An analysis of factors affecting students´ perceptions of learning outcomes with Moodle

Learning Management Systems (LMSs) have a strong effect on the teaching-learning process in higher education. However, specific research on the factors that affect students´ satisfaction and their perceptions of learning outcomes derived from Moodle use is still scarce. Therefore, this study uses the theoretical underpinnings of the Technology Acceptance Model and the Information Systems Success model to contribute to the existing literature in two respects, focusing on the Moodle usage context. First, it analyses the relative impact of pre-acceptance and other e-learning quality-related variables as predictors of students´ satisfaction. Second, it investigates whether communicativeness and students' satisfaction are both determining factors of students´ perceived learning outcomes. The proposed relationships were tested with a partial least squares (PLS) regression technique, using survey data from 151 undergraduate business students at University of Cantabria (Spain). The findings reveal that information quality is the most relevant predictor of students´ satisfaction, while satisfaction is the most relevant determining factor of perceived learning outcomes. Moreover, the effect of communicativeness on perceived learning outcomes could be very dependent on the educational context, e.g. blended versus virtual learning. These findings can help instructors to implement Moodle efficiently, and suggest the need to develop friendly courses with up-to-date and structured learning materials.

Keywords: learning management systems, learning outcomes, Moodle, Partial Least Squares (PLS), Spain.

Word count: 7,993

1. Introduction

The implementation of the European Higher Education Area has significantly transformed contemporary teaching approaches in higher education institutions (Hsieh and Cho 2011; García-Piqueres, Pérez-Pérez, and Serrano-Bedia 2016). In recent years, the higher education sector worldwide has adopted new Learning Management Systems (LMSs) (Diep et al. 2017) to more easily distribute, track, and manage courses (Islam and Azad 2015; Subramanian and

Perumal 2016). This situation has resulted in an increasingly important role of LMSs in contemporary education (Ifinedo, Pyke, and Anwar 2018).

Moodle –Modular Object-Oriented Dynamic Learning Environment – is one of the most popular LMSs. It is used extensively across the world because users can customise the platform to meet their organisational objectives, it is easy to use, and it offers a wide range of services for both educators and students. Overall, Moodle provides more flexibility than other learning environments in terms of the place, time and pace at which learners study (Hung, Chang, and Hwang 2011).

We concur with other researchers in that prior research (Islam 2011; Sumak et al. 2011; Islam 2013; Yeou 2016; Ifinedo et al. 2018) was excellent at identifying the determinants of LMS´ adoption; for a review of this research, see Islam (2015). However, some research gaps still exist within this literature.

First, this research has identified certain pre-acceptance factors (namely, perceived ease of use and perceived usefulness), system quality and information quality as important determinants of students' satisfaction (Roca, Chiu, and Martinez 2006; Hsieh and Cho, 2011; Ifinedo et al. 2018). However, to the best of our knowledge, only Damnjanovic, Jednak, and Mijatovic (2015) have studied all of these factors together. Indeed, the existing literature admits the need of a better understanding of the factors affecting students´ satisfaction with online education (Xu and Mahentiran 2016).

Second, few prior studies have considered the effects of relevant factors on students' perceived learning outcomes. More studies are called for in this new evolving research area (Islam 2012, 2013; Waheed et al. 2016; Ifinedo et al. 2018), but most empirical evidence so far has focused on the relationship between students´ satisfaction and perceived learning outcomes, finding a strong positive relationship between them (Waheed et al. 2016; Ifinedo et al. 2018). However, Moodle can be configured in many different ways and used to deliver courses with

very different underlying pedagogies and in this context students may learn effectively but be unsatisfied with the format and communicativeness of the e-learning course if it do not fulfil their expectations (Wan, Wang and Haggerty, 2008; Paechter and Maier 2010; Damnjanovic et al. 2015). This suggests a need for more studies that explore the effect of Moodle as a tool to enhance interactive learning and foster e-learners and instructors´ communication on students´ perceived learning outcomes.

Third, empirical research on Moodle – the most popular LMS in the world in 2018 – has thus far been limited (Damnjanovic et al. 2015; Islam and Azad 2015; Ifinedo et al. 2018). At present, there are more than 63 thousand registered sites from 228 countries all over the world using Moodle and more than 78 million registered users (Moodle 2018). Furthermore, Spain ranks second in Moodle usage, and nearly all Spanish public and private universities use Moodle (Escobar-Rodriguez and Monge-Lozano 2012). This popularity makes the absence of empirical research on the LMS, and in particular in blended environments (Kember et al. 2010), especially problematic.

Considering all this, the present article builds on the previous literature in two respects. First, it investigates the impact of several determinants on satisfaction in an e-learning context. Second, because of the lack of studies investigating determining factors of students´ perceptions of learning outcomes with Moodle, it includes both communicativeness and student satisfaction as main determinants of students' perceptions. Considering Spain's rank in Moodle usage in 2018 and the lack of studies analysing the Moodle usage context, it focuses on finding the answers to these research questions for this specific LMS in a blended learning environment. In order to attain these objectives, partial least squares (PLS) technique was applied using survey data from students in a Spanish university.

1.1. Theoretical background

The present study proposes a model in which pre-acceptance and other e-learning quality related variables are important predictors of students´ satisfaction with Moodle. In addition, the satisfaction and communicativeness provided by Moodle influence students´ perceived learning outcomes (see Figure 1). The proposed model combines several elements from theoretical frameworks extensively used in e-learning research, such as the Technology Acceptance Model (TAM) (Davis 1989) and the Information Systems (ISs) Success Model (DeLone and McLean 2003), along with previous empirical evidence.

[Figure 1 near here]

Previous literature has pointed to the need to understand factors that affect students´ satisfaction and their perceptions of Moodle as a learning and communication tool (Xu and Mahentiran 2016). Firstly, the Technology Acceptance Model (TAM) (Davis, Bagozzi, and Warshaw 1989) proposes two usability factors – perceived ease of use and perceived usefulness – that cause people to accept or reject information technology (Escobar-Rodriguez and Monge-Lozano 2012), thus strongly influencing their satisfaction. Perceived ease of use refers to the degree to which a person believes that using a particular system would be effortless to use, whereas perceived usefulness is the degree to which a person believes that using a particular system would enhance his or her job performance (Davis 1989; Escobar-Rodriguez and Monge-Lozano 2012; Islam and Azad 2015). Following existing research (Chiu et al. 2005; Ifinedo et al. 2018), these two most relevant predictors of students´ satisfaction (Islam and Azad 2015) have been combined to form a superordinate construct of acceptance pre-cursor.

Other predictors of students´ satisfaction include a number of e-learning environment quality-related variables (Lee and Lee 2008). The ISs Success Models proposed by Delone and McLean (1992; 2003) and Seddon (1997) support the inclusion of two additional variables – system quality and information quality – that show the quality of an IS (Seddon 1997; Hsieh and Cho 2011). In this article, the specific system quality characteristics considered are system

accessibility and reliability (Seddon 1997; Lee, Yoon, and Lee 2009; Islam and Azad 2015), while information quality is defined as being "concerned with such issues as the relevance, timeliness and accuracy of information generated by an information system" (Seddon, 1997, pp. 246).

Secondly, previous empirical research has shown a strong association between students´ satisfaction and perceived learning outcomes (e.g. Waheed et al. 2016; Ifinedo et al. 2018), defined in terms of different competences which students have to achieve (Weinert, 2001). In line with Hsieh and Cho (2011) and Damnjanovic et al. (2015), this paper approximates this concept through students´ perceptions of learning performance and improvements of their subject grades.

The general logic behind these relationships is that satisfaction with e-learning systems is expected to engage students in a user-friendly platform, thus offering them the opportunity to attain new competencies through their learning (Weinert 2001). However, students may learn effectively but be unsatisfied because the format and communicativeness of the e-learning course did not fulfil their expectations (Wan et al. 2008; Paechter and Maier 2010). McArdle and Bertolotto (2012) said that traditional e-learning methods could be boring due to the lack of interaction between students and instructors, and Kember et al. (2010) reported that interactive learning and the development of communication skills have an influence on students´ perceived learning outcomes. Therefore, we have included both communicativeness and students' satisfaction variables in our model to explore their direct relationships with perceived learning outcomes, as in previous research (Damnjanovic et al. 2015). In this article, communicativeness refers to the use of Moodle to facilitate both teacher–student and student–student interactions, making it easier to gain access to other users´ knowledge and share new knowledge with other users (Martínez Torres et al. 2008).

The conceptual model is depicted in Figure 1.

1.2. Research hypotheses

1.2.1. Predictors of students´ satisfaction

We focused on the effect of three relevant factors: acceptance pre-cursor, system quality, and information quality.

As for the acceptance pre-cursor factor (perceived ease of use and perceived usefulness), previous literature (Minovic et al. 2010; Damnjanovic et al. 2015) has suggested that lack of abilities, knowledge, and skills for Moodle use can diminish its results or even lead to a refusal to use it (Paragia et al. 2011). If the technology is perceived as being complex, it may become a distraction to the learning process (Carvalho, Areal, and Silva 2011). However, a user-friendly system decreases any negative perceptions of system usage and increases satisfaction (Lin 2012; Naaj, Nachouki, and Ankit 2012; Ifinedo et al. 2018). Once students acquire the necessary skills and lecturers make greater efforts to use Moodle in their courses, students´ levels of satisfaction rise (Damnjanovic et al. 2015). Previous empirical evidence confirms a positive effect of perceived usefulness (Lee and Lee 2008; Lee 2010; Limayem, Hirt, and Cheung 2011; Damnjanovic et al. 2015; Islam and Azad 2015) and perceived ease of use on satisfaction (Roca et al. 2006); Hsieh and Cho 2011; Islam and Azad 2015). Therefore, we proposed:

H1: Acceptance pre-cursor has a positive effect on students´ satisfaction.

Regarding system quality, authors have suggested reliability and accessibility as two of the main variables (e.g. DeLone and McLean 1992; Seddon 1997; Lee et al. 2009). There is support for the relationship between system quality and user satisfaction (Iivari 2005; Petter, DeLone, and McLean 2008). Previous literature suggests that when technologies are accessible, users tend to experience cognitive absorption (Roca et al. 2006), thus increasing their

satisfaction. The positive effect of both accessibility and reliability has been confirmed by Roca et al. (2006), Chiu, Chiu, and Chang (2007) and Islam and Azad (2015), though no effect was found by Damnjanovic et al. (2015). Thus, we proposed:

H2: System quality has a positive effect on students´ satisfaction.

Finally, previous literature suggests a relationship between information quality and user satisfaction (Iivari 2005). Regarding information quality, when e-learners believe that the e-learning course provides clear, understandable and relevant information for their learning activities they are more interested in using it, which increases their satisfaction (Roca et al. 2006). The positive effect of information quality on satisfaction has been confirmed by Roca et al. (2006), Chiu et al. (2007), and Hsieh and Cho (2011), though Damnjanovic et al. (2015) found no evidence to confirm this effect. Consequently, we proposed:

H3: Information quality has a positive effect on students´ satisfaction.

1.2.2. Predictors of students´ perceived learning outcomes

We focused on the effect of two relevant factors: satisfaction and communicativeness.

Wu, Tennyson, and Hsia (2010) has suggested that satisfaction is the most accepted measure of happiness and agreement with system usage (Al-Busaidi 2013). The relationship between student satisfaction and perceived learning outcomes can create powerful synergies in students' educational experience (Alamri 2019). Previous research suggests more satisfying experiences lead to better learning performance (Shih, Muroz, and Sanchez 2006) for several reasons. First, satisfaction impacts motivation, student success, and course completion rates (Naaj et al. 2012). Second, satisfaction influences the student's level of motivation (Chute, Thompson, and Hancock 1999), which is an important psychological factor in student success (American Psychological Association 1997). Third, satisfaction is linked to student´s performance, as satisfied students learn more easily, are less likely to drop out of class, and

more likely to take additional blended learning courses and to recommend the course to others (Naaj et al. 2012). Finally, if students are provided with better assistance in terms of learning content and teacher feedback, they become satisfied with the content and overall learning environment, which leads to improved perceived academic performance (Islam 2013). The positive effects of satisfaction on learning outcomes have been empirically confirmed by Lee and Lee (2008) and Ifinedo et al. (2018). Thus, we proposed:

H4: Satisfaction has a positive effect on students´ perceived learning outcomes.

Previous literature has shown that Moodle can be configured following different instructional designs for delivering courses with different underlying pedagogies that may affect e-learning outcomes (Wan et al. 2008; Shee and Wang, 2008; Wang, Wang, and Shee 2007). In this vein, more traditional e-learning courses are primarily related to the automation of content delivery, similar to the lecture method in traditional face-to-face classrooms (Wan et al. 2008). On the contrary, other e-learning courses include features that promote both teacher-student communication (i.e. e-mails, forums, chat-rooms) and student-student interactions (discussions or cooperation on-line to complete group tasks) (Damnjanovic et al. 2015). Kember et al. (2010) reported that e-learning courses that enhance interactive learning have a positive influence on students' learning outcomes. Instructors can also interact with their students by offering them personalized comments or feedback that increases individuals´ confidence and helps them develop a better understanding of the course objectives, likely improving their learning outcomes (Hsieh and Cho 2011). Along this line, several authors indicate important advantages of e-learning courses for students´ perceived learning outcomes, including the ease and speed of sharing learning materials and the interaction between students (Jeschke and Viertiz 2007; Yaghoubi 2009). From an empirical perspective, Damnjanovic et al. (2015) found a strong significant relationship between the communicativeness enabled by

Moodle and perceived learning outcomes, while other papers (Wan et al. 2008) found no evidence to confirm this effect. Thus, we proposed:

H5: Communicativeness has a positive effect on students´ perceived learning outcome.

2. Materials and Methods

2.1. Instrument construction

Given our research objectives, a survey approach was adequate (Islam, 2013; Ifinedo et al. 2018),to collect quantitative data. Specifically, we used the most common method in educational research, 'the pencil-and-paper questionnaire' for several reasons. First, paper survey allows participants to complete the questionnaire at their own convenience,offering them some time to think about their answers (Muijs 2004). Second, it provides higher participation rates compared to those in web-survey data collection in academic research (Lefever et al 2007). Third, it can be implemented at reasonably low cost and effort (Delk et al. 2017) and does not require knowing the participant email address, an ethical concern considered in this study for students' perceived privacy and anonymity (Hartley and Chesworth 2000; Johnson and Shaw 2018). Moreover, as in previous articles in the field (Hsieh and Cho 2011; Diep et al. 2017; Islam and Azad 2015), the quantitative approach is appropriate to compare (Muijs 2004) and generalise results.

Theoretical constructs were operationalized using validated scales from prior research (specific items for each construct and their sources are summarized on Table 1).

[Table 1 near here]

All questionnaire items used a seven-point Likert scale, ranging from (1) "strongly disagree" to (7) "strongly agree".

2.2 Blended learning environment description and data collection

The study examined Cantabria University (Spain), where Moodle was adopted in 2008. Specifically, this study sought to present the views of the students in the Operations Management (OP) course, a compulsory course taught in the second course of Business Administration Degree. OP program was composed of 8 different units and 3 assessment activities – two midterm exams and a mandatory practical activity done in groups.

2.2.1 *Blended learning environment description*

The OP Moodle homepage was structured into 10 hubs:

A first general hub provides overall course information –i.e. the syllabus, the textbook's information and assessment -.

Then, each thematic unit has a hub composed of:

- *Lecture slides:* Learning materials in the form of PowerPoint slides or Acrobat PDF documents to allow for anytime, anywhere access for students.

- *Complementary material:* Solved problems, videos or internet links to access to extra reading material.

- *Discussion forums* where students and teachers informally post about the thematic units, thus supplementing and reinforcing face-to-face teaching. In order to create a more comfortable and inviting atmosphere for peer interaction, once a week instructor published shorted posts with an informal tone for enhancing students' participation in online discussions.

- *Self-evaluation activities:* Short quizzes in the form of true/false or multiple-choice questions where students can self-test their knowledge or learning. Students know their scores in real-time, receiving immediate feedback on the correct response for each question.

The last hub, related with the mandatory practical activity, is composed of:

-*Practical activity planning*: where students can consult deadlines, access to work specifications and submit their practical. Specifically, groups had three practical sessions; with follow-up tasks. The teacher returned feedback of the practical work through the platform.

- *Discussion forum* to maintain up-to-date and regular communication with instructors and peers. The instructors can post instructions on how to prepare the practical task, while the students can post any queries they have regarding the task, from questions about assignments to technical problems with the website.

2.2.2 Data collection

The survey took place after some middle assessment results of the course, such as midterm exam' scores and feedback of the practical assignments, were released. During the data collection, ethical considerations were applied. Specifically, at the end of the class one researcher explained the purposes of the survey to motivate students to complete the questionnaires. Participants were told their participation was voluntary, anonymous and they could withdraw it at any time. There was no incentive for participation and the confidentiality of the results was stressed. Furthermore, students were asked for consent. After these explanations, the researcher left the class and the paper questionnaire was delivered by a data instructor who provided support and help with referral of students needed. The questionnaire took approximately 15 minutes to complete. The fact that the entire survey process was carried out anonymously, in combination with a written and verbal guarantee of anonymity and the use of a trained and independent data instructor may have given participants the genuine sense that they could not be identified.

The average response rate for the study was 74.38 %, with 151 valid responses, which shows the researchers did not put pressure on their students to complete the survey. The sample error is 3.51%, providing a confidence level of 95%. This value is considered acceptable both in educational research, where accepted values range between 3% and 5% (Bartlett, Kotrlik, and Higgins 2001), and in survey research, with margins of error ranging from 2% to 6% (Särndal, Swensson, and Wretma 2003).

2.3. Participants

Table 2 shows the respondents' profiles. Most participants (89.4%) were aged 19 to 22 and 50.3% of the participants were female. Regarding Moodle experience, the largest group of respondents (60.26%) reported at least two years of experience and only 15.23% reported less than one year of experience, suggesting most students use Moodle for the first time when begin their university studies. Most participants used Moodle once or twice a week (41.06%), and only 8.61% reported use it more than five times a week.

[Table 2 near here]

2.4. Data analysis

Variance-based structural equation modelling (PLS-SEM) was used to test the proposed research hypotheses. The PLS-SEM approach is a non-parametric method, that does not require multivariate normality of data (Leguina 2015). As our study is exploratory in nature, PLS-SEM is the preferred technique (Grötsch, Blom, and Schleper 2013). The two-step process used to analyse and interpret the PLS-SEM results: (1) assess the measurement model, and (2) test the structural model, is described below.

2.5. Assessment of the measurement model

Table 3 shows the measurement model meets all the general requirements for first-order and second-order reflective constructs (Ali and Park 2016) as well as formative constructs.

For the reflective constructs, we used established criteria to test the reliability and validity of the measurement instrument (Hair et al. 2016). First, all reflective item loadings were above 0.707 or 0.4080 and were significant at the 0.001 level, indicating convergent validity at the item level (Braojos-Gomez, Benitez-Amado, and Llorens-Montes 2015). Second, all values of composite reliability were greater than 0.70, suggesting acceptable reliability. Third, the values of average variance extracted (AVE) for all the constructs were greater than

0.50 at the construct level (Chin 2010). Finally, for each pair of constructs, the correlations between them did not exceed the value of the square root of the AVE of either construct, which suggests discriminant validity (see Table 4) (Roldán and Sánchez-Franco 2012). Finally, the HTMT index values were less than 0.8 (see Table 5) (Henseler, Ringle, and Sarstedt 2015).

For the formative construct (acceptance pre-cursor indicator), the items' weights show how significantly item indicators are linked to their specified constructs. Table 3 shows that weights are significant at the $p>0.001$ level. To assess multicollinearity among the variables, variance inflation factors (VIF) were checked, and all VIF values were below the conservative cut-off of 3.3 (Petter et al. 2008).

[Table 3 near here]

[Table 4 near here]

[Table 5 near here]

2.6. Testing of structural model

The present study followed Hair et al.'s (2014) approach of reflecting on the structural model path coefficients, coefficient of determination (R^2), effect size (f^2) and predictive relevance (Q^2). Table 6 and Figure 2 present a graphical depiction of the PLS analysis. Results show the path coefficients and R^2 values of the endogenous variables of the model were above the 10% level, as recommended by Falk and Miller (1992). R^2 values of 0.19, 0.33 and 0.67 indicate weak, moderate, and substantial explanatory power, respectively (Chin 1998). Thus, the model has a substantial predictive power. The results for t-values show the five path coefficients were all significant and above 0.10 (Hair et al. 2014). Furthermore, the results for the algebraic signs were all positive and significant as well. This study also calculated the f^2 effect sizes, with the values of 0.02, 0.15 and 0.35 suggesting small, medium, and large effects, respectively (Chin 1998). It also tested the predictive relevance of the structural model calculating Stone-Geisser's Q^2 (Q^2=0.199), where a Q^2 greater than 0 implies the model has predictive relevance. Finally,

SRMR is less than 0.08 (SRMR=0.060). Overall, all these results suggest the proposed model has satisfactory structural properties and good explanatory power.

[Table 5 near here]

[Figure 2 near here]

3. Results

3.1. Predictors of students´ satisfaction

This study corroborates the findings of previous research that acceptance pre-cursor, system quality, and information quality are fundamental in the creation of students´ satisfaction.

First, acceptance pre-cursors positively affect students´ satisfaction, thus confirming H1. This result supports the proposition of TAM that two traditional usability factors, perceived ease of use and perceived usefulness, strongly influence satisfaction (Ifinedo et al. 2018; Escobar-Rodriguez and Monge Lozano 2012). Furthermore, according to previous empirical evidence (e.g. Lee 2010; Hsieh and Cho 2011; Damnjanovic et al. 2015; Islam and Azad 2015), perception of Moodle as a user-friendly system decreases negative outcomes associated with its use, increasing students´ satisfaction (Carvalho et al. 2011; Ifinedo et al. 2018).

Second, the study supports the ISs Success Model propositions, confirming the positive effect of both system and information quality perceptions on students´ satisfaction (H2 and H3). These appear to be the two most relevant factors, explaining 31.2% and 25.2% of the total variance, respectively. Regarding system quality, our study suggests that providing a reliable, quick, stable, and accessible system will encourage people to reuse it, experiencing cognitive absorption (Roca et al. 2006) and, therefore, more satisfaction. As far as quality of information, the study reveals that, when students perceive the information provided by a Moodle course as useful and up-to-date, they are more interested in using it and feel more satisfied (Roca et al.

2006). These findings are in line with previous empirical research (Chiu et al. 2007; Hsie and Cho 2011; Islam and Azad 2015).

3.2. Predictors of students´ perceived learning outcomes

This study also supports the relevance of two predictors of perceived learning outcomes: satisfaction and communicativeness. Of these, satisfaction seems to be the most relevant predictor, explaining 27.8% of the total variance, whereas communicativeness only explains 14.1%.

First, consistent with previous research (Al-Busaidi 2013; Damnjanovic et al. 2015; Ifinedo et al. 2018), a high correlation between students´ satisfaction and perceptions of learning outcomes was strongly confirmed, thus supporting H4.

Second, a positive effect of communicativeness on students´ perceptions of learning outcomes (H5) was confirmed, adding support to the scarce previous empirical evidence on this issue (Damnjanovic et al. 2015). When Moodle facilitates student and teacher peer interaction,, it was found to foster positive perception of learning outcomes. However, perceiving the Moodle course as a formal and instructor-monitored platform that requires students to compose messages in an academic style, which takes additional time and effort, may create a barrier to students´ full participation in discussions (Deng and Tavares 2013).

4. Discussion

This study contributes to the literature by analysing together for the first time acceptance-precursor indicators, information quality and system quality as the main determinants of students' satisfaction. Second, it investigates whether communicativeness and students' satisfaction are both determining factors of students´ perceptions of learning outcomes. The results reveal that information quality is the most relevant determinant of

students´ satisfaction, and lend credence to previous research that shows a positive and significant effect of the three analysed determinants on students' satisfaction.

Moreover, the results confirm that although satisfaction has the highest significant effect on perceived learning outcomes, communicativeness, one of the least studied variables, emerges as a relevant antecedent. This variable deserves more attention, as its effect on perceived learning outcomes could be very dependent on the educational context, e.g. instructional design characteristics of the e-learning course, or blended versus virtual learning. Although traditional e-learning courses predominantly are tough to support mainly asynchronous learning via acting as repositories of learning material they can also promote networking learning as it focuses on learning that emerges from dialogues with both online resources and with others (Hodgson and McConnell 2019). On the one hand, learners can take control of their own learning, which provides them with the opportunity to develop critical thinking (Hodgson and McConnell 2019) or engaging in the meaning-making process (Yap 2018) all of which will improve their experience with the e-learning course. On the other hand, this literature highlights the value of collaborative and co-operative online learning facilitated by a tutor by giving feedback, sharing or guidance, between others (Hodgson and McConnell 2019) and how this e-facilitating can foster the meaning-making process of students (Yap 2018). Our study lends credence to these arguments showing e-learning courses that use information and communications technology (ICT) enhance information sharing and promote communication and teacher feedback. All of them allow students to evaluate their course progress and instructional needs, leading to positive students´ perceived learning outcomes (Wan et al. 2008; Hodgson and McConnell, 2018).

Together, these findings also reveal practical implications for educators. First, instructors interested in how to use Moodle to improve students´ perceived learning outcomes should note that when students are provided with a good learning tool that satisfies them, they

perceive better learning outcomes. Instructors should pay special attention to information quality when designing the course content by distributing up-to-date learning materials and organizing them through the Moodle course intuitively to increase students´ satisfaction. That is, developing a learner-friendly Moodle course that enables an easier navigation within the course, thus allowing students to perceive the Moodle course as well organized and easy to use.

Second, the results highlight the importance of designing e-learning courses that foster peer and teacher interactions. Instructional design of Moodle courses involving interaction with content resources (e.g. with interactive tutorials, quizzes, selftests) and with people (e.g. with other students and teachers in forums) appears to have more impact on students' perceived learning outcomes that just having access to information.

Third, student perceptions that using Moodle requires them to write in a structured and academic style has also important implications for instructors who are interested in enhancing online communication for learning. To this end, instructors should consider creating a more comfortable and inviting atmosphere for peer interaction when designing their Moodle courses, modelling shorter posts with a more informal tone, thus enhancing students' participation in online discussions (Deng and Tavares 2013).

Four, the asynchronous communication methods offered within traditional e-learning applications are one of the major drawbacks of the standard LMSs because they do not facilitate peer and teacher interactions. For this reason, this study suggests the use of Moodle in blended learning environments, a context where students can build friendships with their classmates in the real world, helping them to feel they are not alone and have a social presence within the e-learning environment. The blended learning context also allows the establishment of positive interpersonal relations of students with their instructors, an important aspect for the maintenance of learning motivation in the e-learning course.

Despite these contributions, the present work is not without limitations, which provide opportunities for further research. First, the study was cross-sectional in nature, so it could be interesting that future studies capture possible changes in students´ perceptions over time using longitudinal settings. Second, this study used a sample from one course at a single institution, so the results could be influenced by aspects such as the specific educational model followed by the institution or the country's culture. Considering different contexts in future studies would allow for better generalization of these results. Third, our focus was Moodle, so comparing these students´ perceptions with those using other e-learning tools could also provide insight. Finally, although students are a valuable asset in providing feedback on their preferences and how Moodle could be improved as an educational resource, future research should compare students´ and instructors´ perceptions about the variables explored herein.

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Figure 1. Proposed model

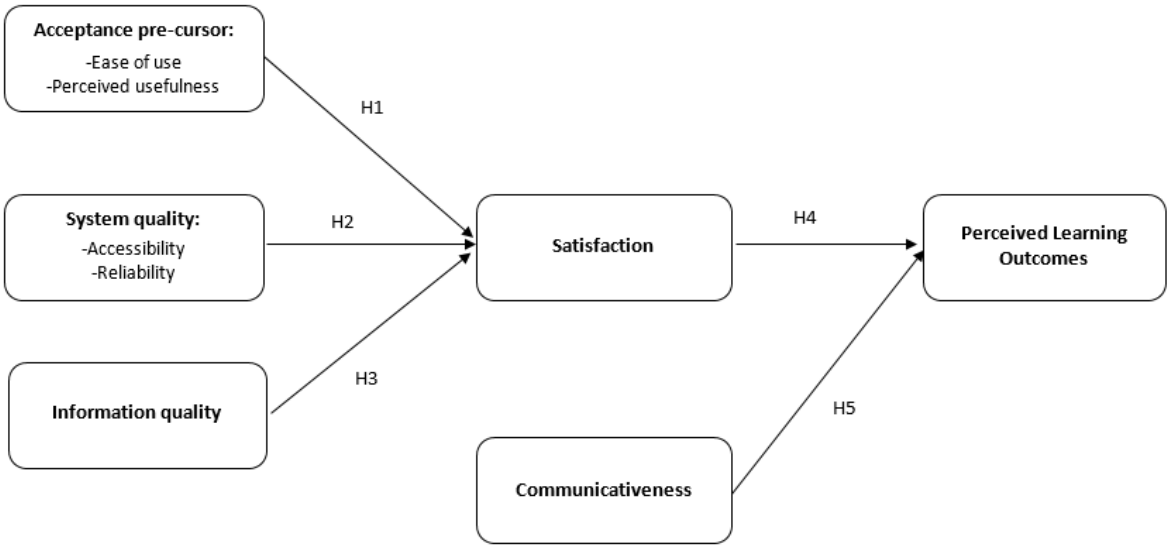

Figure 2. PLS analysis results for the proposed research model

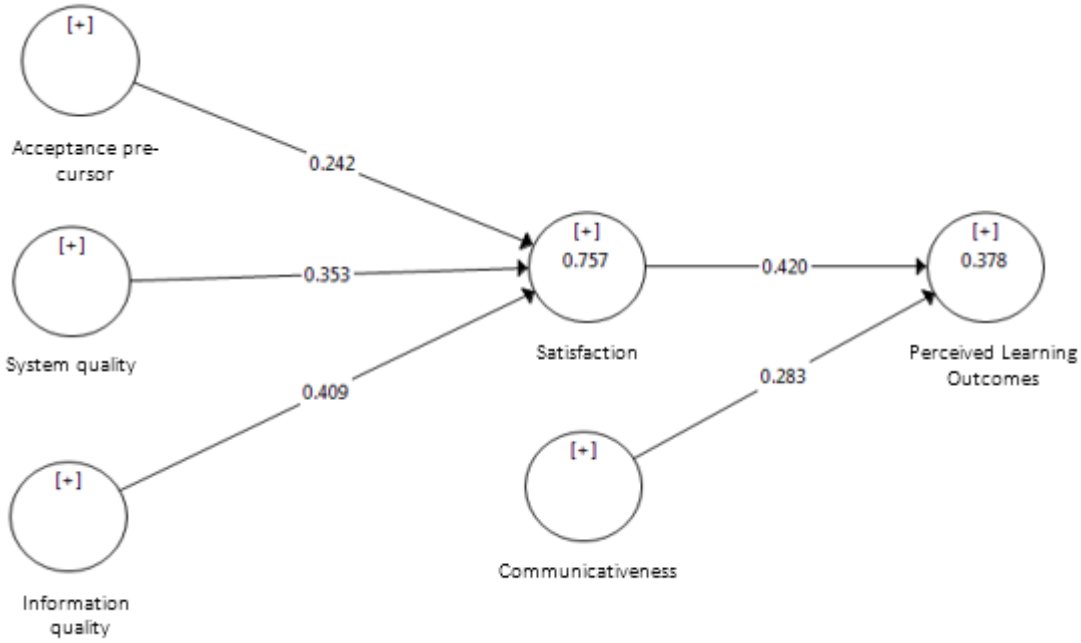

Table 1. Construct operationalization and sources

Variable		Items	Sources
Acceptance precursor	Perceived ease of use	Interacting with Moodle is clear and understandable	Ifinedo et al. (2018), Islam and Azad (2015) Islam (2013), Hong et al. (2006); Wixom and Todd (2005); Martinez-Torres et al. (2008)
		Interacting with Moodle does not require a lot of mental effort	
		I find Moodle to be easy to use	
		I find it easy to get Moodle to do what I want to do	
	Perceived usefulness	Using this e-learning tool made learning easier	Damnjanovic et al. (2015); Hsieh and Cho (2011); Wixom and Todd (2005); Martinez-Torres et al. (2008),
		Using this e-learning tool improved the quality of my tasks	
		Using this e-learning tool enabled me to complete tasks more quickly	
		Using this e-learning tool enhanced the effectiveness of my tasks	
System quality (accessibility and reliability)		Moodle quickly loads all the text and graphics	Lee et al. (2009); Islam and Azad (2015); Wixom and Todd (2005)
		Moodle offers good access	
		Moodle is stable	
		Moodle operates reliably	
Information quality		This e-learning tool provides useful information for my studies	Hsieh and Cho (2011), Damnjanovic et al. (2015); Wixom and Todd (2005)
		This e-learning tool provides up-to-date information for my studies	
Communicativeness		This e-learning tool makes it easier discussions with instructors	Martinez-Torres et al. (2008), Damnjanovic et al. (2015)
		This e-learning tool makes it easier to share new knowledge with other users	
		This e-learning tool makes it easier to gain access to other users' knowledge	
		This e-learning tool makes it easier discussions with other students	
Satisfaction		In general, using this e-learning tool gave me a sense of satisfaction	Damnjanovic et al. (2015), Hsieh and Cho (2011)
		If asked, I would probably recommend this on-line learning system as an ideal learning platform	
Perceived Learning outcome		Using this e-learning tool has improved my overall learning performance	Hsieh and Cho (2011); Damnjanovic et al. (2015)
		Using this e-learning tool improves my grade for the subject	

Table 2. Survey respondents´ profile

Demographics		**Moodle knowledge and use**	
Age		*Moodle Experience*	
19-22	89.4%	<1 year	15.23%
23-30	10.6%	2 years	60.26%
		>2 years	24.50%
Gender		*Frequency Moodle use*	
Male	49.7%	<1per week	10.60%
Female	50.3%	1-2 per week	41.06%
		2-5per week	39.74%
		>5per week	8.61%

Table 3. Summary of measurement model evaluation

	Indicator	**Loadings Weights**	**Second order loadings**	**Second order weights**	**CR**	**Cronbach alpha**	**AVE**	**VIF**
Acceptance pre-cursor indicator (second order reflective-formative construct)								
Perceived Ease of use	Easeuse 1	0.600***	0.860***	0.639***	0.859	0.876	0.604	1.90
	Easeuse 2	0.896***						1.82
	Easeuse 3	0.703***						2.44
	Easeuse 4	0.870***						2.20
Perceived usefulness	Usef 1	0.891***	0.810***	0.556***	0.870	0.865	0.616	1.50
	Usef 2	0.735***						2.72
	Usef 3	0.719***						2.47
	Usef 4	0.783***						3.12
First-order reflective constructs								
System quality (reflective)	Acc 1	0.770***	n/a	n/a	0.813	0.819	0.524	1.71
	Acc 2	0.636***	n/a	n/a				1.62
	Fiab 1	0.710***	n/a	n/a				1.56
	Fiab 2	0.771***	n/a	n/a				1.95
Information quality	Infqual 1	0.971***	n/a	n/a	0.842	0.883	0.751	2.11
	Infqual 2	0.748***	n/a	n/a				2.11
Communicativeness	Com 1	0.871***	n/a	n/a	0.911	0.912	0.719	2.77
	Com 2	0.867***	n/a	n/a				3.12
	Com 3	0.830***	n/a	n/a				2.44
	Com 4	0.823***	n/a	n/a				3.05
Satisfaction	Satisf 1	0.866***	n/a	n/a	0.844	0.884	0.730	2.14
	Satisf 2	0.843***	n/a	n/a				2.14
Learning outcome	Results 1	0.998***	n/a	n/a	0.700	0.887	0.767	1.40
	Results 3	0.638***	n/a	n/a				1.40

Table 4. Discriminant validity (Forner-Larcker matrix).

	1	2	3	4	5	6
1.Communicativeness	0.848					
2.Information quality	0.454	0.867				
3.System quality	0.461	0.543	0.742			
4.Learning outcome	0.497	0.502	0.463	0.80		
5.Satisfaction	0.510	0.762	0.714	0.56	0.854	
6.Acceptance pre-cursor indicator	0.527	0.669	0.688	0.648	0.758	n/a

Diagonal elements (bold) are the square root of variance shared between the constructs and their measures (AVE). Off- diagonal are the correlations among constructs. For discriminant validity, the diagonal elements should be larger than the off-diagonal elements. N/A: not applicable

Table 5. Discriminant validity (HTMT matrix).

	1	2	3	4	5
1.Communicativeness					
2.Information quality	0.462				
3.System quality	0.461	0.540			
4.Learning outcome	0.519	0.523	0.493		
5.Satisfaction	0.510	0.770	0.740	0.593	

Table 6. Structural model

	Path	**R^2**	**T**	**P**	**F^2 effect**	**Variance**
Learning outcome		**37.8*****				
Communicativeness	**0.283*****		2.258	0.024	0.095	14.1%
Satisfaction	**0.420*****	**75.7*****	3.592	0.000	0.210	27.8%
Acceptance pre-cursor	**0.242^t**		1.994	0.052	0.097	18.3%
Information quality	**0.409*****		3.773	0.000	0.371	31.2%
System quality	**0.353*****		2.941	0.003	0.263	25.2%

t $p<0.10$; * $p<0.05$; ** $p<0.01$; *** $p<0.001$

Declaration of Interest

No potential conflict of interest was reported by the authors.