

## The impacts of integrated e-Learning system toward the challenges facing education sector during and post Covid-19 pandemic

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### Abstract

Due to the Covid-19 pandemic, the school campuses have stopped face-to-face lessons to reduce its outbreak among students and staff members. This study presents a conceptual framework to investigate the factors influencing the usage of e-Learning platform among students of higher education institutions and their e-Learning system as course delivery. These factors include technology infrastructure support, system quality, information effectiveness and the e-Learning. The current study applied the Technology Acceptance Model (TAM), Innovation Diffusion Theory (IDT) and DeLone-McLean Model to explain the factors affecting e-Learning platform usage. This study has designed and proposed a theoretical framework based on information obtained from a newly developed questionnaire, which were distributed to two hundred and thirty (230) students from UI, LAUTECH, Ibadan poly and Okeogun poly located in Oyo State, Nigeria. This study involved students of these higher education institutions and the empirical data were analyzed using the Partial Least Squares Structural Equation Modelling. The findings revealed that technology infrastructure support, system quality and information effectiveness significantly influence the usage of e-Learning to enhance the service quality of higher education institutions among students. In this light, the outcomes of this study are useful for higher education institutions adapting e-Learning to help them strategise future e-Learning portals to enhance their performance in different aspects, such as the Websites and multinational web-integration. It is worth noting that the theoretical background of this study is limited to TAM and DeLone-McLean, IDT and its scope is only limited to just four public institutions in Oyo state. Hence, the author did not include other measures of e-Learning usage and other factors like online service quality.

**KEYWORDS:** Covid-19, Technology Infrastructures Support, Information Effectiveness, E-Learning Course Delivery, Higher Education Institutions.

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### 1. Introduction

The first cases of the novel coronavirus, or Covid-19 was reported in Wuhan, China at the end 2019 and the disease has spread to all over the world in early 2020 and to date, it has affected economies and social life globally. Similar to other sectors, the COVID-19 pandemic has affected education in many ways. The WHO advised governments to take actions to reducing the spread of coronavirus by reducing social contact, hence, many countries have enforced a lockdown where schools and universities are forced to close and face-to-

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face teaching and/or exams are halted. Some education systems announced exceptional holidays to better prepare for this distance-learning scenario (Gonzalez *et al.*, 2020; Ehlers, 2020; Branchetti *et al.*, 2021; Capone & Lepore, 2021; Chan *et al.*, 2021). As a result, many schools and universities turn to various e-Learning platforms to facilitate the teachers and students and in some cases, national television shows or social media platforms are used to support virtual learning.

The Covid-19 outbreak has prompted widespread school closure around the world and highlights the role played by e-Learning systems (Viner *et al.*, 2020; Owusu-Fordjour, Koomson & Hanson, 2020). According to a recent report by UNESCO (2020), the Coronavirus pandemic has affected educational systems worldwide, leading to the widespread closure of schools in affected countries. As of 28th March, 2020, over 1.7 billion learners are not attending classes due to school closure. According to UNESCO, over 100 countries have enforced nationwide closure of schools and universities, impacting nearly 90% of the world's student population (UNESCO, COVID-19 Educational Disruption and Response, 2020). School closure does not only affect students, teachers, and families, but have far-reaching economic and societal consequences, (Owusu-Fordjour, Koomson & Hanson, 2020). Furthermore, school closures in response to COVID-19 have shed light on various social and economic issues, including student restrictions (Jamerson, Josh, & Joshua, 2020) and impact of e-Learning (Karp & McGowan, 2020).

Digital learning, has predominantly changed how students learn over the last few months. E-learning helps facilitate teaching and training with the use of information communication technologies (ICT) to any student, anytime and anywhere. Digital learning technologies are mostly employed by universities and other educational organisations to supply new and innovative ways in delivering teaching to students (El-Masri & Tarhini, 2017). In this regard, studies on e-Learning acceptance have mostly incorporated students as subject to explain the factors impacts of the acceptance of e-Learning technology among students. It could also be argued for teachers' and instructors' acceptance and use of technology is crucial for the successful adoption and implementation of e-Learning technologies (Al-Samarraie *et al.*, 2018). The importance of e-Learning is evidenced as schools begin to close to control the Covid-19 outbreak as schools and universities are recognize the benefits of using e-Learning technologies to deliver online classes for their students and other curriculum activities (Marchisio, Rabellino & Sacchet, 2020; Sahu, 2020; Chahrour *et al.*, 2020). It is therefore important to identify the factors that could influence students' and teaching staff's opinion on the use of a specific e-Learning technology from anywhere, any time.

It was reported that by 10 March 2020, one in five students worldwide are studying home due to the school campuses closure due to the COVID-19, and one in four

university students have been sent home. (UNESCO, 2020). On the 13th March 2020, governments in 49 countries have announced or implemented school closure; 39 countries ordered that schools are closed nationwide while 22 countries implemented localised school closure (UNESCO, 2020). Between 16th to 19th March, 2020, this figure increased from 49 to 73 countries according to UNESCO. Nigeria is one of the countries that ordered all school campuses to close in the middle of March 2020 (Adedigba, 2020; UNESCO, 2020). As a result, 50% of students worldwide are affected by school closure as at 19th March, 2020 as 102 countries enforce lockdowns to contain the spread of the virus. Furthermore, 11 countries have ordered a localised lockdown on at-risk locations. The lockdowns and closures have affected 850 million students (UNESCO, 2020; Owusu-Fordjour, Koomson & Hanson, 2020). In this light, most education institutions have turned to the online platform to continue their teaching activities.

E-Learning refers to the spread of knowledge which is facilitated primarily by electronic means through the Multimedia, Tele-learning, Flexible Learning and the intelligent Flexible Learning Models. E-Learning is also described as web-based training, online training, distributed learning, or technology for learning (Hong *et al.*, 2017). While this form of learning currently depends on networks and computers, it will likely evolve into systems consisting of different channels via wireless, satellite and technologies such as cellular phones (Zhang, Patras & Haddadi, 2019). It incorporates application of ICT in performing various institutional activities including course delivery geared towards achieving the goals of an institution. The E-Learning platforms creates a high degree of interactivity between users and incorporate different elements such as Presentation technologies, The World Wide Web, Computer Mediated Conferencing, Multimedia materials, Computer, Computer Based Training, Audio conferencing and Videoconferencing, Streaming Audio and Video, Simulations, Visualisation tools and Email (Sawant, 2016; Hong *et al.*, 2017; Muda & Erlina, 2019). E-Learning helps teachers to work collaboratively to plan programmes, share expertise and provide support to students in remote areas with no or limited educational infrastructure. E-learning ensures quality assurance, quality management and accountability in teaching and learning, (Adams, Sumintono *et al.*, 2018). Due to its many advantages, E-Learning can serve to fill the gaps of school closure in Nigeria due to Covid-19 outbreak.

The Nigerian Federal Ministry of Education has directed the closure of all tertiary, secondary and primary schools nationwide to control the outbreak of Covid-19 in the country. The Permanent Secretary in the Ministry of Education, Sunny Echono, confirmed this to PREMIUM TIMES. The ministry ordered the closure of all the 104 unity schools universities, colleges of education, polytechnics and others in the country from March 26 (Adedigba, 2020). This closure is a bid to maintain social distances between students and teachers to reduce

the spread of Covid-19 among students and staff of higher institutions in Nigeria. Subsequently, e-Learning programmes have been introduced as to provide students access to learning. All public higher education institutions have introduced ICT policies that embrace the adoption and promotion of e-Learning due to the advantages associated with this mode of e-Learning, which has been proved useful in the midst of the Covid-19 outbreak. Several initiatives are taken to improve e-Learning service provision and e-Learning service support in Nigeria; however, these attempts seem to have little real effect (Eze, Chinedu-Eze & Bello, 2018).

It is high time for faculty members, students, and administrators to learn from this critical situation and to overcome these challenges. This crisis has opened up the opportunity to explore the potential of online learning. As most higher education institutions' students are young and energetic, they are capable of learning through the online platform. Thus, faculty members could motivate the younger minds and increase their active participation. Higher education institutions' authorities should also encourage students and faculty members to stay connected through the online or any social media platform to facilitate interactions and communication during this extremely difficult time. Students should be provided with course instruction and other services in an online format to support their academic progress (Sahu, 2020). Training programmes should be organised as quickly as possible for faculty members to support the use of the online learning platform. This experimentation will guide higher institutions around the worldwide to upgrade their technical infrastructure and make online learning a core aspect of teaching and learning (Sahu, 2020). Meanwhile, over the last few months, public universities in Nigeria have started to apply e-Learning, however, there is yet any evaluation the level of e-Learning use as a course delivery method. This study is set to examine the actual status of e-Learning in higher education institutions in Nigeria in a bid to improve the application of e-Learning as course delivery method. The uncertainty over the use of e-Learning in Nigeria higher education institutions, has led to the formulation of the research problem to verify the actual status of e-Learning in Higher education institutions in Nigeria to replace face-to-face lesson during school closure. It is hoped that implementation and usage of e-Learning as a course delivery method could be expanded in Nigeria.

## 2. Literature Review

### 2.1 Covid-19 on School Closure

COVID-19 outbreak has brought some sort of education reform, specifically in the development of online teaching to replace face-to-face lessons due to school closures to contain the spread of Covid-19 worldwide. Many teachers and students have been excited by the move to the online delivery mode. Faculty have already

started preparing lesson plans to deliver online teaching to their students. Online teaching is not a new mode of delivery for many universities where many faculty members have received training to use online learning platforms either as a delivery mode or as an add-on to face-to-face teaching (Sahu, 2020; Chahrour et al., 2020). On the other hand, the transition to online mode has raised questions for the faculty about their efficiencies on using existing technologies (Sahu, 2020). Furthermore, not all students and lecturers have access to computers and IT equipment at home (Xiang et al., 2020). Thus, working from home might present a challenge to some faculty members. Some universities also do not have sufficient infrastructure or resources to facilitate online teaching with immediate effect. Thus, the quality of online education is a critical issue that needs proper attention (Sahu, 2020; Chahrour et al., 2020).

Starting from March 2020, many countries have ordered the closure of educational institutions to reduce the spread of Covid-19 within the community to break the chains of transmission (Spina et al., 2020). Universities across the world have postponed or cancelled all campus events including workshops, conferences as well as intra and inter universities sports tournaments. Researchers have started to examine the potential impact of the COVID-19 outbreak on the academic progress and mental health of university students (Sahu, 2020; Spina et al., 2020). It was reported that universities have moved rapidly to replace face-to-face delivery of courses and programs to online delivery mode (Sahu, 2020). In this regard, e-Learning is the solution to the Covid-19 school closure around the world. Similarly, e-Learning has become front and centre in Nigeria after the ministry of education ordered the closure of Schools in the country from March 26 as a proactive step to prevent the spread of Covid-19 (Adedigba, 2020).

### 2.2 E-Learning Platform as a Course Delivery

This present study highlights the importance of e-Learning to contain spread of Covid-19 pandemic (Capone & Lepore, 2021). In recent months, there is an on-going trend in higher education to set up e-Learning systems that provide students with access to learning content via the online platform. Furthermore, this trend is attributed to the change in students' demographic factors as well as in the educational delivery market conditions and in innovation technology (Al-Rahmi et al., 2018).

Digital Learning is commonly known as e-Learning. Thus, e-Learning is defined as the delivery of learning using completely through the Internet and digital technology. It is among the earliest application of web-based technology (Sfenrianto et al., 2018) and e-Learning is getting more popular worldwide. Almost all universities and colleges have developed their own digital learning portal for their students and faculties (DeLone & McLean, 2016). E-Learning has shown bigger impact on all types of the student in the 21<sup>st</sup>

century as institutions use e-Learning to facilitate learning for students (Al-Samarraie et al., 2018). E-Learning really helps students to participate in online class from anywhere at any time using different platforms. While most Universities have implemented e-Learning earlier (Adams *et al.*, 2018). Freeze, Alshare, Lane and Wen (2019) highlighted that e-Learning users' face lack of system quality, such as software and general applications, lack of technology infrastructure design, low information quality and limited effective information on system usage among students. Studies have found that quality of system and information quality of the e-Learning platform could increase the interest of the users (Panyajamorn, 2019; Freeze et al., 2019). The present study aims to examine Nigerian students' perception on the importance of the e-Learning system.

#### *Technological Infrastructure Support*

It is important to highlight the issue of technology infrastructure support on e-Learning platform in response to school closure to curtail the spread of Covid-19 outbreak. Technological support infrastructure comprises of, among others, the Internet connection. The internet is described as a significant component in the provision of e-Learning portal for students to support remote learning. The study conducted on the adoption of ICT in the Nigerian SMEs content by Ibrahim and colleagues (2017) reported that in 2010, only 28.9% of the population in Nigeria use the internet, indicating a very low internet usage. While internet usage in the country has increased to 46.1% in 2016 (Internet World Stats, 2016), the cost of internet subscriptions in Nigeria is still very high and has caused many business organisations not to use it. The Internet service is also unreliable which creates a major setback for Nigerian MEs. Aremu, Shahzad and Hassan (2019) stated that Nigeria needs to improve the Internet connection in country in order to the enterprise organisations, education sectors to easily adopt and implement ICT technologies for their organisations. In this regard, Ibrahim et al. (2017) reported that even though most SMEs have their own websites, the sites are not functioning well due to the lack of quality Internet connection. This also happens to many universities, both public and private sectors as well among the public in African countries, especially in Nigeria, due to poor technological infrastructure support linked to low Internet connection quality. It is important to note that Internet usage is very important in business operation nowadays and network problems seriously affect MEs business organisation in developing countries, particularly in Africa. Moreover, it generally affects the continent's economy (Aremu, Shahzad & Hassan, 2019).

The provision of ICT infrastructure and support is directly linked to the rate of e-Learning system usage among university students. Poor Internet connection and unreliable Internet access, lack of regular electricity

power supply, high cost of computer ownership, lack of reliable Internet services from Internet service provider have really affected domestic and commercial internet usage (Chopra et al., 2019; Sharma et al., 2020). Therefore, the quality of technology infrastructure support, such as internet connection is very important to enhance the usage of e-Learning platform among students. Thus, it is hypothesized that:

**H1.** There is a positive relationship between the impacts of technological infrastructure support-internet usage on e-Learning as a course delivery.

#### *System Quality*

The Covid-19 pandemic has imposed school closure globally and e-Learning system has been extensively used by teachers and students who are stuck at home. Technical system quality has been found to have a significant positive effect on e-Learning system user's context. According to the information system success model proposed by DeLone and McLean (2016), system quality refers to technical success and the accuracy and efficiency of the communication system that produces information. Chopra et al. (2019) highlight the importance of the system quality on the E-Learning portal. Hence, the e-Learning system should be working efficiently and has a fast response time. The system quality in e-Learning will generate query results more quickly. Thus, system quality will increase the interest of the end user. Moreover, user-friendly interface and modern graphical interface increase the level of the user satisfaction. Aremu, Shahzad & Hassan (2019) highlighted that internet service providers should adopt new changes and modify the system time to time to enhance the quality of the system. The system quality element has been utilized in the area of e-Learning system, which proved whether the user is grateful with the quality of e-Learning system. While, system quality could be reflected by reliable learning, ease learning, the convenience of access, the usefulness of system feature and response time of an information (Freeze et al., 2019). Additionally, as suggested by DeLone and McLean, system quality is conceptualised through the intention of users on e-Learning platform, user friendly, tangible feedback, security and standardisation. Freeze and colleagues (2019) acknowledged system quality based on job performance, work quality, effectiveness of work, usefulness and response time. While validation and reliability of the system quality also have significant relationship with the e-Learning system. In this research, system quality is assumed to have a positive impact on e-Learning system usage among higher institutions students. This study hypothesizes that:

**H2.** There is a positive relationship between system quality and e-Learning course delivery.

#### *Information Effectiveness*

WHO has recommended that schools all around the world to be closed in March, 2019 to reduce the spread

of the Covid-19 outbreak. In this light, the e-Learning system presents a solution to enhance future learning methods. Information effectiveness refers to the use of e-Learning for delivering information which would be important for learning and which is updated regularly. Information effectiveness also refers to the user's belief regarding the effectiveness of data given on a specific portal or the degree to which the user complete precise and well-timed information over the electronic learning interface. Thus, it had been proved by previous e-Learning study's that there was a big impact of effectiveness information on the e-Learning usage among students (Sawant, 2016; Al-Samarraie et al., 2018; Freeze et al., 2019).

Information effectiveness focuses totally on content needs, relevance, information accuracy, completeness, and timeliness. Moreover, the information should be relevant to the actual user, and therefore the required information is available at the proper time to the proper person also as might be captured by all users of the system (Sfenrianto et al., 2018). In this light, the aim of information effectiveness is to support students with the online knowledge with similar effective information at any time. Thus, an e-Learning system should have quality information effectiveness. In this light, past studies found that information effectiveness influences e-Learning usage (Ali, Hossain & Ahmed, 2018; Freeze et al., 2019). Information effectiveness captures e-Learning platform issues and providing students with learning information is the primary goal of a course web site. While, deciding what content to put on a web site is extremely necessary, addressing the difficulty of how user acceptance is affected by web site features and the way information is delivered are equally important (Ali, Hossain & Ahmed, 2018; Sfenrianto et al., 2018; Ali, Hossain & Ahmed, 2018; Freeze et al., 2019). This study proved that content and information effectiveness have a positive impact on the use of e-Learning system among students, thus, this study hypothesizes that:

**H3.** There is a positive relationship between information effectiveness and e-Learning course delivery.

### 2.3 Theoretical background

#### *The Technology Acceptance Model (TAM)*

In this study, TAM was used to determined e-Learning system as a course delivery in the content of higher education institution. The TAM can be applied to any specific domain of human or computer interactions (Taherdoost, 2018). The model indicates that system usage is indirectly affected by e-Learning system. Many researchers have conducted empirical studies to examine the explanatory power of the TAM, which produced relatively consistent results on the acceptance behaviour of IT end users (Agag & El-Masry, 2016; Taherdoost, 2018). Researchers have agreed that TAM has high validity in predicting the individual acceptance of numerous systems (Agag & El-Masry, 2016; Taherdoost, 2018; Dwivedi et al., 2019). In summary, TAM provides an explanation of the determinants of

technology acceptance to explain user intention to use end-user information technologies and user populations (Taherdoost, 2018). Several studies have examined TAM as a model to explain how people adopt and use an e-Learning system. Selim (2003) stated that there is a need to investigate TAM in the context of web-based learning. TAM examines two significant elements, perceived usefulness, which can be defined as the extent to which a university student believes using e-Learning will boost his or her learning, and perceived ease of use which reflects the extent to which one believes using e-Learning will be free of cognitive effort (Selim, 2003). Also, Selim (2003) presented the course website acceptance model and tested the relationships among perceived usefulness, perceived ease of use and intention to use among university students using the structural equation modelling techniques of the program. The researcher concluded that the model fits the collected data. In this light, the usefulness and ease of use are good determinants of the acceptance and use of a course website as an effective and efficient learning technology. In the present study, the e-Learning system refers to the platforms, specifically, Zoom, WebEx, Skype, web-based learning operated by the university to deliver online lectures. The study also measured the perception of the e-Learning system quality among students based on the DeLone and McLean as information system success model, which explains the impacts of system quality on e-Learning context.

#### *Diffusion of Innovation Theory (DOI)*

Agag and El-Masry (2016) introduced the Diffusion of Innovation Theory (DOI). It is defined as a process used to present and spread an innovation among members of a social setting through some particular channels over a specific period of time (Sheikh et al., 2017). In addition, an innovation intended for adoption is defined as an art, idea, practice, or an object perceived as new by an individual. In this regard, this technology may be simply perceived as new by a novice. The Diffusion of innovation theory (DOI) has been in use for years to examine the acceptance of innovations in many fields such as, agricultural tools and organisational innovations (Agag & El-Masry, 2016). Agag, and El-Masry (2016) re-defined the constructs for the adaptation of DOI into the information system context. It is contended that Diffusion of Innovation (DOI) theory is the rate of adoption of innovations, which is influenced by five factors: compatibility, relative advantage, observability, complexity and treatability. It examines the success factor of ERP adoption and individual factor, organisational factor, innovation factor and task factor (Aremu, Shahzad & Hassan, 2019).

The DOI theory has been used to examine the users' acceptance of computer programs (such as computer games) and other widely used technologies. In this regard, it uses communication and media channels to deliver innovation to the society (Aremu, Shahzad & Hassan, 2019). Due to above arguments, IDT was used

in this study to examine the technology infrastructures support while DeLone and McLean model was used to explore information effectiveness on e-Learning system usage among students. Numerous studies have successfully integrated IDT and DOI into TAM to investigate users' technology acceptance behaviour (Agag & El-Masry, 2016; Taherdoost, 2018; Dwivedi et al., 2019). Several studies have attempted to examine all IDT characteristics with the integration of TAM. In this research, the TAM is improved by combining IDT and DeLone-McLean model measured technology infrastructures support, system quality, information effectiveness and e-Learning system as a course delivery platform and will be observed as additional research constructs to increase the credibility and effectiveness of the study.

### 3. Methodology

#### Research Framework of the study

The proposed conceptual framework is based on TAM, IDT and DeLone-McLean model. It stipulates that the key to a successful use of e-Learning among students is to maintain a technology infrastructure support, system quality and information effectiveness to enhance e-Learning system in various higher education institutions.

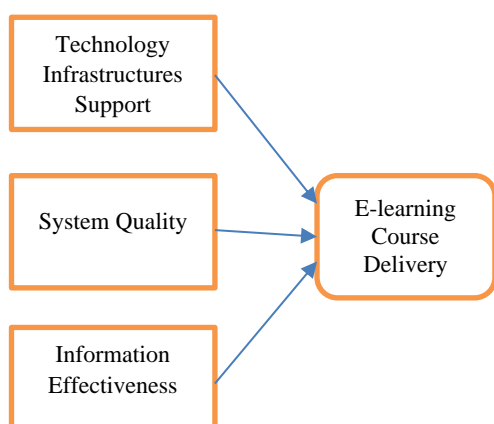


Figure 1 - Research Framework.

#### Data Collection

This study adopts the guiding principle of SEM developed by Hair et al., for sample size. In line with the Hair et al., SEM parameters sample size determination, the study involved a population of 550 university students. Hence, the minimum sample size required is 230 students. 390 sets of questionnaires were distributed via email to university students. Aremu, Shahzad and Hassan (2019) stated that smaller sample size entails greater tendency of error while a bigger sample size could generate more accurate result. The data were collected from students of public higher institutions, namely UI, LAUTECH, Ibadan poly and Okeogun poly located in Oyo State, Nigeria. The sampling size was calculated by parameters numbers of the size. Out of the

390 sets of questionnaires distributed, 369 were received while only 230 were useable. Meanwhile, Tables 1-4 summarise the results for items measuring each construct. The Cronbach Alpha was used to ensure that the items fit this study. Some modifications were made to the items.

No	Items	Alpha
1	Taking class via the e-Learning allowed me to arrange my work for the class more effectively.	0.87
2	The advantages of taking class via the e-Learning outweighed any disadvantages.	
3	Taking class via the e-Learning allowed me to spend more time on non-related activities.	
4	There were no serious disadvantages to taking class via the e-Learning.	
5	Taking class via the e-Learning allowed me to arrange my work schedule more effectively.	

Table 1 - E-Learning Course Delivery (Sun, Tsai, Finger, Chen & Yeh; 2008).

No	Items	Alpha
1	My current internet service provider provides me with sufficient information to participate in e-Learning class.	0.86
2	My current technology internet service provider provides an attractive network to participate in e-Learning class.	
3	My current internet service provider provides an up-to-date internet services to participate in e-Learning class.	
4	My technology internet service provider provides an easy way to use internet services to participate in e-Learning class.	
5	My quality of internet speed is low to participate in e-Learning class.	
6	My technology internet service provider provides a fast and reliable network to participate in e-Learning class.	

Table 2 - Technology Infrastructures Support (Aremu, Shahzad & Hassan, 2019).

No	Items	Alpha
1	I am satisfied with e-Learning functions lectures	0.78
2	I am satisfied with the Internet speed via e-Learning class	
3	I am satisfied with e-Learning content lectures delivered	
4	I am satisfied with e-Learning interaction	
5	I am satisfied with using e-Learning as a learning assisted tool to received lectures	

Table 3: E-Learning System Quality (Liaw, 2008).

No	Items	Alpha
1	I believe e-Learning can assist learning efficiency	0.76
2	I believe e-Learning can assist learning performance	
3	I believe e-Learning can assist learning motivation	
4	I believe e-Learning contents are informative	
5	I believe e-Learning is a useful learning tool	

Table 4: E-Learning Information Effectiveness (Liaw, 2008).

#### 4. Analysis and Discussions

This study used PLS to analyse the data and to test the various hypotheses for this study. In a PLS analysis, the first step is to evaluate the outer model or measurement model, as shown in Figure 2. The outer model involves identifying the reliability, internal consistency reliability, content validity, convergent validity and discriminant validity of individual items (Hair et al., 2016).

##### Measurement Model

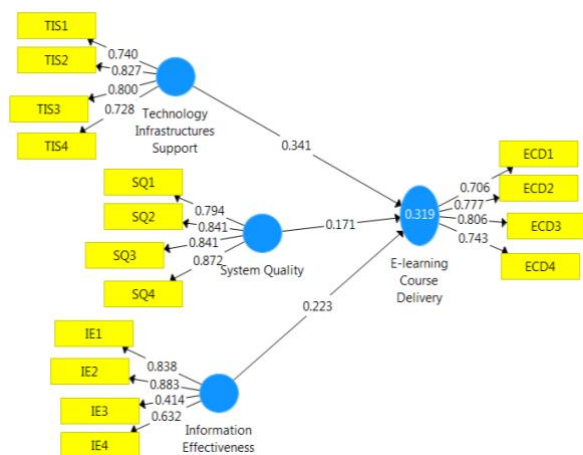


Figure 2 - PLS Algorithm Measurement Model (Source: author's own findings).

##### Internal Consistency Reliability

Internal consistency reliability refers to the extent to which all indicators of a particular (sub) scale evaluate the same concept (Hair et al. 2016). In this regard, the composite reliability score value must be at least 0.70 and AVE score value should be more than 0.50 (Hair et al. 2016). The results of the constructs in Figure 2 are shown in Table 5 and 6 below. As shown in Table 5, all the variables included in this study have AVE and composite reliability more than the threshold value of 0.50, which suggests a reliable measurement model. This study used Cronbach Alpha to observe internal consistency of the data. According to Sekaran and

Bougie (2010),  $\alpha > 0.9$  is deemed as excellent,  $\alpha > 0.8$  is good and  $\alpha > 0.7$  is acceptable. In this study, values of Cronbach are in an acceptable range. The result in Table 5 presents that the average variance extracted (AVE), Cronbach alpha and composite reliability values of all variables are in acceptable range.

Constructs	Items	Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
E-Learning Course Delivery	ECD1	<b>0.706</b>	0.756	0.844	0.576
	ECD2	<b>0.778</b>			
	ECD3	<b>0.805</b>			
	ECD4	<b>0.742</b>			
Information Effectiveness	IE1	<b>0.847</b>	0.696	0.797	0.513
	IE2	<b>0.887</b>			
	IE3	<b>0.622</b>			
System Quality	SQ1	<b>0.794</b>	0.858	0.904	0.702
	SQ2	<b>0.841</b>			
	SQ3	<b>0.841</b>			
	SQ4	<b>0.872</b>			
Technology Infrastructures Support	TIS1	<b>0.754</b>	0.778	0.857	0.600
	TIS2	<b>0.827</b>			
	TIS3	<b>0.863</b>			
	TIS4	<b>0.728</b>			

Table 5 - Indicator Loadings, Internal Consistency Reliability, and Convergent Validity.

Table 5 shows that the Cronbach alpha of each variable is more than 0.70. Except for the information effectiveness with 0.696. While composite reliability of IE shows the threshold value of 0.797. This indicates that all variables of this present study have high consistency, high reliability and their AVEs exceed the threshold values, indicating the reliability of the measurement model.

##### Discriminant Validity

Discriminant validity is another criterion, which assesses the degree to which a variable is truly distinct from other variables (Hair et al., 2016). Thus, it denotes the extent to which a particular element differs from other constructs (Duarte & Raposo, 2010). A greater level of discriminant validity suggests that the variable is distinct and could capture some phenomena that other variables do not. In this study, discriminant validity was ascertained using the square root of AVE and it should be greater than the correlations among latent constructs (Aremu, Shahzad & Hassan, 2019). This study considered the discriminant validity to confirm the external consistency of the model. The comparison



among the latent constructs is explained in Table 6. The square root of AVE of the constructs are e-Learning course delivery (ECD) = 0.759; Information effectiveness (IE) = 0.716; System quality (SQ) = 0.838 and Technology infrastructures support (TIS) = 0.775.

	E-Learning Course Delivery	Information Effectiveness	System Quality	Technology Infrastructures Support
E-learning Course Delivery	<b>0.759</b>			
Information Effectiveness	0.411	<b>0.716</b>		
System Quality	0.355	0.305	<b>0.838</b>	
Technology Infrastructures Support	0.488	0.398	0.345	<b>0.775</b>

Table 6 - Discriminant Validity Matrix.

Note: the bolded numbers in Table 6 represent the square root of average while others represent latent variable correlations.

Table 6 illustrates that the square root of AVE is greater than the correlation between latent variable indicating the acceptable discriminant validity (Aremu, Shahzad & Hassan, 2018). Initially, this research has explained the framework and indicated the links between the relationships among the variables based on the past literature. In this regard, the existing literature might need to be revised and modified based on the confirmatory factor analysis that has been conducted in this study. The CFA indicates that none of the variable should be discarded. This is in line with the recommendation with Hair et al. (2016) that stated variables with at least two items should be retained.

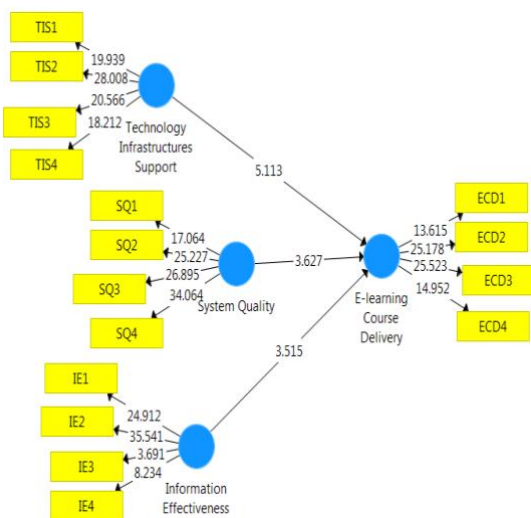


Figure 3 - Structural Model Direct Relationships (Source: author's own findings).

Table 7 highlights that all hypotheses are supported as they have a p-value of less than 0.05. H1 is supported, hence there is positive direct impact of technological infrastructure support on e-Learning course delivery ( $\beta=0.341$ ;  $T=5.113$ ;  $p < 0.000$ ). Furthermore, system quality has a direct positive impact on e-Learning course delivery ( $\beta=0.171$ ;  $T=3.627$ ;  $p < 0.000$ ), and H2 is supported. Information effectiveness also has a positive direct impact on e-Learning course delivery ( $\beta=0.223$ ;  $T=3.515$ ;  $p < 0.000$ ) and based on this result, H3 is supported. Therefore, all the three hypotheses (H1, H2 and H3) are supported. The results show the direct impact of technological infrastructure, system quality and information effective on the use e-Learning system as a course delivery platform.

CONSTRUCTS	Beta	T - Values	P - Values	Decision
Information Effectiveness -> E-Learning Course Delivery	0.223	3.515	0.000	Supported
System Quality -> E-Learning Course Delivery	0.171	3.627	0.000	Supported
Technology Infrastructures Support -> E-Learning Course Delivery	0.341	5.113	0.000	Supported

Table 7 - Result of hypothesis testing.

### 5. Discussions and Conclusion

This study presents a conceptual framework that examined the impacts of e-Learning system usage among higher education institutions. It has demonstrated the relationship between technology infrastructures support, system quality and information effectiveness, variables linked to the performance of e-Learning platform as a platform for course delivery. The determinants in the theoretical framework were chosen based on the input obtained from the newly developed structured questionnaire.

The results have interesting implications to both institutions and students. The finding shows that technology infrastructure support, system quality and information effectiveness significantly influence the usage of e-Learning platform and these inputs could be used to enhance the quality of services provided by higher education insitutions. The findings are in line with Al-Rahmi *et al.* (2018) and Aremu, Shahzad and Hassan (2019) who suggested that technology infrastructures support, system quality and information effectiveness fully impact the usage of e-Learning platform among students. This is because e-Learning platform connects and streamlines school operations and drastically affects the quality of services provided to the



students. Therefore, higher education institutions need to focus on aspects like technology infrastructure support, system quality and information effectiveness to ensure the successful usage of e-Learning system and to enhance the quality of services provided.

This study shows that the use of e-Learning system significantly influences students' and schools' performance. The use of e-Learning platforms has been seen to be highly efficient in providing learning support while students and teachers are forced to stay at home amidst the Covid-19 outbreak. Furthermore, the use of e-Learning platform has been found to minimise operational cost, and improves quality of services. This implies that e-Learning system usage could help schools to sustain their quality of services and competitiveness. Therefore, schools should continue to select the most appropriate e-Learning portal. It is also deduced that the e-Learning usage and implementation, influences school and students quality performance, in line with the findings of other studies (e.g. Al-Rahmi *et al.*, 2018).

This study have used TAM and DeLone-McLean, IDT to empirically establish that technology infrastructure support, system quality and information effectiveness factors generally contribute to technology adoption in the case of e-Learning system usage among students. This implies that e-Learning system could help support learning during the covid-19 outbreak and post-Covid-19 pandemic.

### 5.1. Theoretical Implication

Although technology adoption phenomena have been widely studied across different contexts, specifically at the individual (Student) and school (College) levels. There has been no coherent attempt to examine the phenomena in the perspectives of e-Learning system usage among students to enhance the e-Learning platform usage particularly in the context of Nigerian higher education institutions. This study can be considered as unique in the field of information system and e-Learning system in higher education institutions. Moreover, this present study provides empirical evidence in supporting the theoretical relationships hypothesised in the study's framework. It has explained the relationship between the variables such as, technology infrastructures support, system quality, information effectiveness and their significant impact on the rate of e-Learning platform usage among students.

The implications of this research on the e-Learning platform system is not only limited to validating the TAM and DeLone-McLean, IDT in the context of e-Learning platform, it also extends both constructs to increase the conceptualisation of technology use. This present study examined the factors affecting the use of e-Learning platform system by extending TAM and DeLone-McLean, IDT to include factors that are more related to information system and e-Learning usage among higher education institutions students. Both DeLone-McLean, IDT and TAM are considered as the IS tangible factors that could help higher education

institutions strengthen and enhance their services. This study also helps researchers by providing an understanding about the different relationships between technology infrastructures support, system quality, and information effectiveness and their significant impact on the use of IS for online learning and how higher education institution students use the online learning system. This confirms that the effectiveness of the e-Learning system depends on the students' perceptions.

### 5.2. Practical Implications

This present study has several practical implications on the provision of e-Learning platform technology in Nigerian higher education institutions and other countries. Thus, the study findings will help the Nigeria government, ministry of education and higher education institutions policy-makers as well as the top managements of Nigerian universities, Polytechnics and college of education in designing the policies and programs on e-Learning platform system in the country.

The results of this study can help higher education institutions to understand and verify the significant relationship between the major variables and dependent variable. In this light, there are several practical recommendations drawn logically from the statistical findings and the results provide the top management of higher education institutions with practical recommendations to develop understanding on the implication of technology infrastructures support, system quality and information effectiveness in the improvement of e-Learning system.

The study's findings have empirically established that all factors (i.e., E-Learning system, System Quality, Information effectiveness have significant impact on the e-Learning as a course delivery) generally contribute to IS usage including the e-Learning system based on DeLone-McLean, IDT and TAM. Thus, factors in the DeLone-McLean, IDT and TAM could directly contribute positively or negatively to quality of e-Learning system provided by higher education institutions. Thus, administrators of higher education institutions could use the IS success model to enhance higher education institutions quality services by considering the relationships between factors as proposed based in TAM and DeLone-McLean, IDT. This implies higher education institutions should focus on improving the provision of e-learning system by adapting the DeLone-McLean, IDT and TAM to increase their competitive advantage.

### 5.3 Limitations and Recommendations

This study's scope is limited to the e-Learning among higher education institutions students in Nigeria. In terms of the methodology, this study is only limited to small population which makes it hard to generalise the data accurately to other population. On the other hand, this study provides several recommendations for future studies as stated below, first, future studies should cover

a larger population or a country as a whole so that the results can be generalised to the entire population. Second, future studies should include both private and public institutions to see their level of inclination towards online class through e-Learning systems and how it affects institutions' performance. This study also provides several recommendations for the ministry of education. First, e-Learning system has a high potential to grow and there are many applications have been created to promote and facilitate e-Learning website application for ads only. Second, the ministry of education should use this medium to reach out to their target institutions, especially in promoting their agenda. In this unprecedented health crisis, the e-Learning platform has had higher impacts compared to the traditional way. Meanwhile, students can attend their class online anywhere they go as long as they can access the e-Learning platform and can attend lectures without the need of a complex mechanism. Lastly, the use of e-Learning platform system among students could actively shape a school's learning culture and enhance the quality of services.

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