

# Assessment of the effects of Covid-19 pandemic on the prospects of e-learning in higher learning institutions: The mediating role of academic innovativeness and technological growth

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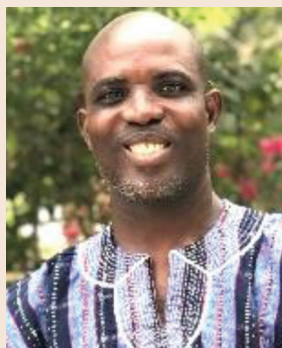
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## INFORMATION & COMMUNICATIONS TECHNOLOGY IN EDUCATION | RESEARCH ARTICLE

# Assessment of the effects of Covid-19 pandemic on the prospects of e-learning in higher learning institutions: The mediating role of academic innovativeness and technological growth

Daniel Edem Adzovie<sup>1,2\*</sup> and Abdul Bashiru Jibril<sup>3</sup>

**Abstract:** This paper assesses the antecedents (prospects) geared toward the implementation of e-learning strategy in the HLI's of Ghana (a developing country) amidst the Covid-19 pandemic. The study again espouses the enabling factors that influence the e-learning system usage during the Covid-19 pandemic in a less digitalized economy. In doing so, the authors relied wholly on a quantitative research paradigm by leveraging on structural equation modelling (SEM) technique to achieve the study goal(s). The findings from 563 valid responses showed that the outbreak of the novel Covid-19 has positively and significantly strengthened the adoption of e-learning strategies across HLI's in Ghana. It also revealed that "academic innovativeness" and "technological growth & development" have a significant mediation effect on the relationship between the Covid-19 pandemic



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### PUBLIC INTEREST STATEMENT

The outbreak of Covid-19 pandemic has necessitated the growing usage of e-learning resources mostly as alternative modes of teaching and learning across the globe. This paper considers the prospects of strategies adopted for the successful implementation of e-learning strategies in Ghana. Valid responses from major stakeholders of higher education sampled from both private and public institutions of higher learning in Ghana revealed that the outbreak of the novel Covid-19 has forced most educational institutions in Ghana to significantly strengthen the adoption of e-learning strategies across the country. Also, the study showed that "academic innovativeness" and "technological growth & development" have a significant mediation effect on the relationship between the Covid-19 pandemic and the adoption of e-learning strategies in higher learning institutions (HLIs) in Ghana.

and the adoption of e-learning strategy. In practice, the study offers contributions for universities' management and policymakers to understand the relevant factors needed urgently by students and instructors of HLI's for ensuring the successful usage of e-learning systems. The conclusion and future research direction has been presented in the paper.

**Subjects: Engineering Education; Technology; Development Studies; Educational Research; Research Methods in Education**

**Keywords: Covid-19 pandemic; academic innovativeness; technology; e-learning; Ghana**

### 1. Introduction

Globally, the novel coronavirus (Covid-19) has arguably brought more meaning to the "e-learning revolution" Welsh et al. (2003:246). Numerous opportunities came along with the introduction of the world-wide web (www), and one of such opportunities is electronic learning (e-learning). According to Welsh et al. (2003), as cited in (Adzovie et al., 2020), transmitting information and instruction over an intranet or Internet to people, using computer network technology is referred to as e-learning. Tavangarian et al. (2004:274) also defined e-learning as "all forms of electronically supported learning and teaching, which are procedural in character and aim to effect the construction of knowledge with reference to individual experience, practice and knowledge of the learner. Information and communication systems, whether networked or not, serve as specific media to implement the learning process". There is extant literature on the relevance and need for e-learning solutions (see, Bhuasiri et al., 2012; Cheng et al., 2014; DeRouin et al., 2005; Nawaz, 2013; Tavangarian et al., 2004); therefore, this fact is in no doubt. E-learning solutions have been applied in most jurisdictions as back-up or alternatives to face-to-face classroom learning.

However, when covid-19 was declared by the World Health Organisation (WHO) as a global pandemic, many educational institutions were forced to move completely from face-to-face modes of teaching and learning to e-learning solutions. One may assume that this phenomenon would have affected only under-developed and/or developing countries. Nonetheless, Nawaz (2013) asserted that effective application of e-learning solutions by institutions of higher learning is a global challenge. This notwithstanding, a developing country like Ghana was hit really hard when government announced the mass closure of all educational institutions after the country recorded her first two Covid-19 cases in March of 2020 (Myjoyonline, 2020). This gave a clear indication to key stakeholders of education in Ghana that covid-19 had emerged, sadly, to disrupt how things used to be done, especially regarding teaching and learning. Although Awidi (2008) asserted that e-learning is not a new experience in Ghana, in a conceptual study, Adzovie et al. (2020:19) identified "inaccessibility of Internet connectivity in some parts of the country, costly nature of Internet data, as well as lack of access to electronic devices such as smart mobile phones/computers" as challenges confronting the successful implementation of e-learning solutions in Ghana. Aside from these challenges, Awidi (2008:67) pointed to what he calls the "culture of Ghanaian public universities"- where policy regulations behave it on students to be physically present at lecture theatres in order to be recognised as having fulfilled their credit hours successfully, as one major challenge preventing institutions of higher learning to fully roll out e-learning solutions.

Contextually, the authors of the present study would define e-learning as any form of teaching and learning that is done with the assistance of an electronic device such as mobile phone, personal computer over an internet platform. We would extend our definition to cover audio/video recording of lessons made by an instructor for the consumption of learners/students and vice versa, devoid of physical traditional face-to-face mode of teaching and learning. With the outbreak of covid-19 pandemic, forcing all institutions in the country to switch to other modes of teaching and learning, an institution's survival, especially during these times may depend largely on how innovative that institution is or becomes, coupled with the availability of needed

infrastructure on which many e-learning solutions function (Dwivedi et al., 2020). Tanye (2017) reported that Ghana had always planned to roll out e-learning solutions in its institutions, particularly, at the tertiary (institutions of higher learning) level by establishing the Centre for National Distance Learning and Open Schooling (CENDLOS) through the Ministry of Education (MoE). This Agency, according to Tanye (ibid) was given the role of reinforcing Open and Distance Learning (ODL) at the tertiary level in the country in order to extend same to the pre-tertiary level. However, efforts of this Agency have not been too successful after deploying content on various subjects for Junior High and Senior High schools in the country. This corroborates Dadzie's (2009) claim that efforts at e-learning implementation in Ghana is not new. However, Kotoua et al. (2015) found that despite being partners to the numerous e-learning projects in Africa, Ghana has not made much progress in respect of successful introduction and implementation of e-learning solutions.

Despite the extant literature on e-learning regarding Ghana, the focus has largely been on the challenges, history and antecedents of e-learning introduction and implementation in Ghana—a phenomenon that is common to most developing countries. It appears that not much has been done regarding the assessment of the prospects of e-learning solutions introduction and implementation, especially in institutions of higher learning in Ghana. Also, little or nothing has been done scholarly, on the mediating role of innovations explored by these institutions, particularly during the outbreak of covid-19 pandemic. In furtherance to this, there is paucity in scholarship regarding the role of technological advancements in ensuring smooth and successful implementation of e-learning solutions in Ghana.

Since, the importance of e-learning to institutions of higher learning, especially in the 21<sup>st</sup> century dispensation cannot be overemphasised (UNESCO, 2015), and having known some, if not all the challenges of e-learning implementation in Ghana, it is imperative to assess the prospects of e-learning in institutions of higher learning in a developing country such as Ghana by examining the mediating role of academic innovations vis-à-vis growth regarding technology. The current study is significant because it appears that e-learning has come to stay, and efforts being made by institutions of higher learning in Ghana to derive the best from e-learning approaches need to be assessed. It is in doing so that progress would be seen and experienced. The main purpose of the study is to assess the future success of e-learning in institutions of higher learning, and also to examine the mediating role(s) academic innovativeness and technological growth play in the successful implementation, especially with the setting in of Covid-19 pandemic.

In doing so, we ask the following two questions in that respect:

- (1) *What are the main antecedents that facilitate the adoption e-learning strategy in the HLI's during COVID-19 Pandemic?*
- (2) *What are the mediating factors that affect the successful usage of e-learning system during COVID-19 Pandemic?*

The remainder of the paper begins with the literature review and leads to the proposed research model with complementary research hypotheses. This is followed by the methodology section, which details the data collection procedure. Next, results followed by general discussion and research implications. Finally, the paper concludes with limitations and future research directions.

## **2. Literature review: conceptual framework and hypothesis development**

Prior literature was reviewed under the following sub-headings: *Academic innovativeness of higher learning institutions; digital divide regarding the use of technology for e-learning; effect of covid-19 on e-learning; and technological growth and development as a result of covid-19. Also, literature was reviewed on controlled variables—socio-demographic features of respondents regarding units*

*within academic institutions; devices used in accessing the Internet; and the platform(s) from which e-learning solutions are accessed, in order to bring the study to perspective.*

### **2.1. Academic innovativeness of higher learning institutions**

With covid-19 drastically changing almost every normal way of doing things, academic institutions of higher learning had to embrace innovations to be able to continue with academic work. This is because almost all academic institutions had to completely move from face-to-face modes of teaching and learning to other modes. Watson et al. (2020) reported that the novelty brought about as a result of covid-19, especially to academic institutions, particularly, institutions providing medical education cannot be swept under the carpet. They observed that medical schools are adapting new ways of delivering lessons as well as assessments to medical students to be able to speed up their completion so that they could join the practicing medical professionals in delivering healthcare during the covid-19 situations in the United Kingdom. They further proposed “rapid risk-assessed remodelling of teaching within a clinical environment in a proactive manner ... call for a fast response from universities and the GMC to reflect on current potential learning opportunities for medical students and to develop a flexible, bold strategy to reshape medical education to rise to the current challenges and new opportunities” (Watson et al., 2020:1). Similarly, Rose (2020) reported that many medical schools have in place of teaching basic sciences, incorporated clinical medicine as an innovative way of making up for the uncertain pandemic period (see, Irby et al., 2010; O’Doherty et al., 2018; Sandhu & de Wolf, 2020). Crawford et al. (2020) concluded that inasmuch as some universities responded and keep responding proactively through the introduction of innovative ways of teaching and learning during the period of the pandemic, other similar academic institutions are lagging. In exploring whether the change in teacher education constitutes innovativeness by institutions, Ellis et al. (2020) asserted that since such measures aggregately improve the quality of teaching and learning; they are a form of innovation (Also see, Frey et al., 1997; Iwanaga et al., 2020). Gomez et al. (2020) found that in comparison with traditional mode of delivering education, student enrolment soared when elective courses which hitherto were delivered through face-to-face modes, were developed to be delivered through online modes. Van Wyk and Lemmer (2007) asserted that in an HIV/AIDs epidemic situation in South Africa, teachers had to be innovative by assuming dual roles of teachers and parents to students who had lost their parents through HIV/AIDs. With the foregoing, it appears that academic institutions as well as individual teachers display varied forms of innovativeness during crisis situations such as the covid-19 pandemic.

### **2.2. Digital divide regarding the use of technology for e-learning**

Access to e-learning solutions may be hindered by the phenomenon of digital divide. According to Joseph (2001), digital divide could be seen as a disparity (which is conspicuous) that exists between people or entities as well as geographical locations in terms of differences in socio-economic standings in respect of available avenues of access to information communication technologies (ICTs) vis-à-vis the utilization of Internet for the purpose of performing different forms of activities (see, Journell, 2007). Relatedly, Sims et al. (2005) defined digital divide as the existing gap between individuals who have access to, and are able to use information communication technologies and individuals who lack this access. Nielsen (2006) categorises the divides into three—economic divide, which refers to the inability of individuals to purchase a computer device; usability divide, which deals with people’s inability to use a computer or unable to use modern technologies; and empowerment divide, which refers to people who, even though the technology and Internet is available, are unable to utilise these opportunities to their fullest. Krönke (2020) reported that UNESCO puts 1.2 billion students and the youth worldwide at a disadvantage as a result of closure of schools and universities due to Covid-19 pandemic; and in Africa, approaches to adaptations to changes in technology-enhanced learning keep improving, but at a snail’s pace. In Ghana, Quaicoe and Pata (2020) found that the level of teachers’ usage of technologies in teaching in half of the sampled population is low (see, Agyei, 2013; Buabeng-Andoh, 2012). Quaicoe and Pata’s study; however, was limited to

only six districts in Ghana; hence, their findings would have to be cautiously utilised. Also, there appears to be paucity in the literature regarding the mediating role of academic innovativeness and technological growth resulting from Covid-19 pandemic, which this study seeks to tackle.

### **2.3. Effect of covid-19 on e-learning**

Covid-19 pandemic has in no doubt brought about varied influence in teaching and learning in most, if not all educational institutions worldwide. De Oliveira et al. (2020) found that in Austria, Covid-19 pandemic has had a great impact on teaching and learning – which used to be largely face-to-face (see, Iyer et al., 2021; Soni, 2020). In China, where online mode of teaching and learning was announced first since the outbreak of Covid-19, Jin et al. (2021) found that push factors—perceived security risk, learning convenience and service quality as well as pull factors—usefulness, ease of use, teachers’ teaching attitude and task-technology fit as well as mooring effects (habit) affected the willingness to change from face-to-face mode to e-learning mode. Shahzad et al. (2021) conducted a comparative study on the use of E-learning portal by males and females in universities in Malaysia and found that system quality had direct relationship with user satisfaction in respect of male students (see, Favale et al., 2020). In Nigeria, Adanikin et al. (2020) found that high cost of Internet, poor Internet availability as well as unstable electric power supply remain factors inhibiting the effective implementation of e-learning in institutions of learning (see, Kulikowski et al., 2021; Saxena et al., 2021). Using a descriptive survey method, Owusu-Fordjour et al. (2020) assessed the impact of Covid-19 on learning in Ghana and found that students’ inability to study on their own from home formed part of the e-learning implementation challenges in Ghana. Also, they found that some of the e-learning platforms deployed by institutions presented challenges to users. Relatedly, Tsitsia et al. (2020) examined student-teachers’ perceptions of e-learning in the Colleges of Education in Ghana and found that high cost of Internet data as well as erratic supply of Internet connectivity hindered effective implementation of e-learning solutions in three Colleges of education in Ghana (see, Andoh & Henaku, 2020).

### **2.4. Technological growth and development as a result of Covid-19**

Uncertain times and situations such as the outbreak of Covid-19 pandemic call for growth and development in ingenuity by affected individuals and entities. Teräs et al. (2020) reported that many educational institutions and commercial digital learning platform vendors have quickly as a matter of urgency and necessity embraced various e-learning technologies, with some providers availing these platforms to educational institutions free of charge to promote technologization of education. Ratten and Jones (2021) opined that the challenges brought by Covid-19 must be viewed from a positive point to force institutions to be innovative with technology in promoting entrepreneurial education (see, Akkermans et al., 2020; Al-edenat & Al Hawamdeh, 2021; Igwe et al., 2021). In the United States of America, Bacq et al. (2020) outlined how Covid-19 pandemic has forced university professors and students to respond rapidly with technological innovations. Clipper (2020) found that Covid-19 has forced entities to urgently and hurriedly deploy technologies that were being developed for future. Similarly, Shaw et al. (2020) assert that certain governments adequately responded to the pandemic due to extensive use of emerging technologies in respect of healthcare (see Polas & Raju, 2021). Anafo et al. (2021) reported that regarding technology growth and development in Ghana, not much could be seen since the outbreak of the pandemic (see Patel & Shah, 2020). It is obvious from the literature that not much scholarship could be seen regarding technology growth and development as a result of Covid-19, particularly in developing countries like Ghana.

Moving on, the authors were interested in the following controlled variables: the socio-demographic features of respondents regarding units/departments within academic institutions. Regarding devices employed in accessing the Internet, Muthuprasad et al. (2021) revealed that in India, majority of students sampled preferred the use of mobile phones in accessing e-learning platforms. Similarly, Kaisara and Bwalya (2020) found that mobile devices were mostly used in Namibia (see, Agung et al., 2020). In Ghana, Ogbonnaya et al. (2020) found that teachers used smartphones in browsing the Internet. With respect to platforms and solutions available

for e-learning during the pandemic, Sreehari (2020) reported that Zoom was the most preferred and the most widely used virtual learning solution in India. It is also the platform(s) from which respondents access e-learning solutions. Kalayci (2015) found that students enjoyed using Moodle in e-learning during the pandemic. Television and social networking sites were heavily used in transmitting e-learning solutions in the Kingdom of Saudi Arabia (Hoq, 2020). Amanormfofo et al. (2020) reported that Television and radio platforms were previously used to transmit e-learning but could not account for the platforms currently being deployed by institutions in Ghana. We believe that exploring the above would expand the frontiers of the study and provide worthwhile dynamics.

The literature reviewed reveals gaps in the assessment of Covid-19 pandemic on the prospects of e-learning in Higher Learning Institutions (HLIs) in developing country settings such as Ghana, particularly, the mediating role of academic innovativeness and technological growth which this study seeks to fill.

### **2.5. Summary of research hypotheses and conceptual model**

**H1:** *The Covid-19 pandemic has positively triggered and exposed the digital divide among staff and student of HLI's in Ghana.*

**H2:** *The Covid-19 pandemic has positively led to academic innovativeness among HLI's in Ghana.*

**H3:** *The Covid-19 pandemic has positively led to technological growth and development among HLI's in Ghana.*

**H4:** *The Covid-19 pandemic has positively led to the inclusion of e-learning strategy among HLI's in Ghana.*

**H5:** *Digital divide among students and staff of HLI's has positively led to the inclusion of e-learning strategy in Ghana.*

**H6:** *The relationship between Covid-19 pandemic and the adoption of e-learning would be positively mediated by academic innovativeness.*

**H7:** *The relationship between Covid-19 pandemic and the adoption of e-learning would be positively mediated by technological growth and development.*

We further summarise and conceptualise the above literature review in a complex model below:

## **3. Research method**

### **3.1. Sampling and data collection instrument**

In this research, we deployed cross-sectional and quantitative research approach. The subjects who took part in the study were drawn from the HLI's in Ghana, i.e University of Cape Coast (UCC), University of Ghana (UG), Sunyani Technical University, (STU), Cape Coast Technical University (CCTU), Takoradi Technical University (TTU) and African University College of Communications (AUCC), through a non-randomised sampling technique. Having considered the restrictions (protocols) of the novel Covid-19 pandemic, both hard and soft copies of the research questionnaire were administered simultaneously for the data collection. Since the research theme aimed at assessing the antecedents of e-learning strategy, it became purposeful to undertake a non-randomized sampling approach to achieve this goal (see, Elkatawneh, 2016). Furthermore, the approach was designed to help the researchers to understand the e-learning system adoption from selected HLIs that have already integrated the e-learning services that could help to explain the numeric

strength of this impact (Elkatawneh, 2016; Myers & Avison, 2002). Data collection spanned between March and June 2021 (3 months). Field officials were recruited from the selected universities. This idea helped in getting fair representation of the study participants: Traditional universities, Technical universities, and Private universities.

The study employed a questionnaire consisting of eleven (11) questions of which two (6) elicit socio-demographic information such as sex, age group, etc. and five (5) also measuring the hypotheses developed from assessment of Covid-19 pandemic on the prospects of e-Learning in HLI's. In other words, the perception of Covid-19 was elicited through five (5) five-point Likert scale: ranging from completely disagree to completely agree. The questionnaires were adapted from related literature of the study theme. By extension, the measurements of the research construct were adapted (modified) to suit the current study, i.e Covid-19 pandemic (see, Adzovie et al., 2020; Ratten & Jones, 2021), academic innovativeness (Teräs et al., 2020), technological growth & development (Nawaz, 2013) and e-learning strategy (Soni, 2020; Welsh et al., 2003).

### **3.2. Data analytical tool**

Since the study relied on SEM, particularly PLS-SEM (partial least square structural equation modelling) method, ADANCO software version 2.2.1 was used for data processing on the structural model (hypothetical relationships). SPSS was used to perform the descriptive analysis of respondents' profile. A quick preview of the respondents' profile (in Table 1) shows that many students (63%) rely on their smartphone/tablet as their main device for engaging and sourcing e-learning materials followed by the use of laptop/notebook, whereas the least being the use of desktop computer. Again, the data showed that students of HLI's in Ghana prefer to use personal device (gadget) for engaging e-learning system whilst the use of university lab was seen as the least among their source of e-learning services. It is important to state that the profiling of the study participants gives some clarity with respect to the readiness and the intent to take up e-learning as a new normal to replace or complement the existing traditional medium of teaching and learning. Nonetheless, inasmuch as the study focuses on the effect of e-learning on HLIs, it will be interesting to understand the varying devices that students in such institutions in Ghana used.

## **4. Results**

### **4.1. Common method bias (CMB)**

To ascertain the presence of CMB, following the work of Bagozzi and Yi (1988) the construct items were carefully designed with assurance stated in the page title of the questionnaire that respondents' responses would be treated in strict confidence. In other words, the survey was designed to ensure that respondents remained anonymous, such that, they could opt out of the research whenever they wanted. More so, because the study was concerned with the test of indirect effect (multiple mediation relationships), the issue of CMB is of least concern since the respondents could not have imagined in this complex test, hence, the study is consistent with the works of (Bagozzi & Yi, 1988; Jibril et al., 2020; Olivia & Ilie, 2013). Finally, to strengthen our argument, we again examined a full multicollinearity test, particularly, VIF (variance inflation factor) to assess the evidence of CMB. The results of this post-hoc evaluation showed that CMB is not an issue since the computed VIF's (see, Table 2) are less than the threshold of ten (10; see, Alin, 2010; Kock & Hadaya, 2018; Podsakoff et al., 2003; Salmerón et al., 2020). Thus, in this analysis, the concerns about CMB are minimal, hence the potential CMB concerns are low.

### **4.2. Model measurement**

Following the analytical objective of our study (PLS-SEM), it is important to perform the first stage in any SEM analysis. In other words, this stage ensures that unobserved variables are measured to their corresponding observed variables. Therefore, we assessed the measurement model using three main criteria; construct reliability and convergent validity, and ultimately, the discriminant validity following the suggestion of Hair et al. (2019). Concerning reliability test of the constructs, Dijkstra-Henseler's rho ( $\rho_A$ ), Jöreskog's rho ( $\rho_C$ ) and Cronbach alpha values were estimated, and



**Table 1. Summary of respondents' profile**

Respondent's Particulars		Frequency	Percentage
Sex	Male	321	57.0
	Female	242	43.0
Age	20–30 yrs	451	80.1
	31–40 yrs	94	16.7
	41–50 yrs	15	2.7
	51 and above	3	0.5
Status	Employee	0	0
	Student but working in the same University/ Institution	122	21.7
	Student only	441	78.3
Category of HLI	Traditional University (UCC & UG)	376	66.8
	Technical University (CTU, TTU, & STU)	121	21.5
	Private University (AUCC)	42	7.5
	Other tertiary institutions	24	4.3
Device used for e-learning service	Laptop	200	35.5
	Desktop computer	9	1.6
	Smartphone/tablet	354	62.9
	Other	0	0
Source of e-learning service	Personal gadgets	515	91.5
	Office	36	6.4
	School lab	12	2.1
	Cafe	0	0
Sample size (n)		<b>563</b>	<b>100</b>

Source: Field data from Ghana, March to June 2021, processing from SPSS.

the analysis confirmed the minimum threshold of 0.7 as recommended in the literature (see, Dijkstra & Henseler, 2015; Ringle et al., 2015). However, the reliability values of the construct “Digital divide” were 0.6844 (for Henseler rho) and 0.6588 (for Cronbach alpha), but in approximation, the values met the threshold (see, Table 2). With regard to convergent validity, outer loadings as well as AVE (Average Variance Extracted) were used to assess the construct’s items. To add, the outer loadings, therefore, provided support for convergent validity as opined by eminent scholars (see, Hair et al., 2019). Regarding the average variance extracted (AVE), the estimates were above the minimum required level of 0.50, as suggested by Bagozzi and Yi (1988); Fornell and Larcker (1981), thus demonstrating the convergent validity for all constructs (see, Table 2). Again, per the threshold given in the PLS-SEM methodology literature (see, Bagozzi & Yi, 1988; Henseler et al., 2016) all outer loadings for items must be  $\geq 0.6$ , to the corresponding construct, whereas item(s) loaded and were less than 0.6 was dropped (see, Table 3).

Notwithstanding, discriminant validity was subsequently assessed based on the heterotrait-monotrait (HTMT) ratio of correlations approach (see, Henseler et al., 2016). The findings from the computation of the aforementioned approach indicated that none of the corresponding correlation coefficients exceeded the minimum cut-off value of 0.85; hence, the conclusion of evidence of discriminant validity (see Table 4).

**Table 2. Construct reliability and validity**

Construct	Dijkstra-Henseler's rho ( $\rho_A$ )	Jöreskog's rho ( $\rho_C$ )	Cronbach's alpha( $\alpha$ )	Average Variance Extracted (AVE)
E-learning	0.8387	0.8774	0.8219	0.5932
COVID-19	0.9203	0.9320	0.9129	0.6960
Academic Innovativeness	0.9062	0.9294	0.8988	0.7671
Technological growth & devt in HLI's	0.8935	0.9026	0.8787	0.5376
Digital divide	0.6844	0.8128	0.6588	0.5927

Source: Authors' computation from ADANCO 2.2.1

### 4.3. Structural equation modelling—Hypothesis testing

Owing to the psychometric assessment of the research constructs, we continue to structural analysis (hypothetical paths), in other words, to measure the relationship between upsurge of Covid-19 pandemic and adoption of e-learning among HLI's in Ghana (see, [Figure 1](#)). The result from the statistical processing of data showed both direct and indirect effects of the structural model. In all, seven hypotheses were developed: five direct and two indirect hypotheses respectively. It is important to establish that both t-statistics (P-values) and p-values were considered for the determination of significant levels of the relationships. All the proposed hypotheses were supported by the empirical findings (see a summary in [Table 5](#) and [Figure 2](#)).

Considering the direct hypotheses (see [Table 5](#)): Hypothesis 1 (H1): COV→DD was supported with the regression (beta) and significant estimates of ( $\beta = 0.4735$ ,  $t = 9.0761$ ,  $p < 0.01$ ). Hypothesis 2 (H2): COV→ACI was also supported with beta and significant estimates of ( $\beta = 0.4017$ ,  $t = 7.8110$ ,  $p < 0.01$ ). With hypothesis 3 (H3): COV→TECHGRD, it was also supported with ( $\beta = 0.3945$ ,  $t = 7.3890$ ,  $p < 0.01$ ). With hypothesis 4 (H4): COV→ELE, this was supported by ( $\beta = 0.4780$ ,  $t = 9.2593$ ,  $p < 0.01$ ). Hypothesis 5 (H5): DD→ELE, it was supported by ( $\beta = 0.0668$ ,  $t = 2.0218$ ,  $p < 0.01$ ).

Regarding the indirect relationships (mediated hypotheses; see, [Table 5](#)): Hypothesis 6 (H6): COV→ACI→ELE, this relationship was supported with significant mediation by ( $\beta = 0.5036$ ,  $t = 13.2900$ ,  $p < 0.01$ ). Finally, hypothesis 7 (H7): COV→TECHGRD→ELE, the mediation was supported with significant estimates of ( $\beta = 0.1979$ ,  $t = 5.4903$ ,  $p < 0.01$ ).

The data processing further assessed the  $R^2$  (coefficient of determination) of endogenous and dependent constructs of the proposed model. It was assessed to purposely find out the predictive power of the model (Kasuya, 2019). In other words, the  $R^2$  values indicate the percentage of variations in the outcome construct (endogenous or dependent) that was explained by the predictive construct.  $R^2$  values of  $> 0.5$  is said to be a strong and better predictor of the model in question (Cameron & Windmeijer, 1997; Gelman et al., 2019). In [Table 5](#), our estimates show a better predictive power of the dependent variable of the model, hence the model is significant.

### 5. General discussion and study implications

Undoubtedly, e-learning has many potentials to the development (technological advancement) of tertiary institutions across the globe. In this light, it acts positively on the educational structures, unlike the physical chalkboard in the classrooms (traditional system of education). Interestingly, the outbreak and quick spread of the Covid-19 led to the closure of schools at all levels in Ghana. However, the attempt to revamp the education service delivery due to prolong lockdown made the government enforce e-learning in tertiary institutions across the country (Favale et al., 2020;

<b>Table 3. Item loading and variance inflation factor (VIF)</b>			
<b>ITEMS</b>	<b>Operationalization</b>	<b>Loadings</b>	<b>VIF</b>
COV_1	Covid-19 pandemic is a dangerous global disease.	0.8502	3.0972
COV_2	Covid-19 (corona-virus) is real.	0.8754	3.9839
COV_3	Covid-19 pandemic has indeed changed my way of doing things.	0.8554	2.6956
COV_4	It is scary for me to get closer to my colleagues because of this pandemic.	0.8068	5.5248
COV_5	It is scary for me to get closer to my Teacher/ Lecturer because of the Covid-19 pandemic.	0.7784	5.2695
COV_6	I am aware there is fear/ anxiety in all social/public gatherings mainly because of the Covid-19 pandemic.	0.8356	2.4331
ACI_2	My university has moved from traditional classroom studies to a virtual one.	0.8413	2.2600
ACI_3	Students and staff are compelled to be creative in their academic work life.	0.8739	2.6493
ACI_4	Several virtual platforms have been created by my university to ensure smooth academic work despite covid-19 pandemic.	0.9078	3.0846
ACI_5	Structural change (from traditional to modern) has intensified in response to the Covid-19 pandemic.	0.8790	2.7382
ELE_1	In recent times, my Lecturers/Professors deliver their lessons through an online platform.	0.8575	2.2725
ELE_2	Relevant teaching materials are delivered electronically.	0.8159	1.9538
ELE_3	I can interact with my Lecturers/Professors if I want to reach out to them.	0.7157	1.5575
ELE_4	Tasks/Assignments are submitted for evaluation via electronic platforms.	0.8457	2.2145
ELE_5	E-Learning is a new thing for me in my academic life as a result of the Covid-19 pandemic.	0.5810	1.2444

(Continued)

ITEMS	Operationalization	Loadings	VIF
TGDHLI_1	Undoubtedly, the Covid-19 pandemic has brought a face-lift (progress) in my academic institution.	0.7405	1.7782
TGDHLI_2	The growth of internet patronage and usage has heightened (intensified) in my university.	0.7677	1.7290
TGDHLI_3	I believe the Covid-19 pandemic has influenced the professional growth of my Lecturers/ Professors at my university.	0.7738	2.3096
TGDHLI_4	I believe the Covid-19 pandemic has brought about fast changes at the administrative level in my university.	0.7724	2.1518
TGDHLI_5	The Covid-19 pandemic has necessitated a sound collaboration between my university and other Telecom (s) companies for affordable data bundles.	0.6285	1.5565
TGDHLI_6	I believe the introduction of e-learning will intensify the use of digital devices on campus.	0.7160	1.9291
TGDHLI_7	Internet connectivity (free Wi-Fi usage) may improve in my university as a result of this pandemic.	0.7466	2.6684
TGDHLI_8	Infrastructural development may occur on my campus (university) in response to the Covid-19 pandemic.	0.7091	2.0831
DD_1	I had to quickly learn how to use certain functions on my phone in order to access e-learning platforms introduced by my university.	0.7599	1.2874
DD_2	I wish my university will give each admitted student a good orientation on the e-learning solutions/ platforms in order not to be found wanting in pandemic situations like this.	0.8391	1.3460
DD_3	I believe my University will endeavour to provide all students with a common gadget that can be used for e-learning.	0.7047	1.2410

Note: COV = Covid-19 pandemic, ACI = Academic innovativeness, ELE = E-learning, TGDHLI = Technological growth & development in HLI, and DD = Digital divide.

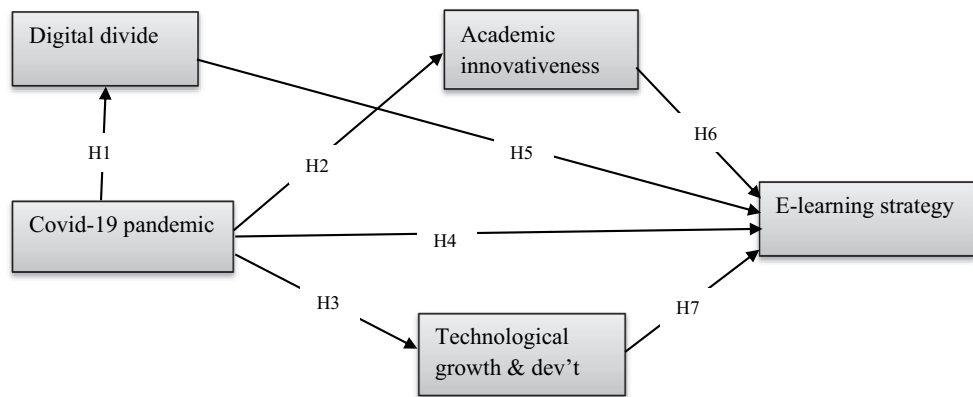
Source: Authors' computation from ADANCO 2.2.1.

**Table 4. Discriminant validity using HTMT**

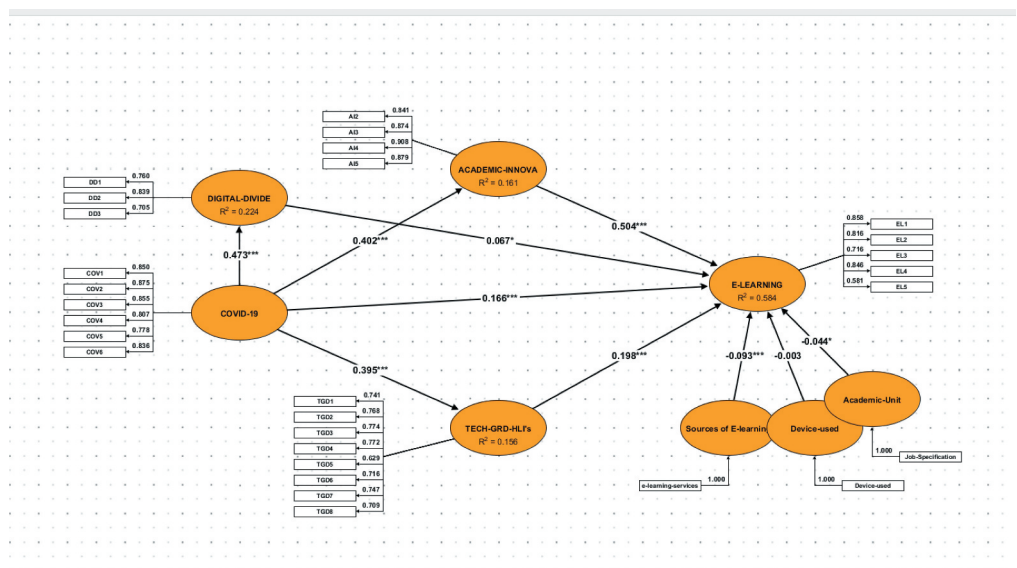
S/N	Construct	1	2	3	4	5
1	E-LEARNING					
2	COVID-19	0.5494				
3	ACADEMIC-INNOVA	0.7983	0.4351			
4	TECH-GROWTH & DEV'T	0.6469	0.4215	0.6013		
5	DIGITAL-DIVIDE	0.5561	0.5967	0.4490	0.5756	

Source: Authors' computation from ADANCO 2.2.1

**Figure 1. A conceptual model of antecedents of e-learning strategy in HLI's.**  
 Source: Authors' own



**Figure 2. Diagnosis of the proposed model.** Source: Author's manipulation from ADANCO 2.2.1.



**Table 5. Hypothetical path—PLS-SEM**

Effect	Beta ( $\beta$ )	M	SD	T-value	P-value	Decision
<b>Direct path</b>						
H1: COVID-19 -> DIGITAL-DIVIDE	0.4735	0.4737	0.0522	9.0761	0.0000	Supported
H2: COVID-19 -> ACADEMIC-INNOVA	0.4017	0.4004	0.0514	7.8110	0.0000	Supported
H3: COVID-19 -> TECH-GROWTH &DEV'T	0.3945	0.3936	0.0534	7.3890	0.0000	Supported
H4: COVID-19 -> E-LEARNING	0.4780	0.4770	0.0516	9.2593	0.0000	Supported
H5: DIGITAL-DIVIDE -> E-LEARNING	0.0668	0.0662	0.0330	2.0218	0.0435	Supported
<b>Mediation analysis</b>						
H6: COVID-19 -> ACADEMIC-INNOVA -> E-LEARNING	0.5036	0.5009	0.0379	13.2900	0.0000	Supported
H7: COVID-19 -> TECH-GROWTH &DEV'T -> E-LEARNING	0.1979	0.2015	0.0360	5.4903	0.0000	Supported
<b>Control variables</b>						
Sources of E-learning -> E-LEARNING	-0.0928	-0.0937	0.0269	-3.4517	0.0006	Supported
Device-used -> E-LEARNING	-0.0030	-0.0025	0.0254	-0.1170	0.9069	Not supported
Academic-Unit -> E-LEARNING	-0.0438	-0.0441	0.0217	-2.0132	0.0444	Supported

**Coefficient of determination (R<sup>2</sup>)**

E-learning = 0.548  
 Digital divide = 0.224  
 Academic innovativeness = 0.1614  
 Technological growth & dev't = 0.1557

Source: Authors' computation from ADANCO 2.2.1.

Oyediran et al., 2020). Following the present empirical research, it is however worthy to note that these directives have given a facelift in the educational system of Ghana, particularly, in the HLI's (including Traditional and technical universities). Furthermore, our inquiry suggests that the provision of e-learning systems by tertiary institutions have become the main alternative for many universities to deliver lectures during Covid-19 pandemic (see, Ogonnaya et al., 2020). The effective and efficient usage of e-learning system relies on understanding the antecedents as well as the main challenges that are characterised by the adoption of the current e-learning systems during Covid-19 pandemic.

It is imperative to note that; the surge in this pandemic, besides its deadly effects, has swiftly ignited the innovation and development in several ways of human life, specifically, within the context of academic innovativeness (including technological growth and development). In this study, the academic innovativeness simply describes the new ideas brought by the HLIs regarding the modalities in which teaching and learning should be implemented to the general satisfaction of the academic user (student). On the other hand, the technological growth and development basically refers to the swift infrastructural change that has occurred in response to the implementation of innovative ideas triggered by the e-learning strategy in the HLIs since the outbreak of Covid-19. So, considering the proposed hypotheses (H1 to H7) of the research theme, all the relationships (both direct and indirect) between the antecedent (Covid-19 pandemic) and the consequent (e-learning strategy) were supported per the empirical evidence employed. This evidence indicates that management and policy makers of HLIs in the country need to reconsider and provide the real necessary logistics and infrastructure about the current e-learning system, while also taking this cue as a guideline to improve the usage of e-learning systems among students and instructors of HLIs.

Regarding the socio-demographics of the sampled population, it is evidently known that the youthful population (particularly, student population) constitute present and future adopters and innovators. It is therefore a fact that technology developers and service providers could capitalise on the profile of users of technology for a better and efficient decision-making on product design and the target market. This, notwithstanding helps to understand the behavioural needs and patterns of individuals in a particular geographical enclave. Finally, knowing the distribution of the demographic characteristics of the population will help in determining how close the sample replicates the population.

### **5.1. Theoretical implication**

This inquiry could be regarded as a benefit to the existing literature, through identifying the main antecedents to the successful usage of e-learning system during Covid-19 pandemic. The study provides some important theoretical relevance and insights into the usage and adoption of e-learning systems in developing countries like Ghana. For example, the antecedent variable (Covid-19 pandemic), not only serves as a direct predictor of e-learning strategy (Almaiah et al., 2020; Kulikowski et al., 2021; Tanye, 2017), but also could have a significant indirect linkage (Aboagye et al., 2021) through enabling factors (mediators) such as academic innovativeness and technological growth and development in the HLIs. It is therefore not surprising that the Covid-19 crisis has influenced HLIs globally in early 2020 to speed up massive innovative activities to ensure teaching and learning activities at all levels. Again, the proposed model, not only adds to the body of knowledge (e-learning literature) but also serves as a foundation for interested scholars to further inquire a more robust framework that is deemed applicable to other jurisdiction of teaching and learning environment. The study also suggests that for e-learning to be successfully achieved in the context of Ghana (less digitalised economy), innovations in HLIs must be heightened to consolidate the rising adoption of technologies in the 21<sup>st</sup> century teaching and learning environment.

### **5.2. Practical implication**

This study, contextually, concerns Ghana regarding e-learning in Higher Learning Institutions (HLIs). However, the implications extend to other HLIs in other developing countries, especially in Africa and other jurisdictions with similar demographics. First, the study is a wakeup call to management of academic institutions in developing countries particularly in higher learning institutions. This is because it affords them the opportunity to be battle-ready in respect of appropriate and proactive measures to adopt for effective and efficient implementation of e-learning solutions (Alqahtani & Rajkhan, 2020). The study, having drawn data from almost all categories of HLIs in Ghana affords management a somewhat first-hand information regarding prospects in technology and innovation as well as possible challenges and solutions, which would inform prudent investment decisions in respect of e-learning. Management would

take a cue from the findings and be well informed about critical decisions concerning the provision of e-learning solutions in their institutions. Finally, the study would be very helpful to university management to be innovative to improve upon already existing e-learning technologies for the provision of quality formal education, being mindful of issues such as digital divide and unreliable Internet connections.

### **5.3. Thoughts and recommendations**

Based on the findings of the current study, the authors recommend that higher education policy makers, who are major stakeholders of education in Ghana, must engage other stakeholders in discussions related to Covid-19. Stakeholders include teachers, instructors, parents, and students. Discussions through various forums to deliberate on innovative ways of effective teaching and learning in respect of e-learning can help everyone work within the “new normal” due to Covid-19 and its attending new variants. The authors believe that such forums would birth strategic innovations peculiar to the Ghanaian context cognisance of the technological advancements of Ghana. Again, it is imperative to expand access to Internet and its related services to all parts of the country. This would enhance e-learning since instructors and learners would no longer be hindered by unavailability of Internet connectivity. Unavailability of Internet connectivity is the backbone of e-learning. Government must therefore, as a matter of deliberate policy decision engage telecommunication service providers in Ghana to expand their reach. We believe that this would go a long way to reduce rural-urban migration and reduce the congestion experienced in the major cities where most of the universities are located. This is because learners could enrol on programmes of study in their various localities without necessarily commuting long distances to access quality education. Also, the authors recommend that since many people are conversant with the use of various social media platforms, institutions of higher learning in Ghana could take advantage of reliable social media platforms as official teaching and learning platforms to enhance e-learning efforts. We believe that this would resonate with the target population because it would not portend any serious form of digital divide. Finally, higher institutions of learning must invest hugely in technological infrastructure to advance e-learning efforts. Consciously, there must be regular workshops/seminars to enlighten instructors and learners on the usage of e-learning platforms. Such workshops/seminars would elucidate challenges and strides in the usage of e-learning platforms of the institutions.

### **6. Conclusion**

This paper contributes to the research of enabling factors of e-learning system usage during Covid-19 pandemic, particularly, in less digitalised economy. This study took into consideration the multiple-mediation analysis in respect of the nexus between Covid-19 pandemic and e-learning strategy adopted in the HLIs within the context of Ghana. Though several studies have investigated the link between the deadly Corona virus (Covid-19) and the adoption of e-learning strategy, mediation analysis of academic innovativeness and technological growth and development is barely known in the literature available. Hence, the findings of the current study represent a novel contribution for Ghanaian universities’ management and policy makers to review and utilize it for ensuring the successful usage of e-learning systems. This inquiry was wholly based on quantitative empirical evidence that identifies the direct and indirect factors that support the usage adoption of e-learning system. Again, the development of factors in the conceptual model (in [Figure 1](#)) is unique and mostly appropriate e-learning strategy for the universities’ management and education practitioners in developing countries who seek to ensure a sustainable delivery of academic services in HLIs.

### **7. Areas for further study**

The current study is not without limitation. First, we admit that the sample size is quite low in relation to the composition of the study respondents who were drawn from public and private HLIs in Ghana. Hence, future study could increase the sample size to strengthen the reliability of the study. Secondly, the conceptual model depicts few constructs (antecedents), which may not represent all the enabling factors of e-learning strategy in HLIs in Ghana and beyond. Therefore,



it would be interesting if future research could investigate other equally important variables in this subject domain. Also, this research considered largely only enabling factors of e-learning strategy in the HLIs amidst Covid-19 pandemic, hence, we call on interested scholars to consider assessing the inhibiting factors of e-learning strategy in a developing economy perspective. This, if implemented, would deepen the insight of e-learning strategy concept for policy making toward educational advancement and growth in technology adoption. Further, the authors recommend future study into the successful deployment of e-learning strategies as well as tools and platforms in less digitalised economies like Ghana with particular focus on issues relating to digital divide. Also, a case study approach could be used in identifying peculiar challenges and progress of individual higher learning institutions in Ghana and other similar institutions in West Africa. The authors of the current study believe that this would enumerate the challenges of various higher learning institutions to be able to proffer institution-specific solutions taking into consideration the peculiarities in respect of geographical locations as well as issues relating to infrastructure.

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