International Journal of Engineering Education Vol. 39, No. 4, pp. 897–905, 2023
Printed in Great Britain

0949-149X/91 $3.00+0.00

Technology in Online Education: The Factors that Influence Student Acceptance and Satisfaction*

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The objective of this study is to identify the factors that have the highest influence on technology acceptance and satisfaction with online education through variables and scales previously used in the literature, including the perception of service quality for online education, online learning acceptance and satisfaction, perceived usefulness, and perceived ease of use, as well as control variables. The hypotheses proposed were validated through a confirmatory factor model, using the responses of an online survey for undergraduate students, totaling 410 responses. The findings are consistent with previous articles, and it was also found that students perceive and evidence that their expectations of usefulness and ease of use come to increase their acceptance and satisfaction with online education. The results also indicate that some variables assessed, such as teachers, support systems, delivery platforms or channels, and internet speed, are factors that affect acceptance regardless of the usefulness or ease of use perceived by students.

Keywords: online education; technology; acceptance; service quality; support; teachers

1. Introduction

Some years ago, the introduction of online methods and the digitalization of learning systems became a necessary change rather than an option in the educational field [17]. This is because for both students and teachers, this type of system can be implemented at any time and in any place, if there is an internet connection [47]. Nevertheless, this change or incorporation of online education has been gradual, as in the beginning it was not fully accepted by students [12, 41]; even today, there is still some degree of resistance to it, according to Pascoal [40]. However, when facing different types of exogenous and uncontrollable events such as economic, social, and health crises like the coronavirus pandemic (COVID-19), a good part of face-to-face educational processes [9, 27] have no other option but to take the alternative path commonly denominated e-learning; yet many times there is not enough preparation for introducing these methodologies into education [28]. Nevertheless, according to Wang [51], the COVID-19 pandemic presents the opportunity to observe those elements that may facilitate the future adoption of online education, so schools are better prepared. In this sense, understanding what elements are related to the perception of online learning systems that allow for increasing student acceptance and satisfaction, such as ease of use and usefulness, is necessary [10]. This has the purpose of generating feedback on which aspects need improvement, or those most influential in such an outcome.

The literature has examined this phenomenon from different perspectives, such as the technology acceptance model (TAM), the theory of planned behavior (TPB), and the expectation-confirmation model (ECM), among others [24, 28, 31, 32, 51]. Despite the above, deepening research on the relationships that explain this phenomenon is imperative. Therefore, the objective of this study is to assess what variables better explain and influence the most acceptance of and satisfaction with online education, in addition to proposing possible guidelines for future studies. That said, this article is structured as follows.

First, a review of the literature is conducted to propose the hypotheses to be tested. Second, the methodology used is explained, as well as the proposed analyses. Third, the results and discussion are presented, and finally, some conclusions are drawn and recommendations for future research are made.

1.1 Literature Review

Electronic learning systems have been defined in diverse ways by different disciplines [52]. For example, Al-Fraihat [2] indicate that they are information systems that can integrate a wide range of instruction materials (audio, video, and text) transmitted via e-mail, live video chat, online discussion, forums, surveys, and assignments. In turn, other

* Accepted 22 March 2023.

authors define electronic learning systems as systems that integrate activities from both human (students, instructors, and administrators) and non-human (learning management) entities to achieve significant educational exchanges [5].

Due to the multiple dimensions of online education, it is essential to research how this process is successfully developed and how participants become satisfied with the system [52]. In this sense, Al-Fraihat [2] explain that if information systems meet the demands of users, the satisfaction of the latter automatically increases, which makes user satisfaction a critical factor for the success of an e-learning system. However, satisfaction is an imperative measure not only of success, but also of the efficacy, use, and acceptance of information systems [46].

1.1.1 Online Learning Acceptance and Student Satisfaction (OLAS)

Based on the theory of reasoned action, the technology acceptance model (TAM) suggests that the acceptance of a technology is determined by the beliefs users have about the consequences of using such a technology [15, 16]. In this line, Davis [15] states that perceived ease of use (PEOU) and perceived usefulness (PU) are the two most important factors that influence the acceptance behavior of users. Perceived ease of use is understood as the physical degree to which individuals believe that using a particular system is free from physical and mental effort, while perceived usefulness is the extent to which individuals believe that the use of a particular system will improve their work performance.

From the online education perspective, students who show a positive attitude towards the use of online learning systems for their studies are more satisfied with online systems. Likewise, the experience and familiarity of students with the system, and the capacity to use it and perform tasks (self-efficacy) can promote positive attitudes towards electronic learning systems and therefore a general satisfaction with them [2, 10, 39, 46, 50]. The evidence shown by Lee [30] demonstrates that perceived ease of use (PEOU) and perceived usefulness (PU) of online learning systems have a positive influence on the Online learning acceptance and student satisfaction with this type of class. Consequently, the following hypotheses are proposed:

H_1: Perceived ease of use will positively influence Online learning acceptance and student satisfaction.

H_2: Perceived usefulness will positively influence Online learning acceptance and student satisfaction.

1.1.2 Perception of Online Education Support Service Quality (PQS)

Several studies address the factors that may influence the perception of online educational systems. Some authors point to aspects related to the technical quality of the online system, such as ease of use, the capacity for complying with the requirements of users, and the flexibility, integration, and consistency among different components, which contribute to the general satisfaction and perceptions about the usefulness of the system [2, 4, 14, 25].

Information quality is also a determinant of satisfaction [2], perceived ease of use, and perceived usefulness [1, 11, 19, 33]. In this sense, aspects such as providing students with necessary, sufficient, concise, and clear information, delivering updated content, and giving students an attractive content design are important for students to have an enjoyable and pleasant experience with e-learning [2, 22]. From this, on two occasions Lee [31, 32] has proposed that PSQ influences or explains directly or indirectly the OLAS variable to an extent. Therefore, the following hypotheses are proposed:

H_3: The Perception of Online Education Support Service Quality influences Online Learning Acceptance and Student Satisfaction through Perceived ease of use (H_{3a}) and Perceived usefulness (H_{3b}).

H_4: The Perception of Online Education Support Service Quality influences Online Learning Acceptance and Student Satisfaction.

1.1.3 Other Elements that Influence Satisfaction with Online Learning

In addition to the above, some studies agree that it is crucial to have technical staff who are available, when necessary, have control over the technology, support students by providing them with orientation and training in how to use the system, and can troubleshoot the technical problems students encounter [2–4, 35, 41, 42, 46]. Other works explain satisfaction with online resources directly through support perceptions [30, 32, 36, 44]. In this sense, Lee [30] argues that the quality perception of the support service for online education serves as an important antecedent for the acceptance of online learning and student satisfaction. Later, Lee [32] confirms that when students perceive educational support, both technical and from peers, they have a higher probability of being satisfied with an online course. The role of the teacher is also considered relevant for students in the online education environment [11] and is even assessed as the most important success factor in e-learning [29]. In fact, the evidence shows that communication between teachers and students is a fundamental factor for

the success of e-learning, regardless of the type of class [13]. In this way, the satisfaction of students with online education is positively influenced by the quality of the instructor [2, 48].

From another perspective, there are factors external to the online education system that may affect the perception of users about these electronic tools. One of these elements may be the quality of internet connection. Studies like the one by Castillo [9] have revealed that although students positively evaluate the use of virtual learning environments, the main difficulties students face are a lack of internet access, connection difficulties, and quality of computers, which cause websites to load slowly, therefore wasting class time. Likewise, the study conducted by Asturizaga-Rodríguez [6] indicates that when the satisfaction levels of students with new information technologies and communication are high, students experience challenges in online education due to the speed of their internet connection.

Thus, this study considers some general control variables, i.e., variables independent from the characteristics of individuals, that may influence technology acceptance and satisfaction with online education. First, it is necessary to assess the feedback and support of information systems both program and the institution (USM). Second, the impact of the digital platforms that are the channel through which content and knowledge are delivered should be verified; this was measured during the operation of the virtual platform provided by the University (AULA USM) together with the online service used for video conferences (Zoom). Third, the performance of the students, teachers, and assistants involved in the learning process needs to be assessed.

Based on the literature examined, Fig. 1 shows the following hypotheses and model:

2. Method

2.1 Sample

The data used to conduct this study originate from the answers to a survey organized by Universidad Técnica Federico Santa María, Casa Central, Valparaíso. Students from day and evening undergraduate programs participated in the survey. Most of them attended an engineering program. Six hundred and forty questionnaires were responded to, of which incomplete ones were removed, with a total of 410 completely usable for this study.

2.2 Scales

The measures and scales used were previously validated by Lee [30] through the indicator Cronbach's Alpha, with results separated by construct, which were used as follows in this study:

"Please, respond to the following statements indicating to what extent you agree with each case. (1) means totally disagree and (7) totally agree."

a. PEOU (α=0.931)
- PEOU1: I find it easy to use the distance learning system to do what I want it to do.

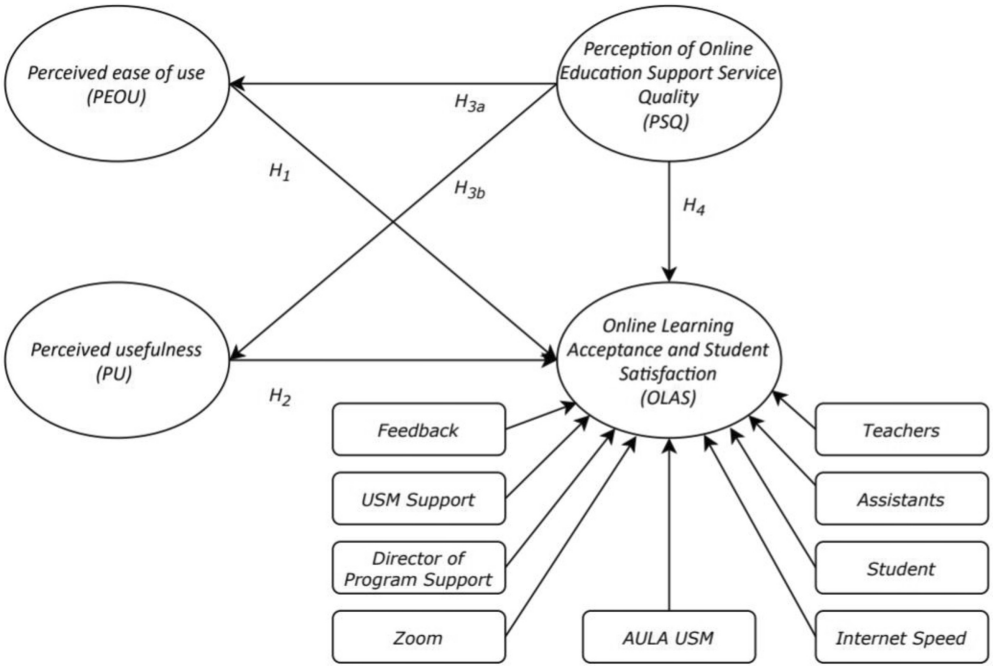

Fig. 1. Proposed Conceptual Model.

- PEOU2: I think the distance learning system is clear and understandable to me.
- PEOU3: It's easy for me to be skilled at using the distance learning system.
- PEOU4: I find the distance learning system easy to use.

b. PU ($\alpha = 0.940$)
- PU1: Using the distance learning system improves my ability to perform academic tasks.
- PU2: Using the distance learning system increases my productivity in performing academic tasks.
- PU3: Using the distance learning system improves my effectiveness in fulfilling academic tasks
- PU4: I find the distance learning system useful for my study.

c. OLAS ($\alpha = 0.914$)
- OLAS1: If I need to study for a degree or higher, I would expect to use USM's distance learning system.
- OLAS2: If asked, I would recommend USM's distance learning system as an ideal learning platform.
- OLAS3: For future degrees, diplomas or postgraduate degrees you would probably use the USM distance learning system.
- OLAS4: Overall, I am satisfied with USM's distance learning system.

d. PSQ ($\alpha = 0.782$)
- PSQ1: When I sign up for courses, I hope to have adequate feedback and career support services.
- PSQ2: When I register for courses, I expect to have adequate information and support services from USM.
- PSQ3: When I sign up for courses, I hope to have adequate support services from the career manager.

e. Control variables

These were measured as follows:

"Please evaluate the following aspects according to your experience with the remote learning system during 2020. (1) means totally unsatisfied and (7) totally satisfied"

- Feedback and support services of the program (Feedback).
- Information and support services of USM (USM support).
- Support service from director of the program (Director of program support).
- Operation of the Zoom Video Communications platform (Zoom).
- Operation of the Aula-USM platform (AULA USM).
- Overall evaluation of teachers (Teachers).
- Overall evaluation of assistants (Assistants).
- My performance as a USM student (Student).

While the variable of internet speed was measured in the following way:

- *"Did you receive the speed you purchased?"*
  (a) Yes, and I have confirmed it through a speed test.
  (b) No, and I have confirmed it through a speed test.
  (c) I don't know.

2.3 Approach: Confirmatory Factor Analysis (CFA)

With the measures and samples available, a confirmatory factor analysis (CFA) is conducted using structural equation modeling (SEM) through the software IBM SPSS Statistics 22 and SPSS Amos 22. This statistical technique allows for testing the hypotheses proposed and shows the simultaneous interrelationships between latent variables [20]. First, the reliability of the measurement scale used for the constructs is verified through the Cronbach(α) construct [18], which must meet the criterion of being above 0.7 [37]. The same criterion is used to measure the standardized regression weights for each construct and its convergences. Second, the fit of the model should be assessed. To measure absolute fit, the statistic called chi square (χ^2) is often used; however, this indicator is too sensitive to small and large sample sizes [26] and therefore other indicators should be analyzed to generate a more complete analysis. This study will use the root mean square error of approximation (RMSEA), which ideally should have a value below 0.05 [9]. Additionally, to measure incremental fit, the Tucker-Lewis index (TLI), which should be higher than 0.9 [23], will be employed, as well as the comparative fit index (CFI) and Bentler-Bonett's normed fit index (NFI), where both should be above 0.9 [23]. Once the model is validated in terms of reliability and adjustment, the effect and significance of the hypotheses proposed in the model are verified. Then, the results are discussed, as well as the conclusions and recommendations for future research.

3. Results

3.1 Reliability of the Scales Used

First, as the Table 1 shows, all the scales used met the criterion proposed, $\alpha > 0.7$. Additionally, the standardized regression weight is higher than 0.7 for all cases, which indicates a good fit in terms of reliability of the scales used.

In turn, Table 2 shows the goodness-of-fit indexes

Table 1. Reliability indicators

Constructo	Item	Standardized regression weight	Cronbach's Alpha
PSQ	PSQ1	0.919	0.919
	PSQ2	0.915	
	PSQ3	0.845	
PEOU	PEOU1	0.839	0.934
	PEOU2	0.820	
	PEOU3	0.821	
	PEOU4	0.799	
PU	PU1	0.897	0.890
	PU2	0.927	
	PU3	0.870	
	PU4	0.843	
OLAS	OLAS1	0.801	0.919
	OLAS2	0.825	
	OLAS3	0.803	
	OLAS4	0.782	

Note(s): *The values in the table indicate the reliability of the scale used for each construct, whose values are between 0 and 1.*

of the model. χ^2 has satisfactory values and the model is significantly different to a null model, with an acceptance level of 5%. In the case of RMSEA, this is the indicator that is the farthest from the suggested value; however, TLI, CFI, and NFI are at acceptable levels, confirming that the model is a good fit, which could be improved by using a larger sample.

3.2 Confirmatory Factor Analysis

First, Fig. 2 shows the results of the model. As it may be seen, hypothesis 3 is completely confirmed as all interactions are significant, i.e., PSQ explains directly both PEOU and PU. Likewise, hypotheses 1 and 2 are confirmed, having significant direct and positive effects on the endogenous variable OLAS. It is observed that the PU variable influences the explanation of OLAS to a great extent, while the same is true for PEOU but to a lesser extent. Finally, hypothesis 4 is also accepted, showing a relevant significance and a negative effect of the exogenous variable PSQ on the OLAS variable.

The results also show that the exogenous variable PSQ does not explain the variables PEOU and PU to a large extent, as their determination coefficient does not exceed 10%. Even more interesting are the results obtained for the OLAS variable. Its determination coefficient reaches 71.9%, which implies that the relationships between the variables (PSQ, PEOU, and PU) explain most of the variance of this variable, which was one of the objectives of this study.

Table 2. Goodness-of-fit indicators for the model

Indicator	χ^2	p	RMSEA	TLI	CFI	NFI
Value	702.67	0	0.13	0.88	0.88	0.87
Suggested value		<0.05	<0.05	>0.9	>0.9	>0.9

Note(s): *The values in the table show the shape indicators of the model compared to the ideal values.*

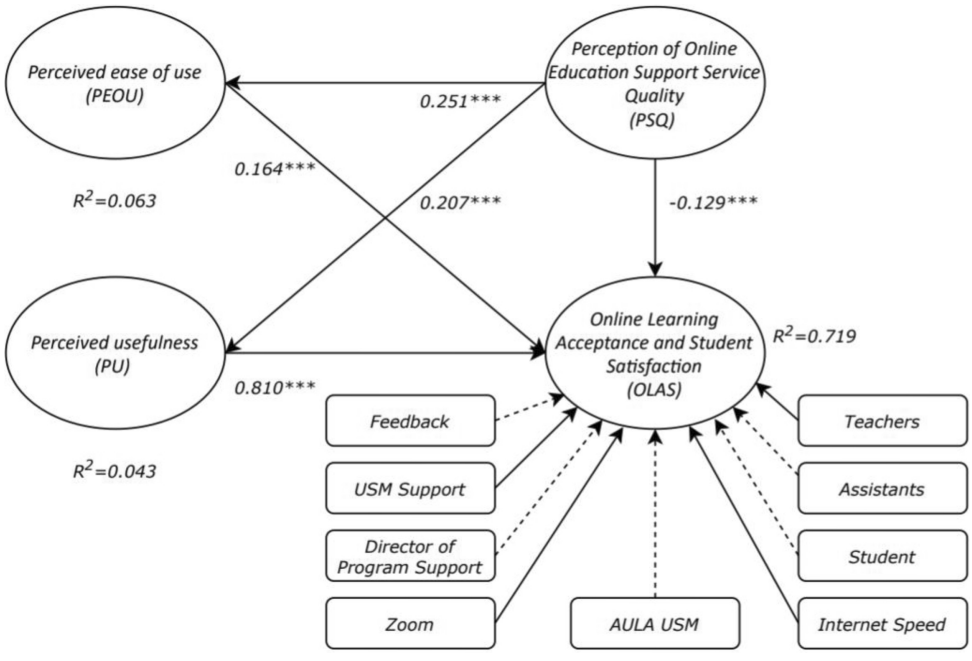

Table 2. Goodness-of-fit indicators for the model

Table 3. Direct and indirect standardized effects

Variable	PSQ	PU	PEOU	Teachers	USM support	Internet speed	Zoom
PU	0.207***	0	0	0	0	0	0
PEOU	0.251***	0	0	0	0	0	0
OLAS	0.081***	0.803***	0.164***	0.073**	0.169***	0.067**	0.082**

Note(s): *(***) significance of the p–value level <0.001; (**) significance of the p–value <0.050 level.*

In addition, it is pertinent to study the total and indirect effects of the endogenous and exogenous variables of the study, as well as the control variables that turned out to be significant. Regarding the former, Table 3 shows that PU and PEOU have a direct and positive impact on the OLAS variable, especially PU, which exerts the most influence (0.803). Another interesting result is the final effect of the PSQ variable on OLAS. First, this variable has a direct and negative effect, but it has a positive and indirect effect on OLAS (0.209) via the mediating variables PU and PEOU. This is attributed to the fact that by means of the sum between the negative and direct effect (–0.129) and the positive and indirect effect (0.209), the variable generates a final positive influence on OLAS (0.081).

Regarding the control variables used, the second objective of this study, 4 out of 9 proposals have a significant effect on the OLAS variable: teachers, USM support, internet speed, and Zoom. With respect to the first one, it is observed that teachers have a positive effect on the online learning acceptance and satisfaction of students, since teachers are in charge of delivering knowledge directly to students. The most influential variable is USM support (0.169 of impact on OLAS when the variable has a unit change), which represents the importance of all information systems managed by the university and the support provided to students. In turn, the internet speed received, which often differs from the speed purchased, also influences OLAS, even when this variable is completely external and independent from the control of university. Finally, the Zoom platform, which is the communication channel between teachers and students, generates a significant positive impact on the endogenous variable OLAS.

4. Discussion

First, it is noteworthy that the variables and the model proposed by Lee [30] satisfactorily explain the Online learning acceptance and student satisfaction (OLAS) of a sample made up of 410 university students in Chile from day and evening programs.

Second, the Perception of online education support service quality (PSQ) has a significant effect on the variables associated with the perceptions about online learning systems, which are perceived ease of use (PEOU) and perceived usefulness (PU). The effect on both variables is similar in terms of size, and PSQ does not satisfactorily explain the variance of any of the two variables under study. Despite this result, both PEOU and PU influence OLAS [15, 38], particularly the latter, as it has a stronger effect than perceived ease of use, i.e., the usefulness perceived by students, which depends on their perception of the quality of online learning, and positively affects the acceptance of such a technology. This does not mean that perceived ease of use is negligible, but that the level of usefulness has a greater contribution than ease at the moment of use and in the acceptance of online learning [2, 10].

Third, it was mentioned that PSQ does not satisfactorily explain the PEOU and PU variables. However, this seems to point at the fact that such variables do not have the purpose of being explained; instead, they seek to mediate and orient the effects of PSQ towards the OLAS variable. This is exactly what is revealed in the results section, and is expectable according to Lee [30], because the impact of PSQ on OLAS will be different depending on culture [45]. PSQ has a negative and direct effect on OLAS that is in contrast with the positive and indirect effect via PEOU and PU towards this variable, which results in a positive total influence on OLAS. In other words, PSQ generates a certain level of expectation for the quality of the support service for online education, which in turn generates an adverse effect on the online learning acceptance if students do not first perceive both ease of use and usefulness of the methodology [53]. Therefore, for the online learning acceptance and satisfaction of students (OLAS) to be positive, students should assess the quality of the support service for online education through their own level of generated usefulness and the ease of use of this methodology, which agrees with previous research in the field [1, 11, 19].

Finally, in a more general way, some factors that have a direct effect on OLAS and support provided by the university were found. For example, the better the quality of the information and support systems provided by the educational institution, the understanding of an online learning system, and the

operation of the learning platform (Zoom particularly), the more likely students are to be satisfied with their online courses [4, 14, 32, 41, 45]. The third variable that positively influences OLAS is teachers, which is coincident with the findings of Al-Fraihat [2] and Cheng [11], where the quality of the teacher influences the satisfaction of students with online education. Finally, internet speed is a factor external to the online education system that affects the level of acceptance, which is in accordance with the works by Castillo [9] and Asturizaga-Rodríguez [6], where it is indicated that even when the levels of satisfaction with new information and communication technologies of students are high, students face difficulties in online education due to the speed of their internet connection.

5. Conclusions and Recommendations

This study successfully identifies factors that impact students' acceptance of and satisfaction with online education according to a proposed model. Specifically, the study identifies factors that could affect the acceptance and satisfaction of students in the first stage, and then identifies the variables that significantly influence their acceptance of and satisfaction with online education through a survey and structural equation modeling.

With respect to the above, it is concluded that the most relevant factor for the acceptance of online education by students is perceived usefulness. This implies that, according to the results, when students perceive that using a distance learning system improves their skills, productivity and effectiveness when performing academic tasks, their degree of acceptance and satisfaction with online education improves. Furthermore, it is noteworthy that the perception of the quality of the online education support service reveals a positive impact on perceived usefulness. Therefore, if the improvement of online education acceptance in students depends on how much they perceive that this education modality improves their academic skills, productivity and effectiveness, universities should pay special attention to the quality of the support provided in terms of information, feedback and support services of both the programs and the university itself. It can be then concluded that as long as the university is concerned with these factors, students will perceive improvement in their academic skills, productivity and effectiveness when using online education, and thus will have higher levels of acceptance and satisfaction with online education.

Another relevant factor for online education acceptance is perceived ease of use. This implies that when students perceive that the distance learning system is clear and understandable, and that it is simple to become skilled in its use, their degree of acceptance and satisfaction with online education rises. Additionally, it may be concluded that as long as universities are concerned with the quality of information, feedback and support services, students will perceive that the remote learning system is clear and understandable, easy to use and that it is simple to become skilled in its use, and therefore will have higher levels of acceptance and satisfaction with online education. This underscores the importance that universities pay attention to the quality of information, feedback and support services.

Finally, this study shows that online learning systems are the product of a set of human and non-human variables. Regarding this, the control variables used to cross-sectionally assess the direct influence on the acceptance of these systems reflect that support, platform and teachers are relevant to OLAS. Thus, although perceived usefulness and perceived ease of use reflect the importance of delivering a quality service in terms of information, feedback and support services, the relevance of the perceptions of students about teacher performance, internet connection speed and the platform used for synchronic activities should be acknowledged.

Declarations

- Availability of data and materials: the data sets generated and/or analyzed during the present study are not available to the public because the questionnaire delivered to the participants accepted an identity confidentiality clause but are available from the corresponding author upon reasonable request.
- Conflicting interests: The authors declare that they have no conflicting interests.
- Funding: The authors declare that they have not received any funding.
- Contributions of the authors: CFR proposed the research topic, specified the concept to be analyzed, guided the methodology and was part of the writing process in the sections of introduction, methodology and conclusion. NS is in charge of analyzing and interpreting the data to transform them into the information and results obtained by the research, participating in the writing process. DY was in charge of obtaining the data, along with proposing the theoretical framework for the research and participating in the writing process. All authors read and approved the final manuscript
- Acknowledgements: Not applicable

List of abbreviations

- **OLAS:** *Online Learning Acceptance and Student Satisfaction.*
- **PQS:** *Perception of Online Education Support Service Quality.*
- **PEOU:** *Perceived ease of use.*
- **PU:** *Perceived usefulness.*
- **USM:** *Universidad Técnica Federico Santa María.*

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