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Technology Acceptance Model in the Application of Online Learning During COVID-19 Pandemic: Case Study in a Remote Area of Indonesia

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Abstract: The COVID-19 pandemic has accelerated the pace of Industrial Revolution 4.0. People have been forced to adapt quickly to the industrial revolution ecosystem. Higher Education Institutions in West Sumbawa Indonesia, a remote area, were forced to implement online learning for all courses. This change was difficult because it was a new perspective on online education and its technological complexity. This study aimed to examine students' self-

efficacy in their ability to use online learning technology and its influence on perceived ease of use, perceived usefulness, attitudes toward computer-based education, and learning performance. Data processing was conducted using Structural Equation Modeling (SEM) with the Smart-PLS™ software. The results of this study indicated that students' self-efficacy significantly influences learning performance in their ability to use online learning technology, mediated by learning engagement, attitudes toward computer-based education, and perceived usefulness. The novelty of this study lies in developing a model based on technology acceptance and measuring its impact on learning performance in higher education institutions (HEIs) in remote areas during the implementation of online learning triggered by the COVID-19 pandemic.

Keywords: Perceived Usefulness, Perceived Ease of Use, Self-Efficacy Attitude, Computer Supported Education, Learning Performance.

Introduction

The COVID-19 pandemic has caused disruption that accelerated the Industrial Revolution 4.0. There was not a single country where its education sector was not affected. The entire education system in the world, from the elementary to tertiary level, collapsed during the pandemic (Mishra et al., 2020). Within 25 days of the announcement of the first positive patient in Indonesia, the pandemic forced 834 HEIs in Indonesia to go online. This also happened to HEIs in remote areas whose locations were relatively distant or isolated and had poor access. The main issue in such remote areas was the lack of access to education and teacher shortages. Reflecting on the situation, Massive Open Online Courses (MOOC) should be suitable for implementation in Indonesia, considering its large areas and the quality of education discrepancy between the cities and remote areas (Kurniasari et al., 2018). However, implementing such significant changes in the education system during the pandemic proved difficult.

The challenges of adopting online learning were interrelated with the new perspectives of online education and the complexity of technology (Mishra et al., 2020). Therefore, for the successful implementation of educational changes, i.e., the shift from traditional to online teaching and learning, the changes' implications need to be addressed. A former study indicated that there was a positive relationship between computer self-efficacy and perceived ease of use in e-learning usage (Akbari et al., 2023); a high-level computer self-efficacy indicated that the students have a high level of trust in using e-learning, especially in doing their job, and it consequently made the e-learning to be easy to use. Hence, it was suggested that a high level of computer self-efficacy could help students improve their performance.

Research Problem

The challenges of shifting to online learning are more significant for universities in remote areas. The main obstacles were related to adjusting the acceptance of new technology in learning

activities, accessibility to broadband packages, and poor internet connections. Temporarily, the accessibility to broadband services has been resolved with the assistance of internet (broadband) plans from the Indonesian Ministry of Education, Culture, Research, and Technology. The problems and challenges that remained were the effectiveness of online lecture implementation. Most students said that online lecture acceptance was not as effective as face-to-face. This was caused by the early-stage adoption of online learning in remote areas, which initially covered only a few courses, and is now required to implement in all courses. This condition can influence students' self-efficacy regarding their ability to use online learning technology, which in turn affects their perceived ease of use and usefulness, ultimately impacting their academic performance.

Research by Yeşilyurt et al. (2016) discusses the relationship between computer Self-Efficacy and attitudes toward Computer Supported Education, while Ramayah and Aafaqi (2004) examine the effect of Self-Efficacy on Perceived Usefulness and Perceived Ease of Use. Additionally, Chen (2017) investigates the influence of computer Self-Efficacy on Learning Engagement and Learning Performance. This study aims to fill the gap in previous research by exploring how Self-Efficacy, Perceived Usefulness, Perceived Ease of Use, and attitudes toward Computer Supported Education Influence Learning Engagement and Learning Performance.

Research Focus

This study focuses on the acceptance of online learning technology and its impact on students' academic performance. This research will explore how students accept and use technology for online learning activities, and how this acceptance may influence their learning outcomes.

Research Aim and Research Questions

The main objective was to determine the effect of students' self-efficacy in their ability to use online learning technology on their perceptions of ease of use, usefulness, and learning performance. The results of this study are expected to provide insights for policymakers to improve the effectiveness of online learning implementation in remote areas. Research questions in this study are:

1. How does self-efficacy affect perceived usefulness and perceived ease of use?
2. How do perceived usefulness and ease of use affect attitudes toward computer-supported education?
3. How does attitude toward computer-supported education affect learning engagement and performance?

4. How does self-efficacy influence learning performance, mediated by perceived usefulness, perceived ease of use, attitude toward computer-supported education, and learning engagement?

Literature Review

This literature review aims to gain an understanding, summarise previous research, and identify gaps in the Technology Acceptance Model, Self-Efficacy, Perceived Usefulness, Perceived Ease of Use, Learning Engagement, and Learning Performance. This process enables the researcher to formulate relevant research questions and provides a solid foundation for developing the theoretical framework.

Technology Acceptance Model

The Technology Acceptance Model (TAM) explains the causal relationship between confidence (over the benefits of an information system and its user-friendliness) and behavior, necessities, and users of an information system. TAM aims to explain and predict a user's acceptance over an information system (Al-Adwan et al., 2023). This theory has been trying to explain the perception of technology users. Granić (2023) explained that acceptance as the first step in technology adoption is an attitude towards technology and is influenced by various factors. The model also explained the behavior of the users based on their beliefs, attitudes, intentions, and user behavior relationships. Among the factors that can influence this model is perceived usefulness (PU) and perceived ease of use (PEoU) for the users, which leads to the users' actions to accept and use the technology (attitude toward usage) (Bakı et al., 2018; Kumar & Krishnan, 2020; Prastiawan et al., 2021).

Attitude in Computer-Support Education

The recent pandemic-induced distance learning has put computer-supported education (CSEd) at the front line of teaching and learning; considering its utilisation of computers as a tool in disseminating instructional content/activities, which is helpful for course instructors to improve the qualities of educational activities. Yeşilyurt et al. (2016) defined CSEd as a benefit of computers as a tool to help educators (teachers) improve the quality of their teaching during educational activities. A critical point in CSEd is using computers for content transfer or educational activities. Hence, the success of CSEd is strongly associated with the attitude in utilising the devices during the teaching facilitation. Most effective CSEd is attainable when the teachers possess positive attitudes toward the CSEd practices. Yeşilyurt et al. (2016) defined an attitude as the tendency of long-term emotional sentiment, belief, and manner that are relatively organised. The most critical factors to successfully implement CSEd are the attitude and self-efficacy toward the CSEd itself (Kutluca & Ekici, 2010; Srisupawong et al., 2018). The findings were also supported by Grover and Pea (2013) who explained that the most important determining

factors in the CSEd implementation are training and demeanor in accepting computer as a technology, confidence, self-efficacy, and attitude, directly or indirectly, concerning each other.

The Teacher, Academic, and Computer Self-Efficacy

Self-efficacy (SE) is a person's conviction in their abilities, developed as a result of an interaction between the external environment, self-adaptation and personal mechanisms, experience, and education, in acting to reach a predetermined goal, to steer any situations in a befitting way, and to overcome any arising problems (Farmer et al., 2022; Niu, 2010). Self-efficacy significantly influences attitude, and improving self-efficacy contributes to developing a positive attitude (Ozkal, 2013; Tarkin & Uzuntiryaki, 2012).

Yeşilyurt et al. (2016) empirically proved that CSEd attitude was influenced by the teachers' self-efficacy, academic self-efficacy, and computer self-efficacy; and the three were considered a special type of self-efficacy. In general, a teacher's self-efficacy can be defined as the conviction of a teacher in fulfilling their duties, i.e., the planning and implementation of ideas and actions that could develop the commitment and skills of the students (Barni, et al., 2019; Hussain et al., 2022). Teachers' self-efficacy can be explained as a concept related to a teacher's effectiveness or successful teaching (Zee et al., 2024). A teacher's self-efficacy may include class management, teaching methods and techniques, and computer and instructional tools applications (Gürol et al., 2010).

Academic self-efficacy is defined as the teachers' or students' belief in their competence to carry out the academic-related activities that affect their learning and improve their achievement, where the more significant their knowledge of a particular subject, the better their academic self-efficacy level on the said subject (Honicke & Broadbent, 2016; Schunk & DiBenedetto, 2022; Yokoyama, 2019). Computer self-efficacy is defined as an individual's belief over their ability to use a computer, whereas those with better computer self-efficacy are usually more prepared to participate in computer-related activities with better expectancies (Dogru, 2020; Wolverton et al., 2020).

Perceived Usefulness (PU) and Perceived Ease of Use (PEoU)

A mediation using perceived usefulness (PU) and perceived ease of use (PEoU) increases the effectiveness of students' self-efficacy in using technology (Ramayah & Aafaqi, 2004). This means that, for self-efficacy to influence the use of technology for students effectively, the students must first develop the perspective that using the associated technology is easy. Akbari et al. (2023) empirically explained a positive correlation between computer self-efficacy and PEoU in the application of e-learning; a high-level computer self-efficacy indicated a higher intensity of students in adopting e-learning platforms in their studies. Additionally, the students could also improve their learning performance. Other than PEoU, the belief that online teaching methods

have more advantages (PU), particularly during the lockdown period, and self-motivation, were the keys to the success of teaching and learning processes (Mishra et al., 2020).

Learning Engagement (LE) and Learning Performance (LP)

There was a positive correlation between self-efficacy and attitude (Li, 2012), which in turn can improve the LP of the students (Liu et al., 2020). Yeşilyurt et al. (2016) argued that academic SE, teachers' SE, and computer SE affect the CSEd attitude, and the attitudes toward the CSEd itself could positively affect the improvement of LP (Kwon et al., 2014; Ponce et al., 2012). LP can be improved through LE, proven empirically by a positive LE statistically and significantly influenced LP (Chen, 2017). Another Chen's (2017) finding revealed that LE fully mediated the relationship between attitudes toward CSEd and LP.

Technology Acceptance Model of Online Learning and Hypotheses

Through the integration of several models (Chen, 2017; Ramayah & Aafaqi, 2004; Yeşilyurt et al., 2016), this study aims to provide a deeper understanding of the relationships between the factors that influence success in learning, particularly in the context of technology use. This model illustrates how individuals feel confident in their ability to succeed in their studies. Figure 1 depicts the state-of-the-art of the current research.

The hypotheses of this study are:

H1: SE affects PU

H2: SE affects PEoU

H3: PU affects attitude toward CSEd

H4: PEoU affects attitude toward CSEd

H5: Attitude toward CSEd affects LE

H6: Attitude toward CSEd affects LP

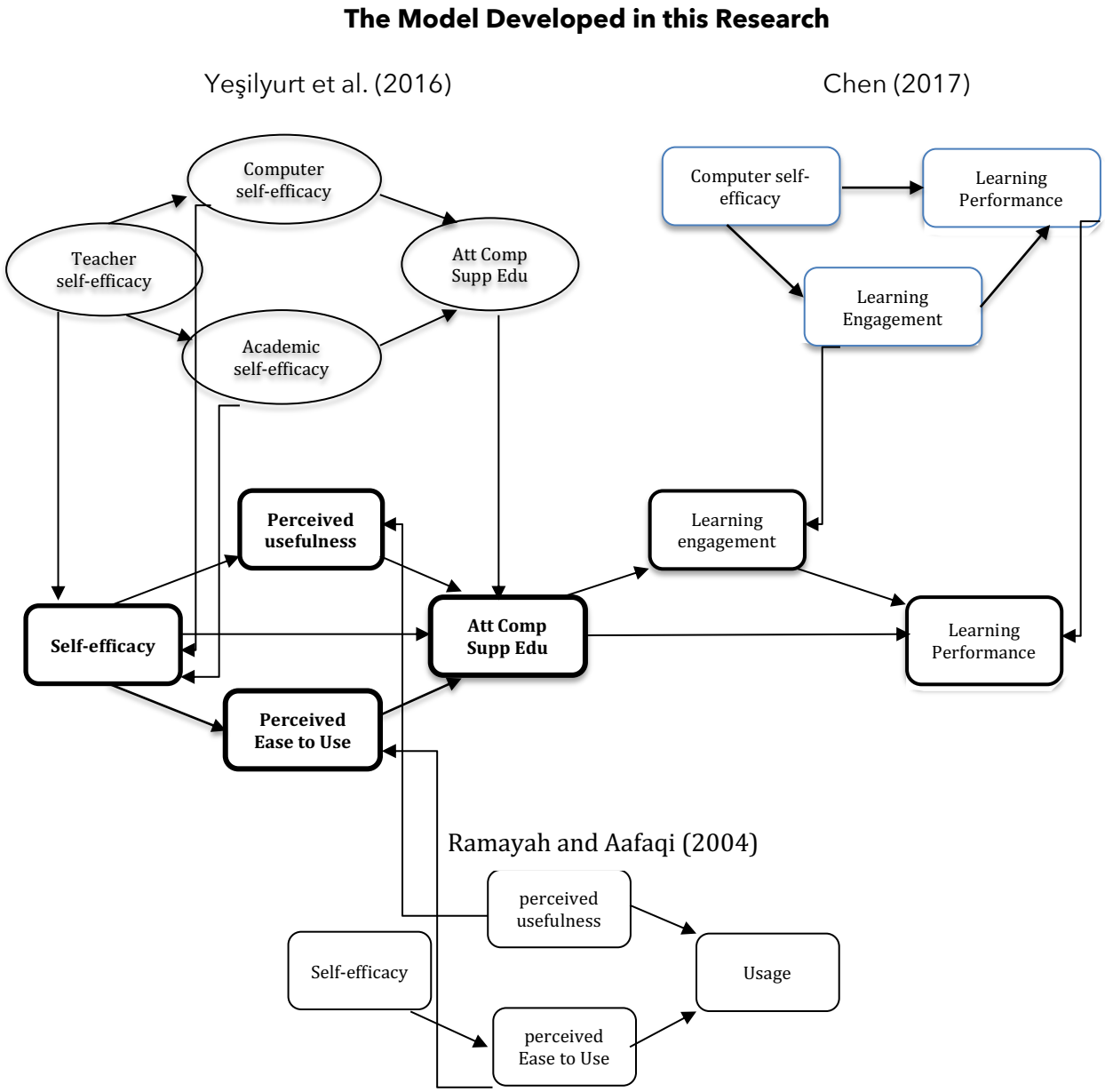
H7: LE mediates the effect of Attitude toward CSEd on LP

H8: SE influences LP through the mediation of PU, attitude toward CSEd, and LE

The current research aimed to fill the gap in previous studies by including PU, PEoU, attitude toward CSEd, and LE as mediating variables between SE and LP.

Figure 1

Proposed Online Learning Technology Acceptance Model



Source: Authors' development.

Materials and Methods

A quantitative method was used to develop a model based on the acceptance of online learning technology and the measurement of its impact on learning performance in higher education institutions in remote areas.

Sample and Participants

This research was conducted in West Sumbawa, which is considered one of Indonesia's most remote areas. The analytical unit of this research was the students of private universities in the region. Since there is only one private university in West Sumbawa, namely Cordova University (UNDOVA), the samples in this study were exclusively UNDOVA students. A total of 150 students were selected as samples, which, according to Slovin (as cited in Farida et al., 2024), a population with an error tolerance limit of 10% or an accuracy rate of 90%. A questionnaire was used to collect students' opinions on the indicators of the research variables. The samples were selected through stratified random sampling from students in Semesters 1, 3, 5, and 7.

Model Description

This model is developed to analyse the impact of technology acceptance factors on learning performance in remote areas. The model consists of six main variables: SE, PEoU, PU, Attitude towards CSEd, LE, and LP. SE is measured through teacher efficacy, computer efficacy, and attitude efficacy in implementing online learning. PEoU is measured through ease of use and understanding when implementing online learning. In contrast, online learning measures PU through perceived time efficiency, skill enhancement, and productivity improvement in completing tasks. Attitude towards CSE is measured by affection, cognition, and behavior when using online learning. LE is measured through cognitive engagement and emotional involvement when using online learning. LP is measured through improvements in terms of knowledge, reasoning, skill, product, and affect by using online learning by using online learning. This model is integrated using the structural equation modeling method to evaluate the relationships between variables and their impact on learning performance. Furthermore, the model provides a more comprehensive view of the acceptance of CSEd technology in the context of education in remote areas.

Instrument and Procedure

Data was collected using a survey method, with a questionnaire as the research instrument. The questionnaire served as a tool to gather respondents' opinions and perceptions regarding the variables and indicators of the study. The following section describes the research variables, stages of data processing, and the research data analysis.

Collection of Implementation Variables in the Application of Online Learning. The research's implementation variables included were teachers' (TSE), computer self-efficacy, academic self-efficacy (ASE), PU, PEoU, attitude toward CSEd, LE, and LP. The measurement of these variables was carried out using a Likert scale of 1 – 5. The details of indicators for each variable are as presented in Table 1.

Table 1

Dimensions and Indicators of Research Variables

Variable	Dimension	Questions
Self-Efficacy Yeşilyurt et al. (2016)	1.Teacher's self-efficacy (TSE)	1. Educator's effort in assisting students to develop critical thinking through the online mode of studying (TSE1) 2. Educator's effort in using various assessment strategies that genuinely represent the capability of the students (TSE2) 3. Educator's effort in properly developing an online class management system (teaching materials preparation, teaching methods variation, teaching media, learning strategy) (TSE3).
	2.Academic self-efficacy (ASE)	1. I consistently earn decent grades when I am ready for the exam (ASE1) 2. I never allow myself to fail in any exam (ASE2)
	3.Computer self-efficacy (CSE)	1. I can use computer effectively (CSE1) 2. I have a good talent in using a computer (CSE2) 3. I am happy and excited to use a computer in learning a course (CSE3)
Perceived Usefulness Lee (2010)	Perceived usefulness (PU)	1. *Online learning system* allows me to complete my program faster (PU1) 2. *Online learning system* improves my skills in completing my assignments (PU2) 3. *Online learning system* improves my productivity in completing assignments (PU3).
Perceived Ease of Use Lee (2010)	Perceived ease of use (PEoU)	1. Online learning system is easy to use (PEoU1) 2. Online learning system is straightforward and easy to comprehend (PEoU2)
Attitude Comp Support Education Cetin and Ozden (2015)	Affection (Aff)	1. Online learning system makes me frustrated (Aff1) 2. Online learning system is boring (Aff2)
	Cognition (Cog)	1. The online learning system has a different skill set (Cog1) 2. Online learning systems have a significant meaning (function) in everyday life (Cog2) 3. Online learning systems make human life easier (Cog3) 4. Online learning systems improve problem-solving skills (Cog4)
	Behavior (Bhv)	1. I always try to follow online learning better (each time) (Bhv1) 2. If I encounter a problem I cannot solve quickly during online learning, I do not quit until I can solve the problem (Bhv2) 3. I always try to finish my online learning before anything else (Bhv3)

Variable	Dimension	Questions
Learning Engagement Manwaring et al. (2017)	Cognitive engagement (CE)	1. Online learning encourages me to study actively during class (CE1). 2. Online learning keeps me active in the class (CE2)
	Emotional involvement (EI)	1. Online learning can keep my attention focused on the class (EI1) 2. I have a good time with online learning during the class session (EI2) 3. Courses became interesting because of online learning (EI3) 4. Online learning reduces the amount of time I spend doing other things in class (EI4) 5. I feel happy when I study using online learning mode (EI5)
Learning Performance	Approached with learning assessment methods by Stiggins (2017) (1) Knowledge (2) Reasoning (3) Skill (4) Product (5) Affect	1. Online learning improves my knowledge acquisition (LP1) 2. Online learning improves my reasoning ability in solving a problem (LP2) 3. Online learning improves my analytical skills (LP3) 4. Online learning improves my skills in delivering works/products (LP4) 5. Online learning improves my skills in turning values as the standards of my behavior (LP5) 6. Online learning improves my grade point averages (GPA) (LP6)

Source: Authors' development.

Confirmatory Factor Analysis and Model Suitability Test. Confirmatory analysis was used to measure the research variables based on the P-value with a significance value below 0.05. Research variable indicators with a loading factor greater than 0.5 were declared valid for measuring the variables. The reliability of the measuring instrument was based on the extract variant values greater than 0.5 and a construct reliability value above 0.7, proving that the research measuring instrument met the reliability requirements. Furthermore, the SRMR, chi square, NFI, and d_ULS values, each with a subsequent value of 0.08 - 0.1, High value, 0.7 - 1.0, and> 0.05 indicated that the research model meets the fit criteria.

Structural Equation Analysis to Test the Existing Hypotheses. To test the hypothesis in this study, a structural equation analysis was carried out using the PLS innovative program. The criteria used for testing were based on the P-value criterion with a cut-off value of C.R. amounting to 0.05.

Results

Respondents Overview

The general description of the respondents describes their characteristics in terms of father's occupation, mother's occupation, and the respondent's family income (Table 2). Most of

the fathers' occupations of the respondents were farmer/fishermen (69%), while the mothers' occupations were mostly farm laborers. Most of the family income level of the respondents was below 1,500,000 IDR or an equivalent of approximately 105.41 USD per month.

Table 2

Characteristics of Respondents

Characteristics	Percentage
Father's occupation	
Farmer/fisherman	69
Government employees	2
Private employees	14
Others	15
Total	100
Mother's occupation	
Housewife	27
Farm workers	47
Merchants	13
Government employees	4
Private employees	4
Others	5
Total	100
Income	
Less than 105.41 USD	72
105.41 USD ~ less than 175.69 US$	20
175.69 USD ~ less than 245.94 US$	5
Greater or equal to 245.94 USD	4
Total	100

Source: Processed primary data.

Another thing that is explained in this sub-chapter is the online learning application programs (services) used by the respondents and the problems they faced during the learning sessions. Most of the respondents used more than one application to participate in the learning sessions. Table 3 shows that WhatsApp (Meta Platforms) was the most used application (39%), followed by the others, including email, zoom (Zoom Video Communications, Inc.), and EdLink (EdLink Sevima Official).

Table 3

Media and Online Learning Problems

Information	Percentage
Types of online application/service	
WhatsApp	39
Email (e.g., Gmail, Outlook, etc.)	24
Zoom	18
EdLink	15

Others (Google Meet, Google Classroom, Telegram)	4
Total	**100**
Problems in the Learning Process	
Lack of understanding	45
Lack of interaction with lecturers and between students	20
Less focus	17
Ineffective submission	15
Limited time	14
Less communicative	10
Too many assignments	7
Disciplinary problems of lecturers and students	6
Cost Problem	71
Charge and signal issues	69

Source: Primary data.

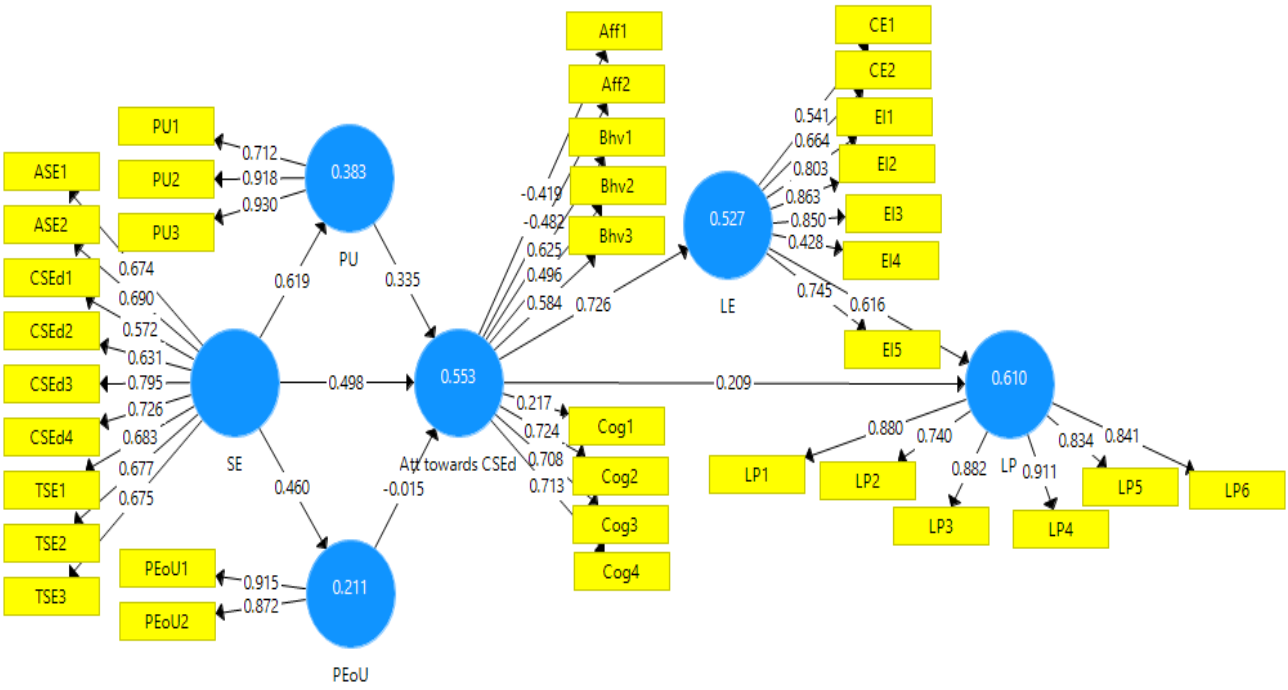
The respondents faced several problems in their attempt to join the online learning. As many as 71% of the students complained about the additional educational expenses as a significant problem. As many as 69% of the students complained about the poor quality of their internet connection. The additional expenses issue was caused by the necessity to purchase an additional credit balance from mobile network operators, subscribe to a broadband plan, and have a laptop or smartphone to attend the learning sessions. Additionally, the problems in the learning process itself were varied, including the difficulties to understand the lessons compared to the face-to-face sessions, lack of interaction between and among the lecturers and the students, lack of focus, ineffective delivery of online learning, perceived time constraints, lack of communication, excessive assignments by, and disciplinary problems by the lecturers and students.

Evaluation of Measurement Model (Outer Model)

The measurement model was evaluated to test the validity and reliability of the research variables, viz. TSE, CSE, ASE, PU, PEoU, attitude toward CSEd, LE, and LP. Figure 2 presents the validity score of each indicator against its construct variable, which is indicated by the value of the loading factor.

Figure 2

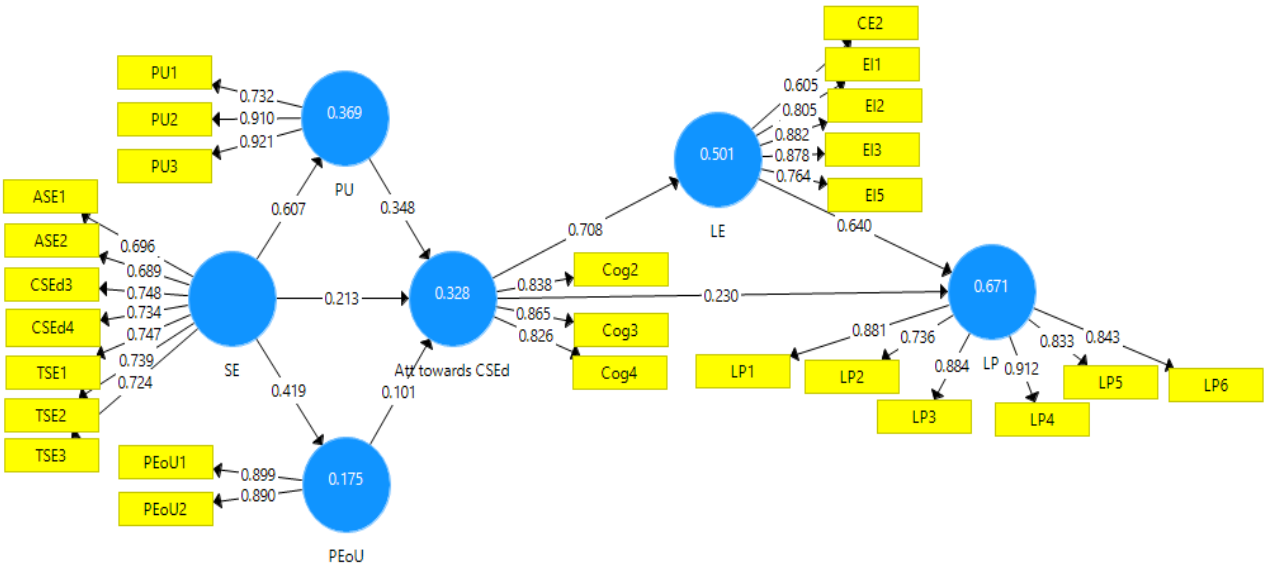
Online Learning Technology Acceptance Model (Model 1)



Based on Figure 2, Aff1, Aff2, Bhv1, Bhv2, Bhv3, Cog1, EI4, CE1, and CSE1 have a loading factor value below 0.6; hence, the removal of these factors resulted in the adjustment of the first model into the second model 2 (Model 2) as depicted in Figure 3.

Figure 3

Online Learning Technology Acceptance Model (Model 2)



The next stage was to test the reliability and validity of the variables. If a variable had Cronbach's alpha, rho_alpha, composite reliability values above 0.7, and an average variance above 0.5, then the variable was categorised as reliable and valid; thus, the consecutive process of structural model (inner model) evaluation could be carried out. The result of the reliability test is presented in Table 4, indicating the Cronbach's alpha, rho_alpha, composite reliability, and average variance values from each variable to be ≥ 0.70, paired with an average variance of more than 0.5; hence, it was concluded that each construct variable is reliable (Farida et al., 2019; Prabowo et al., 2022).

Table 4

Reliability and Validity of Research Variables Model 1

Variables	Cronbach's Alpha	Rho_Alpha	Composite Reliability	Average Variance Extracted
Attitude toward CSEd	0.804	0.808	0.884	0.718
LE	0.853	0.892	0.894	0.631
LP	0.923	0.930	0.940	0.725
PEoU	0.758	0.759	0.892	0.805
PU	0.819	0.824	0.895	0.741
SE	0.854	0.860	0.888	0.530

Source: Processed primary data.

Evaluation of Structural Model (Inner Model)

The structural model (inner model) was evaluated to evaluate the model significance, which was comprised of a significance test and R^2 computation. Based on the significance test, if the effect of the exogenous variable on the endogenous variable was reflected with a t-value above 2.750, then the exogenous variable has a significant effect within the 95% confidence interval range. At the same time, any variable with a t-value below 2.750 would be removed from the model. The R^2 value showed how significant the effects of exogenous variables might influence each variable.

Figure 4

Online Learning Technology Acceptance Model

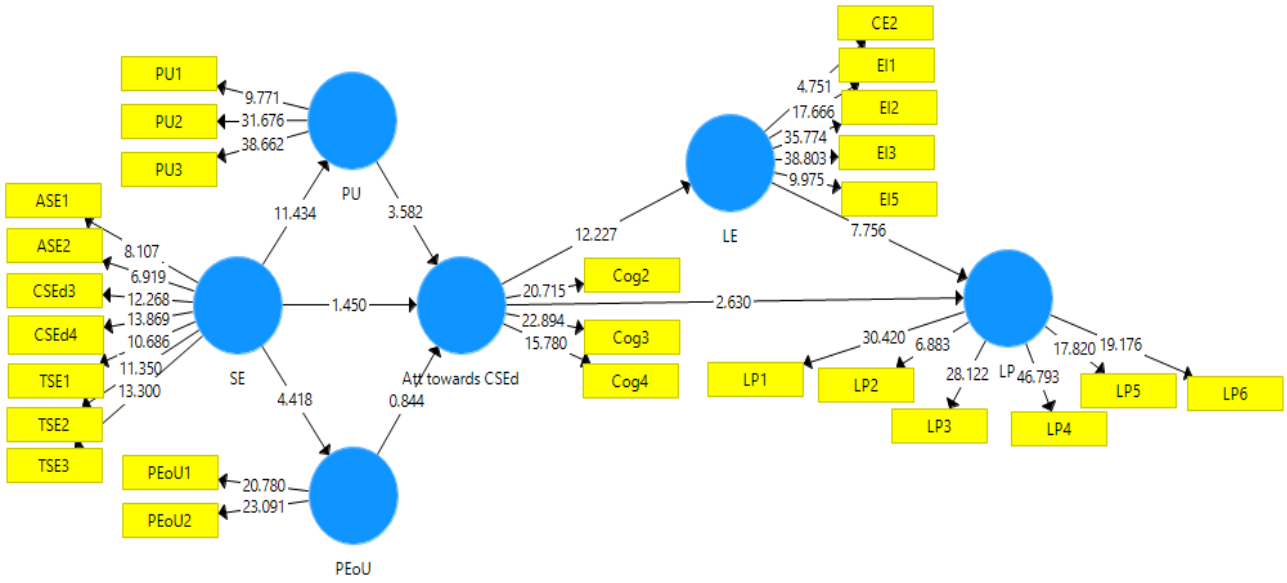


Figure 4 shows that as much as 67% of the LP variable was simultaneously influenced by the LE, attitude toward CSEd, PEoU, PU, and SE variables;. In comparison, the other 33% was affected by other variables not investigated in this research. Table 5 shows that PEoU does not significantly influence Attitude toward CSEd.

Table 5

Significance Test of the Direct Effect

Variable	Original sample	Sample mean	Std dev	t-Stat	p-Value
SE → PEoU	0.425	0.427	0.093	4.591	0.000
SE → PU	0.609	0.621	0.050	12.099	0.000
PEoU → Attitude toward CSEd	0.113	0.114	0.119	0.954	0.341
PU → Attitude toward CSEd	0.470	0.468	0.109	4.299	0.000
Attitude toward CSEd → LE	0.711	0.712	0.058	12.236	0.000
Attitude toward CSEd → LP	0.234	0.224	0.084	2.781	0.006
LE → LP	0.635	0.648	0.082	7.736	0.000

Source: Processed primary data.

Table 6 shows the indirect effects of the research variables. LE significantly mediates the effect of attitude toward CSEd on LP. PU significantly mediates the effect of SE on attitude toward CSEd. PU and attitude toward CSEd significantly mediate the effect of SE on LE and LP. PEoU does not significantly mediate the effect.

Table 6

Significance Test of the Indirect Effect

Variable	Original sample	Sample mean	Std dev	t-Stat	p-Value
SE → PEoU→ Attitude toward CSEd	0.030	0.037	0.057	0.522	0.602
SE → PU→ Attitude toward CSEd	0.371	0.379	0.074	5.040	0.000
SE → PU→ Attitude toward CSEd→ LE	0,271	0.283	0.059	4.593	0.000
SE → PEoU→ Attitude toward CSEd→ LE	0.022	0.021	0.043	0.505	0.613
SE → PU→ Attitude toward CSEd→ LP	0.086	0.087	0.039	2.221	0.027
SE → PEoU→ Attitude toward CSEd→ LP	0.007	0.010	0.015	0,405	0.653
Attitude toward CSEd → LE→ LP	0.438	0.452	0.061	7.163	0.000

Source: Processed primary data.

The consecutive stage was then to test whether or not the overall model is sufficient. For this purpose, a goodness of fit test was conducted using SRMR, and d_ULS values (Dijkstra & Henseler, 2015; Prabowo et al., 2021). The results of the said test are presented in Table 7. Based on the results, the selected model was considered good and fit the distribution of the selected population.

Table 7

Model Fit

Goodness of Fit Index	Score	Cut off value
SRMR	0.08	0.08 – 0.1
d_ULS	2.939	> 0.05

Source: Processed primary data.

Discussion

Acting as the sole university in an area that was relatively remote in Indonesia, an area that has just come out from the category of underdeveloped area, UNDOVA has the vision to become a digital campus and a center for the digitalisation of information systems. In 2019, UNDOVA started the digitalisation program on its campus, which was strengthened by several policies. Nevertheless, the COVID-19 pandemic at the beginning of 2020 has forced online teaching and learning methods, which were initially still in the pilot phase for only a few courses, to be applied to all offered courses being taught. In addition, the respondents with mid-to-lower class incomes, characterised by the parents' common profession of either farmer or fisherman with low income, have a great challenge with the increase in educational expenses. The enforcement of online

learning led to a consequence of having to have a computer/smartphone and the necessity to maintain a sufficient mobile credit balance. Mishra et al. (2020) suggested that efforts should be made to provide students with online learning resources that can be accessed for free so that they can carry out the learning process effectively during the lockdown period. The government of Indonesia has anticipated this issue by providing a free broadband plan under the *Paket Pelajar* (Student Package) program. In 2020, broadband benefits were given for four months. In 2021, the Ministry of Education, Culture, Research, and Technology subsidised the available broadband plan services for three months, from March to May 2021. The distribution of this broadband benefit was carried out between the 11th-15th of each month. The relief for teaching and learning purposes by the ministry in 2021 was 7 GB/month per student for early childhood education, 10 GB/month per student for elementary and secondary education, 12 GB/month for teachers of the said three levels of education and 15 GB/month for college students and lecturers. The given benefit could not be used for social media access and games.

The most critical factors to success in CSEd are attitude and self-reliance (Yeşilyurt et al., 2016). According to Yaqin and Yasin (2024), attitude is a constellation of cognitive, affective, and conative components that interact in understanding, feeling, and behaving towards an object. The results of this study indicated that the attitude toward CSEd was dominated by the cognitive aspect, which showed that students' perception, imagination, judgment, and reasoning on using computers in online learning were important, facilitating, and capable of improving the problem-solving skills. The results align with the findings of Teo and Noyes (2011) and Huang (2021), who stated that perceptions of usefulness and ease of use influence the attitudes of teachers and students toward the use of technology in education. Students thought using computers in online learning during the pandemic was necessary and convenient and enabled them to improve their problem-solving skills.

This study also demonstrates that the learning engagement variables mediated the effectiveness of attitude toward CSEd in improving learning performance. The attitude toward CSEd could effectively improve the learning performance if learning engagement, i.e., cognitive and emotional involvement of the students in following online learning, were good. Kemp et al. (2019) described cognitive engagement as a process enabling users to obtain knowledge. This includes the process of focusing attention, fostering curiosity, and concentrating. Cognitive absorption refers to a state of engagement and flow, which refers to a concentrating state toward one activity without paying attention to anything else (Kemp et al., 2019; Saadé & Bahli, 2005). Emotional involvement is the primary driver of student engagement, which will directly or indirectly impact behavioral and cognitive engagement in the learning process. The students' positive emotion can stimulate their emotion in using knowledge and taking the effective strategies to complete their learning tasks. Completing the current tasks will stimulate their enthusiasm and interest in completing the following learning tasks (Hu & Li, 2017). Therefore, to improve learning performance, online learning materials must be presented in a way that can improve the learning experience, stimulate curiosity, and improve concentration. This will

improve learning engagement through increased cognitive engagement and emotional involvement of the students. Learning materials must be designed to be able to overcome the problems faced by the respondents in the implementation of online learning during the pandemic, such as the difficulties in understanding the lessons, lack of interactions between and among lecturers and students, lack of focus, ineffective delivery, and poor communication.

Another finding of the current research was that attitude toward CSEd was only influenced by PU but not affected by PEoU. This means the students' perception of the ease of using online learning technology was not significantly different from their attitude toward CSEd. This finding was not entirely aligned with the research conducted by Ramayah and Aafaqi (2004), which stated that the attitude toward CSEd was affected by both PU and PEoU. Some reasons that may explain why PEOU does not have a significant effect include the context of information technology used in organisations. Factors such as perceived usefulness are more dominant (Venkatesh et al., 2021). In the case of mobile device usage, PEOU no longer has a significant effect because most people are already familiar with using them (Thong et al., 2006). Organisational policies have a more significant impact than PEOU in influencing technology use in specific contexts. The majority of students in UNDOVA followed the online learning with their smartphones, where only a small number of students used a PC Desktop or laptop; which was indicated by the average ownership of one computer/PC per family, while the average number of the family members who needed to attend online learning with the same device was three people. The utilisation of smartphones was not new for the younger generation, so when they had to follow online lectures, they did not experience any considerable difficulties in the implementation (particularly with smartphones). Hence, the PEoU of online learning technologies did not affect the attitude toward CSEd.

The other finding was that the individual ability or knowledge related to online learning technology, which was also referred to as computer self-efficacy (CSE), was built by teacher self-efficacy (TSE), academic self-efficacy (ASE), and computer self-efficacy (CSE). This means that the effectiveness of the teaching developed the individual ability or knowledge related to online learning technology, students' conviction on their competence to carry out the learning activities, and the individual abilities in using computers (Al-Adwan et al., 2023; Yeşilyurt et al., 2016). Furthermore, this self-efficacy positively influences the individual's ability to use computers through the mediation of PU. This result was aligned with the study conducted by Ramayah and Aaafaqi (2004) which stated that PU was mediated to increase the effectiveness of the students' self-efficacy in using technology. The explanation from Mishra et al. (2020) stated that, for self-efficacy to effectively influence student attitudes in using technology, they must first perceive that online teaching methods have more advantages, particularly during the lockdown period. That self-motivation is the key to the success of the teaching and learning process.

Overall, this study developed a model that describes the influence of SE on LP, mediated by PU, attitude toward CSEd, and LE. This finding is consistent with Ramayah and Aafaqi (2004), who stated that the use of PU as a mediator enhances the effectiveness of SE in utilising technology.

This result is further supported by the findings of Kwon et al. (2014), Ponce et al. (2012), and Yeşilyurt et al. (2016), who concluded that SE affects attitude toward CSEd, and that attitude toward CSEd can improve LP. According to Chen (2017), LP is enhanced through LE.

Limitations of the Study

While this research highlights the importance of self-efficacy and student attitudes, it does not thoroughly explore other potential factors that influence learning performance. Although the study acknowledges the impact of self-efficacy and student independence, it does not examine the role of social factors, such as peer interactions, parental involvement, or support systems. These elements are essential for comprehensively understanding how students engage with computer-supported education. Additionally, while the study suggests improvements in teaching effectiveness, it does not delve deeply into the diverse teaching styles, strategies, and challenges lecturers face in online teaching. Further research in this area is needed to understand better how instructors can effectively support students' self-efficacy.

Conclusion

The most critical factors in achieving computer-supported education were the attitude and self-reliance of the students when encountering computer-supported education. The attitude toward computer-supported education could improve learning performance if learning engagement, i.e., cognitive and emotional involvement of students in online learning, were good. The attitude toward computer-supported education was influenced by self-efficacy and mediated by perceived usefulness. That means the individual ability or knowledge related to online learning technology of a student could be developed by the teaching effectiveness of the lecturers, the students' confidence in their own self-competence to follow the learning activities, and the individual ability to use a computer.

Based on the study's results, improving the students' self-efficacy is advisable by improving the lecturers' teaching effectiveness. Lecturers must improve their teaching effectiveness by creating materials and conveying them to the students more quickly for them to understand, improving their concentration during the learning sessions, and improving the discipline of the students and the lecturers themselves.

Suggestions for Future Research

Further research needs to be conducted with a more holistic and practical approach to improve performance in computer-based education by enhancing students' self-efficacy and independence, particularly in remote areas. The improvement of students' self-efficacy can be achieved through:

A deeper exploration of specific factors that influence students' self-efficacy, such as the social environment, peer support, and parental involvement, is needed to tailor computer-based

teaching to the existing environment better, allowing students' self-efficacy to develop more effectively.

Research focusing on the impact of using various learning technologies (such as online learning platforms, mobile applications, and others) on developing students' self-efficacy and independence in the learning process is needed to gain insights into different learning technologies that can enhance student motivation.

Understanding how social interactions both inside and outside the classroom (such as group discussions or online forums), as well as the role of lecturers in creating a supportive social climate, can contribute to improving students' self-efficacy and enhancing computer-based learning outcomes is also essential. Additionally, a study should also be conducted on the effectiveness of lecturers' teaching—specifically in preparing materials, delivering them in ways that facilitate student understanding, improving student concentration during lessons, and fostering discipline among both students and lecturers.

Comparing online learning with face-to-face learning to identify differences in students' attitudes and self-efficacy in both environments is essential. The findings could guide the best ways to design computer-based education that can be adapted to meet students' needs.

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