RESEARCH ARTICLE

Factors motivating the adoption of virtual learning environments in higher education. Is gender relevant?

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Abstract
This study aims to examine the influence of gender on the adoption of a virtual learning environment (VLE) in higher education in Ghana during COVID-19 restrictions. A survey approach was used, with a total sample of 488 responses from the University of Professional Studies, Accra. To reveal gender differences, both male and female respondents were subjected to a multi-group analysis. The factors impacting students' intention to use VLE were determined using the structural equation modeling approach employing SmartPLS 3.3.3 software. Accordingly, both gender groups show that subjective norm elements significantly influence intention to adopt VLE; however, the male group ($\beta = 0.873$, $p = 0.000$) reports more significant influences than the female group ($\beta = 0.571$, $p = 0.000$). The study establishes that the newly incorporated construct in the theory of planned behavior, attitudes towards social distancing, significantly affects males' behavioral intention to use VLE more than their female peers. This result demonstrates the robustness of the theory of planned behavior for evaluating technology acceptance research.

Keywords: Theory of planned behavior, Social distancing, Learning management system, Virtual learning environment, COVID-19.

Introduction

During the COVID-19 pandemic, many Higher Educational Institutions (HEIs) throughout the world implemented preventive measures to reduce infection rates and mitigate any potential effects on institutions of higher learning (Taamneh *et al.*, 2022). The institutions made a variety of steps, from enforcing safety regulations to improving campus-wide cleanliness to more serious measures, such as canceling large-scale and open meetings, workshops, and conferences. Universities were forced to take far more dramatic measures due to the virus's quick spread and increase in severity. Many HEIs extended their spring holidays and transitioned to e-learning systems immediately (Liguori & Winkler, 2020). Given the aforementioned, institutions were forced to use e-learning to deal with this particular situation. Thus, higher education institutions faced challenges transitioning from face-to-face to virtual learning, including lecturers acquiring the skills and knowledge required to resume the educational process without interruption (Liguori & Winkler, 2020). Similarly, (Bao, 2020) proposed that due to time constraints during the rapid adoption of virtual learning and a lack of past experience with online education, most faculty members face challenges in carrying out their obligations during the COVID-19 pandemic.

In light of the virtual learning environment's (VLE's) integration into higher education and the rise of distance learning in the COVID-19 pandemic, it is relevant to review previous research on VLEs to inform future work, including identifying areas that have received insufficient attention. The quick transition to all current online courses is significant and disruptive. It generally takes a well-thought-out lesson plan design, instructional materials, and technical support teams to provide full and practical online courses (Taamneh *et al.*, 2022).

Digital technologies have made life easier for humans in the COVID-19 era when most people were confined to their homes. The COVID-19 pandemic brought untold pressure on lecturers and students to acquire the requisite

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knowledge and skills within a short period to transition from the face-to-face teaching environment to a VLE. Information technologies facilitate the instructional process in higher education institutions, raising the higher education standard. Lecturers and students face additional obstacles at present, particularly during the COVID-19 pandemic-related lockdown. Thus, the pandemic has made distance/virtual learning a must for students' continuous education (Subashkevych *et al.*, 2021).

VLEs first promised the opportunity for creativity and even transformation. VLE systems started to spread rapidly in the late 1990s and swiftly turned into a status symbol of innovation, according to the following researchers: Dutton *et al.*, (2004) and Flavin & Bhandari (2022). VLEs had the potential to alter teaching and learning by enabling synchronous and asynchronous collaboration regardless of physical and temporal limitations and providing access anytime, anywhere.

For several years, research studies have demonstrated that gender plays a crucial impact in information system utilization and student acceptability. Venkatesh *et al.* (2000) state that males' attitudes towards information technology use are more significant than females'. Other prior studies support the conclusion that there is a gender disparity in several aspects of student information system use (Yang & Hsieh, 2013) (Tarhini *et al.*, 2014). However, a few studies have found no gender differences in accepting and using information systems (Chu, 2010) (Hung *et al.*, 2010). Based on the differences surrounding numerous gender-based research findings, this study examines the factors affecting students' behavioral intentions toward VLE adoption and how they were affected by gender during and after post-COVID-19 restrictions in Ghana. We believe this study will provide a valuable insight for higher learning institutions currently using or planning to develop VLE capabilities, particularly on how to modify their pedagogy to meet the needs of their cherish students during a crisis. Previous studies have been carried out with an additional construct attitude towards social distancing in the area of e-commerce, public health, and others using theory of planned behaviour (TPB) (Kao & André L'Huillier, 2022a) (Das *et al.*, 2021). This constructive attitude towards social distancing has been incorporated in this research on VLE. The inclusion of the construct was necessary because the survey data was collected during the COVID-19 social distance restrictions period in Ghana. As a result, the researchers want to examine its effects on VLE adoption in a blended teaching and learning environment at the University of Professional Studies, Accra (UPSA). The addition of the construct is novel in this study since, according to the existing literature, no study has considered a multi-group analysis of gender on attitude towards social distancing on students' adoption of VLE. The researcher anticipates that it will significantly impact users' behavioral intentions to use VLE.

Finally, this study contributes to our understanding of gender disparity in VLE adoption intentions. To the best of our knowledge, this is Ghana's first investigation into gender disparities in VLE adoption whilst incorporating the construct attitude towards social distancing in TPB. The research questions addressed in this study are:

- How do attitudes, subjective norms, perceived behavioral control, and attitudes towards social distancing influence students' intention to adopt VLE in higher education?
- What is gender's role in the factors, (i.e., attitude, subjective norms, perceived behavioral control (PBC), attitude toward social distance) influencing students' intention to adopt VLE?

Our findings employ a traditional TPB model which supports the literature to significantly influence behavioral intention on VLE adoption. We evaluate the impact of gender on students' perceptions of their beliefs and ability to use a virtual learning environment.

Materials and Methods

A learning management system (LMS) is a technology tool that offers features like user-friendliness, content authoring, and reporting. VLEs, on the other hand, are frequently characterized by constructivist pedagogical principles and are frequently used as a place to collaborate and extend discussions rather than hosting trackable learning objects (Pinner, 2011). In terms of purpose and execution, VLEs and LMSs are very similar. VLE, on the other hand, is more focused on education, while an LMS incorporates training into the workplace (Pinner, 2011) (McGhee, 2022). An LMS extends the essential elements of a VLE to business training. A virtual learning environment enables instructors to provide learners with a fascinating educational experience, irrespective of where they reside (McGhee, 2022).

VLE is a special form of pedagogical technology that is used in the construction of the educational environment and is characterized by the use of particular interactional methods and tactics for students to interact with new information carriers and sources. This entails developing a learning environment for information that includes computer-based information resources, digital libraries, video and audio content, instructional aids, and tutorials. Learners in such an environment can acquire knowledge both independently and with the assistance of a lecturer, as well as participate in a two-way conversation with a limitless number of users whose actions are tracked and regulated (Subashkevych *et al.*, 2021). A VLE is a collection of technology tools combined in an online virtual environment that fosters education, distance learning, and Internet research while making it less difficult for learners to obtain data, information, communication, and training (Hantoobi *et al.*, 2021).

Moodle, Blackboard, and Brightspace are well-known VLEs built to aid in implementing distance teaching and learning processes. A VLE provides a virtual way of interacting and facilitates speed and effectiveness in educational processes by providing multiple learning tools (Mailizar *et al.*, 2021). To ensure the high quality of the educational process, most higher educational institutions now use VLEs which are intended to store learning materials, perform automatic testing of students' knowledge, support remote communication, and create information and reports on students' progress in distant learning courses, such as the number of accesses and time spent on various activities (Syara *et al.*, 2020).

Research Model and Hypothesis

The model for this study (Figure 1) was created using literature on the COVID-19 pandemic and the effect of gender on VLE adoption. TPB was used in this study to investigate gender differences in university students' behavioral intentions toward VLE in higher education institutions. The framework's H1, H2, H3, and H4 indicate a direct path relationship between TPB constructs and behavioral intention to adopt VLE. H5, H6, H7, and H8 show the moderating effect of gender on TPB dimensions related to VLE adoption. The TPB dimensions: attitude (ATT) towards VLE, subjective norms (SN) over VLE, and perceived behavioral control (PBC) over VLE. Our new model incorporates an additional element, attitude towards social distancing (SD), adopted from TPB in the context of VLE. Previous research has focused on attitude as a dominant TPB construct that defines students' intentions toward e-learning systems (Adewole-Odeshi, 2014; Chang *et al.*,2017). Finally, due to the effects of gender disparities on the use of a particular technology, gender was recommended to moderate the relationships in this research. The elements of the model and supporting data for proposed causal relationships are described in detail.

Attitude, subjective norms, perceived behavior control and behavioral intentions over VLE

The primary construct of TPB, which describes students' intentions toward VLE, was the attitude in earlier studies (Lin *et al.*, 2013; Mehra & Omidian, 2011). Adewole-Odeshi, (2014), for instance, looked into how students' attitudes toward e-learning were positively influenced. As a result, technologically based VLE significantly impacts students' intentions to participate actively in their courses (Chang *et al.*, 2017). Subjective norm refers to an individual's perceptions of a particular behavior that are impacted by the opinions of others (family, friends, social setting) (Nasar *et al.*, 2019).

Evidence from empirical investigations suggests that subjective norms significantly impact students' intentions regarding e-learning (Chu & Chen, 2016; Yau & Ho, 2015).
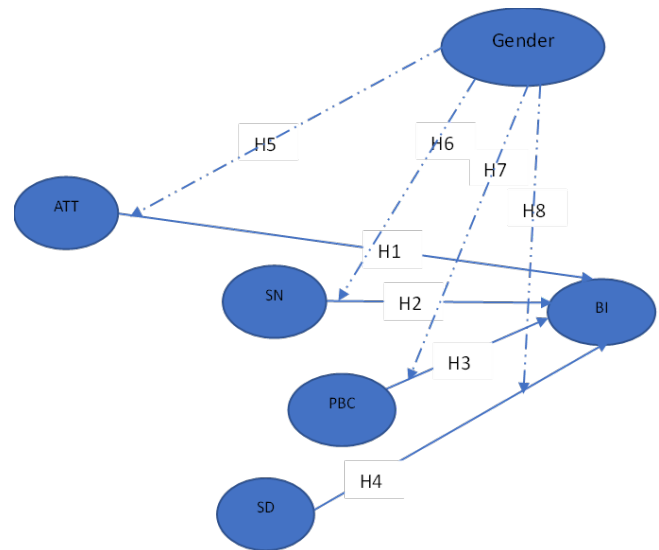

Figure 1: Proposed conceptual model

Additionally, students' intentions toward the virtual learning system are substantially influenced by subjective norms, which inspire others in the class or community (Rejón-Guardia *et al.*, 2020). However, few studies during this COVID-19 pandemic examined how subjective norms affected VLE. The concept of perceived behavior control concerns a person's visual perception when engaging in a specific behavior (Ajzen, 1985). As the e-learning or online course attendance stage where most students experience challenges or comforts, previous research has focused on students' behavioral intentions (Adewole-Odeshi, 2014; Mehra & Omidian, 2011). Published investigations have verified the relationship between e-learning technology and perceived behavioral control (Sugandini *et al.*, 2018). However, little research has been done to use TPB to examine students' intentions regarding VLE, online courses, or e-learning, particularly during this COVID-19 pandemic.

However, other authors have used TPB in a variety of fields, including marketing, technology, consumer behavior, and healthcare, and have characterized how people behave while adopting a new or outdated system (Barnard-Brak *et al.*, 2010; Cheon *et al.*, 2012; Conner & Armitage, 1998; Nasar *et al.*, 2019). This paradigm, according to Ajzen and Fishbein (1980) and Ajzen (1985), aids the authors in identifying specific beliefs for behavior from a given setting and demographic. As a result, the following hypotheses are created.

H1: students' attitudes towards VLE are positively correlated with their intention to engage in VLE.

H2: Subjective norms over VLE of students are positively correlated with their predisposition to engage in VLE.

H3: Perceived behavioral control over VLE by students was positively correlated with their intention to engage in VLE.

Attitude towards social distancing

The degree to which a person views a particular behavior favorably or unfavorably is referred to as their attitude. Attributes that individuals associate with conduct and use to make positive or negative judgments about it help shape attitudes. The possibility (intention) of given conduct increases with a person's favorable disposition (attitude) toward their acts (Verma & Chandra, 2018). Concerning the COVID-19 scenario, it could be inferred that similar to earlier studies on environmental preservation, people with larger protection interests are more likely to act proactively when it comes to their social distancing behavior. Haider *et al.*, (2020) defined lockdown as "a set of measures aimed at reducing transmission of COVID-19 that are mandatory, applied indiscriminately to a general population and involve some restrictions on the established pattern of social and economic life".

These abrupt changes in the short-term functioning of economies have sparked discussion about more changes, such as adopting a permanent work-from-home policy for compatible professions and transitioning from face-to-face teaching and learning to a virtual platform using VLE.

During the pandemic, the implementation of social distancing immediately impacted the economy, affecting various aspects such as fear in educational activities, the stock market, and the halting of labor (Kao & L'Huillier, 2022). This eventually led to changes such as tertiary institutions adopting a virtual learning policy to remain competitive and relevant. Online transaction behaviors and institution plans have shifted (Anupam & Deepika, 2020), raising the possibility that people's perceptions and intentions to engage in other online activities such as virtual learning, have also changed.

Furthermore, the social distancing policy has been shown to influence users' choice of virtual transactions and delivery (Wang *et al.*, 2021). As a result, our hypothesis for this study pertains to the potential effect of the distancing measures on the intention to use VLE for teaching and learning. We examine how students' attitudes toward these measures may affect their behavioral intention, and we suspect that students' attitudes toward social distancing have a negative effect on their behavioral intention. According to Das *et al.*, (2021), an individual's attitude toward social distancing has significant positive effects on their behavioral intention, contradicts Kao and L'Huillier, (2022), whose findings suggest that people's attitude toward social distancing has a negative significant influence on behavioral attentions.

We, therefore, conclude that the potential impact of attitude towards social distancing on behavioral intention to use VLE for teaching and learning is hypothesized as follows;

H4: Students' attitudes toward social distancing negatively affect their behavioral intention to adopt VLE.

Moderating effect of gender on adoption intention

Gender differences in the use of VLEs for teaching and learning are significant for two reasons. First, because men and women have different decision-making processes, gender difference is regarded as one of the most fundamental differences between people (Venkatesh & Morris, 2000). Second, male students used the VLE more frequently than female students (Lim *et al.*, 2020). We create and test hypotheses to provide a greater appreciation of how the decision-making procedure in technology adoption varies between male and female students. We investigate how attitude impact on an intention for VLE services varies by gender, PBC's impact on an intention for VLE services varies by gender, and SN's impact on an intention for VLE varies by gender. Understanding gender disparities in user information technology adoption decisions is a critical issue that is challenging to ignore in light of technology's extensive role in daily life and the growing presence of females in all spheres of life (Venkatesh *et al,*, 2000). This is particularly true in the context of rapidly emerging technology as such VLE.

The effect of attitude on intention to use a system is significant for both males and females. The rationale for this TPB theory is based on the results of countless research showing that the instrumental effects of technology use are more salient to males than women. Earlier research conducted by Glavee-Geo *et al.*, (2017) and Morris *et al.*, (2005) Morris *et al.* (2005) found no significant gender differences in the factors influencing technology use. We propose that there are no gender differences in the influence of attitude on VLE adoption in the e-learning context:

H5: The significant effect of attitude on VLE adoption intention does not differ by gender.

Research conducted earlier detected substantial gender disparities as well as the effect of PBC on intention. Only females showed a significant influence of PBC on intention in their study (Glavee-Geo *et al.*, 2017; Venkatesh *et al.*, 2000). Against this backdrop, we intend to confirm this further in the area of VLE:

H6: The significant effect of PBC on VLE adoption intention varies by gender, with females experiencing a higher effect.

Previous studies by (Glavee-Geo *et al.*, 2017; Venkatesh *et al.*, 2000) found that, when compared to males, females were more strongly influenced by subjective norms. As a result, we hypothesized:

H7: The significant effect of subjective norms on VLE adoption intention differs by gender, with females experiencing a greater effect.

Gender influences behavior, cognition, and social orientation so that when presented with similar information systems stimuli, females and males perceive and behave toward them differently (Ramakrishnan *et al.*, 2014).

Males were more impacted by instrumentality as a predictor of intention, and their view of the worth of an information process is based mostly on its effects on performance (Sanchez-Franco *et al.*, 2009). Males' motives are consequently more extrinsic than females', whilst social variables and environmental limits more heavily impact females. There is limited research on the differences in gender on the effect of social distancing on behavioral intention. Based on the literature above the researchers propose the hypothesis:

H8: The significant effect of attitude towards social distancing on VLE adoption intention differs by gender, with females experiencing a greater effect.

Research Design and Method

The study's design

We used a quantitative technique with a cross-sectional survey in this current study. We used this strategy since it is thought to produce reliable, valid, and generalizable results (Fraenkel *et al.*, 2012). A questionnaire survey can also be distributed to a large number of people. Furthermore, when data is collected from a representative sample, a quantitative study allows researchers to make generalizations about a population (Fraenkel *et al.*, 2012; Mailizar *et al.*, 2021)

Participants of the study

This study's population consisted of approximately 4,000 continued students pursuing an undergraduate degree in a variety of fields of study at the University of Professional Studies in Accra, Ghana who have used the VLE for blended teaching and learning before, during, and after COVID-19 restrictions. The questionnaires were completed by 488 students in total. A sufficient sample size is required for a quantitative investigation, according to Hair *et al.*, (2016). Several rules have been proposed to establish an appropriate sample size for regression analysis. According to Hair *et al.*, (2016), the '10-time rules' are the most widely used sample size estimation method in PLS-SEM, indicating that sample size should be equal to the larger values between the construct with the most formative indicators and the endogenous construct with the most independent exogenous construct predicting it. About 488 survey responses are an adequate sample size when the sample size is taken into account. According to Table 1, the survey has more male respondents (54.7%) than females (45.3%). Most responders (80.1%) were between 20 and 23 years old. The bachelor's program with the highest number of respondents is business administration (41%) and the least is BSc. IT (16%). Finally, all the participants have used VLE for three years.

Instrument design and development

In this study, we modified research tools to assess factors predicting university students' adoption of VLE during and after the pandemic. Regarding attitude toward social

Table 1: Contains further information about the students' backgrounds.

Attribute	Category	Frequency	Percentage(%)
Gender	Male	267	54.7
	Female	221	45.3
Age (in years)	*less than 20*	*15*	*3.1*
	20 – 23	391	80.1
	24 – 27	71	14.5
	Greater than 27	11	2.3
Academic Programme	*Business Administration*	*200*	*41.0*
	BSc. IT	78	16.0
	BA. Public Relations	117	24.0
	BSc. Marketing	93	19.0
Years of using VLE	3	488	100

distancing, the TPB constructs and the items used in this study were taken from (Das *et al.*, 2021) and modified to resonate in VLE context. For example, one of the construct items for SD "For me, practicing social distancing during a pandemic would be: A Bad Idea … A Good Idea" from (Kao & L'Huillier, 2022, p. 5) was paraphrased as "To me, maintaining physical distance from other people during COVID-19 is good and safe to use VLE for teaching and learning." The rest of the modifications are shown in Table 2 under the subheading attitude towards social distancing. In terms of the adaption process, for the current study, an instrument was constructed in which indicators were differentiated and tailored to the context of VLE during the pandemic, as shown in Table 3 under subheadings attitude, perceived behavioral control, attitude towards social distancing, and subjective norms. The survey instrument was made up of two sections. Gender, age, and bachelor's programme were all included in the first section. The second section consisted of questions related to the primary constructs of the suggested model. All constructs were assessed using a multiple-item, five-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5), with "neutral" (3) serving as an anchor. The bulk of the construct items were adapted from previous e-commerce, e-learning, and health research, as shown in Table 3 below indicating the five constructs, sixteen construct items, and their sources. Participants were provided with a link to a Google form-hosted questionnaire, which was open for three weeks.

As part of the content validity process, four selected researchers from the University's Department of Information Technology Studies discussed the instrument to ensure that it was appropriate for the study's context (Lynn, 1986). None of the indicators was discarded after validation, and the

Table 2: Construct reliability and validity

Items	Constructs	Loadings	CA	rho_A	CR	AVE
	Attitude		0.790	0.996	0.863	0.679
ATT1	I like the use of the e-learning system during the COVID-19 pandemic	0.808				
ATT2.	The use of an e-learning system during the COVID-19 pandemic is a good idea	0.741				
ATT3.	The use of an e-learning system during the COVID-19 pandemic is an interesting idea	0.914				
	Behavioral intention		0.846	0.892	0.905	0.760
BI1.	I want all courses to be offered via VLE during COVID-19 and beyond	0.899				
BI2	I will use VLE if it is available in the post-COVID-19 pandemic	0.840				
BI3	I will use VLE in the future	0.876				
	Perceived behavioral control		0.936	0.937	0.954	0.840
PBC1.	I have sufficient extent of knowledge to use VLE for teaching and learning.	0.868				
PBC2.	I have a sufficient extent of control to use VLE for teaching and learning.	0.941				
PBC3.	I have sufficient self-confidence to use VLE for teaching and learning.	0.922				
PBC4	I have adequate control to use VLE for teaching and learning.	0.933				
	Attitude towards social distancing		0.870	0.910	0.919	0.792
SD1.	To me, maintaining physical distance from other people during COVID-19 is good and safe for using VLE for teaching and learning.	0.929				
SD2.	To me, keeping a physical distance from other people is valuable to use VLE for teaching and learning.	0.900				
SD3.	To me, maintaining my physical distance from other people during COVID-19 is a wise move to use VLE for teaching and learning	0.838				
	Subjective norms		0.879	0.905	0.926	0.806
SN1.	Most people who are important to me think it would be sufficient to use VLE for teaching and learning.	0.912				
SN2.	I think other students in my classes would be willing to adapt VLE for teaching and learning.	0.827				
SN3 .	Most people who are important to me would favour using VLE for teaching and learning	0.950				

Table 3: Construct items and their sources

Construct	Construct Items	Sources
Attitude	ATT1, ATT2 and ATT3	(Mailizar *et al.*, 2021)
Behavioral intention	BI1, BI2, and BI3	(Mailizar *et al.*, 2021)
Perceived behavioral control	PBC1, PBC2, PBC3, PBC4	(Das *et al.*, 2021)
Attitude towards social distancing	SD1, SD2, and SD3	(Kao & L'Huillier, 2022)
Subjective norms	SN1, SN2, and SN3	(Saleem *et al.*, 2021)

questions were disseminated for a pilot test. To test initial dependability before data collection, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) were used to assess the convergent validity of construct items and were all within acceptable values. We calculated Cronbach's alpha, and the results revealed that no construct had an alpha value less than 0.7, as stated by (Hair *et al.*, 2017).

Data analysis

We used structural equation modeling (SEM) to test the proposed hypotheses. The SEM was used to determine the relationships between constructs, and the bootstrapping procedure with subsamples 5000 was used. The structural model primarily described path coefficients and coefficients of determination (R^2). As a result, we used SMART PLS 3.3.3 to assess and confirm the model's reliability, validity, and internal consistency.

When evaluating the quality of a structural model, covariant-based SEM (CB-SEM) and PLS-SEM take different approaches. For instance, is based on accurately estimating the observed covariance matrix with CB-SEM fit, whereas PLS-SEM fit is based on reporting for explained variance

in the endogenous constructs (Hair *et al.*, 2014). However, due to model fit requirements, CB-SEM frequently excludes relevant indicator variables, reducing construct validity. Conversely, PLS-SEM generates composite constructs that typically include additional theory-based indicator variables (Rigdon, 2012), all while optimizing predictive accuracy and relevance. Furthermore, PLS-SEM analyses can easily incorporate single-item measures and can yield solutions to much more complex models, i.e., models with a large number of constructs, indicators, and structural relationships (Hair *et al.*, 2014). In addition, the researchers used reflective indicators in this study. Reflective indicators are a representative set of all possible items within a construct's conceptual domain. They are interchangeable, highly correlated, and can be omitted without changing the construct's meaning. Loadings, which are the bivariate correlations between the indicator and the construct, connect reflective indicators to constructs (Diamantopoulos & Winklhofer, 2001). Only in formative indicators or items can a construct be altered when an important indicator is omitted (Diamantopoulos *et al.*, 2008). Previous studies (Hair *et al.*, 2014; Wong, 2016) used PLS-SEM for three or fewer construct items or indicators without counting for bias, as in this study.

Results

Measurement Model

The measurement model's reliability was assessed using CR and Dijkstra-Henseler's rho (rho_A). Table 2 reveals that all CR and rho_A values were significantly over 0.700, indicating that the metrics were reliable (Hair *et al.*, 2014). Assessments of convergent validity (CV) were based on AVE and outer loadings (Hair *et al.*, 2014). In the same table, the AVE for each construct is above the minimum threshold of 0.500, although the outer loading value of each measurement item is greater than 0.700 (Loh *et al.*, 2019); hence, verification of its CV validates the results. The heterotrait-monotrait (HTMT) correlation ratio was used to determine discriminant validity (DV). DV is accomplished since all of the HTMT ratios of correlations in Table 4 are less than the conservative cut-off value of 0.850 (Henseler *et al.*, 2015). The HTMT ratio criterion is a unique condition for testing discriminant validity that outperforms the Fornell-Larcker criterion and cross-loading evaluations in PLS-SEM (Hair *et al.*, 2019). Tables 4 and 5 indicate the HTMT and discriminant validity using the Fornell-Larcker criterion; all computations were provided in accordance with the norms of the examination.

Structural model

The structure model is examined after the measurement model's reliability and validity have been established. This section goes over the primary steps involved in evaluating the structure model. The coefficient of determination

Table 4: Heterotrait-monotrait ratio

	ATT	BI	PBC	SD	SN
ATT					
BI	0.363				
PBC	0.335	0.701			
SD	0.233	0.592	0.500		
SN	0.404	0.946	0.707	0.749	

Table 5: Discriminant validity using Fornell–Larcker criterion

	ATT	BI	PBC	SD	SN
ATT	0.824				
BI	0.358	0.872			
PBC	0.275	0.631	0.916		
SD	0.214	0.523	0.454	0.890	
SN	0.384	0.854	0.644	0.654	0.898

Notes: Construct correlations with the square root of AVE along the diagonals

Table 6: Coefficient of determinations

	R^2
Combined sample (BI)	0.744
Males Sub-sample (BI)	0.865
Females Sub-sample (BI)	0.836

and effective size is calculated to evaluate the structure model. Furthermore, the path coefficient tests the provided hypothesis and uncovers important support relationships (Hair *et al.*, 2017). The sections that follow go into greater detail about inner model evaluation.

The coefficient of determination (R^2) ranges from 0 to 1, indicating how well a statistical model predicts an outcome. An R-square value closer to 1 suggests that the model accounts for a greater fraction of the variance (Alzahrani *et al.*, 2018). The coefficient of determination can also be viewed as a percentage. If the coefficient is 0.80, then the regression line should contain 80% of the points. A greater coefficient indicates better goodness of fit for the observed data. An R-square value of 0.744 for our combined sample in Table 6 indicates that the fit explains 74.4% of the overall variation in the data about the average of students' behavioral intentions to use VLE for teaching and learning. The R^2 values for our sub-samples of males and females are 0.865 and 0.836, respectively as shown in Table 6.

The path coefficient and *p-value*s for the proposed hypotheses are shown in Table 7. The path coefficient quantifies the importance of the hypothesized relationships between the constructs. According to the results in Table 7, apart from H1, all other hypotheses are significantly supported because the *p-value* is less than 0.05.

The path coefficients and *p-value*s were obtained using a bootstrapping approach to test the path significance

level. According to Table 7, of the four (4) hypotheses of the combined sample (488) given, attitude (H1: β = 0.028, p = 0.352) failed to predict an individual's behavioral intention to adopt VLE. However, perceived behavioral control (H2: β = 0.141, p = 0.000), subjective norm (H3: β = 0.797, p = 0.045), and attitude towards social distancing (H4: β = -0.068, p < 0.000) all had a significant effect on behavioral intentions to adopt VLE and also conform to hypothesized theory. Our results show that subjective norm has the highest positive effect on behavioral intention, followed by perceived behavioral control, and the least is the attitude towards social distancing. The effects of subjective norms, perceived behavioral control, and attitude towards social distancing on behavioral intentions were all consistent with the literature (Kao & L'Huillier, 2022b; Venkatesh, 2000).

Multiple group analysis

The multi-group analysis (PLS-MGA) determines whether there are substantial differences in group-specific parameter estimates among predefined data groups. Based on the bootstrapping findings from each group, SmartPLS offers the results of three alternative approaches: (1) Confidence intervals (Bias Corrected), (2) Partial least squares multi-group analysis (PLS-MGA), and (3) Parametric test (Alzahrani *et al.*, 2018). The confidence intervals approach, which is a nonparametric significance test for the difference of group-specific results based on PLS-SEM bootstrapping results, was used to assess the influence of gender. A result is significant at the 5% probability of error level if the *p-value* for a given difference in group-specific path coefficients is less than 0.05 or more than 0.95. As implemented in SmartPLS, the PLS-MGA approach is a nonparametric version of Henseler's MGA method (Henseler *et al.*, 2009).

Table 8 shows the path coefficient and *p-value* for both male and female groups. This table considers The path coefficient significant if the *p-value* ≤ 0.05 or greater than

or equal to 0.95. The *p-value*s in both groups are less than 0.05, indicating that all path coefficients are significant. The influence of students' attitudes towards behavioral intention to use VLE was negatively significant for both genders. It was however more significant in males (H5: β = -0.293, p = 0.000) than in females (H5: β = -0.437, p = 0.000). Perceived behavioral control's effects on students' behavioral intention to use VLE were significant for both genders but had positive effects on females (H6: β = 0.888, p = s0.000) and negative effects on males (H6: β = -0.873, p = 0.000). This implies a stronger impact on females that conforms to previous studies (Glavee-Geo *et al.*, 2017; Venkatesh, 2000). The influence of subjective Norm on behavioral intention to use VLE was positively significant for both genders but had a stronger impact on males (H7: β = 0.873, p = 0.000) than their females (H7: β = 0.571, p = 0.000) counterparts. This contradicts the literature (Glavee-Geo *et al.*, 2017; Venkatesh, 2000). The effects of attitude towards Social Distancing on behavioral intention to use VLE were negatively significant for both genders but more negative in females (H8: β = -0.236, p = 0.000) than males (H8: β = -0.164, p = 0.000). This conforms to our proposed hypothesis.

Discussion

This study better explains how attitude, perceived behavioral control, subjective norms, and attitude towards social distancing influence students' behavioral intention in VLE adoption. PLS-SEM is used to evaluate predicted relationships and determine these factors by creating a path coefficient for each relationship. The path coefficient values emphasize the importance of these relationships. This study focuses on the impact of gender on students' behavioral intentions to use VLE for teaching and learning during and after the COVID-19 pandemic in Ghana. The data collected from the respondents was subjected to a multi-group analysis by employing partial least squares-structural equation modeling (PLS-SEM).

Examining the relationship between ATT and BI shows a positive but insignificant relationship. This contradicts prior studies which show that attitude significantly influences the choice to use e-learning platforms (Hussein, 2017; Taat & Francis, 2019; Zaidan *et al.*, 2021). The multi-group analysis shows that males are less negatively influenced than their female counterparts. Males' attitudes toward using

Table 7: Path coefficients and their significance

Hypotheses	Path	B	T	p-values	Support
H1	ATT -> BI	0.028	0.932	0.352	No
H2	PBC -> BI	0.141	3.819	0.000	Yes
H3	SN -> BI	0.797	20.912	0.000	Yes
H4	SD -> BI	-0.068	2.010	0.045	Yes

Table 8: Gender impact on behavioral attention over VLE

Hypotheses	Path	Male (sub-sample = 267)				Female (sub-sample (221)			
		β	t	p-values	Support	β	t	p-values	Support
H5	ATT -> BI	-0.293	2.592	0.010	Yes	-0.437	4.942	0.000	Yes
H6	PBC -> BI	-0.086	2.708	0.007	Yes	0.888	13.145	0.000	Yes
H7	SN -> BI	0.874	24.328	0.000	Yes	0.571	10.355	0.000	Yes
H8	SD -> BI	-0.164	5.037	0.000	Yes	-0.236	5.334	0.000	Yes

technology are more significant than females (Venkatesh *et al.*, 2000), so females are frequently portrayed as somewhat passive users of technology/innovation (Van Slyke *et al.*, 2002). The implication for theory development is that males and females do not adopt technology/innovation in the same way; gender plays a significant role in how a particular technology/innovation is adopted.

The result between perceived behavioral control (PBC) and behavioral intentions (BI) shows that PBC has a positive and significant relationship with students' BI. The finding is consistent with the assertion that students' PBC positively and significantly influenced their BI (Che Nawi *et al.*, 2022; Otchengco & Akiate, 2021). The effect of PBC on intention was significantly stronger for females in the study context than for males. Our findings are consistent with previous studies by Glavee-Geo *et al.*, (2017), Liao *et al.*, (2007), and Venkatesh *et al.*, (2000), which have shown that gender differences in the effects of PBC on a user's BI can cause discrepancies. Therefore, educational institutions should devise different strategies for each gender group to ensure a seamless adoption of VLE.

We discovered that the subjective norm of both genders has a positive effect on their behavioral intention to use VLE, indicating that students with a higher level of education are more likely to have a higher degree of behavioral intention to use VLE. This finding emphasizes the importance of social influence in the adoption process for student segments. Subjective norm is one of the central components of TPB and has been studied in a variety of settings. This result agrees with the outcomes observed in previous studies (Glavee-Geo *et al.*, 2017; Venkatesh *et al.*, 2000). For the total sample, this study discovered significant effects of subjective norms on the behavioral intention for VLE. According to our findings, males appear to be more influenced by subjective norms in the adoption process than females. Thus, the desire to use VLE may be explained by the desire for social acceptance and influence. Because males are important influencers in teaching and learning and females are fairly passive users of technology/innovations (e.g., VLE), it stands to reason that targeting both genders with student segments will make VLE promotion easier.

The relationship between attitude towards social distancing SD and behavioral intentions BI on gender difference showed a significant negative e effect on both genders. The findings contradict a study by Muangmee *et al.*, (2021), which suggests positive significance. The plausible explanation for this could be the students' prior exposure to blended teaching and learning. Higher educational institutions should, therefore, ensure that in situations where it becomes impossible to implement blended teaching and learning, augmented reality apps could be incorporated into the VLE to ensure the students feel a resemblance to the face-to-face mode of teaching and learning.

Conclusion

Understanding the "new normal" teaching and learning behaviors became crucial during and after the COVID-19 pandemic. Recognizing how gender influences individuals' online teaching and learning behavior is so critical. The findings suggest that, in general, females perceived behavioral control had more influence on their adoption of the VLE than males' colleagues, while the converse is true for male subjective norms. Male students' attitude towards social distancing was more significant in their adoption of VLE as compared to females; hence, they are influenced more to adopt VLE than females, which shows novelty in the context of virtual learning in Sub-Saharan Africa.

The current study contributes to the theory of planned behavior by incorporating the effect of attitude towards social distancing on students' intentions to use VLE, demonstrating gender influence during and after the COVID-19 era. Hence, this research contributes to the ongoing debates on the theory of planned behavior, particularly on the grounds of gender influence on intention to use the VLE. Institutions of higher learning implementing VLE should deploy specific strategies targeting each gender for effective uptake of VLE.

The study reveals many important practical consequences. First, educational institutions that want to use VLE platform to mitigate students' anxieties and improve teaching and learning effectiveness during a pandemic or for blended teaching and learning will profit from knowing the gender effect on VLE adoption. These research findings will help them devise appropriate strategies that seek to derive the best out of both genders. It would also help higher learning institutions' strategies and position themselves in the educational space to appear competitive, relevant, and efficient across both genders.

Finally, it is important to recognize and resolve the limitations of this study. The current study only included individuals from one university in Ghana. As a result, predicting VLE adoption by gender based on this sample from a single university in Ghana will differ from predicting VLE adoption based on a combined population of two or more universities across the country with various stages of VLE uptake. More empirical research is thus required to generalize the findings to other settings. Future research should consider using a population of students from two or more different universities and also broadening the discussion to include a broader range of target groups such as age, academic program, academic year, and so on.

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