Exploring the Use of E-Learning in Chilean Universities: A Study Using Structural Equations Modelling

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Abstract

Higher education institutions had to deploy E-learning for all their students during the year 2020 in Chile, shifting from face-to-face to distance education. This change needed the adaptation of students to uncertain scenarios and affected the online system's outcomes. For example, there were issues with the internet connection, students got distracted easily, and they tend to turn off cameras so often they are losing face-to-face contact, and teachers were unfamiliar with the technology due to their age. This research explores the effects of online learning based on both technology acceptance and success models within this context. We conducted an online survey in engineering students belonging to Chilean universities, using five variables: information quality, system quality, user satisfaction, behaviour intention, and actual use of e-learning. The study used the partial least squares path modelling technique to analyse the measurement and structural model. We conclude that the quality dimension had a more significant impact on user satisfaction. Also, this satisfaction is an indirect antecedent of the use of e-learning systems. These findings show the importance of the system's characteristics in the final acceptance of the e-learning system by Chilean university students in the context of a pandemic.

Keywords
e-Learning, higher education, technology acceptance, IS success model, PLS-PM

1. Introduction
The Chilean higher education system had to switch from face-to-face to online mode during 2020. Chilean universities needed to prioritise learning flexibility and be creative and inclusive due to the health emergency of COVID-19. In Chile, decisions were made to allocate resources and services to promote E-learning. The communication between the student and the teacher was expected to decrease concerning face-to-face mode, and it was not clear whether E-learning was influential in the development of student's abilities.

As a learning process, Chilean universities carried out contingency plans to engage students through the Internet and conducted E-learning in synchronous and asynchronous modes. Electronic equipment was offered to students who lacked the requisite resources for virtual classrooms, allowing distance education to be fully accessible. Synchronously, the student and the teacher interacted with each other at the same time in videoconferencing meetings. Because most of the evaluations were done asynchronously utilising text analysis or group work, class attendance was not a reason for failing a course or a requirement for taking a final exam.

The educational development units at the universities enforced actions to provide tools and more information to teachers and students. Teachers delivered their study material to their students via the E-learning system and email and were trained to facilitate the use of the distance education system. They were compelled to do it as they have

foreseen that the E-learning modality is going to remain in time. During video conferencing, the tendency among students was to turn off cameras, so face-to-face contact was lost. Some teachers did not have the minimum conditions to apply E-learning, such as a stable internet connection, and others were not very friendly with technology because of age.

Thus, despite the potential of E-learning, the skills that students will develop may be harmed, raising doubts about the value of E-learning in the Chilean higher education system. The analysis of various aspects that influence the efficiency of E-learning is complicated. Some actions could have been in conflict with the necessary E-learning settings according to the perception of students.

1.1 Objectives

This paper explores the effects of online learning based on both technology acceptance and success models within a pandemic context in Chile. We propose a model in conformity with the information gathered from the literature review. The measurement and structural model is evaluated using the technique of partial least squares path modelling (PLS-PM) in engineering students at three universities in Chile. We discuss the findings and insights from the analysis of the acceptance of E-learning into students' experiences, with a focus on strategies related to system characteristics in the Chilean higher education system.

2. Literature Review

The acceptance and use of the features of E-learning and the continued use and success of the system are problematic in these uncertain times for higher education institutions. The Technology Acceptance Model (TAM) was developed by Davis (1989) and is based on the TRA model (Fishbein and Ajzen, 1980). TAM model explains the use of Information Technology (IT) by modelling how users accept and use a technological tool. It seeks to predict the behaviour of these users based on their attitudes and intentions. The TAM model relates convictions, attitude, intention and behaviour to indicate IT acceptance:

- Perceived usefulness (PU) refers to the degree to which a person believes that, by using a particular IT system, they will improve their job performance;
- Perceived Ease of Use (PEOU) indicates the degree to which a person believes that using a particular IT system will expend less effort to perform their tasks.
- Attitude toward use (AU), which is the positive or negative feeling regarding the performance of a behaviour (e.g., using an IT system);
- Behaviour intention (BI) is the degree to which a person has formulated prearranged plans to engage in some future behaviour.

The main characteristics of the TAM model have perceived usefulness and perceived ease of use, which represent the certainties that lead to the acceptance of the technology. They are directly affected by external variables and affect AU, which directly affects behaviour intention, leading to the latter being directly affected by perceived usefulness and indirectly by perceived ease of use. Perceived ease of use has a causal effect on perceived usefulness, and all the variables mentioned have a significant impact on the user concerning the use of the system.

The D&M model has proven to be useful for analysing information system success, with several empirical studies confirming the theory's validity (Stacie Petter, DeLone, & McLean, 2008; Stacie Petter & McLean, 2009). This model has also been used in E-learning research (G. Cheng, 2014; Cheng, 2012; Freeze et al., 2010; Ramírez-Correa et al., 2015). It consists of six interrelated dimensions: system quality, information quality, service quality, usage, behaviour intention, and net benefits.

3. Methods

3.1 Research framework

According to their significant relationships with behaviour intention, the research framework integrates TAM and Delone&McLean models (See Figure 1). However, the proposed model does not include the quality of service. Some studies have presented problems incorporating the quality of service (Stacie Petter & McLean, 2009), as students are often unable to understand who supports the platform's technical issues of the E-learning system (Freeze et al., 2010; Lee & Sidhu, 2015).

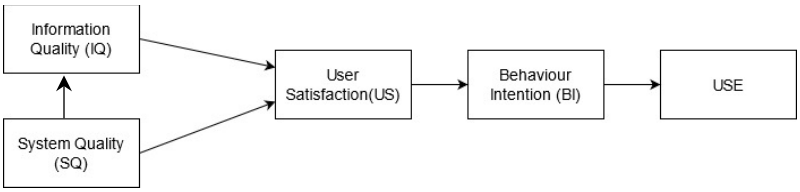

Figure 1: Research model

3.2 Delone & McLean Components

System Quality (SQ) determines how the system's characteristics influence the users' perspective on the information system. It refers to the reliability, convenience, simplicity of use, functionality, and other system metrics. Improvements in the SQ have also been linked to increased system user satisfaction (US). In the D&M model, US is defined as the approbation or likeability of the system and its output. Information Quality (IQ) refers to the features of the result supplied by the information system, such as accuracy, timeliness, and completeness metrics. It has been demonstrated that increased IQ leads to increased US (DeLone & McLean, 1992; DeLone & McLean, 2003). We suggest the following hypotheses based on these ideas:

H1: SQ positive effects US in E-learning systems.
H2: SQ positive effects IQ in E-learning systems.
H3: IQ positive effects US in E-learning systems.

The behaviour intention (BI) increases as user happiness rises. This is often assessed in terms of organisational effectiveness, perceived utility, and impact on work practices (DeLone & McLean, 1992; DeLone & McLean, 2003). According to this idea, hypothesis 4 is presented:

H4: US positive effects the BI in E-learning systems.

3.3 TAM Components

Behaviour Intention refers to how a person has formulated prearranged plans to engage in some future behaviour. The system (USE) usage is defined as its output described in current or self-reported usage. The increase in BI leads to a greater USE, as the E-learning system is used more frequently (DeLone & McLean, 1992; DeLone & McLean, 2003). Based on these findings, we propose the following hypothesis:

H5: BI positive effects USE in E-learning systems.

We applied a pre-questionnaire to 16 students and nine teachers to identify and select a subset of items proven to work from previous studies of individual acceptance and success of E-learning. Two judges coded the responses to items observed for each factor of the research model. As a result (see Table 1), three items on SQ, two on IQ, one on BI, one on USE were used from Salloum et al. (2019). In addition, two US items were adapted from Abu-Dalbouh et al. (2013).

Table 1. Measure items

Component	Item
System Quality (Salloum et al., 2019).	SQ1: I consider the interaction of the E-learning system to be satisfactory. SQ2: I consider the functions of the E-learning system to be satisfactory. SQ3: I am satisfied with the content of the E-learning system.
Information Quality (Salloum et al., 2019).	IQ1: The output information of the E-learning system is clear. IQ2: The E-learning system presents the information in a suitable format (video, audio, text, etc.).
User Satisfaction (Abu-Dalbouh et al., 2013).	US1: I am completely satisfied with the use of the E-learning system. US2: I found it easy to share information in the E-learning system.
Behaviour Intention (Salloum et al., 2019).	UI1: I will use the content and functions of the E-learning system as an aid to my academic activities.
Use (Salloum et al., 2019).	U1: In general, to what extent do you use the E-learning system?

Each indicator was measured using the Likert scale from 1 to 5, except for BI, and expressed as: strongly disagree, disagree, undecided, agree, and strongly agree. In USE, the options were: never, rarely, sometimes, very often, and always.

The research model was evaluated to estimate causal relationships from statistical data and qualitative assumptions using PLS-PM, a multivariate statistical technique. The great advantage of this type of model is that it allows proposing the style and direction of the relationships expected to be found between the various variables contained in it, and then go on to estimate the parameters specified by the relationships proposed at the theoretical level. For this reason, they are also called confirmatory models, since the fundamental interest is to "confirm" by means of the analysis of the sample the relationships proposed on the basis of the explanatory theory that it has been decided to use as a reference.

The theoretical specification of the model makes it possible to propose causal relationships between variables so that some variables cause an effect on other variables, which, in turn, can transfer these effects to other variables, creating concatenations of variables. There are two types of structural equation models: Path analysis, involving only observable variables, and confirmatory factor analysis, involving latent and observable variables.

4. Data Collection

An online survey was applied from March 10 to March 26, 2021. Responses were collected among students from the University of Playa Ancha (Valparaíso and San Felipe campuses), the Pontifical Catholic University of Valparaíso, Technical University Federico Santa María, and University of Valparaiso. The survey link was sent via email.

In this study, 104 valid responses were obtained from volunteer students (N = 104). The participating students were from undergraduate and graduate courses, with degrees in environmental, construction, industrial, computer, transportation engineering, and international business (See Table 2).

Table 2 Student Demographics

Features		Frequency	Percentage
Genre	Men	74	71%
	Women	29	28%
	Others	1	1%
Age	<23	49	47%
	22-26	45	43%
	>26	10	10%
Degree	Environmental	15	14.4%
	Construction	20	19.2%
	Industrial	10	9.6%
	Computer Science	55	52.9%
	Transportation	2	1.9%
	International Business	1	1%
	Don’t answer	1	1%
University	PUCV	51	49%
	UPLA V	36	34.6%
	UPLA SF	8	7.7%
	USM	8	7.7%
	UV	1	1%

5. Results and Discussion

5.1 Numerical Results

The estimated model was tested using Partial Least Squares Path Modelling (PLS-PM), a variance-based structural equation modelling technique. Firstly, there is an evaluation of the measurement model. The measurement model allows us to evaluate whether the theoretical concepts or constructions are properly measured through the observed elements. Secondly, the structural model is reviewed. The extent and significance of the causal relationships between the different variables are evaluated based on this model.

Table 3 illustrates the quality of the model adjustment measures. The standardised root means square residual (SRMR) is using to detection of model misspecification. A cut-off of 0.10, or more conservatively 0.08, is considered a good fit. For the estimated model, the SRMR is 0.088, which shows that the model specification is within the acceptable thresholds.

Table 3. Model adjustment measures

Index	**Value**
SRMR	0.088
d_ULS	0.351
d_G	0.199

Table 4 shows the individual reliability of the items; all the loads are above 0.76. The individual reliability of the item is correct. Furthermore, the VIF value for all items is below 1.8. This result indicates that there are no multicollinearity issues.

Table 4. Individual reliability

Loading	**Value**	**VIF**
IQ1<-Information Quality	0.900	1.419
IQ2<-Information Quality	0.855	1.419
SQ1<-System Quality	0.820	1.630
SQ2<-System Quality	0.818	1.560
SQ3<-System Quality	0.870	1.783
US1<-User Satisfaction	0.890	1.174
US2<-User Satisfaction	0.763	1.174

Table 5 presents the coefficients of composite reliability and average variance extracted (AVE) for all model variables. The internal consistency of the measurement scales is observed in the composite reliability coefficient, these are higher than 0.7, and therefore, we can affirm that the items measure the variables in a convergent way. AVE coefficient represents the proportion of construction variance that its indicators can account for. It is checked that this coefficient is more significant than 0.5 for all variables; we can therefore assert that there is a converging validity for each of the latent variables.

Table 5. Composite reliability and AVE

Latent Variable	Composite Reliability	Average Variance Extracted (AVE)
Information Quality	0.870	0.771
System Quality	0.875	0.699
User Satisfaction	0.814	0.688

The discriminatory validity between the constructions was evaluated using the Fornell-Lacker criterion; the Heterotrait-Monotrait test confirmed this result. Each construction measures different aspects.

Table 6 provides the structural model results regarding path coefficients. All path coefficients are statistically significant.

Table 6. Path Coefficients

Relationship	Path Coefficient						
	Value	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	2.5%	97.5%
Behaviour Intention->Use	0.529	0.525	0.081	6.500	0.000	0.348	0.671
Information Quality->User Satisfaction	0.177	0.175	0.090	1.974	0.049	-0.015	0.334
System Quality->Information Quality	0.591	0.589	0.066	8.933	0.000	0.455	0.712
System Quality->User Satisfaction	0.610	0.616	0.076	8.010	0.000	0.473	0.760
User Satisfaction->Behaviour Intention	0.555	0.558	0.069	8.049	0.000	0.406	0.681

Table 7 shows the structural model results regarding determination coefficients (R-Square). R-Square indicates the proportion of variance in the endogenous construct that is explained by the regression. All coefficient of determination is greater than 0.2 and statistically significant.

Table 7. Determination Coefficients

Latent Variable	R-Square							
	Value	Adjusted	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	2.5%	97.5%
Behaviour Intention	0.308	0.301	0.317	0.076	4.058	0.000	0.165	0.464
Information Quality	0.349	0.342	0.351	0.077	4.556	0.000	0.207	0.507
Use	0.280	0.272	0.283	0.085	3.305	0.001	0.121	0.450
User Satisfaction	0.532	0.522	0.545	0.079	6.741	0.000	0.373	0.679

5.2 Graphical Results

The estimated model shown in Figure 2 was tested using PLS-PM. The nomological network of the figure shows how satisfaction is explained and, in turn, this explains the intent-mediated use. In particular, the analysis results show that the variable use is explained by Behaviour Intention (R-Square = .28), and in turn, Behaviour Intention is determined by User Satisfaction (R-Square = .31). On the other hand, the variable System Quality determines Information Quality (R-Square = .34), and these two explained User Satisfaction (R-Square = .53).

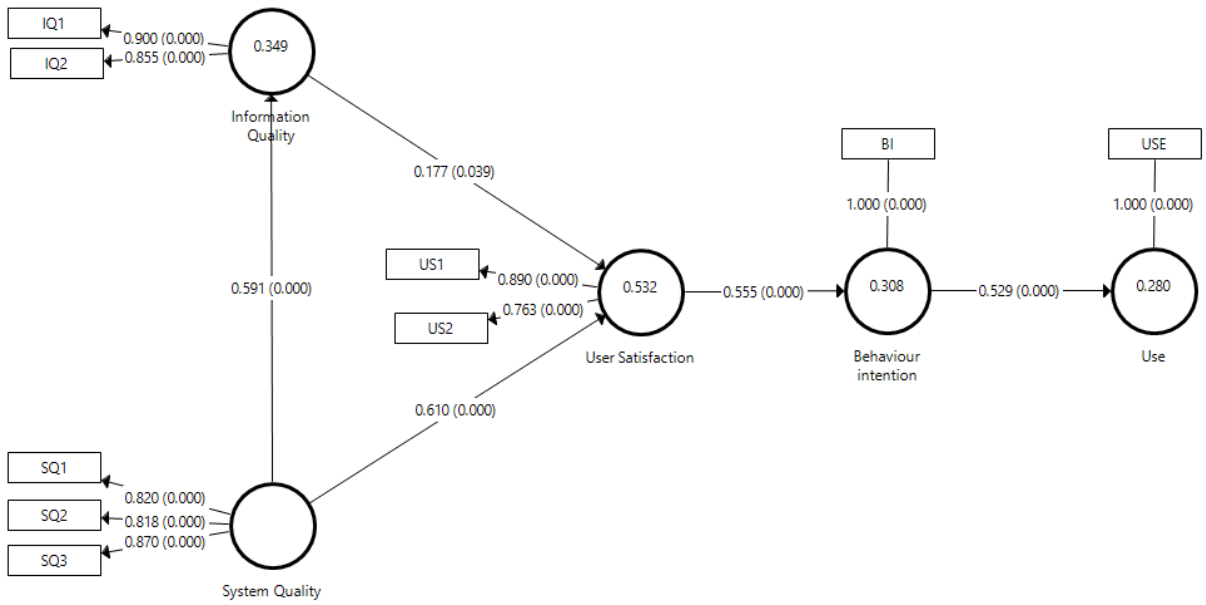

Figure 2: Estimate model

5.3 Proposed Improvements

The findings of the structural model show that improving the quality of the system has a significant impact on the use of the electronic education system. Accordingly, we propose investment in robust technology platforms. More precisely, the total effect of the system's quality on the intention to use is 0.715; thus, each point of improvement in the system impacts almost 3/4 points on the intention of use.

5.4 Validation

Regards validate the importance of both path coefficients and determination coefficients, a bootstrapping procedure with 5,000 subsamples was used to generate t-statistics and the confidence intervals. The results of the process validate the findings, as seen in Tables 6 and 7.

6. Conclusion

This research explored the effects of e-learning on technology uptake and success models in the context of the COVID-19 pandemic in Chile. We conclude that the quality dimension has had a more significant influence on user satisfaction. Furthermore, this satisfaction constitutes an indirect precedent for the use of e-learning systems. These findings demonstrate the importance of system characteristics in the ultimate acceptance of the e-learning system by Chilean university students in the context of a pandemic.

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Biographies

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