The Perceived Satisfaction in Utilizing Learning Management System among Engineering Students during the COVID-19 Pandemic: Integrating Task Technology Fit and Extended Technology Acceptance Model

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Abstract: Online education has become the norm for higher education institutions (HEIs) during this COVID-19 pandemics. HEIs are required to implement a fully online learning system that is structured and readily accessible with the assistance of a learning management system (LMS), including in developing countries such as the Philippines. This study aims to assess factors that positively influence the perceived satisfaction of engineering students when using the LMS during the COVID-19 pandemic in the Philippines. Additionally, it aims to integrate two models: Task Technology Fit (TTF) and Technology Acceptance Model (TAM), with added variables such as the content of the learning management system, social presence, and social space. Upon deploying the convenience sampling, a total of 1011 engineering students responded in the online survey, which consisted of 81 questions. Structural equation modeling (SEM) showed that the Task Technology Fit was positively influenced by technology, individual, and task characteristics. Moreover, behavioral intention to use LMS was positively influenced by perceived usefulness and perceived ease of use. Furthermore, Task Technology Fit had a significant direct effect on behavioral intention to use LMS, which subsequently led to perceived satisfaction. This study is among the first to explore factors affecting perceived satisfaction among engineering students in using the LMS in the Philippines during the COVID-19 pandemic. To evaluate the perceived satisfaction of students in using the learning management system, future works can be extended and the model can be applied in other countries.

Keywords: learning management system; COVID-19; Task Technology Fit; Technology Acceptance Model; online learning

1. Introduction

COVID-19 is a worldwide public health crisis, including in the Philippines. About 1,627,816 people have been infected and 28,427 have died in the Philippines as of 6 August 2021 [1]. Enhanced community quarantines, widely including lockdowns, social distancing, and the wearing of face masks and face-shields, are still enforced in the country to control the spread of the virus. The country has been constantly changing its restrictions depending on the current number of cases. Still, the traditional school setup has not yet returned [2].

The government implemented distanced learning to replace traditional close education as an alternative tool to control the spread of the COVID-19 virus. Through online
learning, academicians and students engaged in continued academic learning. However, the Philippines was not prepared during the initial stage of this pandemic due to the closure of internet shops, internet instability, the isolated location of most students, and other relevant factors [2]. Different types of distance education have been introduced, such as e-learning, mobile learning, online education, distance learning and online learning.

Toquero [3] suggested conducting studies related to the effects of the COVID-19 pandemic on the educational system. It is necessary to strengthen the practices of the curriculum and make it more adaptable to the needs of students beyond traditional setups. In addition, Joaquin et al. [4] highlighted that there are still gaps and challenges in their responses, despite innovations made by HEIs regarding the use of technologies and alternative learning material for delivering academic educations. The study recommends that policy responses and learning innovations should be made on a deeper understanding of online education, and be flexible in times of change for online education [4].

Online education is an instructional method that utilizes a variety of tools and technology that facilitate student–faculty communication for the enrichment of the student learning experience. In the contemporary world, the online education concept is not new anymore, and there are various available means economical internet access, thanks to recent advances in cloud technologies that promote a flexible learning system and support traditional learning methods [5].

During the COVID-19 pandemic, online learning has become the norm for higher education institutions (HEIs) in many countries including the Philippines. HEIs in the Philippines have adjusted to the restrictions inflicted by this global pandemic and are required to implement a fully online learning system. Different HEIs have different policies of online learning, which facilitate student learning activities via the provision of synchronous lectures, or asynchronous, delayed activities [6]. Learning materials are structured and readily accessible, along with the different learning management systems (LMS) offered by HEIs.

Learning Management System is normally used to depict a variety of systems providing access to online educational services for teachers, students, and executives. In general, these services have some essential features such as provision for different types of learning content, types of communication tools, and limited access control to authorized people. It is usually referred to as an online learning platform [7]. LMS was widely used by the different countries to continuously improve the instruction and learning activities in higher education. The improvements of LMS were investigated by comparing the different features of commercially available platforms [8].

There are many benefits of LMS for the students, teachers, and academic staff. For example, they can review lectures, give feedback, answer exam, assignments, hold discussions, and have social interactions. In addition, LMS features have been examined so that writing instructors might become more familiar with writing education [9]. Moreover, the technological efficiency of using LMS for online writing instruction (OWI) allowed the attaining of a sustainable practice [10]. There are available options for higher education institutions in terms of using LMS, such as ANGEL, BBlearn, Canvas, Desire2Learn, Moodle, Sakai, and others [11]. These LMS are widely used, especially in engineering universities and institutes in the Philippines.

An empirical study has been used to examine the adoption and acceptance of e-learning using the structural equation model (SEM) [12–14]. The recent condition of the COVID-19 pandemic has meant other researchers and have evaluated the acceptance of e-learning in their countries using the Technology Acceptance Model [15,16]. The study of Pal and Vanijja [17] evaluated the perceived usability of Microsoft Teams in India using the System Usability Scale (SUS) and Technology Acceptance Model (TAM); the results demonstrate the similarity and equivalency between SUS and TAM. Likewise, Isaac et al. [18] examined the intervention role of Task Technology Fit and its compatibility in the Delone and Mclean information system success model. The results of the proposed model were effective in demonstrating the variables that positively influence a student’s academic
performance. Moreover, an integration of the Task Technology Fit (TTF) and Technology Acceptance Model (TAM) was used in the literature as a robust model [19,20]. The study of Yen et al. [19] integrated both the Technology Acceptance Model (TAM) and the Task Technology Fit (TTF) model in understanding the determinants of users’ intentions to use wireless technology in an organization. Based on the results, the perceived usefulness and ease of use positively influence an individual’s behavioral intention to use wireless technology, while the perceived ease of use has a significant direct effect on perceived usefulness. Technology characteristics and task characteristics positively influence the Task Technology Fit, while there is a significant effect of technology characteristics on perceived ease of use and usefulness. Lastly, TTF positively influences TAM, and this implies that the user’s intention to adopt wireless technology is determined directly by TTF between task characteristics and technology characteristics; the same holds with the user’s perceived usefulness and ease of use.

LMS has been investigated by applying the Technology Acceptance Model (TAM) and employing the Structural Equation Modeling (SEM) approach to examine students’ adaptation process [13]. With the integration of Task Technology Fit and the Technology Acceptance Model, the study assessed the adoption of social networking sites and their impact on students’ performance [21]. The results show that there is a significant relationship between technology characteristics, task characteristics, social aspects and Task Technology Fit (TTF) in using social media as a platform for academic purposes; it also promotes student enjoyment and enhanced academic performance. Moreover, there are significant relationships between comprehension efficiency, enjoyment, ease of use and behavioral intention to use social media for academic purposes, which positively influences satisfaction and achievement. Hence, the study implies that TTF and behavioral intention to use social media significantly improve the learning process of students while enabling them to share knowledge, discussions and information.

This paper aims to evaluate factors that positively influence the perceived satisfaction among engineering students when using the Learning Management System (LMS) in the Philippines during the COVID-19 pandemic. It also aims to integrate the two models of Task Technology Fit (TTF) and the Technology Acceptance Model (TAM) with added variables, such as social presence, social space, and the content of the learning management system. The present study is among the first study to analyze factors that positively influence the perceived satisfaction of engineering students using the Learning Management System in this country during the COVID-19 pandemic. Furthermore, the integrated TAM and TTF, and added variables such as social presence, social space, and the content of the learning management system, can be extended and applied in other countries to evaluate the perceived satisfaction of students using the learning management system.

2. Theoretical Research Model

Figure 1 illustrates the theoretical research model of the recent study. This study integrated the Technology Acceptance Model (TAM) and Task Technology Fit (TTF) with added variables such as social presence, social space, and content of the learning management system. The main objective was to evaluate factors affecting the perceived satisfaction through online education among engineering students in a higher education institution (HEI) in the Philippines. These factors are investigated for their impact on student’s perceived satisfaction when using a Learning Management System (LMS). This study examines 11 hypotheses, as illustrated in Figure 1.
Technology characteristics refer to the current system used by students to complete their tasks [22]. The indicator used in this construct is based on the ability of the LMS to offer information and of the students to perform the task virtually in any location, and can be accessed using mobile devices at any point in time [23]. Previous studies show the integration of information and system quality using social media in informal and formal learning [24]. In view of this, the study suggests the following hypothesis.

**Hypothesis 1 (H1).** Technology characteristics will positively influence Task Technology Fit.

**2.2. Task Characteristics**

Task characteristics refer to the actions accomplished by individuals in transforming inputs into outputs [22]. In this model, some of the indicators used in this construct were based on the different assessment tasks, collaboration with other individuals, and how frequently they coordinate with each other to perform the given task. In view of this, the study suggests the following hypothesis.

**Hypothesis 2 (H2).** Task characteristics will positively influence Task Technology Fit.

**2.3. Individual Characteristics**

Individual characteristics refer to the student’s characteristics that significantly influence the use of the Learning Management System [25]. In this study, self-efficacy and attitude are the two variables considered under individual characteristics. Self-efficacy refers to one’s opinion of one’s own ability to utilize technology in accomplishing certain tasks [26], while attitude refers to an individual’s positive or negative thoughts about performing a task [27]. In view of this, the study suggests the following hypothesis.

**Hypothesis 3 (H3).** Individual characteristics will positively influence Task Technology Fit.

**2.4. Task Technology Fit**

Task Technology Fit refers to the correspondence among the individual’s abilities, the task requirements, and the features of technology [22]. TTF corresponds to the level of technology that supports an individual’s work in order to accomplish a given job. Generally, individuals can use the technology to complete specific tasks under any given condition [28]. In this paper, Task Technology Fit refers to the LMS’s ability to assists students in their various learning activities. These activities include accessible learning...
materials with interactive activities such as quizzes, assignments, discussions, and practical activities. In view of this, the study suggests the following hypothesis.

**Hypothesis 4 (H4).** Task Technology Fit will positively influence behavior intention to use a learning management system.

### 2.5. Behavioural Intention to Use LMS

Individual attitudes, a reaction in a particular way concerning the use of the system, and the perception of its utility are referred to as behavioral intention to use (BIU) [29,30]. In view of this, the study suggests the following hypothesis.

**Hypothesis 5 (H5).** Behavioral intention to use a learning management system will positively influence perceived satisfaction.

### 2.6. Perceived Usefulness

Perceived usefulness refers to the level at which an individual thinks that using a distinct system would improve individual performance [29]. This latent variable including perceived ease of use has been introduced into the Technology Acceptance Model (TAM) to measure an individual’s intention to use technology. In view of this, the study suggests the following hypothesis.

**Hypothesis 6 (H6).** Perceived usefulness will positively influence behavioral intention to use a learning management system.

### 2.7. Perceived Ease of Use

Perceived ease of use refers to the degree to which a person thinks that using a specific system would be free of effort [29]. In view of this, the study suggests the following hypothesis.

**Hypothesis 7 (H7).** Perceived ease of use will positively influence behavioral intention to use a learning management system.

### 2.8. Perceived Enjoyment

The notion of perceived enjoyment was based on the flow theory, under which an activity is perceived as enjoyable aside from the user’s perception of its usefulness or its ability to attain certain performance goals [31,32]. According to Venkatesh et al. [26], an individual who derives enjoyment from using an information system can use it more broadly than those who do not. An individual will be more inspired to use it again if they perceive it as an enjoyable task in contrast to a similar activity that is not. If an individual can experience enjoyment through the implementation of new technology, their attitude towards it will be positive. In view of this, the study suggests the following hypothesis.

**Hypothesis 8 (H8).** Perceived enjoyment will positively influence behavioral intention to use the learning management system.

### 2.9. Social Presence

Social presence refers to the degree to which one feels the existence of participants in communication—the psychological sensation of the other being “there” and “present” [33,34]. In view of this, the study suggests the following hypothesis.

**Hypothesis 9 (H9).** Social presence will positively influence perceived satisfaction.

### 2.10. Social Space

Social space refers to the perceived system of interpersonal relationships between students. Kreijns et al. [35] designed and implement a sociable computer-supported
collaborative learning (CSCL) system, which may increase the probability that a sensible social space will develop. In view of this, the study suggests the following hypothesis.

**Hypothesis 10 (H10). Social space will positively influence perceived satisfaction.**

2.11. Content of Learning Management System

The content of the learning management system (LMS) refers to the tools by which students can gain access to its content. The content of the learning management system provides up-to-date, useful, sufficient and relevant content on the provided topic, quiz, assignment, discussions, practical activity, etc. [36]. The interaction in which individuals are involved is based on the contents of the learning management system. In view of this, this paper proposes the following hypothesis.

**Hypothesis 11 (H11). The content of the learning management system will positively influence perceived satisfaction.**

2.12. Perceived Satisfaction

The degree to which a student is satisfied with all elements of using the Learning Management System (LMS) through online education [34]. As for the studies conducted, this is the first study that evaluates the factors of perceived satisfaction in using a learning management system as part of online education in one of the HEIs in the Philippines during the COVID-19 pandemic.

3. Methodology

3.1. Data Collection

The desired population of this study, to whom the questionnaires were administered, were the engineering students at one of the higher education institutions in the Philippines. The present research used the non-probability convenience sampling method, sent via Google Forms. Data were collected from January 2021 up to February 2021. The research subjects were engineering students who used the Learning Management System as a platform for their online education. In total, 1011 responses were received. Their participation in answering the questionnaire was voluntary and treated confidentially and anonymously.

As shown in Table 1, among the 1011 respondents, 76% were males, and almost 24% were female; 63.90% were between 19 and 21 years old, 22.95% were between 22 and 23 years old, 11.47% were 24 or above and only 1.68% were aged 16–18 years old. Most of the respondents were in their 2nd year, comprising 46.98%, 25.22% were in their 5th year, 20.18% were in their 3rd year, and only 7.62% were in their 4th year. About 71.12% of the respondents lived in cities and 28.88% lived in the province. Most of the respondents were from the Civil Engineering Program, comprising 56.48%, the Industrial Engineering Program (18.69%), the Mechanical Engineering Program (10.68%), the Computer Engineering Program (4.95%), the Electrical Engineering Program (4.06%), the Electronics and Communications Engineering Program (2.87%), the Marine Engineering Program (1.38%), the Sanitary Engineering Program (0.65%) or the Environmental Engineering Program (0.20%). Most of the respondents (64.19%) used laptops as the learning platform and 35.81% used smartphones. As regards to synchronous learning in weekly classes, 35.81% and 35.11% of the respondents declared synchronous activity between 3 and 5 h and 5 and 10 h per week, respectively. Additionally, 14.24% and 14.85% of the respondents declared synchronous learning for less than 3 h and above 10 h per week, respectively. As regards to asynchronous learning in weekly classes, 38.87% of the respondents referred to 3–5 h of asynchronous activity when using LMS, 26.61% of the respondents declared asynchronous activity for 5–10 h with LMS, 17.80% of the respondents declared asynchronous activity for under 3 h with LMS, and 16.72% of the respondents declared asynchronous activity for above 10 h with LMS.
Table 1. Demographics (n = 1011).

| Characteristics       | Value  | Frequency | Percentage % |
|-----------------------|--------|-----------|--------------|
| Gender                | Female | 242       | 23.94        |
|                       | Male   | 769       | 76.06        |
| Age                   | 16–18 years old | 17   | 1.68        |
|                       | 19–21 years old | 646  | 63.90       |
|                       | 22–23 years old | 232  | 22.95       |
|                       | 24 years old above | 116  | 11.47       |
| Year                  | College: 2nd-year level | 475  | 46.98       |
|                       | College: 3rd-year level | 204  | 20.18       |
|                       | College: 4th-year level | 77   | 7.62        |
|                       | College: 5th-year level | 255  | 25.22       |
| Residential Area      | Urban  | 719       | 71.12        |
|                       | Rural  | 292       | 28.88        |
| Area of Study         | IE (Industrial Engineering) | 189  | 18.69       |
|                       | CPE (Computer Engineering) | 50   | 4.95        |
|                       | ENVI (Environmental Engineering) | 2  | 0.20        |
|                       | SE (Sanitary Engineering) | 7   | 0.69        |
|                       | ECE (Electronics and Communications Engineering) | 29  | 2.87        |
|                       | CE (Civil Engineering) | 571  | 56.48       |
|                       | EE (Electrical Engineering) | 41  | 4.06        |
|                       | ME (Mechanical Engineering) | 108 | 10.68       |
|                       | MARE (Marine Engineering) | 14  | 1.38        |
| Consumption Platform  | Smartphones | 362 | 64.19       |
|                       | Laptop  | 649       | 35.81        |
| Interaction Time in LMS per Week (Synchronous) | Under 3 h | 144 | 14.24 |
|                       | 3–5 h | 362       | 35.81        |
|                       | 5–10 h | 355       | 35.11        |
|                       | 10 h above | 150 | 14.84 |
| Interaction Time in LMS per Week (Asynchronous) | Under 3 h | 180 | 17.80 |
|                       | 3–5 h | 393       | 38.87        |
|                       | 5–10 h | 269       | 26.61        |
|                       | 10 h above | 169 | 16.72 |

3.2. Questionnaire

The questionnaire consists of 13 sections, such as (1) Demographic Information (Age, Year, Residential Area, Area of Study, Consumption Platform, Synchronous and Asynchronous Time per Week), (2) Perceived Enjoyment, (3) Perceived Usefulness, (4) Perceived Ease of Use, (5) Behavioral Intention to Use LMS, (6) Content of Learning Management System, (7) Task Characteristics, (8) Technology Characteristics, (9) Individual Characteristics, (10) Task Technology Fit, (11) Perceived Satisfaction, (12) Social Presence, and (13) Social Space. The research instrument with all latent variables included in the SEM was assessed using a five-point (1–5) Likert scale, in which 5 meant “strongly agree” and 1 meant “strongly disagree”. Table 2 shows the constructs and measures used in the survey.
### Table 2. Constructs and measures.

| Constructs                        | Item | Measures                                                                 | Source |
|-----------------------------------|------|--------------------------------------------------------------------------|--------|
| Perceived Enjoyment               | PE1  | Using LMS is enjoyable                                                  | [37]   |
|                                   | PE2  | Using LMS system is entertaining                                        | [37]   |
|                                   | PE3  | Using LMS system is fun                                                 | [37]   |
|                                   | PE4  | Using LMS system makes academic learning more interesting               | [37]   |
|                                   | PE5  | Overall, I find the system exciting                                     | [37]   |
| Perceived Usefulness              | PU1  | Using the Learning Management System (LMS) will enhance my academic performance during online education | [16]   |
|                                   | PU2  | Using the Learning Management System (LMS) will enhance my efficiency during online education | [16]   |
|                                   | PU3  | Using the Learning Management System will enhance my productivity during online education | [16]   |
|                                   | PU4  | Using the Learning Management System will be beneficial for me during online education | [16]   |
|                                   | PU5  | Using the Learning Management System provides new ways of learning       | [26,29]|
| Perceived Ease of Use             | PEOU1| Learning to use the Learning Management System during online education is easy | [16]   |
|                                   | PEOU2| Using the Learning Management System during distance online education was clear and easy to understand | [16]   |
|                                   | PEOU3| Using the Learning Management System during online education was flexible | [16]   |
|                                   | PEOU4| It is effortless to become skilled in using the Learning Management System during online education | [16]   |
|                                   | PEOU5| This Learning Management System improves the quality of learning         | [26,29]|
| Behavioral Intention              | BI1  | I will use a Learning Management System during online education in the future | [16]   |
|                                   | BI2  | I would suggest using a Learning management system during online education in the future | [16]   |
|                                   | BI3  | Learning management is of benefit to me                                  | [38]   |
|                                   | BI4  | I have no objection to use a Learning Management System for educational learning | [39]   |
| Content of Learning Management System | CO1  | The Learning Management System provides up-to-date content on the provided topic, quiz, assignment, discussions, etc. | [36]   |
|                                   | CO2  | The Learning Management System provides useful content for the topic, quiz, assignment, discussions, etc. | [36]   |
|                                   | CO3  | The Learning Management System provides sufficient content for the topic, quiz, assignment, discussions, etc. | [36]   |
|                                   | CO4  | The content in the Learning Management Systems is relevant               | [40]   |
|                                   | CO5  | The content in the Learning Management Systems is readable               | [40]   |
|                                   | CO6  | The content in the Learning Management Systems is accurate               | [40]   |
|                                   | CO7  | The content in the Learning Management Systems is concise and to the point | [40]   |
| Technology Characteristics        | TECH1| This Learning Management System offers me the ability to receive information and perform assessment tasks from virtually any location | [19]   |
|                                   | TECH2| This Learning Management System offers me the ability to receive information and perform assessment tasks from virtually any location at any time | [19]   |
|                                   | TECH3| This Learning Management System can be accessed on mobile devices through a mobile app to represent information in ways appropriate to me | [19]   |
|                                   | TECH4| Learning Management Systems can also be subject to frequent problems and crashes | [40]   |
| Task Characteristics              | TC1  | Using this Learning Management System, I frequently deal with different assessment tasks | [19]   |
|                                   | TC2  | Some tasks given to me have never been replicated before                | [19]   |
|                                   | TC3  | The task problems I cope with often involve more than one assessment task | [19]   |
|                                   | TC4  | I frequently deal with nonroutine task problems                         | [19]   |
|                                   | TC5  | I have to collaborate with others in my coursework                      | [40]   |
|                                   | TC6  | My coursework requires frequent coordination with the efforts of others  | [40]   |
| Individual Characteristics       | ICAT1| Using a Learning Management System (LMS) in my studies is pleasant       | [41]   |
| attitude                         | ICAT2| My frequent use of LMS is good                                         | [41]   |
| attitude                         | ICAT3| All things considered, the Learning Management System (LMS) in my studies is beneficial | [41]   |
| attitude                         | ICAT4| Using this Learning Management System in my studies is great             | [41]   |
| computer self-efficacy           | ICSE5| I feel confident using the Learning Management System                    | [42]   |
| computer self-efficacy           | ICSE6| I feel confident operating the Learning Management System functions      | [42]   |
| computer self-efficacy           | ICSE7| I feel confident using Learning Management System contents                | [42]   |
Table 2. Cont.

| Constructs          | Item                                                                 | Measures                                                                 | Source          |
|---------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------|
| **Task Technology Fit** |                                                                     |                                                                          |                 |
| TTF1                | The Learning Management System (LMS) is well suited to the way I have to study | [41]                                                                    |                 |
| TTF2                | The Learning Management System (LMS) is well suited to all aspects of my study | [41]                                                                    |                 |
| TTF3                | The Learning Management System (LMS) is easy to use | [41]                                                                    |                 |
| TTF4                | The Learning Management System (LMS) is user-friendly | [41]                                                                    |                 |
| TTF5                | Using the LMS is easy to learn | [41]                                                                    |                 |
| TTF6                | Using the LMS provides me with updated information | [41]                                                                    |                 |
| TTF7                | This Learning Management System (LMS) provides information I need in time | [41]                                                                    |                 |
| TTF8                | This Learning Management System (LMS) provides output about exactly what I need | [41]                                                                    |                 |
| TTF9                | The Learning Management System (LMS) is appropriate in assisting me to accomplish my academic assignments | [41,43]                                                                |                 |
| TTF10               | The Learning Management System is necessary to my academic tasks | [41,43]                                                                |                 |
| **Social Presence**  |                                                                     |                                                                          |                 |
| SP1                 | Using the Learning Management System in a conference (*Big Blue Button), I felt that we were in a face-to-face group | [34]                                                                    |                 |
| SP2                 | Using the Learning Management System in a conference (*Big Blue Button), I felt that I dealt with "real" people and not anonymous abstract persons | [34]                                                                    |                 |
| SP3                 | Using the Learning Management System in a conference (*Big Blue Button), I can derive discrete impressions of some of my fellow students | [34]                                                                    |                 |
| SP4                 | Using the Learning Management System in a conference (*Big Blue Button), I felt that my classmates were real physically | [34]                                                                    |                 |
| SP5                 | Using the Learning Management System in a conference (*Big Blue Button), I envision that I see my fellow students in front of me | [34]                                                                    |                 |
| SP6                 | Using the Learning Management System in a conference (*Big Blue Button), my classmates feel so "real" considering that we are not virtual at all | [34]                                                                    |                 |
| SP7                 | Using the Learning Management System in a conference (*Big Blue Button), my classmates feel that I am "real" physically | [34]                                                                    |                 |
| SP8                 | Using the Learning Management System in a conference (*Big Blue Button), I felt that my classmates and I were in the same room | [34]                                                                    |                 |
| SP9                 | Using the Learning Management System in a conference (*Big Blue Button), I felt that my classmates and I were in close proximity | [34]                                                                    |                 |
| SP10                | Using the Learning Management System in a conference (*Big Blue Button), I strongly felt the presence of my classmates | [34]                                                                    |                 |
| **Social Space**     |                                                                     |                                                                          |                 |
| SS1                 | Using the Learning Management System in a conference (*Big Blue Button), I felt free to criticize and scrutinize the ideas or opinions of my classmates | [34]                                                                    |                 |
| SS2                 | Using the Learning Management System in a conference (*Big Blue Button), I guaranteed that we kept in touch with each other | [34]                                                                    |                 |
| SS3                 | Using the Learning Management System in a conference (*Big Blue Button), I preserved connection with all of my classmates | [34]                                                                    |                 |
| SS4                 | Using the Learning Management System in a conference (*Big Blue Button), I conducted open, happy conversations | [34]                                                                    |                 |
| SS5                 | Using the Learning Management System in a conference (*Big Blue Button), I spontaneously started conversations with others | [34]                                                                    |                 |
| **Perceived Satisfaction** |                                                                     |                                                                          |                 |
| SS6                 | Using the Learning Management System in a conference (*Big Blue Button), I asked others how the work task (assignment, quiz, discussions, etc.) was going | [34]                                                                    |                 |
| PS1                 | The Learning Management System satisfies my educational needs | [36]                                                                    |                 |
| PS2                 | I learned new things in this Learning Management System | [34]                                                                    |                 |
| PS3                 | This Learning Management System fulfilled my expectations | [34]                                                                    |                 |
| PS4                 | I am overall satisfied with this Learning Management System | [18]                                                                    |                 |

“*Big Blue Button*” is a conference open-source system for online education and is embedded in the Canvas platform.

3.3. Structural Equation Model

The Structural Equation Modeling (SEM) approach is a multivariate approach that is used in testing hypotheses concerning the impacts among interacting variables [44]. This paper utilizes AMOS 22 when running the SEM. This is a user-friendly structural equation modeling tool that investigates the correlation between latent variables to validate the relationship and test hypotheses. Figure 2 shows the SEM constructs consisting of 12 latent variables, with 9 exogenous latent variables (Technology Characteristics, Task Characteristics, Individual Characteristics, Perceived Usefulness, Perceived Ease of Use, Perceived
Enjoyment, Social Presence, Social Space, Content of Learning Management System) and 3 endogenous latent variables (Behavioral Intention to Use LMS, Task Technology Fit, and Perceived Satisfaction).

Figure 2. Initial model results for evaluating perceived satisfaction in using LMS throughout online education.

Prior studies used six sets of measurement to analyze the model fit, such as the Tucker Lewis Index (TLI), the Comparative Fit Index (CFI), the Incremental Fit Index (IFI), the Goodness of Fit Index (GFI), the Adjusted Goodness of Fit Index (AGFI), and Root Mean Square Error of Approximation (RMSEA). A value greater than 0.90 indicates a good model fit for TLI, CFI, and IFI [45,46]. On the other hand, a value greater than 0.80 is the lowest sign of a good model fit for GFI and AGFI [47]. Lastly, a value smaller than 0.07 is also an indication of a good model fit for RMSEA [48].

4. Results

Figure 2 shows the initial SEM results from AMOS 22 in evaluating the perceived satisfaction, using LMS among engineering students in the Philippines. Based on the figure, one hypothesis was not significant: the relationship of perceived enjoyment and behavioral intention to use LMS (Hypothesis 8), $\text{PE} (\beta = 0.0037)$. Thus, this latent variable has been omitted to increase the model’s fit.

Tables 3 and 4 demonstrate the reliability and validity, and the model fit, respectively. Based on Table 3, it is apparent that each construct in our proposed model possessed internal consistency, reflected by the Cronbach $\alpha$ and composite reliability (CR), since the values were found to be higher than 0.7. Furthermore, the constructs also had a degree of discriminant validity, with a minimum value of 0.5, which is represented by the average variance extracted (AVE); all of the constructs surpassed this value. Finally, an evaluation of the data observed throughout the study in relation to the proposed model was also
conducted; this was made possible by assessing the value of model fit. Inspired by the study of Gefen et al. [47], here, values of GFI and AGFI higher than 0.80 were the cut-off. In addition, as derived from the study of Hair [45], we recommend the values of IFI, TLI, and CFI be greater than 0.9, and the RMSEA be smaller than 0.07 [45,47]. Therefore, the model fit measures were within the acceptable value range. Figure 3 shows the final model for evaluating perceived satisfaction in using LMS through online education during the COVID-19 pandemic.

Table 3. Tests of reliability and validity.

| Latent Variables                             | Items          | Cronbach’s α | Factor Loadings | Average Variance Extracted (AVE) | Composite Reliability (CR) |
|----------------------------------------------|----------------|--------------|-----------------|---------------------------------|----------------------------|
| Perceived Ease of Use (PEOU)                 | PEOU1          | 0.932        | 0.82            | 0.726                           | 0.930                      |
|                                               | PEOU2          |              | 0.88            |                                 |                            |
|                                               | PEOU3          |              | 0.85            |                                 |                            |
|                                               | PEOU4          |              | 0.86            |                                 |                            |
|                                               | PEOU5          |              | 0.85            |                                 |                            |
| Perceived Usefulness (PU)                    | PU1            | 0.938        | 0.85            | 0.744                           | 0.936                      |
|                                               | PU2            |              | 0.91            |                                 |                            |
|                                               | PU3            |              | 0.88            |                                 |                            |
|                                               | PU4            |              | 0.84            |                                 |                            |
|                                               | PU5            |              | 0.83            |                                 |                            |
| Perceived Enjoyment (PE)                     | PE1            | 0.958        | 0.89            | 0.766                           | 0.942                      |
|                                               | PE2            |              | 0.92            |                                 |                            |
|                                               | PE3            |              | 0.91            |                                 |                            |
|                                               | PE4            |              | 0.80            |                                 |                            |
|                                               | PE5            |              | 0.85            |                                 |                            |
| Content of Learning Management System (CO)   | CO1            | 0.960        | 0.81            | 0.725                           | 0.949                      |
|                                               | CO2            |              | 0.87            |                                 |                            |
|                                               | CO3            |              | 0.84            |                                 |                            |
|                                               | CO4            |              | 0.89            |                                 |                            |
|                                               | CO5            |              | 0.85            |                                 |                            |
|                                               | CO6            |              | 0.85            |                                 |                            |
|                                               | CO7            |              | 0.85            |                                 |                            |
| Social Space (SS)                            | SS1            | 0.950        | 0.81            | 0.776                           | 0.954                      |
|                                               | SS2            |              | 0.90            |                                 |                            |
|                                               | SS3            |              | 0.91            |                                 |                            |
|                                               | SS4            |              | 0.90            |                                 |                            |
|                                               | SS5            |              | 0.90            |                                 |                            |
|                                               | SS6            |              | 0.86            |                                 |                            |
| Social Presence (SP)                         | SP1            | 0.978        | 0.87            | 0.816                           | 0.978                      |
|                                               | SP2            |              | 0.85            |                                 |                            |
|                                               | SP3            |              | 0.950           |                                 |                            |
|                                               | SP4            |              | 0.92            |                                 |                            |
|                                               | SP5            |              | 0.92            |                                 |                            |
|                                               | SP6            |              | 0.93            |                                 |                            |
|                                               | SP7            |              | 0.93            |                                 |                            |
|                                               | SP8            |              | 0.94            |                                 |                            |
|                                               | SP9            |              | 0.93            |                                 |                            |
|                                               | SP10           |              | 0.91            |                                 |                            |
| Perceived Satisfaction (PS)                  | PS1            | 0.937        | 0.83            | 0.716                           | 0.909                      |
|                                               | PS2            |              | 0.79            |                                 |                            |
|                                               | PS3            |              | 0.86            |                                 |                            |
|                                               | PS4            |              | 0.90            |                                 |                            |
| Task Technology Fit (TTF)                    | TTF1           |              | 0.69            |                                 |                            |
|                                               | TTF2           |              | 0.69            |                                 |                            |
|                                               | TTF3           |              | 0.80            |                                 |                            |
|                                               | TTF4           |              | 0.83            |                                 |                            |
|                                               | TTF5           |              | 0.79            |                                 |                            |
|                                               | TTF6           |              | 0.80            |                                 |                            |
|                                               | TTF7           |              | 0.81            |                                 |                            |
|                                               | TTF8           |              | 0.83            |                                 |                            |
|                                               | TTF9           |              | 0.84            |                                 |                            |
|                                               | TTF10          |              | 0.81            |                                 |                            |
### Table 3. Cont.

| Latent Variables                  | Items   | Cronbach’s α | Factor Loadings | Average Variance Extracted (AVE) | Composite Reliability (CR) |
|----------------------------------|---------|--------------|-----------------|---------------------------------|---------------------------|
| Individual Characteristics (IND) | IND1    | 0.971        | 0.89            |                                 |                           |
|                                  | IND2    |              | 0.86            |                                 |                           |
|                                  | IND3    |              | 0.89            |                                 |                           |
|                                  | IND4    |              | 0.93            |                                 |                           |
|                                  | IND5    |              | 0.90            |                                 |                           |
|                                  | IND6    |              | 0.91            |                                 |                           |
|                                  | IND7    |              | 0.89            |                                 |                           |
| Technology Characteristics (TECH)| TECH1   | 0.890        | 0.90            | 0.647                           | 0.877                     |
|                                  | TECH2   |              | 0.90            |                                 |                           |
|                                  | TECH3   |              | 0.81            |                                 |                           |
|                                  | TECH4   |              | 0.56            |                                 |                           |
| Task Characteristics (TC)        | TC1     | 0.922        | 0.76            | 0.534                           | 0.873                     |
|                                  | TC2     |              | 0.78            |                                 |                           |
|                                  | TC3     |              | 0.75            |                                 |                           |
|                                  | TC4     |              | 0.69            |                                 |                           |
|                                  | TC5     |              | 0.71            |                                 |                           |
|                                  | TC6     |              | 0.69            |                                 |                           |
| Behavioral Intentions (BI)      | BI1     | 0.941        | 0.83            | 0.686                           | 0.897                     |
|                                  | BI2     |              | 0.83            |                                 |                           |
|                                  | BI3     |              | 0.87            |                                 |                           |
|                                  | BI4     |              | 0.78            |                                 |                           |

### Table 4. Model fit.

| Goodness of Fit Measures of the SEM | Parameter Estimates | Minimum Cut-Off | Recommended By |
|------------------------------------|---------------------|-----------------|----------------|
| Goodness of Fit Index (GFI)        | 0.817               | >0.80           | [47]           |
| Adjusted Goodness of Fit Index (AGFI) | 0.803               | >0.80           | [47]           |
| Root Mean Square Error of Approximation (RMSEA) | 0.061               | <0.07           | [49]           |
| Incremental Fit Index (IFI)        | 0.914               | >0.90           | [49]           |
| Tucker Lewis Index (TLI)           | 0.903               | >0.90           | [49]           |
| Comparative Fit Index (CFI)        | 0.907               | >0.90           | [49]           |

Figure 3. Final model for evaluating perceived satisfaction in using LMS throughout online education.
5. Discussion

The study integrated the Task Technology Fit (TTF) and Technology Acceptance Model (TAM) to evaluate factors affecting the perceived satisfaction among engineering students using a Learning Management System (LMS) in the Philippines amidst the COVID-19 pandemic. A total of 1011 engineering students responded to the online questionnaire deployed using Google Forms, which consisted of 81 questions. Structural Equation Modeling (SEM) was used to analyze the interrelationship among Technology Characteristics (TECH), Task Characteristics (TC), Individual Characteristics (IND), Task Technology Fit (TTF), Behavioral Intention to Use LMS (BI), Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Social Presence (SP), Social Space (SS), Content of Learning Management System (CO), and Perceived Satisfaction (PS).

With regard to Task Technology Fit, SEM was significantly affected by TECH ($\beta = 0.38$), TC ($\beta = 0.201$), and IND ($\beta = 0.754$). The model indicated that the LMS equipped the students to perform their assigned tasks at virtually any location and at any time. It shows that accessing the LMS through a mobile application is generally accepted by the students in terms of representing information. In addition, it also shows that group collaboration to perform a certain task is effective, and the use of LMS will give the students confidence in performing different tasks. Furthermore, the individual attitudes of students towards using LMS in their studies are acceptable, and they considered it beneficial to them. Additionally, the LMS’s functions and contents give confidence to students constantly using the platform. The study of Khan et al. [50], which examined the factors that influence the student’s adoption of massive open online courses (MOOCs) in Pakistan, showed that Task Technology Fit was significantly affected by Technology Characteristics and Task Characteristics. Moreover, a prior study regarding the significant effect of individual characteristics on TTF was carried out in the context of the adoption of e-books in academic settings [51].

The SEM also indicated that Task Technology Fit had a significant direct effect on BI ($\beta = 0.526$). The students think that the LMS is easy to use, user-friendly, easy to learn, provides updated information, provides output based on their needs, and helps them to accomplish assignments and academic tasks. Generally, it shows that the students were satisfied in using LMS and would remain so in the future, and it has benefits for the students. Previous studies also established consistent results regarding the significant direct effect of Task Technology Fit on behavioral intention [50,52,53].

Regarding the behavioral intention to use LMS, the current model showed that it was significantly affected by PU ($\beta = 0.379$) and PEOU ($\beta = 0.511$). This implies that when using LMS, students will increase their performance, efficiency, productivity, flexibility, and effectiveness in performing tasks. In addition, it will provide new ways of learning and provide benefits during online education. It also shows that students perceived the LMS as easy to understand and flexible to interact with, and that it improves the quality of learning. Furthermore, several studies presented a significant effect of perceived usefulness and perceived ease of use on behavioral intention [15,16,20].

As discussed before, the study integrated variables such as social presence (SP), social space (SS), and the content of the learning management system (CO). The results prove that perceived satisfaction was significantly affected by SP ($\beta = 0.255$), SS ($\beta = 0.416$), and CO ($0.239$). This shows that using LMS in a conference via Big Blue Button gives the students a feeling of being in a real face-to-face class, and distinct impressions of their fellow students. It also allows them to feel the presence of their fellow students physically within the same room. In addition, the students felt that, when using LMS, they were free to criticize and scrutinize the ideas and opinions of their fellow students. Students also kept in touch with each other, conducted open and happy conversations, and preserves connections regarding work tasks, such as assignments, quizzes, and discussions. Furthermore, the students perceived a network of interpersonal relationships when using LMS. Prior studies support the significant effects of social space and social presence on student satisfaction by providing learning experiences that consider the aspect of a sociable learning environment [34]. In addition, the content of LMS provides up-to-date and useful information on the provided...
activities, such as quizzes, assignments, discussions, and even practical activities. There are numerous academic tasks, such as online practicum, online experiments, and online simulations. Despite the challenges during the COVID-19 pandemic, the results of the study show that online learning platforms could still satisfy engineering students. This also implies that the provided contents were relevant, readable, accurate, and concise. Previous studies looked at how the content will be offered in the future [54].

The practical benefits of LMS offer several advantages to improve the students’ studies. The first aspect is how the video content referring to both theoretical and practical aspects can be viewed by all students, customized, and repeated according to their learning needs and availability. Offline mode only allows one-time viewing, and the learning capacity of students varied. Customized learning in terms of flexibility is surely a great advantage for students. The second aspect is how the quality of content can be increased by different sources. The teachers can use different sources such as reputable videos or invited teachers without complex preparations. The limited geographical sources of content will be eliminated in the approach of LMS.

Finally, SEM indicated that behavioral intention to use LMS had a significant direct effect on PS ($\beta = 0.594$). It showed that the students were fully satisfied in terms of their educational needs, and all their expectations were fully met when using LMS as a distance learning method.

6. Conclusions

The COVID-19 pandemic has been a worldwide health crisis. To control the spread of COVID-19, the Philippine government implemented a distance learning method as an optional tool to replace traditional close education. To assess its effectiveness for students, this paper utilizes a Learning Management System (LMS) as a distance learning method among engineering students in one of the higher education institutions (HEI) in the Philippines. The contribution of this research is that it provides insight into case studies on confirmatory factor analysis, specifically on the satisfaction of engineering students utilizing LMS.

The paper uses Task Technology Fit (TTF) [55–57] and a Technology Acceptance Model (TAM), with added variables such as social presence, social space, and content of the learning management system, in assessing the factors affecting the perceived satisfaction of students when using LMS. A total of 1011 engineering students responded to the online questionnaire, which comprised 81 questions. A total of 10 hypotheses were supported (H1, H2, H3, H4, H5, H6, H7, H9, H10, H11), and 1 hypothesis was not—the relationship of perceived enjoyment with behavioral intention to use LMS (Hypothesis 8), PE ($\beta = 0.0037$). This implies that, in the initial model, perceived enjoyment had no significant effect on the behavioral intention to use LMS. Thus, this latent variable has been omitted to increase the model’s fit.

The results show that the Task Technology Fit was positively influence by technology characteristics, task characteristics, and individual characteristics. In addition, behavioral intention to use LMS was positively influenced by perceived usefulness and perceived ease of use. As a result, Task Technology Fit had a significant direct effect on behavioral intention to use LMS, which subsequently led to perceived satisfaction.

6.1. Theoretical Contribution

This study provides theoretical contributions to the existing literature on using a Learning Management System (LMS) in online education during the COVID-19 situation in the Philippines. The study contributes to building a novel method related to the factors that affect perceived satisfaction in using LMS in online education by integrating Task Technology Fit and a Technology Acceptance Model. In addition, added variables such as social presence, social space (adopted from Weidlich and Bastiaens [34]), and content of learning management system (from Wang [36]) are considered as factors affecting the perceived satisfaction of students. This implies that the social aspects involved in students
using LMS were significant factors as regards perceived satisfaction in using LMS during online education. The result shows that an average 29% improvement in the model fit was obtained after omitting one latent variable. Lastly, this paper is among the first to analyze the factors affecting perceived satisfaction in using a Learning Management System (LMS) in the Philippines during the COVID-19 pandemic.

6.2. Practical Implication

The findings from this study can be used by any higher educational institution (HEI) to increase the level of satisfaction of students using online learning platforms during the COVID-19 pandemic. The model fit measures were within an acceptable range (see Table 4). If students are satisfied with their learning experience when using the LMS platform, they will be able to continue their studies without having to search for other schools that offer online education. Despite the COVID-19 pandemic, students can easily learn and study at home with the help of LMS. They would only need an internet connection and the correct technology to attend the online class. Likewise, teachers can conduct lectures and continue to educate students. Thus, the distance and location will not be an issue for academic learning for either students or teachers.

One benefit of LMS is that it makes it easy to access information. Information is readily accessible to all users, and learning materials are structured and can be accessed virtually anytime and at any location. Students have access to lesson materials, such as quizzes, assignments, practical exercises, discussions, and resources. These resources include a PDF e-book copy and other online links, and can be integrated into the class page for online learning. Additionally, the platform can be used as an instrument to create content, on which students can upload, share work, and carry out projects with their teachers and fellow learners.

Another benefit of LMS is the diverse range of formats of the resources that are being used and disseminated in the class modules. The instructor gathers multiple resources on the topic that will help the students understand the context of the subject. Interactive videos and external sites can be embedded easily into the class page. Institutional resources can be accessed through different e-journals, and e-books are also embedded in the module.

The assessment tasks in the LMS can also be in various formats, such as multiple-choice questionnaires that provide immediate feedback. The teacher can also reference an external site in an interactive video format, apply the questions for assignments, carry out practical activities, and host graded discussions.

Moreover, clear feedback from the teacher for assignments, quizzes, activities, etc., is also one benefit of LMS for students. Feedback can be easily shared with the student via Speed Grader. Speed Grader is a tool embedded in the LMS that is used by teachers to view, annotate and assess student’s submissions without the need to download any files. Through this, students can download copies of their work after it is graded with the instructor’s comments. Instructors can “mark-up” student’s work using in-line text comments, highlighting and drawing tools, and can quickly assess work using custom-designed rubrics within Speed Grader. All scores are automatically entered into the course grade book.

Big Blue Button, which is an open-source conference system for online education and is embedded into the Canvas platform, is part of the Learning Management System. These features of the LMS enable the students to interact with their classmates and teachers virtually. Through this, they feel that they are really physically present, just like in a traditional classroom. Additionally, students, teachers, employees, and administrators can facilitate the overall management of communication through individual emails, messages, announcements, and agendas. Moreover, the online learning experience using LMS during this pandemic has introduced flexibility and tailored pacing into the learning of students. Students can return to past lecture material using LMS if they are not comfortable enough to ask their professors about a specific detail of the topic.
6.3. Limitations and Future Research

We would like to acknowledge some limitations of the study. First, this study mainly focused on the general perception of engineering students regarding their perceived satisfaction in using the LMS during the COVID-19 pandemic. Second, the survey deployed was limited to engineering students only; it only shows that LMS works in engineering program, as other programs were not considered, such as management, business, accounting, medicine, law, etc.

Future works in this area can consider other latent variables, such as the instructional delivery method, and analyze whether this could positively influence the perceived satisfaction with using learning management systems during online education. Additionally, the proposed model can be expanded to other programs and different educational levels, such as grade school and high school. Moreover, the proposed model can also be applied to assess teacher’s perceived satisfaction when using LMS during COVID-19. Additionally, it can be extended and applied in other countries to evaluate the perceived satisfaction of students and teachers when using the Learning Management System. Lastly, the possibility of improving the LMS in terms of its features could also be addressed in future research.

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