A Structural Equations Model Approach to Examining University Students' Acceptance of a Learning Management System

Jasper Vincent Alontaga [1], Karen Sacdalan [1],
Minie Rose Lapinid [1] ,Von Christopher Chua [2]

[1]*De La Salle University, Manila, Philippines*
[2]*Philippine Science High School-Main Campus, Quezon City, Philippines*

Abstract **– The study examined university students' acceptance of a Learning Management System (LMS) during the emergency transition to online distance learning (ODL) brought on by the COVID-19 pandemic. The study involved 408 university students and employed a concurrent triangulation mixed methods design and Structural Equation Model (SEM) to investigate the Technology Acceptance Model (TAM) and several external variables, specifically social influence (SI), system characteristics (SC), individual differences (ID), facilitating conditions (FC), and academic performance. Results of SEM revealed that FC, SI, and SC are significant factors in LMS acceptance, with SC having the strongest influence on perceived ease of use (PEU) and perceived usefulness (PU). A significant path coefficient was also observed for actual use (AU) on academic performance. LMS analytics revealed the utility of discussion and assignment features of the LMS are greater over quizzes in ODL. Most students described LMS features as generally effective, particularly the use of modules, announcements, and assignments, and the provision of course materials as the best teaching practice. The quality of the Internet connectivity was determined as a major challenge affecting students' ODL experience.**

DOI: 10.18421/TEM132-69
https://doi.org/10.18421/TEM132-69

Corresponding author: Minie Rose Lapinid,
De La Salle University, Manila, Philippines
Email: minie.lapinid@dlsu.edu.ph

Received: 20 December 2023.
Revised: 06 March 2024.
Accepted: 12 March 2024.
Published: 28 May 2024.

Keywords **– Technology acceptance model, online distance learning, learning management system, structural equations model.**

1. Introduction

The global suspension of educational activities during the COVID-19 pandemic necessitated the shift from the typical in-person learning setup to one that involves a combination of digital and remote teaching and learning modes. The sudden change in the educational landscape catalyzed the need to understand non-traditional learning modalities. In comparing these modalities, Bozkurt *et al.* [1] distinguished between online education and what is referred to as emergency remote education. While distance education, blended learning, online learning, or other similar derivations determine optional and supplementary opportunities for learning beyond in-person interactions among teachers and students, emergency remote education works under the premise that in-person interactions pose substantial risks, health and otherwise. Such circumstances elevate online and remote learning activities, not as optional opportunities but as necessary measures for education to continue. Of the many forms of emergency remote learning, online distance learning (ODL) used to be primarily associated with non-formal education. Still, due to the limitations imposed by the circumstances of the pandemic, it has been widely used by schools to continue formal education. Essentially the approach of ODL became more of a necessity in wide-scaled emergencies rather than a learning delivery option.

A substantial number of studies suggest that the sudden move to emergency remote education beset many educational institutions with the acquisition of online systems infrastructure, the need to review institutional educational policy, and the formulation of innovative pedagogical approaches [2].

While research on these areas continues to be crucial to redefining education even after the pandemic, we emphasize the importance of deepening our understanding of two other areas for ODL to be effective.

The first area of interest is technology acceptance. Factors determining users' acceptance of educational technology also significantly affect learning effectiveness and must be equally explored [3], [4]. As educational institutions restructure their overall online delivery processes, the impact of these changes is not just on the macro-level but across multilayering factors down to individual experience - if students and teachers accept the technology they are encouraged to use. Even with the pandemic over, online learning modalities will continue to advance. Hence, there is a constant need to deal with change and adapt to the requirements of the times.

Among these many technologies for education are online learning and instructional platforms collectively referred to as learning management systems (LMSs). These software applications are systems for schools to administer, document, trace, report, and deliver educational programs. Because the features and capabilities of various LMSs vary and these determine how effectively students and teachers interact in an online platform, choosing and managing a new LMS is crucial for any higher education institution (HEI) [5]. One of the platform providers of LMS for higher education is called Canvas. Dobre [6] describes Canvas as a cloud-based LMS designed to be used online, on mobile, and on a tablet that makes teaching and learning easier. According to Bhatia, *et al.* [7], online LMSs are low-cost solutions that heavily rely on the convenience and flexibility of online technology. Some of the advantages of using them include ease of accessibility and management through an internet browser, dedicated features that support real-time feedback and the availability of a dedicated mechanism for system maintenance support provided by the LMS platform administrators as part of their subscription package.

The second area of interest is users' self-regulation and efficacy. In exploring the effectiveness of ODL, we raise the need to study the balance of cultural, technological, and economic conditions to determine equitable opportunities for all students. Bozkurt *et al*. [1] explained that the limited options that schools had during the pandemic not only re-exposed, but may have exacerbated issues of social injustice, inequity, and the digital divide. Such issues demand innovative and context-specific solutions. It was also evident that there is a necessary approach to providing a pedagogy of care, affection, and empathy. The educational online process must also investigate re-working alternative assessments and evaluation methods to carry out ethically sound mechanisms that will meet learner's needs.

Mainly, for online education to transition effectively, Murphy *et al.* [8] suggest the need to strengthen constant communication within the school community, the employment of an effective LMS as well as the importance of developing a mechanism to support the technology and its users. This support may come in the form of ensuring better flexibility and ease of use of the adapted technology, appropriate and effective online classroom engagement, and course management. In addition, Rizun and Strzelecki [9] suggested that to understand student success in the shifting of the education system to distance learning, we can study their engagement and self-efficacy which binds technology acceptance and user experience.

When all these are considered, it is then imperative to understand the wide range of factors that mobilize a nation's key resources such as educational, social, environmental, and economic structures as doing so will effectively prepare us for challenging times like the pandemic. UNESCO reported that around 180 countries chose to temporarily halt formal school operations - a decision that affected more than one and a half billion students. In the case of HEIs, while some have begun taking initial steps toward online learning, many were not 100 percent ready for a fully online curriculum [10].

This paper reports a study that investigated a university's readiness for ODL by assessing the robustness of its e-learning infrastructure as the technological backbone for effective remote delivery of content. Specifically, the study aimed to answer three questions: (1) What is the level of students' acceptance of the LMS in terms of perceived ease of use, perceived usefulness, attitude towards use, behavioral intention to use, and actual usage? (2) How are students' acceptance of the LMS influenced by individual differences, system characteristics, social influence, and facilitating conditions? and (3) How does a student's acceptance of the LMS influence their academic performance?

1.1. Theoretical Framework

The study used the technology acceptance model (TAM) as a framework to understand which pre-identified user-motivation-related factors among university students determine their actual use of an LMS (Figure 1). Technology acceptance, as a learning behavior, identifies perceived usefulness and perceived ease of use as necessary aspects for an individual's attitude, intention, and actual use of an instructional system [11]. TAM has been used in various studies investigating the use of LMS [12], [13]. In this context, we refer to acceptance of technology as the degree of a student's intentionality to use various features of the LMS to meet the demands of their online courses.

Based on the model, LMS acceptance is determined by two factors: (a) perceived usefulness (PU) captures the students' belief that interaction with the LMS can significantly enhance their performance in the online courses, and (b) perceived ease of use (PEU) refers to their perception of the LMS as user-friendly. These two factors are influenced by four determinants identified by Venkatesh and Bala [14] as individual differences, system characteristics, social influence, and facilitating conditions. Individual differences are aspects of the student's personality that may affect their perception of the usefulness and ease of use of the LMS. In the study, these include the student's year level, age, prior experience with any LMS, and online self-efficacy and self-regulation.

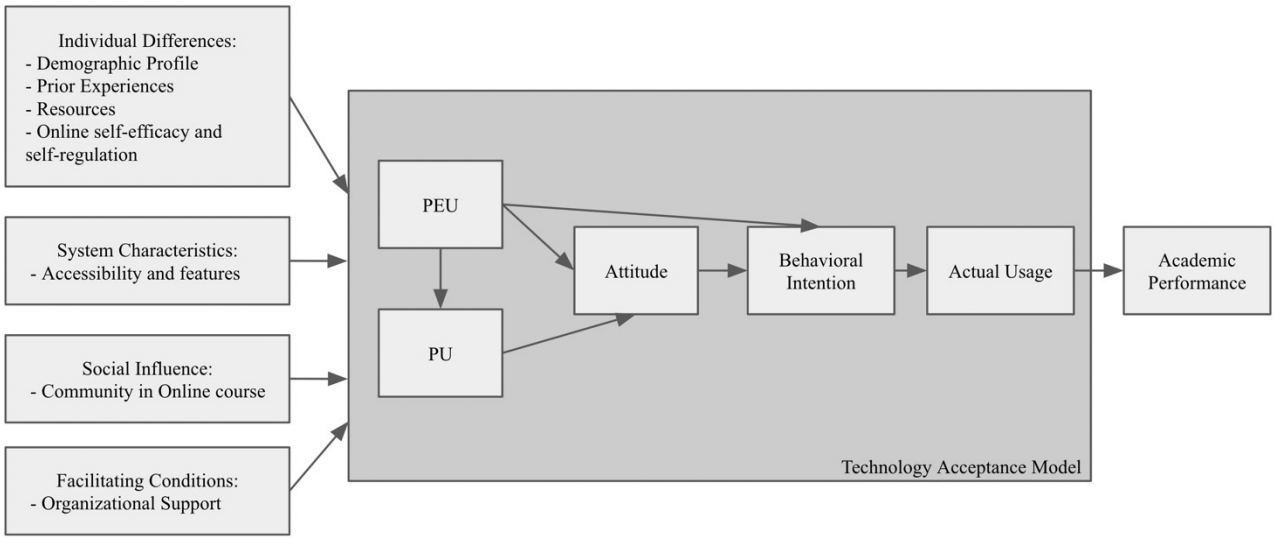

Figure 1. The external variables and their hypothesized relationship with the technology acceptance model

System characteristics are the LMS features that allow students to favorably (or unfavorably) perceive it. Social influence, as a construct related to the community within which the online courses thrive, involves different social processes and mechanisms that direct students to form perceptions of various aspects of the LMS. Facilitating conditions cover organizational support that enables the use of the LMS.

Attitude is an expression of approval or disapproval of the LMS [15] whereas behavioral intention refers to the willingness to execute the behavior [16]. Attitude is the precursor of an individual's behavior intentions or inclination towards LMS which greatly depends on one's PEU and PU based on their experiences in using the LMS. Studies [17] have shown that a positive attitude toward the LMS increases behavioral intentions to use it. Behavioral intentions, in turn, mediate the effects of attitude on behavior which, in this context, is the actual use of the LMS [18].

Perceived ease of use and behavioral intention lead to the actual usage of the LMS for academic performance. Students' actual usage of the LMS is reflected in its data analytics. The study also extends the model by examining how university students' technology acceptance affected their academic performance based on their grades from the LMS Marks tool.

2. Methodology

The study followed a concurrent triangulation design described by Creswell *et al.* [19] as appropriate when the purpose is to use both quantitative and qualitative data to accurately define the relationships among variables of interest.

2.1. Participants

The research involved the participation of undergraduate and graduate students of one of the leading private universities in the Philippines. Convenience sampling was employed in the study due to pragmatic reasons as only students who were enrolled in the university by September 2018 and who expressed consent to respond to the survey formed part of the study.

There were 792 initial responses from active LMS users. These responses were examined based on a completeness criterion and the data from 408 respondents were determined. Of this number, 237 (58.1%) are female and 171 (41.9%) are male. The majority were undergraduate students (82.1%) with 93.9 percent of the sample being 18 to 29 years old. The majority (43.9%) of the respondents had one to three years of LMS experience before the academic term.

Access to LMS was mostly through a personal device (87.7%). This device was either a laptop computer (93.9%) and/or a smartphone (83.8%).

2.2. Instruments

The study utilized an online questionnaire containing six sections. Section one sought the informed consent of the participants and only upon agreement were the participants able to proceed with the rest of the questionnaire. Section two included questions on the participants' demographic profiles. The third section contains statements about LMS acceptance based on the TAM adapted from the questionnaire developed by Alharbi and Drew[13]. As a seven-point Likert scale, it required respondents to determine their level of agreement with 29 questions that collectively measure their PEU, PU, ATU, and BI of the LMS as well as FC and SC. All six components of the instrument have Cronbach's alpha and composite reliability scores of 0.85 or higher. As a measure of convergent validity, the average variance extracted (AVE) was also computed with all six components obtaining a score of 0.57 or higher.

The fourth section of the instrument is the Community of Inquiry Survey (CoIS) by Arbaugh *et al.* [20] which was used to gauge social influence. It is a 34-item, five-point agreement scale that measures teaching, cognitive, and social presence in online courses. Cronbach's alpha and composite reliability were also calculated per subdimension of the instrument and all values are above 0.83. The average variance index was greater than or equal to 0.62.

Section five is the Online Academic Success Indicators Scale (OASIS) by Bradley, *et al.* [21]. This 23-item, seven-point scale was used to assess the respondents' self-efficacy beliefs for online courses and their perceived ability to utilize self-regulated learning strategies in online courses. Together with the demographics profile, this served as the measure of individual differences. Cronbach's alpha and composite reliability scores of the two components, self-regulation and self-efficacy beliefs are at least 0.92 while the average variance expected is at least 0.55.

The computed Cronbach's alpha and AVE of all sections of the instrument meet the minimum required values of 0.7 and 0.5, respectively, as determined by Hair *et al*. [22].

The last section of the questionnaire contained open-ended questions regarding LMS-user experience including aspects about respondents' engagement and use of the LMS tools. Another source of data is the LMS analytics mined through the server which included information on page views and participation in their course's quantitative indicators of actual use. The respondents' grades were also collected as the measure of academic performance.

2.3. Data Gathering Procedure

Upon approval of the University Research Ethics Office, the student questionnaire was converted into digital format using Google Forms. This was then disseminated using the LMS global announcement feature. To participate in the survey, students approved the consent form and proceeded to answer an online questionnaire. The data collection covered a period of two months during the onset of the pandemic and the transition to full-online delivery for the academic year, 2019-2020 (March to October 2020). The LMS analytics were also extracted at the end of this period through the reports dashboard of the LMS. Specifically, the user access report was generated which shows all the activity from users enrolled in each course or all courses in each term.

2.4. Data Analysis Procedure

The data on TAM and external variables (demographic profile, TAM, CoIS, OASIS) was described using the appropriate summary measures. The academic performance in terms of grades showed a left-skewed distribution. As such, the academic performance was categorized as either high or low based on the median score of 92.75. structural equation modelling (SEM) was used as a statistical technique to determine significant multiple interrelationships existing among variables found in the multidimensional structure of TAM, the external factors, and academic performance.

Moreover, the LMS data analytics served as data-derived code providing a succinct summary of the explicit content of the data which were then labelled as semantic codes [23].

The qualitative data generated from open-ended questions were analysed and coded simultaneously by the researchers. Inter-coding validation was conducted by comparing the independently determined, researcher-developed codes. We agreed on the final coding and created the conceptual and theoretical frameworks that identified implicit meanings within the data forming latent codes. Such latent codes consist more of theoretical terms [24]. Interpretation of the qualitative data followed Stake's [25] idea of categorical aggregation and pattern searching. Categorical aggregation refers to the process of looking for multiple 'instances' from the gathered data - anticipating that 'issue relevant' meanings emerge [26].

This study used thematic analysis formulated by Braun and Clarke [27] to achieve the optimum system of analysing the result and presenting the data, as it provides a highly flexible approach that is adaptable depending on the study's needs in providing a thick and detailed, yet complex data reporting [27], [28].

3. Results

The results of this study highlight the examination of the user's understanding and acceptance of LMS. The internal dimensions of TAM were presented and analyzed revealing the significant differences among the variables as key determinants in understanding users' decisions to resist or embrace technologies.

3.1. Students' Acceptance of the LMS

Table 1 shows the summary measures of the four TAM dimensions. Students mostly perceived the LMS to be moderately easy to use. Their responses point to the perception of the LMS interface as moderately clear and understandable, easy to master, and flexible. However, there was a slight agreement among students that they have limited ability to use the LMS due to their lack of experience with any LMS. Responses also revealed some discrepancies in the responses as the mean scores are affected by low ratings. For example, in response to the last item, *my ability to determine the LMS's ease of use was limited due to my lack of experience*, the mean score indicated slight agreement among the sample despite the majority expressing moderate agreement. There were a few respondents who strongly disagreed with the statement albeit, almost 9.55 percent admitted they lack experience. This indicates that students who responded negatively have a slight effect on the mean response in this item.

Table 1. Summary measures of the dimensions of technology acceptance model

Dimension of TAM	Mean	Std Dev
Perceived Ease of Use	5.34	1.49
Perceived Usefulness	5.30	1.39
Attitude Towards Usage	5.69	1.31
Behavioral Intention to Use	5.80	1.21
Overall	5.34	1.49

Ease of use was one of the best features of the LMS determined by students as reflected in some of their responses: "The interface was easy to use and navigate… information is properly arranged", "…was very easy to use since I could monitor which courses I have assignments to do", "it has a wide array of user-friendly features for both students and professors", and "ease of use is most probably its noteworthy feature."

Some students explained that because of the sudden shift to full-online delivery, they needed time to develop familiarity of the LMS, "at first, it looks difficult", "It took some time to transition and get familiar with the LMS", and "some barriers were the confusing layouts and inexperience with the LMS as a whole."

In terms of perceived usefulness, students moderately agreed that the LMS was useful as it was able to help them accomplish their tasks more quickly in their academic courses. Nonetheless, they slightly agree with its usefulness in improving their course performance, course productivity, effectiveness on the course, and in making the course easier.

Students explained how the LMS was useful to them. The following statements are worth mentioning: "The LMS served as a platform where we can constantly track course information and it gave us the motivation to do tasks properly", "It provided the framework of all the lessons to be tackled and allowed us to study in advance or to look back on previous lessons, discussion, or conferences easily", "It helped me feel a sense of structure in my learning even with minimal guidance from professors". The LMS was a useful tool for students to communicate with their professors and their peers. The following were some of the ways this was experienced, "asking questions in the discussion forum/inbox"', "use of the discussions features' to engage the class before or after a session", "discussion posts help me understand the lesson better", and "frequent announcements and updates from teachers".

Students also thought using the LMS is environment friendly: "submission of assignments and quizzes was always in digital form which saved the environment by not using paper." They like "receiving feedback from their teachers in the form of annotated documents" and "immediate feedback after a quiz." The students like the animated celebration icons whenever they have accomplished a particular task, "I like the small celebrations icon" especially when there is a panda icon that says, "You have nothing left to do, take some rest" It gives me positive feedback... or when I submitted an assignment, confetti would pop out on screen." Additionally, one student said, "The LMS provides a digital portfolio of students' output, highlighting their best work for job search and career networking after graduation."

The LMS served as a good repository of learning materials which are readily accessible at students' own convenient time and pacing.

These statements support this finding: "Learning resources are all readily accessible. Most of my instructors post their materials in advance, so it is easy to advance study", "I like reviewing the lecture videos after participating in the real-time live conference." and "The Modules are extremely helpful. It organizes the lessons and dates. I wish all teachers would use this instead of randomly posting files everywhere without organization."

Some students did not expect that full-online classes that use the LMS are as good, if not better, than face-to-face classes. Here are some of the students' responses: "To my surprise, learning was actually engaging, wholesome, and very spacious and relaxing as an undergraduate", and "I was able to maximize my learning through the LMS. I value self-paced learning; thus, online classes work for me".

When asked if they intend to use the LMS, students moderately agree. Students expressed that the use of the LMS is important and relevant in their courses and that they intend to use it even soon if they have access to it. In terms of the frequency distribution of responses, students manifested a strong behavioural intention to use the LMS as the highest frequencies are for agreement to statements in support of this. Overall, students expressed moderate acceptance of the use of the LMS as this naturally follows their consistent response in the four dimensions of TAM.

3.2. Actual Use of the LMS

In the 14-week duration where most courses are three units, students devoted 2.5 hours per week to the course for every unit of each lecture class. Most students (53.7%) viewed the LMS facility less than 5,000 times in the academic term while 31.6 percent did so between 5,000 to 9,999 times. The same percentage also participated 100 to 199 times in the LMS activities, followed by 200 to 299 times (28.2%). Around four percent were recorded to have participated in LMS activities 500 times or more. The length of time (in hours) per access by students does not show any increasing nor decreasing pattern as the highest number of students would stay in the LMS for half an hour to an hour (23.5%) or three hours or more (22.8%) per access.

3.3. Self-Regulation and Self-Efficacy Beliefs

In general, university students registered a mean of 4.98 (sd=1.3, out of a possible 6.00) for self-regulation and 5.34 (sd=1.24) for self-efficacy beliefs. These scores reflect desirable attitudes toward independent learning in an online environment. Of the respondents, 164 expressed strong agreement that the LMS promoted self-regulation, particularly in the system feature of meeting online deadlines in academic requirements. It helped organize and regulate the students' pacing in complying with school requirements on time as usual rigors of the academic environment. In terms of self-efficacy, students generally find the online experience to have sustained their focus and determination such as the ability to upload assignments to meet requirements.

3.4. System Characteristics

University students rated the LMS with a mean score of 5.32 (sd=1.24) in terms of system characteristics. Most of the students find moderate agreement in terms of accessibility, usability, reliability, and security issues of the LMS used. However, data suggests that the experience could have been improved if there were more customization options available. This means that with the actual use of the system characteristics, students experience that there are still some ways to customize the system to be more reliable and robust in its features. Customization was found to have less agreement which could be accounted for by the unique learning needs that required further alignment of both students and the system features.

Collaboration and communication features were generally perceived as effective among students. They also liked it "when professors communicate with all of their students", and "the inbox section allows communication with professors for inquiries and concerns." The course content in the LMS can be found in the files, modules, pages, and syllabus. Students find this effective because they "can view course materials anytime", and "learning resources are all readily accessible".

However, course management was found to be the most effective in the LMS allowing students to do "automatic course registration based on university email." According to them, there is not much time needed to be spent on the site, and they can see all that they need to do when they log in which essentially improves their time management. Although the course management was perceived to be the most effective by some students, still others find some of its features need improvement: "We did not use the calendar - but maybe this could be utilized to note due dates of assignments."

In terms of the assessment, students find assignments to be the most effective feature of the LMS because of its convenience as regards submitting their documents and getting feedback through the comments and annotation features, particularly for submissions involving file attachments, e.g. Word or PDF documents.

3.5. Social Influence

In terms of social influence, students' general agreement with the CoIS confirmed strong teaching presence (μ=3.95, sd=0.94), social presence (μ=3.69, sd=0.92), and cognitive presence (μ=3.93, sd=0.80). Notable responses indicate that when it comes to online learning instructions, students find a better experience when important due dates and time frames for learning activities are communicated. The same is true with exploring and utilizing a variety of information sources in solving problems posed in the course. However, students have a relatively lower agreement in terms of affective expression suggesting that online or web-based communication is a less enticing medium for social interaction.

Group cohesion indicates less amount of comfort in terms of disagreements with other course participants while still maintaining a sense of trust. According to students, the posted discussion topics initiated the interaction between them and their professors: "Specifically using posting of videos, holding of conferences, and posting of relevant files. Moreover, having access to recordings, I was able to watch the class again to understand the topics better."

3.6. Facilitating Conditions

Data showed overall students' response to facilitating conditions (μ=4.94, SD=1.38) generally had a slight agreement in terms of the factors involved in the facilitating conditions of online learning. Students find there is no adequate help that is easily available during the regular usage of the LMS. Students find adequate support at the start through the provision of orientation and training except for added system tools where they still find it to be highly helpful if there is someone who can attend to their needs immediately, "an additional support that can be provided to us is a brief introduction to the features of this platform". Likewise, they added, "a virtual assistant"; "emergency notification to someone you need to immediately contact through the LMS" and suggested live chat support.

3.7. External Variables and Acceptance

Pearson correlation indicates a significant positive correlation between all the external variables and the TAM variables of PEU, PU, ATT, and BI ($r(406)=0.233, p<0.01$). The number of views also showed a significant positive correlation with participation. There was an observed significant negative correlation between participation and the external variables, except for the social influence of cognitive presence - exploration, integration, and resolution. Participation and PEU also had a significant negative correlation ($r(406)= -0.102$, $p=0.039$).

Finally, students' academic performance had a significant positive correlation with the social influence of teaching presence - design and organization ($r(406)=0.102$, $p=0.039$), and facilitation ($r(406)=0.122$, $p=0.014$); and with the social influence of cognitive presence - exploration ($r(406)=0.099$, $p=0.046$) and integration ($r(406)=0.122$, $p=0.013$).

3.8. Structural Equation Model

Figure 2 illustrates the initial research model for the study. It reflects the twenty-three (23) hypotheses based on the conceptual framework, wherein each of the external variables posited as relating to the TAM, particularly to PEU and PU (H1 to H16), the established TAM relationship (H17 to H22), and TAM with academic performance (H23).

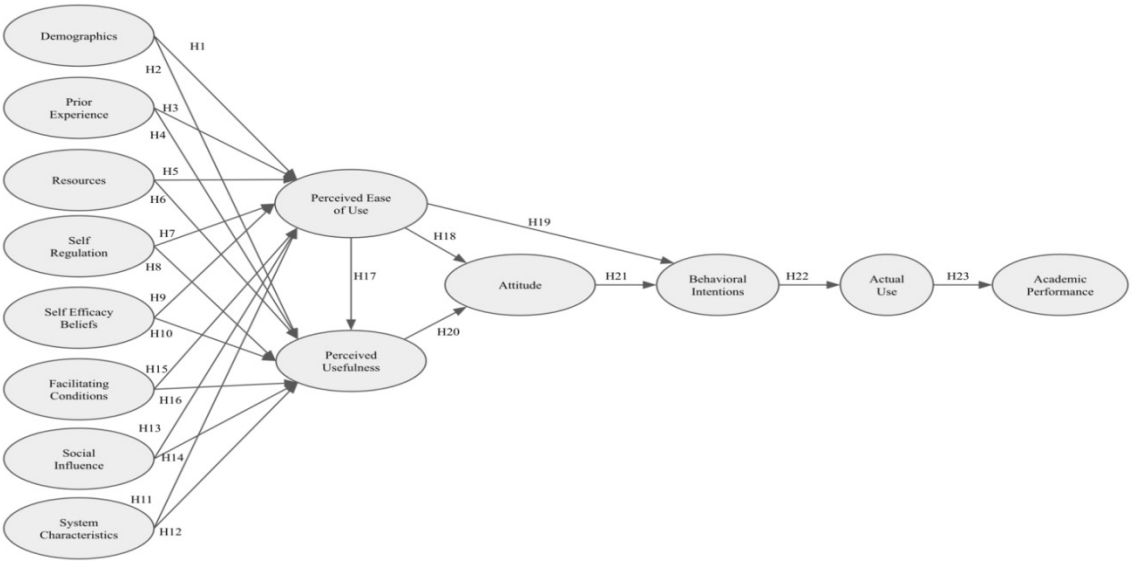

Figure 2. Initial research model

Based on the structural component, only 13 of the initial 23 hypotheses were supported by the model. Particularly, hypotheses involving individual differences were not supported (H1 to H10). This means that the data did not support claims that demographic profile, prior experience, resources, online self-regulation, and online self-efficacy are related to PEU and PU. An alternative model was explored taking out the unsupported external variable of individual differences in the initial research model. Consequently, the alternative research model tested the remaining 13 hypotheses, and all these were found to be supported.

Results of model comparison between the research and alternative models using the Akaike Information Criterion (AIC) and Expected Cross-Validation Index (ECVI) were calculated. The alternative model yields a lower value for both AIC (1263.356 vs 2175.998) and ECVI (3.104 vs 7.381) indicating that the data fit the alternative model better. Figure 3 illustrates the alternative model for the study. The SEM results support the TAM. Additionally, it shows significant path coefficients among the external variables and TAM. This indicates that FC, SI, and SC influence the PEU and PU.

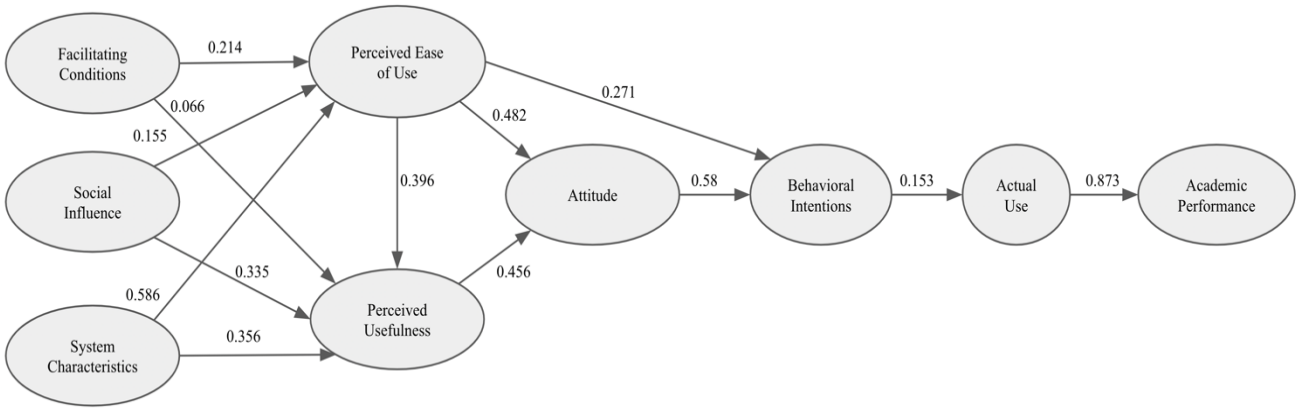

Figure 3. Alternative model for usage of LMS

Students who had higher ratings for the external variables also had higher PEU and PU of the LMS. The SEM results also show that holding other predictors constant, the system characteristics of the LMS have the biggest influence on PEU (PPEU, SC=.740) and PU (PPU, SC=.400) for acceptance of the LMS.

In terms of social presence, open communication appeared to have the greatest contribution to the social influence component of the LMS, with a loading coefficient of 0.887. It was followed by cognitive presence - triggering event with a loading of 0.843 and social presence - affective expression with a loading of 0.829. Cognitive presence - exploration has the least influence on social influence with a loading of 0.721.

3.9. Acceptance and Academic Performance

The alternative model for LMS supports the claim that actual use relates to academic performance. The SEM results showed a significant path coefficient of actual use on academic performance (PAP, AU=.873). This means that respondents who had more student activity in the LMS are those who were in the high academic performance category. It is also important to note the shift in activities in the LMS before and during the pandemic, with increased adoption for quizzes (15-34 percent of courses), and more so for discussions (58-89 percent), and assignments (63-83 percent of courses). This suggests that students in the high academic performance category have more 'Page Views' compared to other students.

The system characteristics variable has the biggest positive effect on the grades (PAP, SC=.0638), with almost tripled value compared to facilitating conditions and social influence variables. The LMS features allowed flexibility of student learning as it helped students "feel a sense of structure in learning even with minimal guidance from professors" and "provided the framework of all the lessons to be studied in advance or to look back on previous lessons, discussion, or conferences easily."

4. Discussion

This study explores the significant influences of the TAM on student learning and highlights how these factors dynamically shape the educational experience. By synthesizing the empirical evidence with related literature support, findings outcomes on this section highlighted other extraneous factors that influence the quality of student's acceptance of technology and academic performance.

4.1. Improving LMS Acceptance through System Characteristics, Facilitating Conditions, and Social Influence

The results of self-regulation and self-efficacy showed riveting findings that both external variables, being controlling behaviours in nature, were not quite significant in the online learning experience. This may explain why students' background and training could have prepared them well before the full-length experience of ODL during the pandemic period. Landrum [29] explains that understanding the purpose that students have for taking online courses even if these require the development of new skills and learning strategies is a worthwhile pursuit to evaluate online classes. The student's economic and cultural background served as protective factors in attaining well-adjusted training in terms of online learning.

Apart from these controlling behaviours, aspects of personality also play a part in establishing adaptability to online learning. According to Besser *et al.* [30], personality traits have an indirect association with how a student generally views and reacts to online learning based on adaptability. Their analyses showed that students who manifested a healthier sense of belongingness and mattering in their communities also had more positive reactions and better learning adaptability. As such, students' proactive personality affects their self-efficacy and the quality of interactions in an online learning environment [30]. Thus, this turned out not to be statistically significant in the current findings. As far as the student dimension is concerned, familiarity with computers as a prior knowledge adds up to the way of adjusting quickly to asynchronous e-learning systems [32].

Notably, most of the qualitative responses also showed that communication and collaboration are largely about the teacher's guidance and discussion enabling students to be attuned and engaged with the ongoing lessons. Once students become interested in the topics, the LMS (e.g. discussion forums) elicits facilitating participation, having freedom granted to students to make the topic of discussion of their own [33].

Based on the findings, the system characteristics (P=0.586) turned out to be the highest significant external variable affecting the acceptance of technology by students. The current choice of LMS features allows flexibility to affect the perceived ease of use. This finding suggests that the choice of LMS is essential in the learning process more than other variables such as the social influence and facilitation condition. In terms of students' attitudes towards online learning: technical difficulties like intermittent internet connection and even availability of access for some students understandably affects their ability to participate and succeed in online classes. Furthermore, there may be certain factors in the learning environment established by the student at home that also contribute to the quality of their learning experience. When such factors appear to be deficiencies rather than affordances, they are detrimental to student success.

4.2. Focusing on Teacher Presence (Design Organization) and Social Presence (Affective Expression)

The design organization appeared to have a highly significant impact on students' learning. Based on their narrative responses, they see the platform to be efficient in terms of providing readily available materials (16.90%), and easy to use (7.25%) in terms of achieving knowledge, competencies, and understanding course content. However, enthusiasm towards learning decreased due to the inconvenience at home which made online learning even more challenging. Teachers were also worried about students' progress and were unable to realize the demands that other courses impose on students. These, among others, affected the motivation of students to perform at their optimum in all their online courses [2], [34].

The ODL made students more familiar with the new platform as part of the learning experience, however, during action, requirements felt more like "compliance" rather than actual learning.

The affective expression being the least appreciated is due to the limited in-person interaction with the mentor, a longer response time that depended on a variety of factors, and the absence of socialization that can only be experienced in an in-person class [2], [35]. Since ODL is carried out through a technological medium, teachers are challenged by lesser authentic forms of interaction and a lack of spontaneity in comparison to traditional learning environments - factors that lower the quality of social interactions in their classes [34]. The learner's tendency toward experiencing anxiety, depression, self-doubt, and other negative feelings, was significantly associated with all the different learning experiences which may produce an undesirable impact on students' learning behaviours [30], [31].

4.3. Assessment Shifts in Online Distance Learning

Results shown in the analytics reveal a preference for discussions and assignments over quizzes in the online distance learning environment.

This sudden shift in the assessment practices may be due to reasons such as teachers' fear of students cheating and doubt in the integrity of the online exams or sheer preference towards alternative assessments than traditional assessment online or a combination of both. During the pandemic, teachers' doubt of valid practices is inevitable due to a lack of physical control over students in an online setting posed by limited Internet access and other challenges posed by logistical issues [36], [37]. Nonetheless, evidence suggests a high percentage of completed output using alternative assessment methods, permitting students to receive higher grades. The shift in the assessment practice has helped boost students' performance online as there had been higher scores and grades possibly because teachers are more considerate and can empathize with students in terms of adjusting to the sudden shift of mode of instruction from face-to-face or blended learning to a full online. Intermittent and weak Internet connectivity, inexperienced instructors and students, and abrupt adoption of distance education were similarly identified as challenges that pose the issue of the validity of assessments [38].

4.4. Acceptance Leading to Online Academic Performance

LMS acceptance was shown to be influenced by external variables of FC, SI, and SC. This points out that several organizational factors contribute to the success of emergency remote teaching [39]. Firat [40] explained that effectiveness, interaction, reinforcement, attractive design, social media support, and accessibility in an LMS help increase student academic achievement. In the study, the influence of system characteristics was greatest with approximately 0.586 positive effects on PEU. This means that better system accessibility and features lead to higher PEU. PEU drives the actual use of LMS which, in turn, leads to higher academic performance [41]. Similarly, Chan *et al.* [42] noted that perceived ease of use has a positive and significant relationship with students' academic performance.

The study also found that system characteristics have the greatest effect on actual use, accounting for an indirect effect of approximately 0.073. This indicates that holding the other variables constant, for every unit increase in system characteristic can increase the actual use by as much as 0.073. Avci and Ergün [43] mentioned that LMS participation levels could play an important role in student academic performance.

Finally, system characteristics accounts for the highest positive effect on academic performance with approximately 0.064 total indirect effects.

This implies that holding the other variables constant, an increase of 0.064 can be observed in academic performance for every unit increase in system characteristics.

5. Conclusion

This study explored the LMS acceptance of students during the COVID-19 pandemic. Moderate agreement was expressed by students for all the dimensions of the technology acceptance model. Through structural equation modeling, three external variables namely facilitating condition, social influence, and system characteristics had significant path coefficients for the TAM dimension of perceived ease of use and perceived usefulness. However, the study did not find sufficient evidence to show that variables related to individual differences (including demographic profile, prior experiences, resources, online self-efficacy beliefs, and self-regulation) significantly affect LMS acceptance. A significant path coefficient was also observed for actual use on academic performance. Student activity of page views has the greatest influence on actual use. Finally, system characteristics has the biggest influence in terms of acceptance of technology such as perceived ease of use and perceived usefulness. Corollary to this, by influencing PEU, system characteristics also has the biggest positive effect on academic performance.

Based on these results, the study notes the following key recommendations to further improve the acceptance and usage of learning management system (LMS):

1. In terms of LMS selection/criteria, it is important to focus on system characteristics as this captures the appropriate organization of the curriculum modules and the details of the features that enable users to optimize the learning experience (e.g., engaging in discussion forums).
2. Given the interplay of the social influence component and the nature of the subject matter (e.g., those requiring laboratory setup), results suggest that blended learning (or concurrent delivery) may be a better delivery method in terms of practical application providing experiential learning that can only be achieved in a face-to-face environment.
3. The TAM is essentially dependent on ODL and for that matter, is tied to the Internet system infrastructure. The results of this study showed that the quality of the Internet connectivity remains a problematic experience for users. Hence, there is a need to evaluate this area first before considering setting up an LMS.

4. The assessment of security and integrity should be reinforced. Considering that the ODL experience is mostly self-paced in complying with requirements, the security portals of the system must be efficient enough to launch some kind of monitoring system (even without human intervention) to address possible online cheating activities (e.g., plagiarism).

6. Limitations and Future Research

The methods employed in the research are bound by certain uncontrollable limitations of the research locale. We recognize that the sample size may not be large enough to notice the significant effects of TAM factors against external variables (e.g., individual differences and system characteristics). Although data were collected from students coming from varying backgrounds, multi-level analysis proved to be impossible as there was an uneven distribution of the survey tools at a particular time. Future related studies may employ similar research models with larger sample sizes and on varied time series to validate the results of our study. The study also considers the abrupt transition period which compelled everyone to go fully online may have other extraneous factors affecting the readiness of students to learn at limited bounds of learning alternatives.

Additionally, researchers can consider the conditions of ethnicity or socio-cultural context, as well as the differences in educational policies determined by the political government of each country. Similar studies based on a sample involved in traditional learning modalities may show different results. This study is also limited to the internal variables of the TAM which did not include other possible extraneous variables such as motivation and other individual differences (e.g., personality).

Acknowledgements

This is a funded interdisciplinary research project by the Research and Grant Management Office of De La Salle University – Manila.

References:

[1]. Bozkurt, A. et al. (2020). A global outlook to the interruption of education due to COVID-19 pandemic: Navigating in a time of uncertainty and crisis. *Asian Journal of Distance Education*, *15*(1), 1-126.

[2]. Lazim, C. S. L. M., Ismail, N. D. B., & Tazilah, M. D. A. K. (2021). Application of technology acceptance model (TAM) towards online learning during covid-19 pandemic: Accounting students perspective. *Int. J. Bus. Econ. Law*, *24*(1), 13-20.

[3]. Rashid, A. H. A., Shukor, N. A., Tasir, Z., & Na, K. S. (2021). Teachers' Perceptions and Readiness toward the Implementation of Virtual Learning Environment. *International Journal of Evaluation and Research in Education*, *10*(1), 209-214.

[4]. Kirmizi, Ö. (2015). The influence of learner readiness on student satisfaction and academic achievement in an online program at higher education. *Turkish Online Journal of Educational Technology-TOJET*, *14*(1), 133-142.

[5]. Chao, I. T. (2008). Moving to Moodle: Reflections two years later. *Educause Quarterly*, *31*(3), 46-52.

[6]. Dobre, I. (2015). Learning Management Systems for higher education-an overview of available options for Higher Education Organizations. *Procedia-social and behavioral sciences*, *180*, 313-320.

[7]. Bhatia, S. (2014). Learning management system trends. *Training Magazine*.

[8]. Murphy, L., Eduljee, N. B., & Croteau, K. (2020). College student transition to synchronous virtual classes during the COVID-19 pandemic in Northeastern United States. *Pedagogical Research*, *5*(4).

[9]. Rizun, M., & Strzelecki, A. (2020). Students' acceptance of the COVID-19 impact on shifting higher education to distance learning in Poland. *International journal of environmental research and public health*, *17*(18), 6468.

[10]. Lynch, M. (2020). E-Learning during a global pandemic. *Asian Journal of Distance Education*, *15*(1), 189-195.

[11]. Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science*, *46*(2), 186-204.

[12]. Al-Busaidi, K. A., & Al-Shihi, H. (2010). Instructors' acceptance of learning management systems: A theoretical framework. *Communications of the IBIMA*, *2010*(2010), 1-10.

[13]. Alharbi, S., & Drew, S. (2014). Using the technology acceptance model in understanding academics' behavioral intention to use learning management systems. *International Journal of Advanced Computer Science and Applications, 5*(1), 143-155.

[14]. Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision sciences*, *39*(2), 273-315.

[15]. Farahat, T. (2012). Applying the technology acceptance model to online learning in the Egyptian universities. *Procedia-Social and Behavioral Sciences*, *64*, 95-104.

[16]. Raza, S. H., Abu Bakar, H., & Mohamad, B. (2017). Relationships between the advertising appeal and behavioral intention: The mediating role of the attitude towards advertising appeal. In *SHS Web of Conferences*, *33*. EDP Sciences.

[17]. Prior, D. D., Mazanov, J., Meacheam, D., Heaslip, G., & Hanson, J. (2016). Attitude, digital literacy and self efficacy: Flow-on effects for online learning behavior. *The Internet and Higher Education*, *29*, 91-97.

[18]. Kim, M. S., & Hunter, J. E. (1993). Relationships among attitudes, behavioral intentions, and behavior: A meta-analysis of past research, part 2. *Communication research*, *20*(3), 331-364.
[19]. Creswell JW, Plano Clark VL, Gutmann ML and Hanson WE (2003) Advances in mixed methods research designs. In Tashakkori A, Teddlie C, (Eds.), *Handbook of mixed methods in social and behavioral research*, 209–240. SAGE, Thousand Oaks, CA.
[20]. Arbaugh, J. B., Cleveland-Innes, M., Diaz, S. R., Garrison, D. R., Ice, P., Richardson, J. C., & Swan, K. P. (2008). Developing a community of inquiry instrument: Testing a measure of the community of inquiry framework using a multi-institutional sample. *The internet and higher education*, *11*(3-4), 133-136.
[21]. Bradley, R. L., Browne, B. L., & Kelley, H. M. (2017). Examining the influence of self-efficacy and self-regulation in online learning. *College student journal*, *51*(4), 518-530.
[22]. Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt M., Danks, N.P., Ray, S. (2021). *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R*: Springer Nature. Doi: 10.1007/978-3-030-80519-7
[23]. Braun, V and Clarke V (2013) *Successful Qualitative Research: A Practical Guide for Beginners*: SAGE.
[24]. Braun, V., Clarke, V., & Terry, G. (2014). Thematic analysis. In Lyons, A. & Rohleder, P. (Eds.), *Qualitative Research in Clinical and Health Psychology*: Palgrave MacMillan.
[25]. Stake RE (1995) *The Art of Case Study Research*. Sage Publications, Inc.
[26]. Falaiye, C., Labrecque, L. & Stephenson, K. (2008) *Case Studies*. Canadian Evaluation Society.
[27]. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101. Doi: 10.1191/1478088706qp063oa
[28]. Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International journal of qualitative methods*, *16*(1). Doi: 10.1177/1609406917733847
[29]. Landrum, B. (2020). Examining Students' Confidence to Learn Online, Self-Regulation Skills, and Perceptions of Satisfaction and Usefulness of Online Classes. *Online Learning*, *24*(3), 128-146. https://doi.org/10.24059/olj.v24i3.2066
[30]. Besser, A., Flett, G. L., & Zeigler-Hill, V. (2022). Adaptability to a sudden transition to online learning during the COVID-19 pandemic: Understanding the challenges for students. *Scholarship of Teaching and Learning in Psychology*, *8*(2), 85. Doi: 10.1037/stl0000198
[31]. Zheng, F., Khan, N. A., & Hussain, S. (2020). The COVID 19 pandemic and digital higher education: Exploring the impact of proactive personality on social capital through internet self-efficacy and online interaction quality. *Children and Youth Services Review*, *119*, 105694. Doi:10.1016/j.childyouth.2020.105694
[32]. Kabassi, K., Dragonas, I., Ntouzevits, A., Pomonis, T., Papastathopoulos, G., & Vozaitis, Y. (2016). Evaluating a learning management system for blended learning in Greek higher education. *SpringerPlus*, *5*, 1-12. Doi: 10.1186/s40064-016-1705-8
[33]. Zulfikar, A. F., Muhidin, A., Suparta, W., Trisetyarso, A., Abbas, B. S., & Kang, C. H. (2019). The effectiveness of online learning with facilitation method. *Procedia Computer Science*, *161*, 32-40.
[34]. Niemi, H. M., & Kousa, P. (2020). A Case Study of Students' and Teachers' Perceptions in a Finnish High School during the COVID Pandemic. *International journal of technology in education and science*, *4*(4), 352-369.
[35]. Adnan, M., & Anwar, K. (2020). Online learning amid the COVID-19 pandemic: Students' perspectives. *Online Submission*, *2*(1), 45-51.
[36]. Ferretti, F., Santi, G. R. P., Del Zozzo, A., Garzetti, M., & Bolondi, G. (2021). Assessment practices and beliefs: Teachers' perspectives on assessment during long distance learning. *Education Sciences*, *11*(6), 264.
[37]. Cahapay, M. B. (2020). Reshaping assessment practices in a philippine teacher education institution during the coronavirus disease 2019 crisis. *Pedagogical Research*, *5*(4). https://doi.org/10.29333/pr/8535
[38]. Şenel, S., & Şenel, H. C. (2021). Remote assessment in higher education during COVID-19 pandemic. *International Journal of Assessment Tools in Education*, *8*(2), 181-199.
[39]. Iglesias-Pradas, S., Hernández-García, Á., Chaparro-Peláez, J., & Prieto, J. L. (2021). Emergency remote teaching and students' academic performance in higher education during the COVID-19 pandemic: A case study. *Computers in human behavior*, *119*, 106713. Doi: 10.1016/j.chb.2021.106713
[40]. Firat, M. (2016). Determining the effects of LMS learning behaviors on academic achievement in a learning analytic perspective. *Journal of Information Technology Education-Research*, *15*, 75-87.
[41]. Kim, D. (2017). The impact of learning management systems on academic performance: Virtual Competency and student Involvement. *Journal of Higher Education Theory and Practice*, *17*(2), 23-35.
[42]. Chan, T. J., & Zhang, D. (2021). Usage of blackboard and academic performance of university students: A partial least square approach. *J. Arts Soc. Sci*, *4*, 44-56.
[43]. Avcı, Ü., & Ergün, E. (2022). Online students' LMS activities and their effect on engagement, information literacy and academic performance. *Interactive Learning Environments*, *30*(1), 71-84.