result conforms with the work of Dampson[7].

3.2.2 Coefficient of determination (R2)

The variance percentage in endogenous variables that the exogenous variable may predict is interpreted as the coefficient of determination (R^2). The coefficient of determination (R^2) is the output value of regression analysis. It assesses a suggested model's predictive accuracy. It is calculated as the square of the correlation between two endogenous constructs. The R^2 scale runs from 0 to 1; a more significant number indicates a higher level of R^2, 0.75 indicates a significant level of R^2, 0.50 indicates a moderate level, and 0.25 indicates a poor level of R^2[33]. From Table 8, the results are as follows: ATU (0.367, moderate), PU (0.194, poor), and BI (0.436, moderate). In summary, the results of R^2 show a sufficient level of R^2.

3.2.3 Predictive relevance (Q2)

Research shows the accuracy in predicting data points of items if the model performs predictive relevance[33]. PLS-SEM was used to create the Q^2 values, and the blindfolding process was used. Q^2 values greater than 0 showed that the model's predictive relevance had been established. According to Hair et al.[33], a Q^2 value of 0.02 indicates a low predictive relevance, 0.15 indicates a medium predictive relevance, and 0.35 indicates a high predictive relevance. Attitude Toward Using had the highest predictive relevance ($Q^2 = 0.207$), whereas Behavioural Intention to Use had the lowest predictive relevance (0.159). Refer to Table 7 for the detailed report on Q^2.

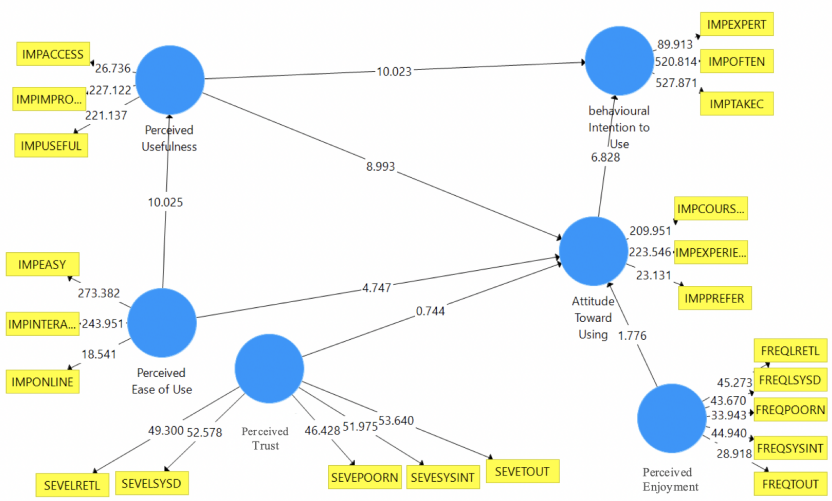

Fig 4. Structural model of students' attitude towards IT (PLS-SMART results)

Table 7. Hypotheses testing

Hypothesis	Hypothesis Statement	Path	Original Sample (O)	T Stats	P Value	Status
H1	PEU has a significant effect on PU	PEU — > PU	0.440	10.025	0.000	Accepted or supported
H2	PEU has a significant effect on ATU	PEU — > ATU	0.227	4.747	0.000	Accepted or supported
H3	PU has a significant effect on ATU	PU — > ATU	0.430	8.993	0.000	Accepted or supported
H4	PU has a significant effect on BI	PU — > BI	0.432	10.023	0.000	Accepted or supported
H5	ATU has a significant effect on BI	ATU — > BI	0.314	6.828	0.000	Accepted or supported
H6	PE has a significant effect on ATU	PE — > ATU	0.085	1.776	0.076	Rejected or not supported
H7	PT has a significant effect on ATU	PT — > ATU	0.033	0.744	0.457	Rejected or not supported

Table 8. Coefficient of determination and Predictive relevance

	R Square	Q^2 predict
Attitude Toward Using	0.367	0.207
Perceived Usefulness	0.194	0.188
Behavioural Intention to Use	0.436	0.159

This study sought to investigate the variables that affect students' attitudes toward IT use in developing countries and to better understand the process of IT acceptance in tertiary institutions amid Covid-19. Regarding perceived usefulness (PU), perceived ease of use was observed to predict perceived usefulness (O = 0.440, t = 10.025, p = 0.000), which was also the strongest relationship. The effect of perceived ease of use (PEU) on perceived usefulness (PU) was significant. This supports the findings of previous studies[5,9]. This implies that student's perception of the usefulness of IT in tertiary institutions in developing countries is affected by their perception of how easy it is to use IT. Hence, educational institutions, educators, and instructional designers in tertiary institutions in developing countries should aim at deploying less complicated yet robust and "user-friendly" IT platforms that students can easily engage with.

Also, the results showed that the effect of perceived ease of use (PEU) and perceived usefulness on attitude towards use (ATU) was significant. That is, PEU — > ATU (O = 0.227, t = 4.747, p = 0.000) and PU — > ATU (O = 0.430, t = 8.993, p = 0.000). This reveals that students' desire or propensity to favour or disfavour the use of IT amid the pandemic is hinged on their thoughts about how easy it is to use IT and how useful IT helps them to achieve their learning goals. Students willingly embrace IT when they perceive it as easy to use and useful for improving their academic performance. This finding confirms previous studies [7,9]. Regarding students' behavioural intention (BI) to use IT in tertiary educational institutions in developing countries, the findings of the study suggest that perceived usefulness (PU) and attitude towards use (ATU) significantly affected BI. This aligns with the literature on the significant effect of PU on BI [6,8] and ATU on BI [5].

The results showed that the effect of perceived enjoyment (PE) and perceived trustworthiness (PT) on attitude towards use (ATU) was not significant. That is, PE — > ATU (O = 0.085, t = 1.776, p = 0.076) and PT — > ATU (O = 0.033, t = 0.744, p = 0.457). The insignificant effect of PE and PT on students' attitudes to the use of IT may connote a paradigmatic shift in students' attitudes towards using IT to achieve educational goals. This study was conducted during the peak of the Covid-19 pandemic when tertiary institutions in developing countries mandated the use of IT as an institutional strategy for educational continuity. Governments, medical and educational authorities insisted on a shift from in-person teaching and learning to remote learning to conform with the protocols required to minimize the spread of the Covid-19 virus. As a result, students were left with fewer options than to use educational IT platforms made available by their respective institutions, regardless of whether they enjoyed and trusted such systems. In such situations, several questions arise regarding the quality of education and students' engagement during the outbreak of Covid-19. Therefore, perceived enjoyment and perceived trustworthiness might be considered less important factors in students' decision to use IT.

4 Conclusion

This study sought to understand better factors that determine students' attitudes towards IT to stimulate their attitude towards IT amid Covid-19. Moreover, considering the inadequate number of technology acceptance research for students in tertiary institutions in developing countries and the need for more encompassing studies addressing determinants of students' attitudes towards LMS use, this research is expected to make valuable contributions to theory and practice. Furthermore, TAM was extended by including two constructs, namely perceived enjoyment (PE) and perceived trustworthiness (PT), and their potential effect in determining students' attitudes towards technology use was tested. The model proposed in this study effectively explains BI ($R^2 = 0.436$) of students' use of IT amid the Covid-19 pandemic. The study's findings revealed that students' PEU strongly affected PU towards IT ((That is, PEU — > PU [O = 0.440, t = 10.025, p = 0.000]). On the contrary, perceived enjoyment and perceived trustworthiness did not affect students' attitudes toward IT use (That is, PE — > ATU [O = 0.085, t = 1.776, p = 0.076] and PT — > ATU [O = 0.033, t = 0.744, p = 0.457]), and this confirms the study of Navarro et al. [23] who also found that Perceived enjoyment has no significant effect on the behavioural intention to use LMS This, however, is a deviation from the findings of Cavus et al. [9] in Nigeria, Khalid [24] and Munabi et al. [25] who had positive results with perceived enjoyment. Furthermore, the study's findings suggest that perceived usefulness and perceived ease of use affect students' attitudes toward LMS use (That is, PEU — > ATU [O = 0.227, t = 4.747, p = 0.000] and PU — > ATU [O = 0.430, t = 8.993, p = 0.000]), which affects students' behavioural intention to use LMS (That is, ATU — > BI [O = 0.314, t = 6.828, p = 0.000]). This is in line with the work of Dampson [7], who also had similar results**.** In applying the findings to the actual practical situation in a tertiary institution, it is worth noting that students in tertiary institutions in developing countries prioritize ease of use concerning LMSs to determine their usefulness and willingness to use them. Hence, this study indicates that it is crucial to ensure that tertiary institutions in developing countries customize the LMS to make it "user-friendly". Furthermore, in line with the findings from perceived trustworthiness and perceived enjoyment, it is clear that in a mandated, controlled environment such as Covid-19, the focus of management should not be on the trustworthiness of or enjoyment by the students of the willingness of students to use the LMS or not; the main issue at stake here is the ease of use of the LMS. This calls for detailed and regular training by management for the students to make the LMS very user-friendly for the students to patronize the LMS. It is worth acknowledging that this study has limitations, and researchers can address them as a basis for further studies. First, study participants of this current study were from only five public universities in Ghana; it might influence the generalizability of the study findings. In addition, regarding gender, the study was dominated by male students. 53.9% were male students, while 46.1% were female students. This gender imbalance might somewhat provide biased study findings.

Similarly, regarding the program of study, the study participants were dominantly degree students (84.8%), while diploma students constituted 15.2%. This imbalance may provide biased findings. Furthermore, this study included two external factors, perceived enjoyment and perceived trustworthiness, as determinants of students' attitudes toward IT use. Other external variables may also exist. Therefore, future studies should investigate other external variables influencing students' attitudes toward IT amid mandated environments such as Covid-19.

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