

# The Extent to which Pre-Service Teachers Use Moodle to Enhance Learning

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## Abstract

The increase in student populations in higher education institutions means face-to-face service delivery is now very expensive. Most institutions are therefore exploring the possibility of online learning on a massive scale, which the restrictions of the Covid-19 pandemic have now expedited. This study aims to investigate the extent to which pre-service teachers use Moodle to enhance learning. The study used a quantitative approach in which quantitative data were gathered using a five-point Likert-scale questionnaire developed by the researchers, using previous studies. A stratified sample of 400 pre-service teachers selected from a population of 4 000 participated in the study. A total of 332 participants successfully completed and returned the questionnaires, giving a return rate of 83 per cent. The study used the Technology Acceptance Model as its theoretical framework. The results indicated that seven of the 13 hypotheses were statistically significant, leading to the adoption of all six model constructs. The coefficient of determination of the model was a substantial 69.8 per cent, which explained the extent to which pre-service teachers use Moodle to enhance learning. By using moderation, it was established that all three demographic factors of the study did not influence the pre-service teachers' use of Moodle. The results indicated that the developed model is valid, robust and suitable for use by stakeholders. Pre-service teachers are therefore encouraged to use Moodle to enhance learning. Future research could be done to establish the 30.2 per cent of factors this model did not capture.

**Keywords:** pre-service teachers, Moodle, learning, learning management systems

## Introduction

Information technology in the teaching and learning of universities have necessitated the use of learning platforms. These learning platforms support e-learning used by students and lecturers (Rets et al., 2020). As enrolments increase, universities attempt to equip students with the skills, knowledge and values required to become economically independent individuals through science and technology (Evans & Mutula, 2015; Hanson & Asante, 2014; Shaikh & Khoja, 2011). To communicate with the growing student population, connectivism is now being adopted by institutions. This is a learning theory for a digital age, which seeks to explain complex learning in a rapidly changing social digital world (Siemens, 2014). Connectivism has required universities to adopt learning management systems (LMSs) as a paradigm for engaging students in meaningful learning experiences and improving pedagogical practice (Siemens, 2014).

In response to connectivism, various higher education institutions (HEIs) have implemented e-learning as one approach used for teaching and learning. Through knowledge-sharing systems, e-learning, staff and students in HEIs have online access to learning content (Alharbi & Drew, 2014; Kinney & Robertson, 2003; Park, 2009; Yidana et al., 2013). Universities are investing in LMSs as tools for inculcating autonomous learning, student-centred learning, higher-order thinking, problem-solving, cooperative learning and understanding of the subject (Mwalongo, 2012; Rabaa'i, 2016). However, a study conducted by Maphalala and Mpofu (2018) found that although academics are willing to implement e-learning in their institution to enhance teaching and learning, they are constrained by the technology infrastructure, internet accessibility and lack of structures for technical and system support for staff when using LMSs.

There are different types of LMS such as Modular Object-Oriented Dynamic Learning Environment (Moodle), Blackboard, TalentLMS, and Desire2Learn. Many HEIs adopt a particular LMS based on parameters suitable to the HEI in question (Subramanian et al., 2014). Some parameters considered are users' attitude towards a particular LMS, ease of use and functionality, usability, maintenance, control features, supported formats and capabilities (Davis, 1989; Konstantinidis et al., 2011; Lawler, 2011). However, Moodle as an open source is widely used by most HEIs (Damnjanovic et al., 2015; Nagunwa & Lwoga, 2012). According to Al Kurdi et al., (2020), technology adoption can be investigated at an organisational or individual level. This study focused on the individual level, focusing on the extent to which pre-service teachers use Moodle to enhance learning. The study was underpinned by the Technology Acceptance Model (TAM) developed by Davis (1989). Building on previous research (Al Kurdi et al., 2020; Šumak et al., 2011; Venkatesh & Davis, 2000), this study therefore investigated the extent to which pre-service teachers use Moodle to enhance learning.

## Purpose of the Study

The purpose of this study was to examine the extent to which pre-service teachers use Moodle to enhance learning. This was achieved by answering the following research questions:

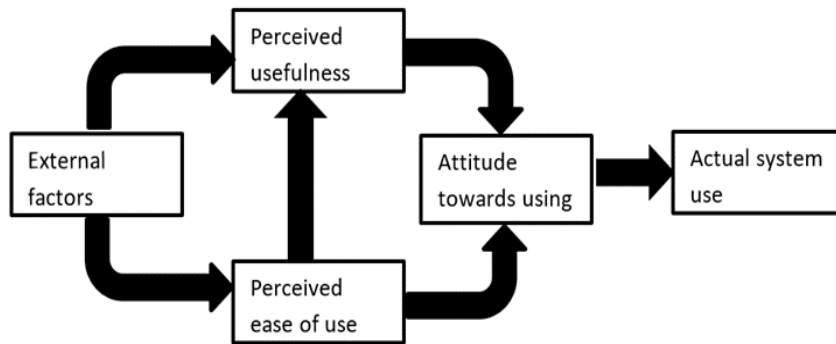
- What are the factors that pre-service teachers consider important when using Moodle?
- To what extent does the use of Moodle enhance learning?
- How much influence does pre-service teachers' demographics exert on their use of Moodle to enhance learning?

## Literature Review

### Theoretical Framework

The TAM proposed in this research aims at analysing the extent to which pre-service teachers use Moodle to enhance learning. Davis proposed the TAM in 1986 (Alassafi, 2021; Lim & Lee, 2021). The TAM is mainly used for researching, describing and forecasting the way in which individuals accept and use technology and the reasons that affect these decisions (Jameel et al., 2021). The TAM specifies the causal relationships between system design features, perceived usefulness, perceived ease of use, attitude towards using and actual usage behaviour. It predicts an individual's perception of the acceptability of an information system (Davis, 1993).

The theory states that the acceptability and use of an information system is informed by two distinct factors. These two factors are the perceived ease of use (PEOU) and perceived usefulness (PU) of the technology. The PEOU is the degree to which an individual believes that using a system will be easy. The PU is the degree to which an individual believes that using a system will improve their performance. The PEOU and PU (Figure 1) can influence individuals' attitudes towards using technology in their individual capacities. However, the PEOU and PU are also interrelated and the PEOU of information technology can directly affect the PU of the same information system. External factors also influence the PEOU and PU of an information system and these influence the attitude towards the system, leading to the actual use of the information system or the decision not to use it.



**Figure 1:** Technology Acceptance Model (Chibisa et al. 2021, p. 3)

The outbreak of Covid-19 has compelled HEIs to implement transformed contemporary teaching theories amid the Fourth Industrial Revolution (Galindo-Domínguez & Bezanilla, 2021). Some of these theories advocate the use of suitable LMSs, and Moodle is one such platform. Moodle ranks among the most popular LMSs because it is open source and institutions may customise it to meet their objectives (Pérez-Pérez et al., 2019). Pérez-Pérez et al. (2019) further state that institutions can configure Moodle differently to offer courses according to various pedagogies. However, factors may affect the students to learn effectively and to be satisfied. The literature indicates that integration of the LMS educational process helps to increase students' motivation, develop their digital capability, and improve learning interest, creativity, and learning strategies (Aikina & Bolsunovskaya, 2020). Moodle allows lecturers to design online courses that encourage students' participation in an interactive and collaborative environment. Through Moodle, lecturers provide the information and support in gaining knowledge, skills, and experiences. Importantly, Moodle offers flexibility to meet students' needs (Hasmy, 2020). E-learning systems make it imperative for developers, administrators and lecturers to understand the way in which users consider and perceive e-learning systems. This understanding will provide insight into the way in which an e-learning approach can be designed in an effective and efficient manner (Al Kurdi et al., 2020) to enhance pre-service teachers' learning experience.

The demographic data in this study provide an understanding and information about the participants. The studies mentioned next explored the effects of gender, level of study and age of pre-service teachers on Moodle. Dogru (2020) argues that gender should be considered within cultural, physiological and social contexts. Some studies revealed that men display a higher level of competence in technology than women (Dogru, 2020; Hong & Kim, 2018; Saleem et al., 2016). On the contrary, male and female students display the same degree of satisfaction toward using Moodle (Alkhateeb & Abdalla, 2021). As far as the academic level is concerned, satisfaction based on the academic

level was almost the same (Alkhateeb & Abdalla, 2021; Šumak et al., 2011). Furthermore, digital competence in Moodle increases with time as students near the completion of their degrees in Education. Finally, with the course of age and years, digital competence in Moodle improves because older students develop a better attitude towards LMSs (Galindo-Domínguez & Bezanilla, 2021). However, Buthelezi and Van Wyk (2020) found that older students encountered a problem using the Moodle platform to conduct their learning because they lacked proper understanding of the importance of Moodle.

## **Conceptual Framework**

To establish the extent to which pre-service teachers use Moodle to enhance learning, a conceptual model was developed, underpinned by the TAM. The model has seven constructs which were all carefully examined for their importance to pre-service teachers. The seven constructs are: subjective norm (SN), perceived resources (PR), perceived enjoyment (EN), PEOU, PU, attitude towards use (ATT), and actual use (AU). There were two exogenous variables SN and PR. The explained variable was AU, and the rest were endogenous explanatory variables.

### *Subjective Norm (SN)*

The SN refers to the degree to which individuals perceive that important people's views determine if they should use the new technology. Sometimes, individuals use a system to obey important people and not to focus on their beliefs (Al-Emran & Salloum, 2017). The PEOU has a positive effect on the SN. A study indicated that the SN has a positive effect on the PU, AT and the intention to use. However, researchers do not agree on the results for the SN; therefore, the following hypotheses are proposed (Buabeng-Andoh & Baah, 2020; Lim & Lee, 2021):

- H1: The SN affects the PU towards the use of Moodle.
- H2: The SN affects the AU of Moodle.

### *Perceived Resources (PR)*

Resources may be defined as the support delivered by the service institution, such as people assisting the users of computer hardware and software products, online support services, knowledge bases, faxes, automated telephone voice responses, systems, and other facilities (Al Kurdi et al., 2020). According to Alkhateeb and Abdalla (2021), PR was a key indicator predictor of the satisfaction of both students and instructors. However, Al-Emran and Salloum (2017) argued that the PR has no significant influence on students' satisfaction. The following hypotheses are therefore formulated:

- H3: The PR affect the pre-service teachers' PU of Moodle.
- H4: The PR affect the pre-service teachers' ATT of Moodle.
- H5: The PR affect the pre-service teachers' perceived EN of using Moodle.

*Perceived Moodle Enjoyment (EN)*

Perceived Moodle EN can be regarded as perceptions of joyfulness when using a specific technology. For example, when a person experiences e-learning systems and enjoys them, that person is prone towards a positive attitude concerning the ease of use and usefulness of that e-learning system (Lim & Lee, 2021; Su & Chiu, 2021). The following hypotheses are therefore proposed:

- H6: The perceived EN affects the PEOU of Moodle.
- H7: The perceived EN affects the AU of Moodle.

*Perceived Ease of Use (PEOU)*

The PEOU is defined as individuals' perception of how free of effort they will use the technology. The PEOU is predicted to have an influence on the attitude of individuals towards using technology. The AU from the TAM model is called the motivational factor which affects the individuals' behaviour to use the system. Several studies have been conducted which declare that the PEOU has a positive relationship with the AU to use e-learning systems (Aikina & Bolsunovskaya, 2020). Furthermore, research findings confirm that the PEOU has a positive effect on the PU (Lim & Lee, 2021). The following hypotheses are therefore proposed:

- H8: The PEOU affects pre-service teachers' PU of Moodle.
- H9: The PEOU affects pre-service teachers' ATT of Moodle.
- H10: The PEOU affects pre-service teachers' AU of Moodle.

*Attitude (ATT)*

Research has indicated that the ATT directly affects the AU (Al-Emran & Salloum, 2017). Dwiputranti et al. (2019) revealed that the ATT positively relates to the AU. Šumak et al. (2011) also found that the AU of Moodle is positively affected by attitudes. Other researchers found similar results in which the attitude towards using (ATU) was significantly influenced by the PEOU and the PU (Al Kurdi et al., 2020; Saroia & Gao, 2019). The discourse confirms that the ATT e-learning has a strong and positive influence on the intention to use e-learning (Ejdys, 2021). From the above discourse, the following hypothesis is proposed:

- H1: Pre-service teachers' ATT affects their AU of Moodle.

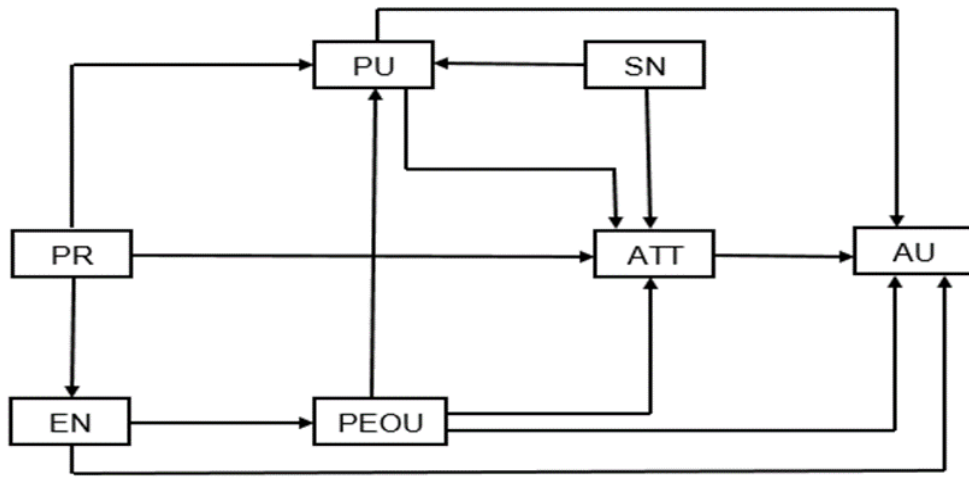
*Perceived Usefulness (PU)*

Davis (1989) defined the PU as the degree to which individuals believe that using a particular system would enhance their performance. Bhattarai and Maharjan (2020) found that social influence and enjoyment positively influence pre-service teachers' PU of digital learning systems. The PEOU of digital systems has a positive influence on the PU of digital systems. They concurred that if the system is easy and friendly to use, it

increases the effectiveness and performance of learning. However, the PU positively influences pre-service teachers' ATU digital systems. In support, Sabah (2020) found that the PU affects users' intention to use a system. We therefore propose the following hypotheses:

- H12: The PU affects pre-service teachers' ATT of Moodle.
- H13: The PU affects the AU of Moodle.

A conceptual model was proposed based on the theoretical underpinnings and the reviewed literature. The hypothetical model is shown in Figure 2. An analysis of this model will be used to answer the research questions.



**Figure 2:** Model to measure the use of Moodle

## Research Methodology

### Research Approach

This study adopted a quantitative research design. Mutambara and Bayaga (2020a) described quantitative research as research in which quantitative data are collected through a survey and then analysed to gain meaning through statistical means. The data for the study were collected using a structured questionnaire with a five-point Likert scale, ranging from 1 (strongly agree) to 5 (strongly disagree).

### Respondents

A total of 332 respondents, out of a sample of 400 Mathematics, Science and Technology Education students selected from a population of 4 000 students, successfully completed and returned the questionnaires. The questionnaire return rate was 8 per cent. A total of 68 questionnaires were incomplete or spoilt or were not

returned. The respondents were stratified by their level of study from level 1 to level 4. Their gender and age were also profiled.

### **Ethical Clearance**

After obtaining ethical clearance, consent was sought from and granted by the respondents, who were informed that they had the right to participate voluntarily and could withdraw from the study at any time. The respondents were adult pre-service teachers studying at the institution in which the study took place. The instrument was then distributed by the researchers and collected within two days.

### **Data Analysis**

Descriptive statistics were used to analyse the demographic data using the SPSS version 25 software. The model constructs and their hypotheses were analysed using partial least squares structural equation modelling. SmartPLS was employed for this analysis. Analysis of the model constructs followed the two-stage method by Hair et al. (2016), which states that the strength of a model is evaluated through the fitness and eminence of its measurement and structural models. The measurement model confirms associations between the constructs and their indicators whereas those among constructs are established via the structural model analysis (Hair et al., 2016). In this study, the measurement model was evaluated first to ascertain the reliability and validity of the indicators of its many constructs. Then testing of the structural model followed. This was done by examining the statistical significance of the path coefficients, f-squared, q-squared, and the explained variance of the endogenous variables.

### **Presentation and Analysis of Data**

In the presentation of the results, the respondents' demographic profiling was presented first. Factor analysis followed through testing of the measurement model. The structural model was verified and presented last. Constructs of the current model were the SN, PR, perceived EN, PEOU, PU, ATT, and AU.

### **Demographic Data Profiling**

The demographics of the respondents were measured by three variables, namely, gender, level of study, and age. The demographic distributions are given in Table 1.

**Table 1:** Demographic profiling (N = 332)

Demographic variables		Frequency	Valid percentage
Gender	Male	151	45.5
	Female	181	54.5
Level of study	Level 1	2	0.6
	Level 2	43	13.0



Demographic variables		Frequency	Valid percentage
	Level 3	100	30.1
	Level 4	116	34.9
	Postgraduate qualification in education	71	21.4
Age (years)	18 and below	3	0.9
	19–20	98	29.5
	21–22	92	27.7
	23–24	81	24.4
	25 and above	58	17.5

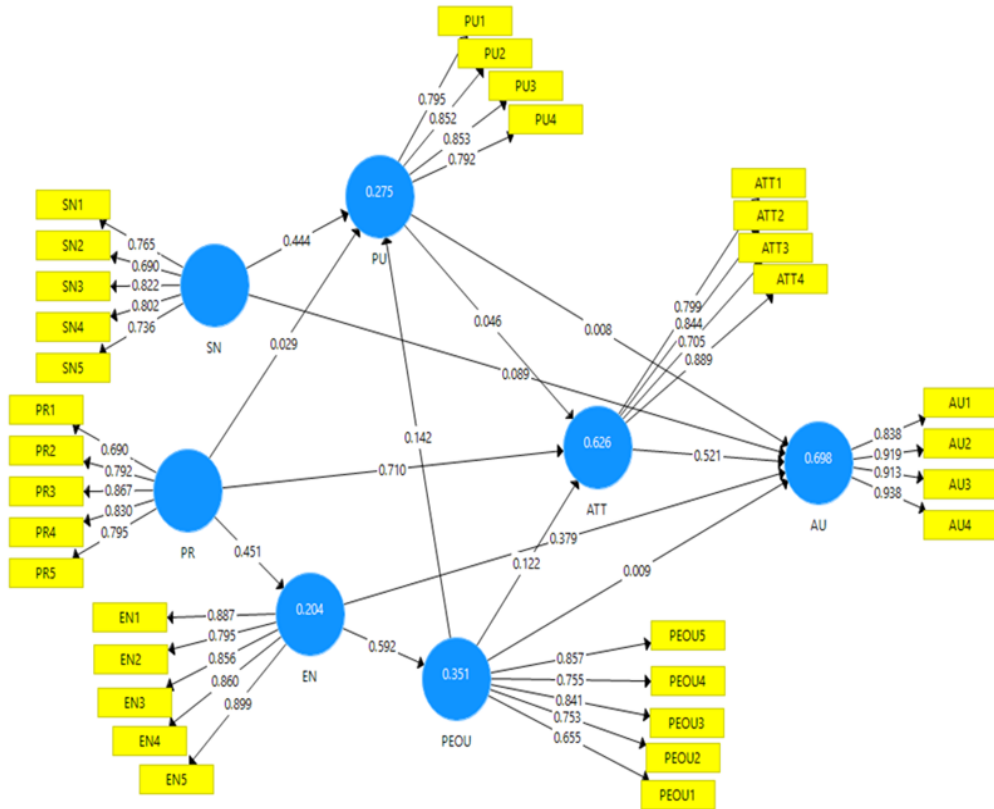
Table 1 indicates that there were more female respondents (54.5%) than male respondents (45.5%) in this study. The levels of study of most respondents were at level 4 (34.9%) and level 3 (30.1%). This may be because the senior students found it more worthwhile using Moodle; they now know how to use the system given their experience at university. The ages of the respondents ranged from younger than 18 years to over 25 years. Most respondents were between the ages of 19 and 24 (81.6%), rightly so because these respondents were undergraduate pre-service teachers. The number of those over the age of 24 is justified because the institution allows a quarter of mature entry students.

### The Measurement Model

The measurement model was assessed for indicator reliability, construct reliability, convergent validity, and discriminant validity. Outer loadings were used to evaluate indicator reliability using factor loadings. The results in Figure 3 show that all outer loadings were greater than 0.7, except for PR1 (0.690), which was retained because it helped sustain a high explanatory power of the model in this exploratory study (Hair et al., 2016). These results confirmed the reliability of the indicators (Hair et al., 2016). Cronbach's alpha and composite reliability indexes were calculated to assess construct reliability. The results, given in Table 2, indicate that their values were all greater than the 0.70 minimum threshold, confirming the reliability of the constructs.

The average variance extracted (AVE) and outer loadings were used to assess the convergent validity. The convergent validity assesses the degree to which there is a strong relationship between theoretically identical constructs (Hair et al., 2019). All factor loadings were statistically significant at a 5 per cent level of significance (Hair et al., 2016). The results in Table 2 also indicated that all the AVEs were greater than the

minimum required value of 0.5, confirming the stability of the identified indicators. These outcomes confirmed the measurement model's validity and reliability.



**Figure 3:** The Moodle use empirical model

The discriminant validity was evaluated using the Fornell-Larcker criterion. According to Hair et al. (2016), the degree to which a latent variable differs from other latent variables in the model is measured by the discriminant validity. This means that a latent variable should share more variance with its assigned indicators than with any other latent variable. The numbers in bold in Table 2 are greater than any other value in each column, indicating that each latent variable shared more variance with its indicators. This also confirms the discriminant validity.

**Table 2:** The measurement model

Construct	CA	CR	AVE	ATT	AU	EN	PEOU	PR	PU
ATT	0.827	0.885	0.660	<b>0.812</b>					
AU	0.924	0.946	0.815	0.733	<b>0.903</b>				
EN	0.912	0.934	0.740	0.469	0.693	<b>0.860</b>			

Construct	CA	CR	AVE	ATT	AU	EN	PEOU	PR	PU
PEOU	0.833	0.882	0.601	0.491	0.524	0.592	<b>0.776</b>		
PR	0.857	0.897	0.635	0.781	0.739	0.451	0.499	<b>0.797</b>	
PU	0.842	0.894	0.678	0.246	0.323	0.366	0.317	0.226	<b>0.823</b>
SN	0.825	0.875	0.584	0.315	0.524	0.695	0.362	0.285	0.503

CA = Cronbach's alpha, CR = convergent reliability

## The Structural Model

After confirmation of the reliability and validity in the measurement model, the next stage was to assess collinearity issues and variance inflation factor values (VIF) in evaluating the structural model. The results in Table 3 indicate that all the VIFs were less than four, indicating the absence of collinearity among the latent variables of the study. To assess the significance of the standardised path coefficients, representing the hypotheses depicted in Figure 2, a full bootstrapping procedure of 5 000 subsamples was performed (Hair et al., 2016). To assess the structural model, the  $R^2$ ,  $f^2$ ,  $Q^2$  and the path coefficients were used.

According to Chin (1998), the  $R^2$  values of 0.19, 0.33 and 0.67 are “weak”, “moderate” and “substantial” respectively. The results in Figure 2 show that the  $R^2$  values of the ATT, AU, EN, PEOU, and PU were 0.626, 0.698, 0.204, 0.351, and 0.275, respectively. This means that the  $R^2$  value of the AU was considered substantial. Those of the ATT and PEOU were considered moderate, whereas those of the EN and PU were considered weak. The results, when using the blindfolding method, indicate that the  $Q^2$  values of the ATT (0.397), AU (0.563), EN (0.147), PEOU (0.203), and PU (0.178) were all greater than zero, confirming the predictive validity of the structural model. These results imply that the PR explains 20.4 per cent of the variance in the EN. Likewise, the EN explains 20.4 per cent of the variance in the PEOU. The 27.5 per cent variance in the PU is explained by the four factors SN, PR, EN and PEOU. These variables of the PU, SN, PR, EN and PEOU explain the 62.6 per cent of the variance in the ATT. Last, all six variables combine to explain a substantial 69.8 per cent of the variance in the AU of Moodle by pre-service teachers.

**Table 3:** Path coefficients,  $f^2$ , and VIF

Path	Std beta	T statistics	P-values	Decision	$f^2$	VIF
ATT $\geq$ AU	0.521	10.374	0.000	Accepted	0.636 <sup>c</sup>	1.412
EN $\geq$ AU	0.379	5.682	0.000	Accepted	0.174 <sup>b</sup>	2.728
EN $\geq$ PEOU	0.592	13.747	0.000	Accepted	0.541 <sup>c</sup>	1.000
<b>PEOU <math>\geq</math> ATT</b>	<b>0.122</b>	<b>2.626</b>	<b>0.009</b>	<b>Rejected</b>	0.028 <sup>a</sup>	1.414
<b>PEOU <math>\geq</math> AU</b>	<b>0.009</b>	<b>0.170</b>	<b>0.865</b>	<b>Rejected</b>	0.000 <sup>a</sup>	1.747
PEOU $\geq$ PU	0.142	2.953	0.003	Accepted	0.019 <sup>a</sup>	1.431

Path	Std beta	T statistics	P-values	Decision	f <sup>2</sup>	VIF
PR $\geq$ ATT	0.710	20.744	0.000	Accepted	1.006 <sup>c</sup>	1.340
PR $\geq$ EN	0.451	8.872	0.000	Accepted	0.256 <sup>b</sup>	1.000
<b>PR <math>\geq</math> PU</b>	<b>0.029</b>	<b>0.495</b>	<b>0.620</b>	<b>Rejected</b>	0.001 <sup>a</sup>	1.354
<b>PU <math>\geq</math> ATT</b>	<b>0.046</b>	<b>1.256</b>	<b>0.209</b>	<b>Rejected</b>	0.005 <sup>a</sup>	1.119
<b>PU <math>\geq</math> AU</b>	<b>0.008</b>	<b>0.247</b>	<b>0.805</b>	<b>Rejected</b>	0.015 <sup>a</sup>	1.388
<b>SN <math>\geq</math> AU</b>	<b>0.089</b>	<b>1.717</b>	<b>0.086</b>	<b>Rejected</b>	0.016 <sup>a</sup>	2.296
SN $\geq$ PU	0.444	9.733	0.000	Accepted	0.232 <sup>b</sup>	1.170

<sup>a</sup> = small effect, <sup>b</sup> = moderate effect, <sup>c</sup> = large effect

The Moodle use empirical model in Figure 3 displays all the latent variables of this study with their indicators. All the indicators load well except PR1 (0.690), but it was retained since it has a significant positive influence on both the PEOU and the PU (see the measurement model). None of the explanatory variables of this study were excluded outright from the model. This model, therefore, is deemed a good fit for explaining the extent to which pre-service teachers use Moodle to enhance learning.

The results given in Table 3 and Figure 3 indicate that six of the 13 hypotheses of the study were not statistically significant and were therefore rejected. The rejected hypotheses are the ones printed in bold in Table 3. The rest of the hypotheses were accepted.

The f<sup>2</sup> value is the effect size between two variables, and it measures the strength of the relationship between two nominated variables. According to Cohen (1988), the f<sup>2</sup> values of 0.35, 0.15, and 0.02 indicate high, medium, and low levels of effect size, respectively. The results in Table 3 indicate that three of the 13 hypotheses had a high effect on the AU of Moodle, another three hypotheses had a medium effect on the AU of Moodle. The remaining seven hypotheses wielded a low effect on Moodle use while one of them (PEOU  $\geq$  AU) had no effect.

### Moderation Effect of Demographics

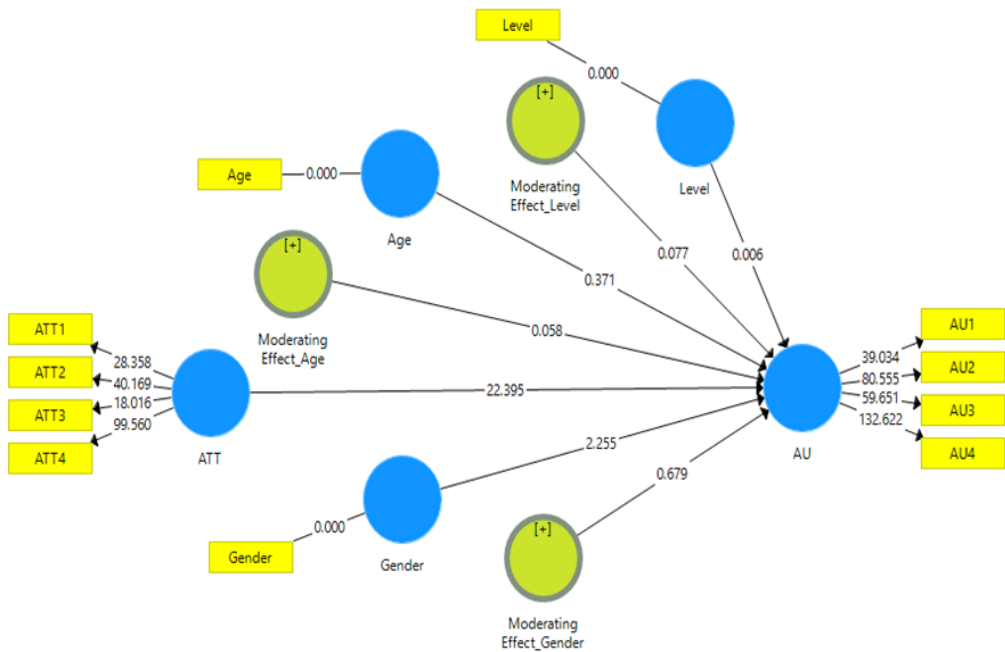
Having established the measurement and structural models of the study, the focus is now on the moderation effects of the study's demographic variables. In SmartPLS, moderation refers to a situation in which the relationship between two variables is not static but depends on a third variable (moderator), which can change the strength or direction of the relationship between the two model variables under consideration (Hair et al., 2016).

A bootstrapping procedure with 5 000 subsamples was used to test for the significance of the moderation effect of the demographic items, i.e. the gender of the respondents, their level of study and their ages, on the relationship between the ATT and the AU of Moodle to enhance learning. The results given in Table 4 and Figure 4 indicate that all

three demographic variables do not moderate pre-service teachers' ATT against the AU of Moodle to enhance learning.

**Table 4:** Moderation effect of demographics

Paths	Std beta	T statistics	P-values	Decision
ATT $\geq$ AU	0.742	22.395	0	Accepted
Age $\geq$ AU	0.014	0.371	0.711	Rejected
Gender $\geq$ AU	0.084	2.255	0.024	Accepted
Level $\geq$ AU	0.000	0.006	0.995	Rejected
Moderating effect age $\geq$ AU	-0.003	0.058	0.954	Rejected
Moderating effect gender $\geq$ AU	0.036	0.679	0.497	Rejected
Moderating effect level $\geq$ AU	-0.005	0.077	0.938	Rejected



**Figure 4:** Moderation effect of demographics

## Discussion

This study examined the extent to which pre-service teachers use Moodle to enhance learning. To achieve this, the proposed model was used to answer the research questions.

Altogether, the model had seven constructs, two exogenous and five endogenous including the explained variable AU of Moodle. Thirteen hypotheses connected these seven constructs. The empirical analysis produced mixed results. The data supported seven of these hypotheses whereas six were rejected. However, this did not result in any of the constructs being rejected outright. Instead, the remaining hypotheses effectively anchored the model.

Research question 1: This question aimed to find the factors that pre-service teachers regarded as important when using Moodle. The researchers identified six factors as the key influencers of pre-service teachers' use of Moodle to enhance learning. These factors were: SN, PR, perceived EN, PEOU, PU, and ATT. Altogether, these factors explained a substantial 69.8 per cent of the variance in the AU of Moodle; only 30.2 per cent of the variance in factors affecting the AU are not explained by the model. The performance of this model was very impressive compared to the 40 per cent found by Davis and Venkatesh (1996) and the 37.9 per cent found by Mutambara and Bayaga (2021). The overall performance of the model can be broken down into segments. First, the perceived EN and PR explained 35.1 per cent of the variance in the PEOU. This means that pre-service teachers value the availability of resources such as computers and data, and also connectivity and their enjoyment when using the resources ahead of using Moodle for learning. This result was also supported by Mutambara and Bayaga (2020a) who found that the resources accounted for 18.1 per cent of the explained variance in the PEOU whereas the PR accounted for 31.8 per cent (Mutambara & Bayaga, 2021).

It was also interesting to note that the external variables PR, SN and EN explained 35.1 per cent of the variance in the PEOU and 27.5 per cent of the variance in the PU, where both the PEOU and the PU were essential factors affecting AU. Strangely, the PU did not have a statistically significant effect on both the ATT and the AU. Contrary to the findings of this study, the PU improved both the ATT and the AU in a study conducted by He et al. (2018). The results also indicated that the PU and the PEOU had a significant effect on pre-service teachers of Moodle to enhance learning. Both variables with the indirect effects of the SN, PR, and EN accounted for 62.6 per cent of the variance in the ATT. Liu et al. (2009) and Lee et al. (2005) separately found that the ATT is directly influenced by these variables. The same results were reported in more studies (Fang et al., 2019; Nikou & Economides, 2017; Teo & Milutinovic, 2015).

This study also found that the ATT, with the indirect effects of the SN, PR, EN, PEOU, and PU, accounted for a substantial 69.8 per cent of the variance in the AU of Moodle. In support of this finding, Ariff et al. (2012), Hasan (2003), and John (2013) found that individuals' perceptions and attitude have a great influence on their AU of any resource.

The six factors selected for this study were the SN, PR, perceived EN, PEOU, PU, and ATT. None was rejected during empirical and statistical tests. Altogether, they contributed a substantial 69.8 per cent of the explained variance in pre-service teachers'

AU of Moodle to enhance learning. This means that all the factors are considered important by pre-service teachers when considering the use of Moodle to enhance learning. The mediation process was used to calculate the total indirect effect of each of the six factors, which was used to rank their impact on pre-service teachers' use of Moodle to enhance learning. The variable which loaded the most effects on the AU was the ATT (0.521). This was partly because of its direct relationship with the explained variable of the model. This result means that a unit increase in the ATT results in a 0.521 increase in the AU. The next most significant variable to pre-service teachers was the EN with a total indirect effect of (0.036), followed by the PR (0.036), the SN (0.021), and the PEOU (0.007).

Research question 2: This question examined the extent to which pre-service teachers use Moodle to enhance learning. The hypothesis  $ATT \geq AU$  was the one connecting the explained variable AU to the rest of the model. The results indicated that the hypothesis  $ATT \geq AU$  was statistically significant ( $\beta = 0.521$ ,  $t\text{-value} = 10.374$ ,  $p < 0.05$ ) (see Table 3). This result follows that of Al-Emran and Salloum (2017), who found that attitude directly affects the AU and that of Dwiputranti et al. (2019) who also concluded that attitude positively relate to the AU.

The extent to which pre-service teachers use Moodle to enhance learning can also be explained by the impact of the statistically valid and robust "Moodle use empirical model" (see Figure 3) developed in this study. The model can predict pre-service teachers' use of Moodle to enhance learning. It wields a substantial coefficient of determination of 69.8 per cent which is very high compared to 40.8 per cent (Mutambara & Bayaga, 2020b), 46.8 per cent (Nikou & Economides, 2017), and 31 per cent (Venkatesh & Bala, 2008). Other researchers also produced high performing models such as the 76 per cent by Liu et al. (2010) and the 70.8 per cent by Sánchez-Prieto et al. (2019).

Research question 3: To determine how much influence pre-service teachers' demographics exert on their use of Moodle to enhance learning, the moderation process in SmartPLS was used. This calculated the net effect of a moderator variable on the relationship between an independent variable and its dependant variable. The three demographic variables in this study were used to moderate between pre-service teachers' ATT and their AU of Moodle to enhance learning. These were gender, level of study, and age. The results of the moderation process are given in Table 4 and Figure 4. The data did not support the three moderation hypotheses, moderating effect  $age \geq AU$ , moderating effect  $gender \geq AU$ , and moderating effect  $level \geq AU$  and were therefore rejected. The implication of these results is that the demographic variables in this study do not have a significant effect on the relationship between pre-service teachers' ATT and their AU of Moodle to enhance learning. It can comfortably be concluded that pre-service teachers' background information does not influence their AU of Moodle to enhance learning.

These findings may not be surprising, especially with the outbreak of the Covid-19 pandemic. Most learning and teaching activities moved online owing to the need for all and sundry to observe the Covid-19 restrictions. Social distancing became the new normal such that social boundaries brought about by demographics could be ignored to access learning using online platforms (Moodle being one of them).

These findings were supported by Sarfo et al. (2017) who found no differences in using online resources by teachers of various age groups. The implication is that the age of teachers does not influence their living online. These findings are contrary to the claim by Muslichah (2018) that the use of computers is positively related to one's attitude and behavioural intention. In an independent study, Simsek (2011) suggested that male and female teachers were more realistic so there may not be gender differences with regard to their use of computers. Male and female students display the same degree of satisfaction toward using Moodle (Alkhateeb & Abdalla, 2021). As far as the academic level is concerned, satisfaction based on the academic level was almost the same (Alkhateeb et al., 2021; Šumak et al., 2011).

## Conclusion

The main aim of this study was to examine the extent to which pre-service teachers use Moodle to enhance learning. Three research questions supported this aim. The important aspect in the findings was that all the variables chosen in this study had statistically significant effects on the AU of Moodle to enhance learning.

In the first question, six factors that pre-service teachers consider important in deciding to use Moodle were investigated and established. The factor with the most effect was the ATT of Moodle. This was followed by the perceived EN, then PR, SN, and then PEOU. On the extent to which pre-service teachers use Moodle to enhance learning, it was established that using Moodle to enhance learning was substantial. The established coefficient of determination of the study was  $R^2 = 69.8$  per cent, implying that the developed model used to predict pre-service teachers' use of Moodle to enhance learning was valid and robust. For the third question, it was established that all three demographic factors of the study did not influence pre-service teachers' use of Moodle to enhance learning.

## Limitations

Similar to any other research, this study had its own limitations. Therefore, the results need to be considered in light of the following limitations:

- The researchers of the current study chose the constructs and indicators, in consultation with stakeholders. Care was taken to include all the critical variables,



but some important constructs and indicators could still have been left out. This could have understated the extent of the influence of the model.

- This study followed a quantitative design. However, applying a qualitative method could reveal further details and deep opinions to explain the relationships among constructs differently.
- The model developed in this study explained 69.8 per cent of the variance in the continued use of the Moodle LMS. This means that factors outside this model explain 30.2 per cent of the variance. It would be interesting if future studies try to find these factors.
- The current study found that pre-service teachers' demographics do not moderate their use of Moodle to enhance learning. Future studies may need to determine why.

## Recommendations

The following recommendations are proposed:

- Future research should use a qualitative method which could reveal further details and deep opinions to explain the relationships among constructs differently.
- Future studies could be conducted to find the factors outside this model to explain the 30.2 per cent of the variance.
- Future studies should be conducted to determine why the pre-service teachers' demographics do not moderate their use of Moodle to enhance learning.

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