

Integration of the technology acceptance model and the information systems success model in the analysis of Moodle's satisfaction and continuity of use

Moodle's
satisfaction
and continuity
of use

467

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Abstract

Purpose – This paper aims to analyse the factors that influence the satisfaction and intention of continuity of use, of teachers and students, regarding using Moodle in undergraduate courses in one Campus at the Federal Institute of Rondônia in Brazil. The starting point was an integration of DeLone and McLean's Information Systems Success Model (ISSM) with Davis' Technology Acceptance Model (TAM).

Design/methodology/approach – A quantitative research approach was adopted. After the definition of the hypotheses, data were collected through self-administered questionnaires. The questionnaires were designed to measure the five constructs: Quality of Information (QI), Perceived Ease of Use (PEOU), Perceived Usefulness (PU), User Satisfaction (US) and Behavioural Intention to use (BI) that make up the conceptual model of the study. The data were analysed based on 144 valid questionnaires. The technique of maximum likelihood estimation was adopted in the data analysis through structural equation modelling (SEM).

Findings – The results confirmed six of the nine hypothesised relationships. QI positively impacts PEOU and US. PEOU positively impacts PU, which in turn positively impacts US and BI. Similarly, US positively impacts Moodle's BI. It was also evidenced that PU is the strongest predictor of US.

Practical implications – These results can help educational institutions, managers, administrators and designers of e-learning systems to develop strategies to increase Moodle's user satisfaction.

Originality/value – This study provides insights into the perception of students and teachers regarding the use of Moodle. A model that integrates constructs from two models widely used in research related to e-learning (TAM and ISSM) was used in a developing country context. This is important, given cultural differences and social idiosyncrasies in different contexts, particularly in an educational institution in the Amazonia region in northern Brazil.

Keywords User satisfaction, Behavioural intention to use, E-Learning, Moodle, Students, Teachers

Paper type Research paper

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1. Introduction

The technological development and the popularisation of the Internet have enhanced the use of Information and Communication Technologies (ICTs). In education, ICT have ushered in a new era of electronic learning (e-learning), providing students with the ability to access more diverse learning experiences without the limitations of time, space and place (Chen, 2011).

E-learning refers to all kinds of learning supported by the web. In the international context, it has successfully been adopted in higher education to expand the educational sector (Rocha *et al.*, 2020). This modality presents itself as a flexible and personalised way of learning, allowing learning on demand and reducing the cost of learning (Cidral *et al.*, 2018). E-learning is based on the use of Virtual Learning Environments (VLE), also known as Learning Management Systems (LMS), making use of Internet resources for communication and distribution of content, often used as an extension of the classroom in the virtual space of the Internet (Rocha *et al.*, 2020).

Social and technological transformations have brought organisational, didactic and pedagogical challenges in educational institutions facing a change process. Consequently, the use of VLE has been gradually growing in educational institutions. The ease of using ICT and the development of VLE contributed to this growth (Meyer and Mont'Alverne, 2020). Examples of e-learning tools include WebCT, Blackboard and Moodle platforms.

In Brazil, the use of LMS, such as Moodle, to offer distance or semi-attendance education has been significantly expanded (Cardoso, 2016). After the change in the legislation, which allowed educational institutions to offer up to 20% of the workload of their courses in VLE, many educational institutions have included the use of LMS in their pedagogical projects (Bedregal-Alpaca *et al.*, 2019).

The Vilhena Campus within the Federal Institute of Education, Science and Technology of Rondônia (IFRO) was a precursor in the implementation of Moodle. Since 2015, Moodle has been used to offer of up to 20% of the workload in VLE. The model was also implemented in the other campus undergraduate courses in the following years. From March 2020, with the advent of the new COVID-19 and the consequent adoption of remote teaching, the classes, content and materials became available to students through Moodle. However, aspects about satisfaction and intention of continuity of Moodle use by its users were never formally investigated, so far, within the institution.

Numerous pieces of research that study why individuals adopt new information technologies, as is the case of Moodle, result in theoretical models with roots in Information Systems (IS), psychology and sociology (Venkatesh *et al.*, 2012). Several models developed are based on the *Theory of Reasoned Action* (TRA) by Fishbein and Ajzen (1975), in which the authors sought to establish a relationship between individual beliefs and behaviours within human action. One of the most influential extensions of TRA is the Technology Acceptance Model (TAM) by Davis (1989). The model relates user beliefs, attitudes, intentions and behaviour to predict technology acceptance (Bedregal-Alpaca *et al.*, 2019). TAM has been configured as one of the most used models in studies that aim to explain and predict the individual acceptance of technologies based on users' perceptions (Al-Azawei *et al.*, 2017; Pires and Costa Filho, 2008; Šumak *et al.*, 2011; Surendran, 2012).

Although the initial use (acceptance) is a crucial step, the success of the e-learning service still depends on its continued use (continuation) (Chiu *et al.*, 2005). Besides analysing the intention to use a given technology, other models also seek to understand the factors influencing user satisfaction. One of the best-known is the Information Systems Success Model (ISSM) by DeLone and McLean (2003), which considers that system quality, quality of information and service quality are the main determinants of user satisfaction. Although this model was developed in an organisational context (Dağhan and Akkoyunlu, 2016), researchers have adopted this model to estimate the success, use and continuity of various information systems, including e-learning systems (Wang and Chiu, 2011).

Given the above, this study proposes a model that integrates the constructs of the TAM of Davis (1989), adding the constructs of quality of information and satisfaction of the ISSM of DeLone and McLean (2003) to analyse the satisfaction and the intention to continue to use Moodle by students and teachers of undergraduate courses of IFRO–Campus Vilhena.

The rest of this paper is organised as follows: Section 2 reviews existing studies that seek to analyse satisfaction and intention to continue using e-learning. Next, in Section 3, the conceptual model and the research hypotheses are presented. Section 4 addresses the research methodology, where the emphasis is placed on data collection and analysis methods. The results are presented in Section 5 and discussed in Section 6. Finally, the conclusion, limitations and contributions to the research are explained in Section 7.

2. Related works

Although several studies have been found on the factors that affect the acceptance and use of VLE, such as Moodle, few studies have tried to measure the impact of the quality of information on satisfaction and the intention to continue using e-learning services. Examples are the work of Chiu *et al.* (2005), Roca *et al.* (2006) and Sun *et al.* (2008).

Chiu *et al.* (2005) proposed extending the Expectancy Disconfirmation Theory Model (EDTM) to analyse the cognitive beliefs and effects influencing the user's decision to continue using e-learning services. The research results evidenced that the intention to continue using the e-learning service is determined by user satisfaction.

The study of Roca *et al.* (2006), taking EDTM as a basis, proposed a decomposed model of TAM in the context of an e-learning service. Perceived performance was decomposed into perceived quality and perceived usability. The results indicated that users' continuance intention is determined by satisfaction, which is influenced by perceived usefulness, quality of information, confirmation, service quality, system quality, perceived ease of use and cognitive absorption.

In order to investigate the factors affecting students' satisfaction with e-learning, Sun *et al.* (2008) developed a model integrating six dimensions: students, instructors, courses, technology, design and environment. The results show that student anxiety towards the computer, instructor attitude towards e-learning, e-learning course flexibility, e-learning course quality, perceived usefulness, perceived ease of use and diversity in evaluations are the critical factors affecting students' perceived satisfaction.

Wang and Chiu (2011) by incorporating communication quality, information quality, system quality and service quality in their theoretical model to assess user satisfaction and loyalty intentions to an e-learning system showed that all significantly and positively affect user satisfaction and loyalty as well as intentions to use the e-learning system to share experiences, communicate with others and get feedback.

In a model integrating TAM and ISSM, Mohammadi (2015) examined the effects of quality, perceived ease of use and perceived usefulness on e-learning users' intentions and satisfaction from four public universities in Iran. The results showed that user intentions and satisfaction predict actual e-learning use and that system quality and quality of information were found to be the main drivers of users' intentions and satisfaction regarding e-learning use.

Daghan and Akkoyunlu (2016) developed an integrated model that explores learners' intentions to continue using online learning environments and found that quality of information, system quality and service quality affect satisfaction and explain confirmation of the use of online learning environments. Confirmation predicts satisfaction, which in turn predicts the intention to continue use. Quality of information, system quality, service quality, confirmation, utility value, outcome expectations and perceived value significantly affect confirmation and satisfaction.

Al-Fraihat *et al.* (2020) investigated the factors considered for evaluating e-learning systems' success. As a result, a multidimensional and comprehensive model for assessing e-learning success was developed, proposing an extension of DeLone and McLean's (2003) original ISSM. The proposed model was empirically validated and showed strong predictive power between perceived usefulness, perceived satisfaction and benefits and moderate predictive power for use.

In the Brazilian context, studies that follow this approach are even scarcer. One of the first studies conducted to understand and modulate the Brazilian reality of e-learning was the work of Carvalho Neto (2009), who sought to identify the quality dimensions in VLE. The results showed that the quality of information and the system quality influence the satisfaction and the benefits perceived by users.

Machado-da-silva *et al.* (2014) sought to evaluate the associations between system quality, quality of information and service quality on learner satisfaction and system usage in virtual learning environments, using the e-learning success model, adapted by Holsapple and Lee-Post (2006) from DeLone and McLean (1992, 2003). In this study, the authors observed that quality of information, service quality and system quality directly impacted the use and satisfaction of e-learning systems.

Pereira, Ramos and das Chagas (2015) investigated the influence of TAM's (Davis, 1989) and ISSM's (DeLone and McLean, 2003) constructs on users' satisfaction and on the intention to continue using a VLE in the context of e-learning services. The results showed that quality of information, perceived ease of use and perceived usefulness are precedents of user satisfaction and that satisfaction determines the intention to continue using.

In another study, Pereira *et al.* (2015) sought to identify the factors that influence the satisfaction and the intention of continuous use of e-learning services aimed at training employees of public organisations. For this, a theoretical model was developed based on the Technology Readiness Index (TRI) and the Decomposed Expectancy Disconfirmation Theory (DEDT). The results showed that quality, quality disconfirmation, value, value disconfirmation, usability disconfirmation, innovativeness and optimism positively impact satisfaction. Also, satisfaction is determinant in the intention to continue using.

The study of Mondini *et al.* (2016) sought to investigate whether the system quality and the quality of the information in VLE influence the satisfaction, the use and the benefits perceived by distance undergraduate students. The results showed that both the quality of information and the quality of the system influence the perceived benefits and user satisfaction.

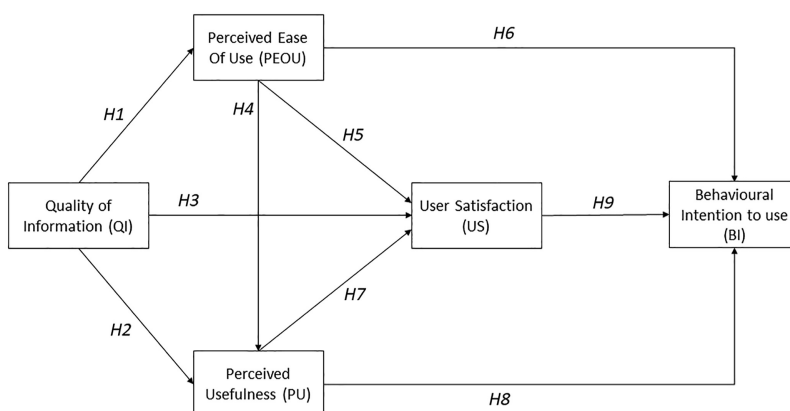
The research by Cidral *et al.* (2018) proposed a model that combined the IS success theory of DeLone and McLean (1992, 2003) with the satisfaction theory of e-learning systems (Sun *et al.*, 2008) and collaboration quality (Urbach *et al.*, 2010). The results confirmed that the quality of information positively impacts user usage and satisfaction. The authors suggested that future research should be conducted in universities and colleges (public and private) in order to compare the impact perceived by students with the impact perceived by teachers.

3. Research model and hypothesis

TAM has been widely extended, employing different variables. It has also been successfully used to explain the usefulness and the use in different contexts, including e-learning (Al-Fraihat *et al.*, 2020; Surendran, 2012), being the most widely used theory in e-learning acceptance research, with 86% of studies using this model as a base theory (Sumak *et al.*, 2011). However, TAM seeks to determine and explain acceptance and use but does not assess user satisfaction. Therefore, we propose a theoretical model that integrates the TAM's constructs of perceived usefulness, perceived ease of use and behavioural intention to use with the ISSM's constructs of quality of information and satisfaction.

The proposed theoretical model comprises five constructs: quality of information (QI), perceived ease of use (PEOU), perceived usefulness (PU), user satisfaction (US) and behavioural intention to use (BI), as illustrated in Figure 1. Table 1 presents the definition of each of the analysed variables.

Good quality information allows a greater understanding of the course content and increases the system's perceived usefulness and user satisfaction (Chen, 2010). The quality of information increases the perceived usefulness and ease of use of the system because the better the quality of the information generated, the less effort will be required to perform the tasks and, therefore, the greater the perceived usefulness of the use of e-learning (Silva *et al.*, 2013). DeLone and McLean's (2003) ISSM holds that the quality of information directly affects user satisfaction and use of information systems. Previous studies have also found that the quality of information *positively affects* e-learning users' satisfaction (Carvalho Neto, 2009; Cidral *et al.*, 2018; Dağhan and Akkoyunlu, 2016; Machado-da-silva *et al.*, 2014; Mohammadi, 2015; Mondini *et al.*, 2016; Pereira, Ramos and das Chagas, 2015; Roca *et al.*, 2006; Wang and Chiu, 2011). Thus, the quality of information positively affects perceived ease of use, perceived usefulness and user satisfaction. Therefore, the following hypotheses are proposed:



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Figure 1.
Research model

	Definition	Model/Author
QI	Quality of information that the system can store, deliver or produce	ISSM DeLone and McLean (2003)
PEOU	The degree to which a person believes using a particular system would be free of effort	TAM Davis (1989), Davis <i>et al.</i> (1989) and TAM 2 Venkatesh and Davis (2000)
PU	The degree to which a person believes using a particular system would enhance his or her job performance	TAM Davis (1989), Davis <i>et al.</i> (1989)
US	The degree to which a person believes that using a particular system will improve their job performance	ISSM DeLone and McLean (2003)
BI	Users' intention regarding the continued use of the information system	TAM Davis (1989), Davis <i>et al.</i> (1989)

Note(s): Quality of Information (QI); Perceived Ease of Use (PEOU); Perceived Usefulness (PU); User Satisfaction (US); Behavioural Intention to Use (BI)

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Table 1.
Definition of the analysed variables

H1. Quality of information positively affects perceived ease of use.

H2. Quality of information positively affects perceived usefulness.

H3. Quality of information positively affects user satisfaction.

Perceived ease of use positively affects perceived usefulness (Chen and Tseng, 2012). Furthermore, the TAM states that perceived ease of use affects behavioural intention indirectly through perceived usefulness (Davis, 1989). Thus, perceived usefulness measures the effect of perceived ease of use on behavioural intention (Venkatesh and Davis, 2000). Furthermore, previous studies have investigated and confirmed a direct relationship between perceived usefulness and perceived ease of use on continuance intention (Gefen and Straub, 2000; Klopping and Mckinney, 2004; Lederer *et al.*, 2000; Teo *et al.*, 1999). The study of Pereira *et al.* (2015) pointed out that perceived ease of use is an antecedent of user satisfaction. Thus, we propose the following hypotheses:

H4. Perceived ease of use positively affects perceived usefulness.

H5. Perceived ease of use positively affects user satisfaction.

H6. Perceived ease of use positively affects the behavioural intention to use Moodle.

Perceived usefulness was used by Davis (1989) as a key construct in TAM. Some studies have found that perceived usefulness significantly affects attitude toward the use of e-learning systems (Chen and Tseng, 2012; Davis, 1989; Sumak *et al.*, 2011). Consequently, the higher the perceived usefulness of the e-learning system, the more positive the intention to use it; therefore, the more likely it is to be used (Davis, 1989; Sumak *et al.*, 2011). The studies of AL-Sabawy (2013) and Pereira *et al.* (2015) confirmed that perceived usefulness significantly and directly affects user satisfaction. Thus, we expect the perceived usefulness of Moodle to positively affect user satisfaction and continuance of use intention. Therefore, we propose the following hypotheses:

H7. Perceived usefulness positively affects user satisfaction.

H8. Perceived usefulness positively affects the behavioural intention to use Moodle.

The satisfaction construct is common to DeLone e McLean (2003) and satisfaction models. Some studies on e-learning success maintain that the more satisfied users are, the more they will use e-learning systems (Roca *et al.*, 2006; Wang and Chiu, 2011). Previous studies have indicated that satisfaction significantly positively affects users' continuance intention (Chiu *et al.*, 2005; Dağhan and Akkoyunlu, 2016; Lee, 2010; Pereira, Ramos and das Chagas, 2015; Roca *et al.*, 2006). Thus, we expect user satisfaction to positively affect the intention to continue using Moodle. Based on this, we propose the following hypothesis:

H9. User satisfaction positively affects the behavioural intention to use Moodle.

4. Methodology

The present study is based on the hypothetical-deductive method developed by Popper (1935). As to the form of approach to the problem, a quantitative approach is adopted. Quantitative research is rooted in positivism and seeks to identify relationships between variables and, based on the results, confirm or modify existing theories or practices (Leedy and Ormrod, 2015).

4.1 Population and sample

The participants of this study comprise the teachers and students of the higher education courses of the Campus Vilhena of IFRO, constituting a target population of 76 teachers and 201 students.

The sampling technique was simple random since the questionnaire was sent to all individuals in the population; therefore, each population element had an equal opportunity to be included in the sample (Prodanov, 2013).

The final sample consisted of 144 ($n = 144$) valid questionnaires, 44 from teachers and 100 from students, corresponding to a net response rate of 57.89% and 49.75%, respectively. The total net response rate was 51.99%.

4.2 Data collection

All measurement items of the latent variables were taken from previous studies and adapted to the context of this study since, according to Davis *et al.* (1989), the analysis of the adoption of a technology or innovation should be adjusted to the context in which it is submitted.

The PEOU and PU items were adapted from Davis (1989), DeLone and McLean (2003), Roca *et al.* (2006) and Venkatesh and Davis (2000). Items referring to IQ were adapted from Chiu *et al.* (2005) and Pereira *et al.* (2015). US items were taken from Al-Fraihat *et al.* (2020), Chiu *et al.* (2005) and Dağhan and Akkoyunlu (2016) and BI items were adapted from Chiu *et al.* (2005) and Venkatesh *et al.* (2003). Table 2 presents the constructs, code and items of the theoretical research model.

All statements comprising the questionnaire were arranged on a five-point Likert scale. Following the guidance of Hair *et al.* (2014), the coding of the answers was: 1: Strongly Disagree, 2: Disagree, 3: Neutral or Uncertain, 4: Agree and 5: Strongly Agree, thus meeting the requirement of equidistance between the items and ensuring the symmetry of the scale. Although Likert scales are ordinal, when a Likert scale is symmetrical and equidistant, it tends to approximate an interval-level measurement, enabling the corresponding variables to be used in the structural equation modelling (SEM) (Hair *et al.*, 2014).

Data was collected through a self-administered questionnaire implemented in the Google Forms tool and made available to the participants through the Internet. The datasets are available on the Zenodo platform at the following link: <https://zenodo.org/record/7493061#.Y64DbnZKjIU>.

4.3 Data analysis

For data analysis, SEM was adopted because, according to Hair *et al.* (2009), “if a set of dependent/independent variable relationships is postulated, then structural equation modelling is appropriate” (p. 32).

A three-step strategy was adopted (Pahlevan Sharif and Sharif Nia, 2018). The first step consisted of cleaning the data, where missing values and atypical observations (outliers) were checked and treated, and verifying that the data met the assumptions for applying SEM. In this step, the data collected with Google Forms was exported to Microsoft Excel® (version 2107) spreadsheet (.xlsx), where the data was cleaned, formatted and coded. Coding is the process of assigning numbers to categories in order to facilitate their measurement (Hair *et al.*, 2014).

The second step involved applying the confirmatory factor analysis (CFA) to evaluate the measurement model. In this step, the reliability of the constructs was evaluated by analysing factor, convergent and discriminant validities using IBM SPSS Statistics (version 26) and IBM SPSS Amos (version 26).

The third and last step was to evaluate the structural model by SEM. In this step, the quality of the model fit was verified, and the hypotheses were tested using the techniques for estimating the structural coefficients and evaluating their statistical significance using IBM SPSS Amos (version 26).

5. Results

5.1 Structural equation modelling assumptions

Previous studies have noted that good results can be achieved in SEM analyses when n is < 200 (Gerbing and Anderson, 1985) or at least above 100 (Boomsma, 1985). Furthermore,

Code	Item	Adapted from
<i>Perceived Ease of Use (PEOU)</i>		
PEOU1	Learning to use Moodle is easy for me	Davis <i>et al.</i> (1989), Roca <i>et al.</i> (2006)
PEOU2	I would find it easy to get Moodle to do what I want it to do	Davis <i>et al.</i> (1989)
PEOU3	My interaction with Moodle is clear and understandable	Davis <i>et al.</i> (1989), Roca <i>et al.</i> (2006)
PEOU4	I find the interaction with Moodle flexible	Davis <i>et al.</i> (1989)
PEOU5	It is easy for me to become skilled in using Moodle	Davis <i>et al.</i> (1989), Roca <i>et al.</i> (2006)
PEOU6	Overall, I find Moodle easy to use	Davis <i>et al.</i> (1989), Delone and McLean (2003)
<i>Perceived Usefulness (PU)</i>		
PU1	Using Moodle allows me to get tasks done more quickly	Davis <i>et al.</i> (1989), Venkatesh and Davis (2000)
PU2	Using Moodle improves my job performance. (Teachers) Using Moodle improves my academic performance. (Students)	Davis <i>et al.</i> (1989), Roca <i>et al.</i> (2006)
PU3	Using Moodle increases my productivity	Davis <i>et al.</i> (1989)
PU4	Using Moodle increases my effectiveness at work. (Teachers) Using Moodle increases my learning effectiveness. (Students)	Davis <i>et al.</i> (1989), Roca <i>et al.</i> (2006)
PU5	Using Moodle makes my job easier. (Teachers) Using Moodle makes it easy to follow and study the course material. (Students)	Davis <i>et al.</i> (1989)
PU6	Overall, I find Moodle useful for my work. (Teachers) Overall, I find Moodle useful for my learning. (Students)	Davis <i>et al.</i> (1989), Roca <i>et al.</i> (2006)
<i>Quality of Information (QI)</i>		
QI1	Moodle's layout and user interface is user friendly	Chiu <i>et al.</i> (2005), Pereira <i>et al.</i> (2015)
QI2	Navigating through Moodle is easy	
QI3	Moodle offers the resources I need	
QI4	I feel comfortable using the features offered by Moodle	
QI5	Moodle provides comprehensive information	
QI6	Moodle offers information that is easy to understand	
<i>User Satisfaction (US)</i>		
US1	I am satisfied with the experience of using Moodle	Chiu <i>et al.</i> (2005), Dağhan and Akkoyunlu (2016)
US2	I am satisfied with Moodle's performance	Al-Fraihat <i>et al.</i> (2020), Chiu <i>et al.</i> (2005), Dağhan and Akkoyunlu (2016)
US3	Moodle meets my educational needs	Al-Fraihat <i>et al.</i> (2020)
<i>Behavioural Intention to use (BI)</i>		
BI1	I intend to continue using Moodle in my work often. (Teachers) I intend to continue using Moodle in my studies often. (Students)	Chiu <i>et al.</i> (2005), Venkatesh <i>et al.</i> (2003)
BI2	I predict I will use Moodle for my day-to-day work. (Teachers) I predict I will use Moodle for my day-to-day studies. (Students)	
BI3	I have plans to continue using Moodle in my work in the future. (Teachers) I have plans to continue using Moodle in my studies in the future. (Students)	

Table 2.
Constructs, codes and items of the theoretical research model

Source(s): Created by author

Hair *et al.* (2009) point out that “SEM models containing five constructs or fewer, each with more than three items (observed variables) and with high communalities (0.6 or more), can be adequately estimated with sample sizes as small as 100–150” (p. 565). Therefore, with a sample size of $n = 144$, we consider it feasible to proceed with SEM.

The scales used in this study were checked for normality to examine whether the data correspond to a normal distribution. Asymmetry and kurtosis indices with values between ± 2 are considered acceptable to prove that it is a normal distribution (Field, 2000, 2009; Gravetter and Wallnau, 2014; Trochim and Donnelly, 2006). According to Hair *et al.* (2009), indices with values between ± 2.58 , for a significance level of 0.01, and ± 1.96 , for a significance level of 0.05, are the most commonly used values. All items tested are within acceptable limits, indicating that the data have a normal distribution and corroborating the application of SEM as an analysis method.

The sample covariances are non-zero; thus, the nature of the relationships between the variables, latent or observed, were assumed to be linear (Marôco, 2010). It is worth noting that although the model satisfies this assumption, as the estimation method used in SEM to calculate the model parameters and their discrepancy functions was the maximum likelihood, this does not require linearity.

As the goal is to identify sets of interrelated variables, some multicollinearity is desirable (Hair *et al.*, 2009). A tolerance value of 0.10, which corresponds to a VIF value of 10, is commonly used as a cut-off reference (Hair *et al.*, 2009; Kline, 2016). The result of the analysis indicates that the tolerance and VIF values align with the respective cut-off references, indicating an acceptable level of multicollinearity.

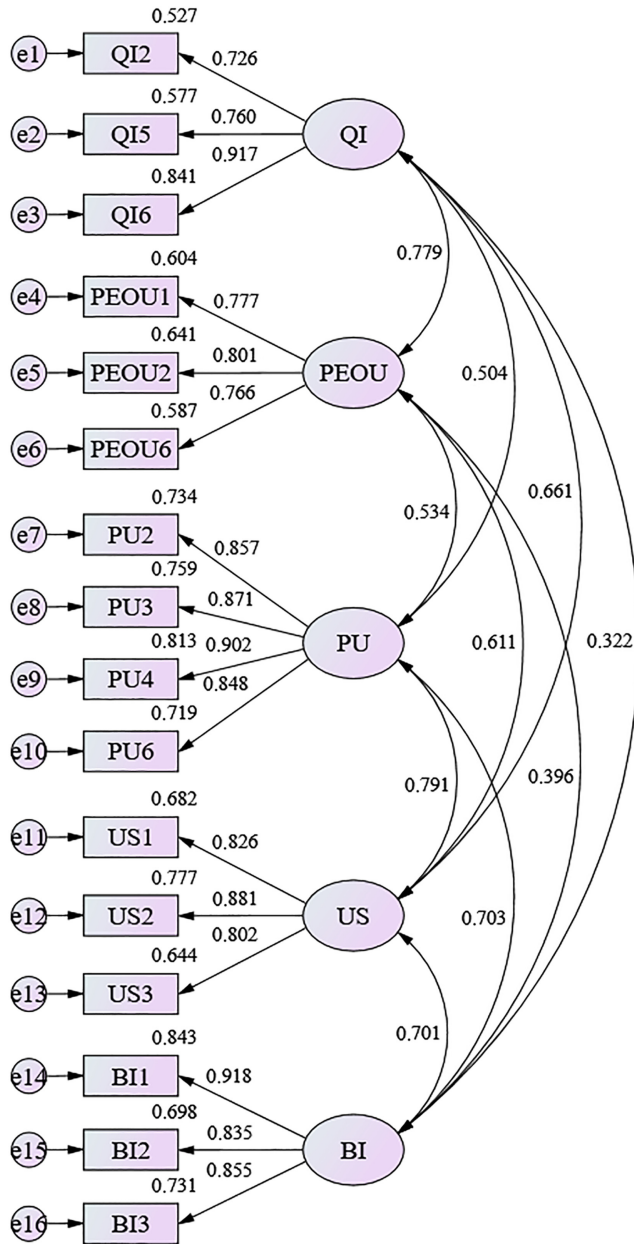
As Jöreskog and Sörbom (1993) proposed, the variance of the errors is constant, and the residual covariances have an absolute value < 2 , indicating homoscedasticity in the residuals.

5.2 Measurement model analysis

The first step of the CFA consisted of analysing the factor validity of the measurement model. The CFA allows for identifying the items related to each latent variable and verifying the loadings associated with each item. Factorial validity is commonly assessed by loadings (λ). Significant factor loadings ≥ 0.50 and ideally ≥ 0.70 indicate high convergent validity (Hair *et al.*, 2009). The model did not present a good fit in the first analysis, performed with the 24 indicators of the five constructs. When evaluating the factor loadings of the measurement model, the items QI1, QI3, QI4, PEOU3, PEOU4, PEOU5, PU1 and PU5 showed problems, with $\lambda < 0.70$, demonstrating that they did not present a good adherence to their 64 respective constructs, being then excluded from the model, as suggested by Hair *et al.* (2009). After removing the mentioned items, the model presented a satisfactory fit. The measurement model, after the adjustments, is shown in Figure 2.

The measurement model has 16 indicators, 42 parameters to be estimated and 94 degrees of freedom; therefore, the model has more degrees of freedom than paths to be estimated. Thus, according to Hair *et al.* (2009), the model is characterised as overidentified, which means that the parameters to be estimated are lower than the information obtained from the manifest variables and can determine their significance and fit quality. An over-identified model is the preferred model identification for SEM (Hair *et al.*, 2009).

The statistical measure χ^2/df presents a value of 1.780, indicating a good fit, as proposed by Jöreskog and Sörbom (1993), therefore, the model is considered compatible with the population covariance matrix, i.e. the model fits the data. According to Hair *et al.* (2009), a sample size of < 250 and with 12–30 variables, an RMSEA < 0.08 with a CFI ≥ 0.95 shows a good fit for a model. Only the GFI (0.879) showed a value slightly below the recommended level of 0.90. However, Bagozzi and Yi (1988) argued that a GFI > 0.80 indicates an acceptable model. Furthermore, according to Kline (2016) and Hu and Bentler (1999), the CFI is a better indicator for small samples. The model presents a CFI of 0.956, therefore above the recommended minimum. In addition, the other incremental fit indices are above 0.90, indicating a good level of fit.



Source(s): Created by author

Figure 2.
Measurement model
estimation

The psychometric properties of the measurement model in terms of reliability and validity were also assessed. The result revealed that all model items have $\lambda \geq 0.70$, indicating a highly significant factor loading (Bagozzi and Yi, 1988; Hair *et al.*, 2009). In addition, all λ^2 values

were bigger than 0.50, indicating appropriate individual reliability (Marôco, 2010). Two indicators were used to assess the constructs' validity: composite reliability (CR) and Cronbach α (CA). The CA and CR for all constructs have values ≥ 0.70 , suggesting good reliability and high internal consistency (Hair *et al.*, 2009). The values are presented in Table 3.

Convergent validity was also assessed through the estimation of the Average Variance Extracted (AVE), which should be ≥ 0.50 to indicate adequate convergent validity (Bagozzi and Yi, 1988; Fornell and Larcker, 1981; Hair *et al.*, 2009). Table 4 indicates an AVE ≥ 0.50 for all constructs, meeting Fornell and Larcker's (1981) criterion and indicating that each construct is strongly related to its indicators. Therefore, the convergent validity of the model is satisfied.

As for the discriminant validity, in Tables 4, it can be seen that each construct's MSV and ASV values are lower than the AVE. Moreover, the roots of the AVE (diagonally, in italics) are higher than the square correlation coefficients established between the constructs, as proposed by Fornell and Larcker (1981), indicating that the relationship between the constructs and their respective indicators is stronger than with other constructs in the model. Therefore, the discriminant validity of the model was achieved.

Construct	Items	Loading (λ) ⁽¹⁾	SMC (λ^2) ⁽²⁾	CA ⁽³⁾	CR ⁽⁴⁾
Quality of Information (QI)	QI2	0.726	0.527	0.835	0.846
	QI5	0.760	0.577		
	QI6	0.917	0.841		
Perceived Ease of Use (PEOU)	PEOU1	0.777	0.604	0.823	0.825
	PEOU2	0.801	0.641		
	PEOU6	0.766	0.587		
Perceived Usefulness (PU)	PU2	0.857	0.734	0.924	0.925
	PU3	0.871	0.759		
	PU4	0.902	0.813		
	PU6	0.848	0.719		
Behavioural intention to use (BI)	BI1	0.918	0.843	0.904	0.903
	BI2	0.835	0.698		
	BI3	0.855	0.731		
User Satisfaction (US)	US1	0.826	0.682	0.875	0.875
	US2	0.881	0.777		
	US3	0.802	0.644		

Note(s): ⁽¹⁾Factor loading; ⁽²⁾Squared Multiple Correlation; ⁽³⁾Cronbach α ; ⁽⁴⁾Composite Reliability
Source(s): Created by author

Table 3.
Constructs reliability measures

Construct	AVE ⁽⁶⁾	MSV ⁽⁷⁾	ASV ⁽⁸⁾	QI ⁽¹⁾	PEOU ⁽²⁾	PU ⁽³⁾	US ⁽⁴⁾	BI ⁽⁵⁾
QI ⁽¹⁾	0.648	0.607	0.350	<i>0.805</i>				
PEOU ⁽²⁾	0.611	0.607	0.356	0.779	<i>0.781</i>			
PU ⁽³⁾	0.756	0.626	0.415	0.504	0.534	<i>0.870</i>		
US ⁽⁴⁾	0.701	0.626	0.482	0.661	0.611	0.791	<i>0.837</i>	
BI ⁽⁵⁾	0.757	0.495	0.312	0.322	0.396	0.703	0.701	<i>0.870</i>

Note(s): ⁽¹⁾Quality of Information; ⁽²⁾Perceived Ease of Use; ⁽³⁾Perceived Usefulness; ⁽⁴⁾User Satisfaction; ⁽⁵⁾Behavioural Intention to use; ⁽⁶⁾Average Variance Extracted; ⁽⁷⁾Maximum Shared Variance; ⁽⁸⁾Average Squared Shared Variance

Source(s): Created by author

Table 4.
Measures of constructs validity

5.3 Structural model analysis

After evaluating the measurement model's fit, the next step was to submit the data for further analysis, examining the hypothetical relationship between the proposed model's exogenous and endogenous variables. The maximum similarity method was used to estimate the coefficient of each path. The final model is shown in Figure 3.

The quality of fit of the structural model was examined using the same fit indices as the measurement model. The results were consistent with the measurement model. Except for the GFI, which, as with the measurement model, shows a lower value than recommended, the other indices show values that meet the recommended minimum, so it is concluded that the structural model in this study shows a good fit. Given a satisfactory fit of the structural model, one can analyse the model's hypotheses.

Six hypotheses are supported based on the SEM results presented in Table 5. IQ has a positive impact on PEOU ($\beta = 0.785, p < 0.001$) and US ($\beta = 0.320, p < 0.01$), confirming H1 and H3, respectively. However, H2 is not confirmed. PEOU positively impacts PU ($\beta = 0.379, p < 0.05$), confirming H4. However, H5 and H6 are not confirmed. PU has a positive impact on US ($\beta = 0.613, p < 0.001$) and BI ($\beta = 0.441, p < 0.001$), confirming H7 and H8, respectively. Finally, US positively impacts BI ($\beta = 0.414, p < 0.01$), confirming H9.

The hypotheses of the research model are again identified in Figure 4. The line drawing distinguishes between confirmed and unconfirmed hypotheses.

6. Discussion

The results of the path analysis of the structural model, conducted in IBM SPSS Amos through SEM, revealed that the QI, a construct that forms the ISSM, positively impacts the

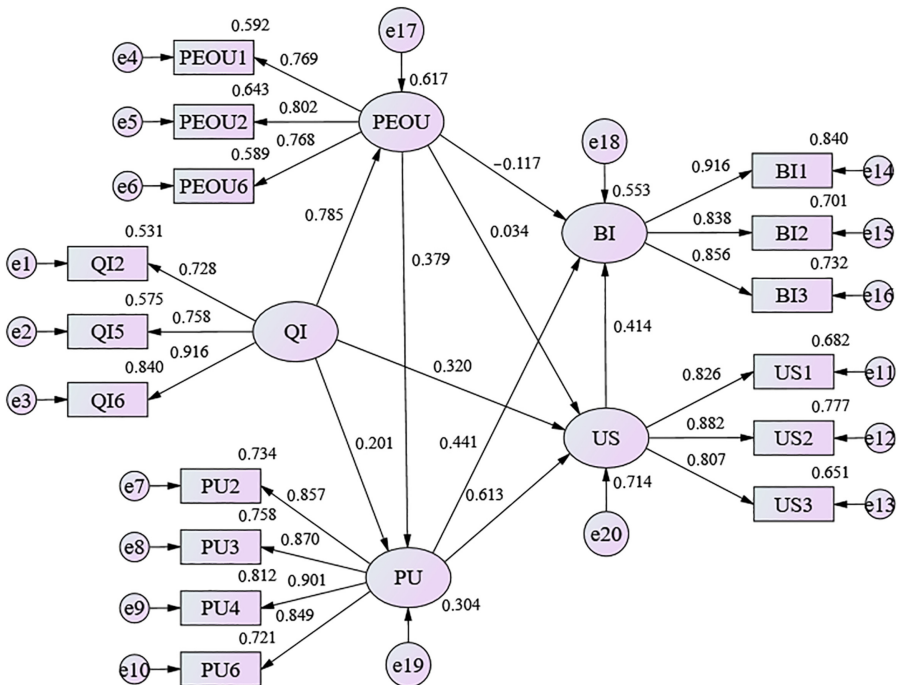


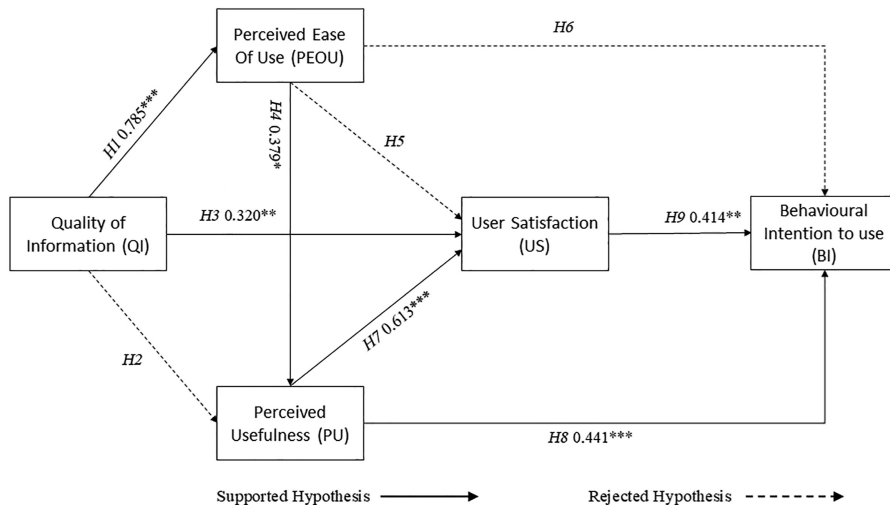
Figure 3. Final model estimation

Source(s): Created by author

Hypothesis	Path	Standardised estimate (β)	SE ⁽¹⁾	CR ⁽²⁾	p-value	Outcome
H1	QI → PEOU	0.785	0.090	7,207	***	Supported
H2	QI → PU	0.201	0.157	1,262	0.207	Rejected
H3	QI → US	0.320	0.108	2,582	**	Supported
H4	PEOU → PU	0.379	0.198	2,285	*	Supported
H5	PEOU → US	0.034	0.136	0.263	0.793	Rejected
H6	PEOU → BI	-0.117	0.111	-1,219	0.223	Rejected
H7	PU → US	0.613	0.076	7,159	***	Supported
H8	PU → BI	0.441	0.123	3,472	***	Supported
H9	US → BI	0.414	0.157	2,884	**	Supported

Note(s): * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$. ⁽¹⁾Standard Error; ⁽²⁾Critical Ratio
Source(s): Created by author

Table 5.
Analysis of the model's
causal relationships



Note(s): * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

Source(s): Created by author

Figure 4.
Model after
hypothesis tests

PEOU, confirming hypothesis H1. This result is consistent with previous studies (Pereira, Ramos and das Chagas, 2015; Silva *et al.*, 2013) and suggests that the more understandable and complete the information offered by Moodle, the greater the perceived ease of use of Moodle by users. Contrary to expectations, the QI had no significant direct effect on PU, so hypothesis H2 was not confirmed. This finding contrasts with results from previous studies (Al-Fraihat *et al.*, 2020; Pereira, Ramos and das Chagas, 2015; Wang and Wang, 2009) and suggests that the fact that Moodle is easy to navigate and offers complete information that is easy to understand does not affect users' perceived usefulness. Hypothesis H3 was confirmed, demonstrating that the QI positively impacts US. This result is consistent with the findings of previous studies (Al-Fraihat *et al.*, 2020; Carvalho Neto, 2009; Chen, 2010; Cidral *et al.*, 2018; Daghan and Akkoyunlu, 2016; DeLone and McLean, 2003; Machado-da-silva *et al.*, 2014; Mohammadi, 2015; Mondini *et al.*, 2016; Pereira, Ramos and das Chagas, 2015; Roca *et al.*, 2006) and suggests that the more complete and understandable the information offered by Moodle, providing good navigation, the more satisfied users will be.

The results showed that PEOU positively impacts PU, confirming hypothesis H4. This finding is consistent with the TAM proposed by Davis (1989) and the results reported by Chen and Tseng (2012), indicating that the easier Moodle is to use, the greater the perceived usefulness by users. However, hypotheses H5 and H6 were not confirmed. PEOU did not have a significant positive impact on US (H5). This finding contrasts with Pereira *et al.*'s (2015) results, indicating that users will not be more satisfied just because Moodle is easy to use. This discrepancy may be related to the users' profile; since 97% of the participants in this study considered to have sufficient mastery in the use of ICT, the perception of ease of use may have been affected, influencing this result.

PEOU did not have a significant direct impact on the BI (H6), contrasting with the finding of Chen and Tseng (2012). However, other studies have found similar results, indicating that individuals are unlikely to use Moodle simply because it is easy to use (Davis *et al.*, 1989; Mohammadi, 2015; Wang and Wang, 2009). According to Davis *et al.* (1989), perceived ease of use directly impacts usage intention when users are still learning to use the system. However, this effect becomes less noticeable and is eventually replaced by an indirect effect through perceived usefulness as users gain experience.

The PU positively impacts US and BI, confirming hypotheses H7 and H8, respectively. This result is consistent with findings from previous studies. It indicates that the higher the perceived usefulness of Moodle for participants' academic (students) and professional (teachers) performance, the higher the user satisfaction (Al-Sabawy, 2013; Pereira, Ramos and das Chagas, 2015) and the intention to continue using Moodle (Chen and Tseng, 2012; Mohammadi, 2015; Šumak *et al.*, 2011; Wang and Wang, 2009).

Previous research results showed that user's belief in the ease of use and usefulness of e-learning systems is a decisive antecedent in their perceived satisfaction (Chiu *et al.*, 2005; Pereira, Ramos and das Chagas, 2015; Roca *et al.*, 2006; Sun *et al.*, 2008). Also, previous studies have confirmed a direct relationship between perceived usefulness and perceived ease of use on the behavioural intention to use (Gefen and Straub, 2000; Klopping and McKinney, 2004; Lederer *et al.*, 2000; Teo *et al.*, 1999). Nevertheless, the same was not observed in our results. Our findings confirmed the direct and positive relationships between PU and US (H7) and PU and BI (H8), but the direct relationships between PEOU and US (H5) and PEOU and BI (H6) were not confirmed.

Our results showed that PU had a more significant impact than PEOU on US and BI, supporting previous findings (Davis, 1989; Lee, 2010; Pereira, Ramos and das Chagas, 2015; Roca *et al.*, 2006).

US positively impacts the BI, confirming hypothesis H9. This result is consistent with the findings in the literature, indicating that the increase in user satisfaction can increase the user intention to continue using Moodle (Chiu *et al.*, 2005; Dağhan and Akkoyunlu, 2016; Lee, 2010; Mohammadi, 2015; Pereira, Ramos and das Chagas, 2015; Pereira *et al.*, 2015; Roca *et al.*, 2006; Wang and Chiu, 2011).

Finally, the results also showed that, of all the relationships in the proposed model, the most substantial impact is found in the high and positive relationship between QI with PEOU ($\beta = 0.785, p < 0.001$). On the other hand, PU proved to be the main determinant of US ($\beta = 0.613, p < 0.001$). Therefore, the PU and US were shown as determinants of the BI.

7. Conclusion

This study sought to analyse the factors that influence the satisfaction and the intention to continue using Moodle, of students and teachers, through a model that integrates the constructs quality of information and satisfaction of ISSM (DeLone and McLean, 2003) with the constructs perceived usefulness, perceived ease of use and behavioural intention to use of TAM (Davis, 1989). As revealed in the fit test, the model showed a good fit to the data

collected. The study tested a total of nine hypotheses, of which three were rejected. The SEM results confirmed six of the nine proposed hypotheses. The strongest relationship occurs between the quality of information and perceived ease of use.

Similarly, perceived usefulness is the factor that most influence user satisfaction and the behavioural intention to use Moodle. The proposed model was able to explain 71.4% of the variance in user satisfaction, 61.7% of the variance in ease of use, 55.3% of the variance in behavioural intention to use Moodle and 30.4% of the variance in perceived usefulness. Therefore, all endogenous constructs of the proposed model have high explanatory power.

Besides reinforcing the importance of Moodle as the most used VLE in the world, this research contributes to the creation of knowledge about the perception of Moodle users as a support for face-to-face teaching. This study provides researchers with a validated model that integrates constructs from TAM and the ISSS, two widely used models in research related to e-learning.

The results indicate the quality of information and the perceived usefulness as influencing factors of satisfaction and intention of continuity of use, in students and teachers, regarding the use of Moodle. Because, when improving Moodle attributes related to these two factors, it can generate an increase in user satisfaction and intention to continue using Moodle. This finding brings practical implications for educational institutions, managers, administrators and designers of e-learning systems.

Educational institutions must conduct periodic surveys with users so that they can identify possible problems and deficiencies and thus seek continuous improvement in the use of Moodle. Thus, we hope that this research is a driver for further research aimed at analysing users' perceptions regarding the use of Moodle in our institution.

Finally, the results of this study can also contribute to the development of strategies that can increase user satisfaction regarding the use of Moodle.

However, some limitations were recognised. First, the study focused on undergraduate students and teachers from only one public educational institution. Thus, there may be some interesting insights if future research is conducted with larger populations, from different levels of education, in public and private institutions. Second, the participants' responses represent cross-sectional data, so the determinant impacts in our model may change with increasing user experience over time. Thus, longitudinal studies are recommended. Finally, we encourage future research to propose new models resulting from the integration of existing models and investigate other external factors that may significantly impact user satisfaction and behavioural intention to use Moodle.

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