Determinants and Moderators of Behavioral Intention to use E-Learning Systems During COVID Era: A Model-Based Cross-Sectional Study in Thailand

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Abstract

This study elaborated on the influencing factors (direct and indirect moderators) of the E-learning utilization in Thailand universities and developed a modified theoretical based on the previous studies combining the factors from different E-learning models. Gender, Age, E-learning Experience, and Technology Innovativeness were included as moderators of direct effects of Perceived Ease of Use and Perceived Usefulness on Attitude. The sample includes 476 students from four public universities in Thailand. Structural equation modeling was used to analyze and develop the theoretical model. Enjoyment was the strongest influencing factor on Perceived Usefulness. Besides, Perceived Usefulness has the greatest total influence on Behavioral Intention to use E-learning. Technology Innovativeness was not a significant moderator for either of direct effects between Perceived Usefulness and Attitude or Perceived Ease of Use and Attitude. Age and Experience moderated the direct effect of Perceived Ease of Use on Attitude. This study enhances the current knowledge related to behavior and attitude toward as well as the determinant factors of E-learning use among Thai students. The results could inform the future practice of digital learning and promote the theoretical understanding of the E-learning framework in similar settings.

Keywords: E-learning, Mediators, Moderators, Technology Acceptance, learning model

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Introduction

The traditional pattern has existed for centuries in the fields of teaching and learning; so that class existed, and the physical presence of students and teachers was required, and other forms of education were used with suspicion. With the advent of computers, the perspective of learning and education changed. E-learning is a computer-based learning tool or system that allows us to learn anywhere and anytime (Abdullah et al., 2017).

The widespread schools and universities closure due to the COVID-19 epidemic has compelled a substantial number of institutions to use online platforms and E-learning measures to deliver educational materials and resources to the students for the first time (Huang et al., 2020). This could have a long-lasting impact on the educational system after the COVID-19 epidemic and E-learning could become an inevitable component of education afterward (Lockee, 2021). However, there are several issues such as instructive tutoring, learner procrastination, social isolation, and technological distraction that could impair the gain and education outcome (Broadbent, 2017; Margaryan et al., 2015; Rasheed et al., 2020), which could result in higher drop-out rate due to the leaner dissatisfaction (O'Neill & Sai, 2014; Pursel et al., 2016). During the COVID-19 epidemic, the unexpected and sudden transition from traditional to more sophisticated measures of learning such as online platforms and E-learning apps have also had some technical complexities and challenges for both learners and instructors such as technological insufficiencies in remote areas, poor knowledge/attitude toward online platforms and sense of alienation and boredom (Toader et al., 2021).

Thus, it is of great importance to explore the influencing factors that could impact the learner's intention and attitude toward using E-learning measures. This could surface the challenges and difficulties that learners may encounter using online platforms and reveal the shortfalls in existent online learning practice. It would be valuable for informing the online learning in post COVID era; when E-learning would definitely be an inextricable component of the education system worldwide. Moreover, identifying the factors that could have an impact on learners' intention and attitude toward using the online platform could communicate invaluable knowledge and inform the future platform to provide appropriate online educational materials and resources and improve the learner's experience and gain from such online learning measures. Besides, previous research mostly focused on the main constructs of online platforms and the potential effects of mediators and moderators such as age, gender, experience, and Technology innovativeness have not been considered properly.

Previous literature has demonstrated a number of influencing factors that could affect learners' intention and attitude toward using online platforms for learning purposes (Abdullah & Ward, 2016; Al-Gahtani, 2016; Cidral, Oliveira, Di Felice, & Aparicio, 2018). The theory of technology acceptance was first suggested by Davis (1985) and consists of core variables including Perceived Usefulness and Perceived Ease of Use and is expanded by some other variables, such as Self-Efficacy and Self-Perception (Scherer et al., 2019). The underlying relationship between and role of these unique components within a comprehensive framework; however, is not yet clear and more research is necessary to disentangle the cohesive effect and interaction between these factors and their potential role in shaping the learners' attitude and intention to use online platforms.

Most of the studies concerning the intention and attitude toward using online platforms among university students have been conducted in western countries; where the online platform and E-learning measures existed long before the COVID-19 epidemic and were well adopted by the students and instructors; however, there is a scarcity of research concerning the influencing factors of E-learning intention-to-use in developing countries such as Thailand in which the concept of online learning is novel and there are several unknown aspects to be revealed. The COVID-19 provided a unique opportunity for research in online learning platforms' efficiency and influencing factors on intention-to-use among learners and instructors in Asian developing countries such as Thailand. We took this opportunity to

evaluate the effects of influencing moderators for intention-to-use online learning platforms among a sample of university students in Thailand. We hypothesized that the Gender, Age, E-learning Experience, and Technology Innovation could moderate the effect of Perceived Usefulness and Perceived Ease of Use on the Attitude and Behavioral Intention to Use online learning platforms among Thai students by suggesting a hypothetical model and examined the interplay between these construct using Structural Estimating Model (SEM) and developing a fitted model that could best explain these relationships.

Proposed Model

Existing literature clarifies the complexity of E-learning system nature and shows that the Attitude toward E-learning systems directly affects the learner intention to use. A preliminary semi-structured interview with Learners (n=5) supported the idea of a hypothetical relationship between learners' demographic characteristics and the intention to use E-learning systems with Perceived Usefulness, Perceived Ease of Use, and all external constructs that are in the proposed model. Thus, integrating the key construct from relevant models into one theoretical framework for predicting intention to use in E-learning contexts. Accordingly, this study pro-

poses the following model to investigate Thai university students' online learning intention based on the theory of TAM and UTAUT. Figure 1 illustrates the hypothetical model and the schematic description of the hypotheses that were developed in the present study and reflects on the moderator effects of AGE, Gender, E-learning Experience, and Technology Innovativeness on such effects. Against these hypotheses, we developed a modified model that best explained the moderator effects of and the interplay between the study variables.

Methods

Study Design

This analytical cross-sectional study was conducted from September 2020 to December 2020 to explore the Thai students' experiences using E-learning systems. This method has been used successfully in prior studies of E-learning. The design decisions for this study were informed by the guideline provided by Neuman (2006).

Study Setting and Population

The study was conducted among Thai students aged at least 18 years and had experience using an E-learning system at four public universities in Thailand; namely, Assumption University (Bangkok), Chulalong-
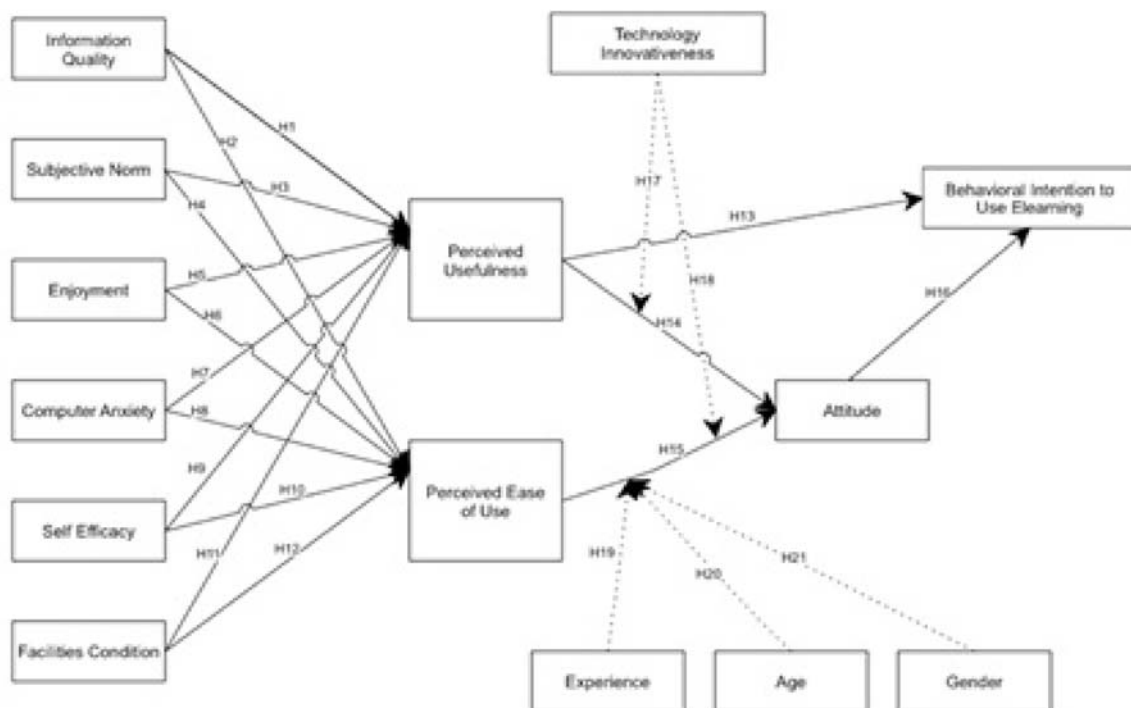

Figure 1. The primary proposed theoretical model and the hypotheses assumed in the present study

korn University (Bangkok), Rajapruk University (Phuket), and Walailak University (Nakhon Si Thammarat). With 5 percent precision and a 95 percent confidence level, a minimum sample size of 400 has been proposed (Taherdoost, 2016) to ensure the statistical validity of the study, especially the use of SEM. A purposive sampling method was used to distribute questionnaires to the members of the target population through the Google form platform. This was accomplished through online and social channels with the assistance of personal contacts in each setting.

Measurement and Scales

Based on a comprehensive review of relevant literature and a focus group discussion with the experts, we developed a self-administered questionnaire in both the English and Thai languages (appendix 1). The questionnaire collected data in two sections including questions related to the students' sociodemographic information and questions related to the latent variables in the proposed theoretical model based on a 5-point Likert scale (1=completely disagree, 5=completely agree). The construct of the questionnaire's items was instructed by the derived dimensions from previous studies as described in Table 1. To ensure the face validity of the questionnaire, we conducted a discussion panel including 10 E-learning system bilingual experts. Both English and Thai versions of the questionnaire were reviewed and additional recommended revisions were included in the final versions. Construct validity (convergent and discriminant) was examined using Principal Axis Factor analysis (Table 2). The indicators had satisfactory construct (convergent and discriminatory) validity. Each indicator has a factor loading with a magnitude of at least 0.4 or more on only its associated latent variable

with an associated eigenvalue of at least 1 (Straub, Boudreau, & Gefen, 2004). The Equivalence Reliability (internal consistency) for the sets of indicators for the latent model variables was examined using Cronbach alpha coefficients. Each of the coefficients exceeded the acceptable value of 0.4 according to the interpretation by (Gliem & Gliem, 2003). The values for all CR and AVE values of the latent variables were greater than 0.7 and 0.5, respectively. Moreover, the value of √AVE was greater than the correlation coefficients for correlations between each latent variable and other latent variables. This suggested an acceptable discriminant validity for the measures of the latent variables (Fornell & Larcker, 1981).

Data Analysis

The data were entered into an SPSS worksheet by the principal investigator. A random sample of 49 questionnaires was selected to check for the accuracy of data entry. No errors were found, and there were no missing values for any of the variables. However, 14 questionnaires were removed from the sample because they contained at least one outlier value for a variable and the records of 476 participants were included in the final analysis. Descriptive statistics were employed to describe the characteristics of the participants. Principal Axis Factor analysis examined the construct and reliability of the questionnaire. The structural equation modeling (SEM) was employed to construct different hypothetical theoretical models using drawing tools in IBM SPSS Amos software V.6 and the correlation coefficients and causal effects between the different constructs and were estimated and compared across different models and the best-fitted model was selected. The significant statistical level was set at 0.05.

Table 1. Latent variables based on the dimension derived from previous studies

Variable	Indicator	Measuring instrument	Existing Measuring Instrument
Information Quality (IQ)	IQ1	The information provided by the E-learning system is useful.	(Cidral et al., 2018) (Yakubu & Dasuki, 2018)
	IQ2	The information provided by the E-learning system is understandable.	
	IQ3	The information provided by the E-learning system is interesting.	
	IQ4	The information provided by the E-learning system is reliable.	
Subjective norm (SN)	SN1	People who influence my behavior would think that I should use E-learning.	(Abdullah & Ward, 2016)
	SN2	People who are important to me would think that I should use E-learning.	
	SN3	My friends think that I should use E-learning.	
Enjoyment (ENJOY)	ENJOY1	I find using E-learning enjoyable.	(Abdullah & Ward, 2016)
	ENJOY2	The actual process of using E-learning is pleasant.	
	ENJOY3	I have fun using E-learning.	
Computer anxiety (CA)	CA1	Computers do not scare me at all.	(Abdullah & Ward, 2016)
	CA2	Computers make me feel uncomfortable.	
	CA3	Working with computer makes me nervous.	
Self-efficacy	SE1	I am confident of using E-learning even if there is no one around to show me how to do it.	(Abdullah & Ward, 2016)
	SE2	I am confident of using E-learning even if I have never used such a system before.	
	SE3	I am confident of using E-learning even if I have only the software manuals for reference.	
Facilitating Conditions (FC)	FC1	My University usually provides support for E-learning	(Thomas, Singh, & Gaffar, 2013)
	FC2	My university provides support for E-learning (such as infrastructure, technical support, network premium, etc.)	
	FC3	I possess the resources and materials necessary to use E-learning.	
	FC4	I possess the knowledge necessary to use E-learning.	
	FC5	I received appropriate support when I encountered a problem with E-learning system.	

Table 1. (Continue)

Variable	Indicator	Measuring instrument	Existing Measuring Instrument
Perceived Usefulness (PU)	PU1	I believe that E-learning could allow me to accomplish learning tasks more quickly.	(Davis, 1985) (Elkaseh, Wong, & Fung, 2016)
	PU2	I believe that E-learning has improved my learning performance.	
	PU3	I believe that E-learning would enhance my effectiveness in learning.	
Perceive ease of use (PEOU)	PEOU1	Learning to use E-learning would be easy for me.	(Davis, 1985) (Elkaseh et al., 2016)
	PEOU2	It is easy to get the E-learning to do what I want it to do.	
	PEOU3	I am quite clear on my interaction and understand my responsibilities using E-learning	
Technology innovativeness (TI)	TI1	If I heard about new information technology, I would look for ways to try it out.	(Ngafeeson & Sun, 2015)
	TI2	Among my peers, I am usually the first to try out new information technologies.	
	TI3	I like to experiment with new information technologies	
Behavioral Intention	BI1	Assuming I had access to the E-learning, I intend to use it.	(Venkatesh & Davis, 2000) (El Alfy, Gómez, & Ivanov, 2017)
	BI2	Given that I had access to the e-learning, I predict that I would use it.	
	BI3	I plan to use E-learning in the future.	
Experience (EXP)	EXP1	I enjoy using computers.	(Abdullah & Ward, 2016)
	EXP2	I am comfortable using the internet.	
	EXP3	I am comfortable saving and locating files.	
Attitude (ATT)	ATT1	Using E-Learning technologies is a good idea.	(El Alfy et al., 2017)
	ATT2	I would like to use E-Learning technologies.	
	ATT3	I believe that working with E-Learning technologies would be fun.	

Table 2. Validity and reliability of the questionnaire using Principal Axis Factor analysis

Latent Variable		Loading	Initial Eigenvalues			CR	AVE (√AVE)	Cronbach Alpha	Interpretation
			Total	Percent of Variance	Cumulative Percent				
Information Quality	IQ4	.685	1.418	3.635	72.815	.880	.590 (.768)	.927	Excellent
	IQ1	.665							
	IQ3	.656							
	IQ2	.646							
Subjective norm	SN2	.840	3.007	7.710	60.259	.902	.698 (.835)	.943	Excellent
	SN1	.770							
	SN3	.736							
Enjoyment	ENJOY1	.698	1.042	1.930	83.433	.856	.599 (.774)	.946	Excellent
	ENJOY3	.685							
	ENJOY2	.650							
Computer anxiety	CA3	.958	1.037	1.880	85.313	.821	.534 (.731)	.948	Excellent
	CA2	.926							
	CA1	.858							
Self-efficacy	SE2	.756	1.335	3.423	76.238	.909	.768 (.876)	.941	Excellent
	SE3	.725							
	SE1	.714							
Perceived Usefulness	PU2	.721	1.065	2.731	78.970	.881	.711 (.843)	.960	Excellent
	PU3	.720							
	PU1	.655							
Perceive ease of use	PEOU2	.679	1.015	1.647	86.960	.881	.711 (.843)	.909	Excellent
	PEOU1	.639							
	PEOU3	.639							
Attitude	ATT2	.741	1.058	2.534	81.504	.881	.711 (.843)	.949	Excellent
	ATT1	.685							
	ATT3	.612							
TechnologyInnovativeness	TI2	.825	1.904	4.882	65.141	.881	.711 (.843)	.943	Excellent
	TI3	.775							
	TI1	.754							
Behavioral Intention	BI1	.684	1.004	1.408	88.368	.881	.711 (.843)	.925	Excellent
	BI2	.645							
	BI3	.539							

Table 2. (Continue)

Latent Variable		Loading	Initial Eigenvalues			CR	AVE (√AVE)	Cron-bach Alpha	Interpre-tation
			Total	Percent of Variance	Cumulative Percent				
Experience	EXP2	.776							
	EXP1	.715	1.575	4.039	69.180	.812	.591 (.769)	.937	Excellent
	EXP3	.776							
Facilitating Conditions	FC2	.721							
	FC1	.711							
	FC5	.681	3.007	7.710	60.259	.812	.591 (.769	.947	Excellent
	FC3	.662							
	FC4	.622							

The Rotation Method engaging the Equamax with Kaiser Normalization was used to report the statistics. Rotation was converged in 9 iterations.

Results

Sociodemographic Characteristics

There was almost an equal number of male and female respondents in the present study. The mean age was 22.3 years. The majority of the respondents were at Bachelor's programs. The most frequent platform for E-learning was google.

Variable Selection

Table 4 indicates the descriptive statistics for the variables and their indicators in the modified the-oretical model. Using the standard deviations of indi-cators as the weight, a single scale measure for each latent variable was calculated as the weighted mean of the values of the indicators. As it is noted in the Ta-ble, the magnitudes of skewness and kurtosis are less than 3 and 7, respectively so that the data is considered acceptable for the use of the maximum likelihood esti-mation technique in structural equation modeling (SEM) analyses (Kline & Walters, 2016).

Table 3. Sociodemographic characteristics of the student

	N (%)
Age in year (mean±SD)	22.3 ± 2.1
Gender	
Male	219 (46)
Female	257 (54)
Level of Education	Frequency
Bachelor degree	439 (92.2)
Master degree	33 (6.9)

Table 3. (Continue)

	N (%)
Doctoral degree	4 (.9)
Platform Used	
Moodle	34 (7.1)
Google	264 (55.5)
MS Team	66 (13.9)
Zoom	96 (20.1)
Other (LMS, Plook, Schoology)	16 (3.4)
Total	476

Table 4. Descriptive statistics for latent variables in the modified model

Variable/ Indicator	Mean	Std. Dev.	Skewness	Kurtosis	Variable/ Indicator	Mean	Std. Dev.	Skewness	Kurtosis
Information Quality	3.80	.809	-.260	-.406	Perceived Usefulness	4.55	.511	-.927	-.107
IQ1	3.96	.821	-.285	-.690	PU1	4.56	.601	-1.010	-.003
IQ2	3.71	.919	-.231	-.560	PU2	4.64	.541	-1.173	.376
IQ3	3.71	.930	-.257	-.507	PU3	4.44	.651	-.751	-.492
IQ4	3.84	.888	-.452	-.061	PU4	4.59	.558	-.931	-.156
Subjective Norm	3.43	1.025	-.278	-.486	Perceived Ease of Use	4.60	.488	-.930	-.077
SN1	3.46	1.043	-.324	-.492	PEU1	4.52	.561	-.652	-.615
SN2	3.45	1.078	-.310	-.490	PEU2	4.60	.563	-1.033	.066
SN3	3.38	1.122	-.196	-.600	Technology Innovativeness	3.51	1.000	-.352	-.195
Enjoyment	3.49	1.053	-.382	-.546	TI1	3.51	1.019	-.251	-.248
ENJOY1	3.61	1.083	-.593	-.257	TI2	3.45	1.086	-.316	-.389
ENJOY2	3.49	1.087	-.313	-.568	TI3	3.56	1.060	-.416	-.321
ENJOY3	3.37	1.150	-.261	-.674	Behavioral Intention	3.89	.849	-.149	-.916
Computer Anxiety	2.93	1.160	-.073	-.999	BI1	3.71	.986	-.457	-.134
CA1	3.13	1.113	-.113	-.601	BI2	3.65	.931	-.211	-.329
CA2	2.86	1.286	.006	-1.084	BI3	3.62	1.028	-.336	-.388
CA3	2.83	1.263	.006	-1.045	Experience	4.40	.739	-1.005	.252

Table 4. (Continue)

Variable/ Indicator	Mean	Std. Dev.	Skewness	Kurtosis	Variable/ Indicator	Mean	Std. Dev.	Skewness	Kurtosis
Self-Efficacy	3.60	.946	-.330	-.354	EXP1	3.81	.991	-.505	-.268
SE1	3.64	1.017	-.404	-.329	EXP2	3.89	1.038	-.622	-.278
SE2	3.59	.994	-.341	-.312	EXP3	3.81	.981	-.420	-.491
SE3	3.57	.989	-.240	-.444	Attitude	3.60	1.018	-.319	-.578
Facilitating Conditions	3.64	.872	-.238	-.441	ATT1	3.64	1.065	-.356	-.551
FC1	3.68	.966	-.315	-.372	ATT2	3.58	1.088	-.398	-.423
FC2	3.61	1.013	-.282	-.531	ATT3	3.59	1.051	-.245	-.636
FC3	3.67	.925	-.271	-.397	Perceived Ease of Use	3.71	.839	-.053	-.917
FC4	3.66	.934	-.188	-.563	PEOU1	3.70	.972	-.138	-1.006
FC5	3.56	.953	-.241	-.253	PEOU2	3.82	.857	-.109	-.849
Perceived Usefulness	3.34	1.129	-.319	-.599	PEOU3	3.62	.893	-.010	-.625
PU1	3.37	1.170	-.299	-.659					
PU2	3.31	1.168	-.262	-.627					
PU3	3.34	1.184	-.333	-.632					

Distributions of Moderators

Based on the characteristics of the distributions for four moderator variables (Technology Innovativeness, Experience, Gender, and Age), we decided to form two groups for each variable as described in Table 5. Table 6 presents a range of descriptive statistics for distributions of variables for each of the groups in Table 5.

Table 5. Groups used for moderator analyses

Moderator	Group 1 (Size)	Group 2 (Size)	Basis Used to Form Groups
Gender	Males (219)	Females (257)	Nominal Category
Age	21 years or younger (252)	22 years or older (224)	Mode = Median= 21 years
Technology Innovativeness	Score of 3.33 or less (232)	Score of 3.34 or more (244)	Median = 3.3
Experience	Score less than 4 (227)	Score of 4 or more (249)	Median = 4

Table 6. Descriptive statistics for variables within each group

Group/ Statistic	Information Quality (IQ)	Subjective Norm (SN)	Enjoyment (ENYOY)	Computer Anxiety (CA)	Self-Efficacy (SE)	Facilitating Conditions (FC)	Perceived Usefulness (PU)	Perceived Ease of Use (PEOU)	Technology Innovativeness (TI)	Behavioral Intention (BI)	Experience (EXP)	Attitude (ATT)
Gender												
Group 1: Males												
Mean	3.685	3.367	3.389	2.889	3.430	3.496	3.190	3.616	3.427	3.525	3.640	3.502
Standard Deviation	.814	1.035	1.066	1.034	1.003	.914	1.145	.819	.980	.937	.990	.995
Skewness	-.213	-.284	-.282	-.091	-.277	-.144	-.262	.185	-.237	-.263	-.343	-.286
Kurtosis	-.215	-.369	-.648	-.567	-.414	-.490	-.575	-.783	-.093	-.117	-.383	-.333
Group2: Females												
Mean	3.900	3.482	3.567	2.966	3.746	3.757	3.467	3.790	3.573	3.775	4.003	3.693
Standard Deviation	.794	1.017	1.036	1.259	.870	.818	1.102	.848	1.015	.888	.875	1.031
Skewness	-.298	-.270	-.471	-.091	-.261	-.256	-.361	-.256	-.460	-.434	-.715	-.370
Kurtosis	-.565	-.592	-.402	-1.260	-.546	-.447	-.625	-.887	-.196	-.147	-.006	-.731
Age												
Group 1: 21 Years or Younger												
Mean	3.678	3.179	3.299	2.967	3.454	3.552	3.115	3.621	3.345	3.498	3.727	3.410
Standard Deviation	.806	1.049	1.065	1.107	.975	.849	1.145	.814	1.029	.925	.998	1.071
Skewness	-.096	-.154	-.239	-.100	-.180	-.158	-.115	.134	-.316	-.251	-.508	-.143
Kurtosis	-.386	-.618	-.674	-.806	-.454	-.224	-.724	-.893	-.210	-.180	-.379	-.707
Group 2: 22 Years or Older												
Mean	3.938	3.710	3.694	2.890	3.765	3.732	3.592	3.809	3.687	3.842	3.958	3.824
Standard Deviation	.791	.923	1.000	1.219	.886	.890	1.058	.857	.936	.878	.871	.908
Skewness	-.461	-.297	-.544	-.033	-.472	-.354	-.546	-.270	-.324	-.484	-.525	-.414
Kurtosis	-.205	-.409	-.241	-1.174	-.100	-.564	-.170	-.807	-.310	.015	-.249	-.436
Technology Innovativeness												
Group 1: Score of 3.33 or Less												
Mean	3.452	3.021	3.003	2.909	3.176	3.281	2.836	3.313	2.692	3.176	3.421	3.128

Table 6. (Continue)

Group/ Statistic	Information Quality (IQ)	Subjective Norm (SN)	Enjoyment (ENYOY)	Computer Anxiety (CA)	Self-Efficacy (SE)	Facilitating Conditions (FC)	Perceived Usefulness (PU)	Perceived Ease of Use (PEOU)	Technology Innovativeness (TI)	Behavioral Intention (BI)	Experience (EXP)	Attitude (ATT)
Standard Deviation	.743	.899	.956	1.006	.878	.782	1.009	.747	.663	.813	.918	.890
Skewness	.064	-.170	-.111	-.193	-.194	.103	-.038	.431	-1.222	-.103	-.185	.149
Kurtosis	-.183	-.166	-.462	-.591	.033	-.186	-.314	-.241	.533	.568	-.191	.021
Group 2: Score of 3.34 or More												
Mean	4.131	3.817	3.944	2.952	4.005	3.975	3.818	4.087	4.280	4.120	4.230	4.059
Standard Deviation	.727	.989	.929	1.292	.824	.819	1.026	.742	.552	.764	.792	.921
Skewness	-.696	-.686	-.873	-.037	-.545	-.753	-.838	-.533	.084	-.846	-1.043	-1.058
Kurtosis	.571	-.032	.487	-1.296	-.402	.576	.282	-.406	-1.423	.965	.968	.934
Experience												
Group 1: Score Less Than 4												
Mean	3.401	3.049	2.964	3.113	3.143	3.186	2.815	3.219	3.034	3.138	3.006	3.032
Standard Deviation	.680	.900	.939	.898	.831	.727	.951w	.643	.819	.734	.621	.793
Skewness	.096	-.188	-.064	-.307	-.242	-.022	-.277	.330	-.530	-.443	-1.241	-.208
Kurtosis	.322	-.086	-.396	-.178	.112	.368	-.259	.134	.716	.859	1.420	.485
Group 2: Score of 4 or More												
Mean	4.164	3.775	3.960	2.765	4.018	4.048	3.818	4.157	3.936	4.136	4.592	4.127
Standard Deviation	.743	1.012	.918	1.337	.847	.787	1.066	.740	.957	.804	.399	.915
Skewness	-.927	-.643	-.943	.198	-.708	-.811	-.809	-.747	-.815	-.981	-.367	-1.111
Kurtosis	.946	-.207	.742	-1.337	.089	.506	-.032	-.033	.208	1.054	-1.424	.757

Moderators Distribution; By Group

Significant results from t-tests showed that (p < 0.05):

(a) Computer Anxiety has a neutral to low level of importance among the participants, especially among participants with more Experience;

(b) Subjective Norm and Enjoyment have a mainly neutral level of importance among participants with lower scores for Technology Innovativeness and less Experience

(c) Participants with less Experience assign mainly a neutral level of importance to Technology Innovativeness. They have neutral level attitudes toward e-learning systems and neutral level intentions to use these systems in the future

(d) The mean values of:

(i) Subjective Norm, Enjoyment, Computer Anxiety, and Technology Innovativeness ware the same for males and females;

(ii) Computer Anxiety between younger and older participants as well as participants with lower and higher Technology Innovativeness scores was the same.

Correlation Between Moderation in Modified Models

Table 7 indicates the model variables' correlation coefficients. All of the correlations were significant and positive at p < 0.05. The 16 direct effects that exist in the modified theoretical model are indicted in gray cells (Figure 2).

Table 7. Correlations among model variables

Variable	Information Quality (IQ)	Subjective Norm (SN)	Enjoyment (ENYOY)	Computer Anxiety (CA)	Self-Efficacy (SE)	Facilitating Conditions (FC)	Perceived Usefulness (PU)	Perceived Ease of Use (PEOU)	Technology Innovativeness (TI)	Behavioral Intention (BI)	Experience (EXP)	Attitude (ATT)
IQ	1											
SN	.570	1										
ENJOY	.698	.655	1									
CA	.024	.072	-.008	1								
SE	.636	.516	.599	-.047	1							
FC	.615	.479	.606	-.042	.643	1						
PU	.632	.642	.719	.032	.609	.637	1					
PEOU	.661	.522	.670	-.095	.655	.647	.688	1				
TI	.501	.479	.573	-.020	.577	.519	.542	.543	1			
BI	.687	.548	.706	-.064	.613	.668	.708	.714	.634	1		
EXP	.567	.417	.566	-.199	.590	.613	.525	.608	.534	.677	1	.
ATT	.606	.617	.714	-.044	.519	.615	.736	.656	.591	.735	.648	1

Model Analyses

IBM SPSS Amos software was used to perform the SEM. The following format was used to report the effects; the unstandardized effect marked by *, **, ***, or NS, indicating the level of statistical significance of 0.05, 0.01, 0.001, or not statistically significant, respectively. The standardized effect is shown in parenthesis and its magnitude was scaled as follows: Small (S, ≤ 0.1), Medium (M, between 0.1 and 0.5), or Large (L, ≥ 0.5) based on Cohen (1988) criteria.

The Modified Theoretical Model Development Using SEM Analysis

Figure 2 indicates the direct effects of moderators in the modified theoretical model from the SEM analysis.

The fit statistics for the modified theoretical model are χ^2 = 959.112, df = 464, NC = χ^2/df = 2.067, RMR = 0. 055, GFI = 0. 891, AGFI = 0.868, NFI = 0.947, IFI = 0.972, CFI = 0.972, and RMSEA = 0.047, meeting the standard assessment criteria proposed by Kline (2016). A satisfactory level of the variance for each endogenous variable was observed; Attitude (0. 647), Perceived Usefulness (0.682), Perceived Ease of Use (0.694), Behavioral Intention (0.666)). The three (3) direct effects that are not statistically significant in Figure 2 (Information Quality → Perceived Usefulness, Subjective Norm → Perceived Ease of Use, and Computer Anxiety → Perceived Usefulness) were made optional in a specifi-
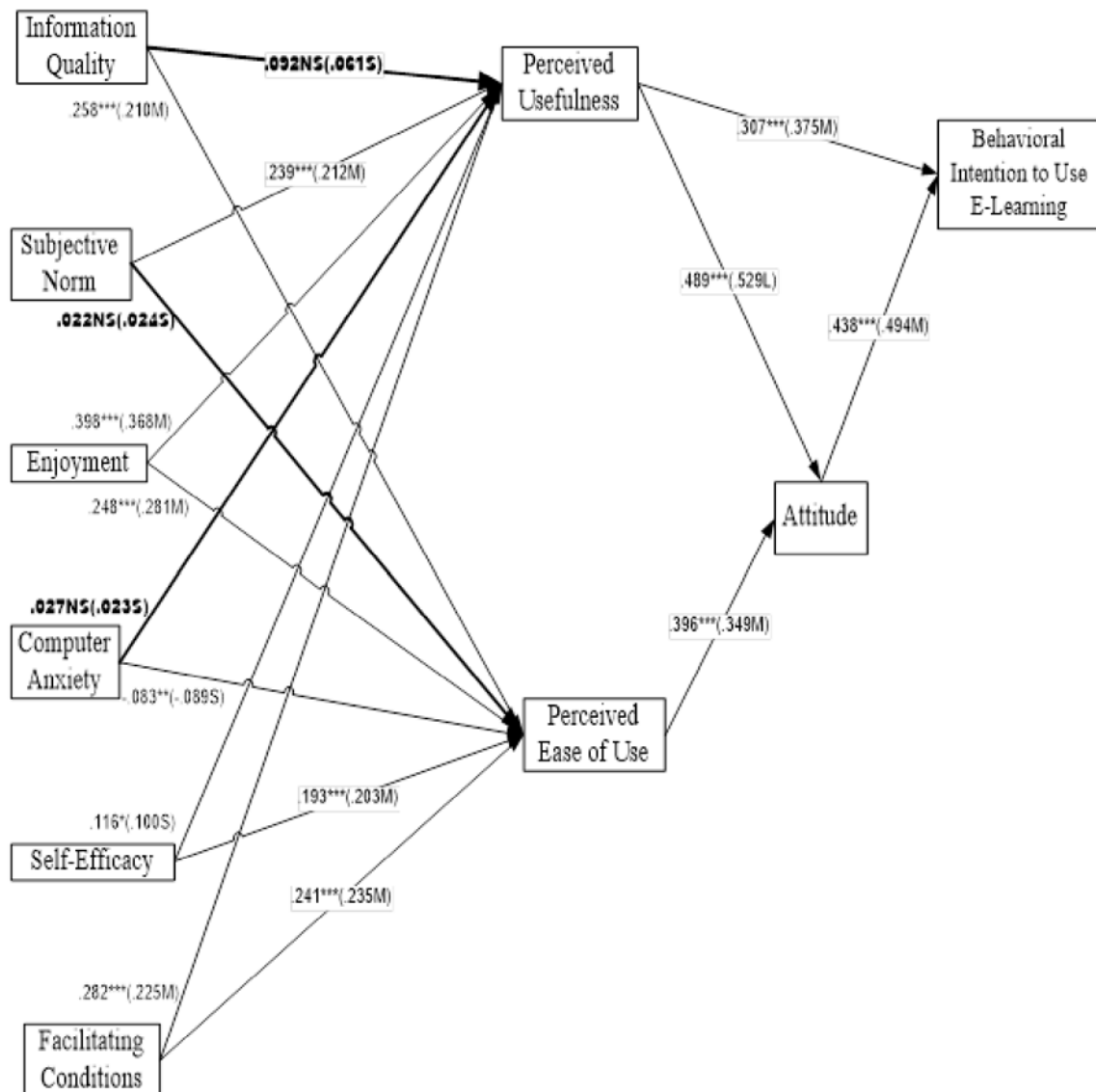

Figure 2. Direct effects in the modified theoretical model

cation search of the resulting hierarchy of 2^3 = 8 models. Following Kline (2016), the model with the smallest value for NC was selected as the final model shown in Figure 3.

The fit statistics for the final model are slightly better than for the theoretical model but the final model is preferred as being a simpler model with the three direct effects Information Quality → Perceived Usefulness, Subjective Norm → Perceived Ease of Use, and Computer Anxiety → Perceived Usefulness) not included. Fit statistics for the final model are χ^2 = 961.529, df = 467, NC = 2.059, RMR = 0.056, GFI = 0.900, AGFI = 0.869, NFI = 0. 947, IFI = 0.972, CFI = 0.972, and RMSEA = 0.047. Compared to the modified model, the fit sta-

tistics for the final model are improved. The proportion of the variance of each endogenous variable that is explained is satisfactory (Attitude (0.646), Perceived Usefulness (0.682), Perceived Ease of Use (0.694), Behavioral Intention (0.666). However, it is should be noted that the modifications made to construct the final model are exploratory and are merely based on the empirical evidence from the sample of participants. Table 7 illustrates the statistics for the analysis of the final model. Applying the heuristic model suggested by Cohen (1983), the indirect effects of moderators were determined. Using nonparametric bootstrapping with 1,000 random samples, the statistical significance of totals of effects was also determined in the final model.
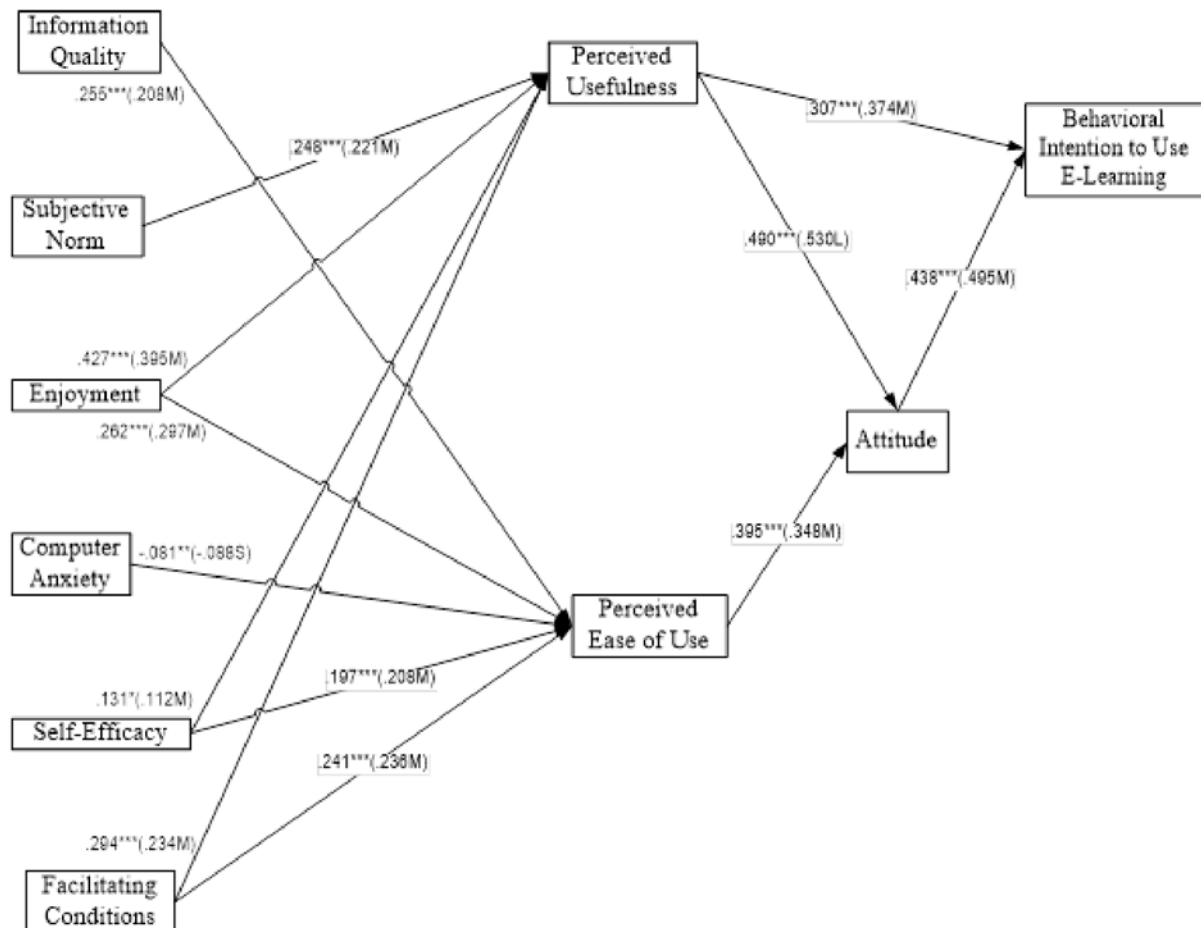

Figure 3. Direct effects of the final model

Table 7. Analysis of the final model

Variable	Effect	Endogenous Variable			
			Intervening		Dependent
		Perceived Use-fulness (PU)	Perceived Ease of Use (PEOU)	Attitude (ATT)	Behavioral Intention to Use E-Learning (BI)
Information Quality (IQ)	Direct	Nil	.255***(.208M)	Nil	Nil
	Indirect	Nil	Nil	IQ-PEOU-ATT .101***(.072S)	IQ-PEOU-ATT-BI .044***(.014S)
	Total Indirect	Nil	Nil	.101***(.072S)	.044***(.014S)
	Total	**Nil**	**.255***(.208M)**	**.101***(.072S)**	**.044***(.014S)**
Subjective Norm (SN)	Direct	.248***(.221M)	Nil	Nil	Nil
	Indirect	Nil	Nil	SN-PU-ATT .122***(.117M)	SN-PU-BI .076***(.083S) SN-PU-ATT-BI .053***(.058S)
	Total Indirect	Nil	Nil	.122***(.117M)	.129***(.141M)
	Total	**.248***(.221M)**	**Nil**	**.122***(.117M)**	**.129***(.141M)**
Enjoyment (ENJOY)	Direct	.427***(.395M)	.262***(.297M)	Nil	Nil
	Indirect	Nil	Nil	ENJOY-PU-ATT .209***(.209M) ENJOY-PEOU-ATT .103***(.103M)	ENJOY-PU-BI .131***(.148M) ENJOY-PU-ATT-BI .092***(.104M) ENJOY-PEOU-ATT-BI .045***(.051S)
	Total Indirect	Nil	Nil	.235***(.312M)	.278***(.303M)
	Total	**.427***(.395M)**	**.262***(.297M)**	**.235***(.312M)**	**.278***(.303M)**
Computer Anxiety (CA)	Direct	Nil	-.081**(-.088S)	Nil	Nil
	Indirect	Nil	Nil	CA-PEOU-ATT - .032**(.031S)	CA-PEOU-ATT-BI - .014**(- .015S)
	Total Indirect	Nil	Nil	- .032**(.031S)	- .014**(- .015S)
	Total	**Nil**	**-.081**(-.088S)**	**- .032**(.031S)**	**- .014**(- .015S)**

Table 7. (Continue)

Variable	Effect	Endogenous Variable			
			Intervening		Dependent
		Perceived Use-fulness (PU)	Perceived Ease of Use (PEOU)	Attitude (ATT)	Behavioral Intention to Use E-Learning (BI)
Self-Efficacy (SE)	Direct	.131*(.112M)	.197***(.208M)	Nil	Nil
	Indirect	Nil	Nil	SE-PU-ATT .064*(.059S) SE-PEOU-ATT .078***(.072S)	SE-PU-BI .040*(.042S) SE-PU-ATT-BI .028*(.029S) SE-PEOU-ATT-BI 034***(.036S)
	Total Indirect	Nil	Nil	.142*(.131M)	.102*(.107M)
	Total	.131*(.112M)	.197***(.208M)	.142*(.131M)	.102*(.107M)
Facilitating Conditions (FC)	Direct	.294***(.234M)	.241***(.236M)	Nil	Nil
	Indirect	Nil	Nil	FC-PU-ATT .144***(.124M) FC-PEOU-ATT .095***(.082S)	FC-PU-BI .090***(.088S) FC-PU-ATT-BI .063***(.061S) FC-PEOU-ATT-BI .042***(.062S)
	Total Indirect	Nil	Nil	.239***(.206M)	.195***(.211M)
	Total	.294***(.234M)	.241***(.236M)	.239***(.206M)	.195***(.211M)
Perceived Usefulness (PU)	Direct	Nil	Nil	.241***(.236M)	.307***(.374M)
	Indirect	Nil	Nil	Nil	PU-ATT-BI .215***(.262M)
	Total Indirect	Nil	Nil	Nil	.215***(.262M)
	Total	Nil	Nil	.241***(.236M)	.522***(.636L)
Perceived Ease of Use (PEOU)	Direct	Nil	Nil	.395***(.348M)	Nil
	Indirect	Nil	Nil	Nil	PEOU-ATT-BI .173***(.172M)
	Total Indirect	Nil	Nil	Nil	.173***(.172M)
	Total	Nil	Nil	.395***(.348M)	.173***(.172M)
Attitude (ATT)	Direct	Nil	Nil	Nil	.438***(.495M)
	Indirect	Nil	Nil	Nil	Nil
	Total Indirect	Nil	Nil	Nil	Nil
	Total	Nil	Nil	Nil	.438***(.495M)

Moderating Effects

In Figure 4, four variables (Gender, Age, Technology Innovativeness, and Experience) are suggested to be the significant moderators of the two direct effects on Attitude. The moderator effects in the modified model were separately reported for two groups (Table 5). The fit statistics for the modified theoretical model were satisfactory for each group. There were only two significant moderator effects: Age moderates the direct effect of Perceived Ease of Use on Attitude and also Experience moderates the direct effect of Perceived Ease of Use on Attitude (Table 8).

From table 8, it is seen that:

(a) The direct effect Perceived Ease of Use → Attitude is significantly greater for participants of age 22 years or older compared to younger participants;

(b) Perceived Ease of Use has a significantly less direct effect on Attitude among those with Experience scores of 4 or more compared to those with experience scores of less than 4;

(c) Although the other moderator effects are not significant, it is noted that the direct effect Perceived Ease of Use → Attitude is significant, positive, and at least medium for all of the groups except for those with a Technology Innovativeness score of 3.34 or more (out of 5) where the direct effect is positive, medium, but not statistically significant at a level of 0.05 or less.

Figure 4. Moderators (Technology Innovativeness, Gender, Age, and Experience)

Table 8. The significant moderator effects

Direct Effects in Final Model	Gender				Difference	The magnitude of the Critical Ratio for the Difference
	Group 1: Males		Group 2: Females		Unstandardized Effect Group 1 – Unstandardized Effect Group 2	
	Unstandardized Effect	Standardized Effect and Magnitude	Unstandardized Effect	Standardized Effect and Magnitude		
PEOU → ATT	.401***	.350 M	.372***	.330 M	.029	0.282 NS
Age						
	Group 1: 21 Years or Younger		Group 2: 22 Years or Older		–	
PEOU → ATT	.336***	.286 M	.601***	.570 L	- .265	2.631**
Technology Innovativeness						

Table 8. (Continue)

Direct Effects in Final Model	Gender				Difference Unstandardized Effect Group 1 – Unstandardized Effect Group 2	The magnitude of the Critical Ratio for the Difference
	Group 1: Males		Group 2: Females			
	Unstandardized Effect	Standardized Effect and Magnitude	Unstandardized Effect	Standardized Effect and Magnitude		
	Group 1: Score 3.33 or Less		Group 2: Score 3.34 or More		-	
PU → ATT	.509***	.557 L	.588***	.701 L	- .079	0.971 NS
PEOU → ATT	.215***	.201 M	.124 NS	.106 M	.091	0.905 NS
Experience						
	Group 1: Score Less than 4		Group 2: Score 4 or More		-	
PEOU → ATT	.396***	.352 M	.124 NS	.106 M	.272	2.519 *

Discussion

The study aimed to address: (a) a gap in the literature related to E-learning systems in Thailand; (b) analyses of direct, indirect, and total effects among constructs in a theoretical model derived from previous studies; (c) moderating effects of gender, age, technology innovativeness, and E-learning experience on direct influences on a user's attitude to using E-learning systems; and (d) practical implications of the theoretical findings.

Direct Effects

From the full analysis of the final model (Figure3), It is seen that all of the total effects are positive except, as expected, those associated with Computer Anxiety. The dependent variable in the final model, Behavioral Intention, is defined as a measure of the strength of an individual's intention to use E-learning in the future assuming that it is available to them. Compared to other constructs, Thai students place less importance on Information Quality as a motivation for using E-learning systems. However, a previous study conducted by Cidral et al.(2018) showed that the effect of Information Quality on Student intention was large and significant Thus, the effect of Information Quality on Behavioral Intention still needs to be explored in future studies. The total effects of Computer Anxiety on students Behavioral intention is negative while all of the other total effects on Behavioral Intention are positive. This result is in line with several prior studies. (Chang, Hajiyev, & Su, 2017; Mac Callum & Jeffrey, 2014).

It appeared that Attitude has the strongest direct effect on Behavioral Intention, with medium magnitude. This finding is consistent with research conducted by (Chang et al., 2017). This possibly happened since the data collection was carried out during the COVID-19 pandemic; thus, the Thai University Students' interest in using E-learning systems could have increased to avoid being infected with the virus. Therefore, using E-learning to continue their learning could be a very useful measure. Perceived Ease of Use has the second-largest direct effect on Attitude, with medium magnitude. This result is in line with several prior studies (Elkaseh et al., 2016)

Indirect And Total Effects

All of the indirect effects on Behavioral Intention appeared to be positive and significant except for Computer Anxiety. Every exogenous variable had at least one indirect effect on Behavioral Intention and the effects of Information Quality and Computer Anxiety were small and for the other four exogenous variables, the effect was medium. Perceived Ease of Use as an intervening variable had only indirect and medium effects on Behavioral Intention. For the other two intervening variables, the situation was different; Perceived Ease of

Use → Attitude→ Behavioral Intention was almost as influential as the direct effect of Perceived Ease of Use on Behavioral Intention. This finding emphasizes the importance of the impact of Perceived Ease of Use on Behavioral intention both directly, and indirectly through the mediator Attitude that has been supported by several previous studies (Abdullah & Ward, 2016; Elkaseh et al., 2016); besides, Attitude has only direct and medium effects on Behavioral effect. The finding also highlights the mediation role of Perceived Usefulness through Attitude on Intention-to-Use. The total effects of these factors on Behavioral Intention were all statistically significant.

The total effect of Computer Anxiety on Behavioral intention was negative while all other total effects were positive. The only small total effects on Behavioral Intention were due to Computer Anxiety and Information Quality while all other total effects on Behavioral Intention were medium with exception of the large total effect due to Perceived Usefulness.

The largest total effect on Behavioral Intention was due to Perceived Usefulness followed in decreasing order of magnitude by Attitude, Enjoyment, Facilitating Conditions, Perceived Ease of Use, Subjective Norm, Self-Efficacy, Computer Anxiety, and Information Quality. However, this order was in contrast with the order when one only analyses the direct effects. This emphasized the importance of analyses for indirect and total effects rather than only direct effects. Based on total effects:

(a) Only four exogenous variables including Subjective Norm, Enjoyment, Self-Efficacy, and Facility Conditions have direct effects on Perceived Usefulness. These were all positive, medium in magnitude, and statistically significant. The decreasing order of influence on Perceived Usefulness starts from Enjoyment, followed by Facilitating Conditions, Subjective Norm, and Self-Efficacy.

(b) Perceived Ease of Use is influenced directly by five of the exogenous variables in the following decreasing order of magnitude Enjoyment, Facilitating Conditions, Information Quality, Self-Efficacy, and Computer Anxiety. Each direct effect is statistically signifi-

cant. The direct effect of Computer Anxiety is negative but small while each of the other four direct effects is positive and medium in magnitude.

(C) The intervening variable Attitude is directly influenced by Perceived Ease of Use and Perceived Usefulness and indirectly influenced by each of the six exogenous variables. Considering total effects on Attitude the most influential is due to Perceived Ease of Use, Followed in decreasing order of magnitude by Enjoyment, Perceived Usefulness, Facilitating Conditions, Self-Efficacy, Subjective Norm, Information Quality, and Computer Anxiety.

Moderator Effects

Among the five hypotheses concerning significant moderator effects in the modified theoretical model (Figure 2) only two significant moderator effects were found (Table 8). In both cases, the hypotheses were classified as exploratory due to the lack of previous studies which have examined moderator effects in the context of E-learning systems. These moderator effects involving Age and Experience :

(a) For students who were 21 years old or younger, the direct effect of Perceived Ease of Use on Attitude was significant, positive, medium, and for students who were 22 years or older this effect was significant, positive, and large.

(b) For students who had E-learning usage experiences score less than 4, the direct effect of Perceived Ease of Use on Attitude was significant, positive, medium; and for those with E-learning usage experiences score of 4 or more, this effect was positive, medium, but not statistically significant.

These findings advance the understanding of the direct effects that Perceived Ease of Use and Perceived Usefulness have on Attitude.

Contributions

The findings represent theoretical and practical contributions to understanding E-learning systems, especially in Thailand.

Theoretical Contributions: Some of the findings are new, while others are reported in only a few studies, or evidence in other studies is contradictory :

(a) The 13 hypotheses associated with direct causal effects that were supported by the findings do not represent new findings but do add confirming support to the developing theoretical basis for the understanding of E-learning systems. However, the three hypotheses associated with direct effects of Information Quality, Subjective Norm, and Computer Anxiety that were observed in the present study, did represent new findings. Previous studies have found limited support for these three hypotheses.(Abdullah & Ward, 2016; Al-Gahtani, 2016; Cidral et al., 2018; Yakubu & Dasuki, 2018).

(b) All of the indirect effects, totals of indirect effects, and totals of all effects presented in Table 7 are important new findings. Most previous studies do not evaluate these different effects and instead only focus on direct effects and this provides a less than adequate understanding of influences on a dependent variable due to exogenous and intervening model variables. For example; In this study, none of the exogenous variables has a direct effect on the dependent variable Behavioral Intention and the influences of these exogenous variables, as well as the mediation role of intervening variables, on Behavioral Intention.

(c) The results related to correlations among the model variables represent findings that are rarely evident in previous studies. Because correlation and causal effects are not the same all of the correlations among model variables displayed in Table 6 and the associated discussion are considered to be new findings in relation to E-learning systems.

(d) There has been very limited attention paid to moderator effects in previous studies and the findings concerning moderators presented in this study are considered to be new but exploratory with a strong recommendation for more attention to moderator effects in future studies of E-learning systems. For example, Chen et al. have shown that Technology Innovativeness moderates the effect of Perceived Usefulness and Perceived Ease of Use on Attitude (Chen & Tseng, 2012). On the contrary, this study finds that Technology Innovativeness does not have a significant moderator effect on either of these direct effects. Chang et al. and Huang et al. have shown that Age, Gender, and Experience moderate the direct effect of Perceived Perceived Ease of Use on Attitude (Chang et al., 2017; Huang et al., 2020). However, this study found that only Age and Experience have these significant moderator effects but it is not significant for Gender.

Understanding the factors influencing a student's acceptance of E_learning system bring insights to e-learning systems designers and providers and will help them to be able to make strategic decisions to achieve success. This study proposes a model including factors on which organizations can concentrate in order to increase the number of users of E-learning systems. It appeared that Enjoyment is the strongest factor that influences Perceived Usefulness and Perceived Usefulness and has the greatest total influence (direct and indirect through the mediating effect of Attitude) on Behavioral Intention to use E-learning systems. This implies that Universities with E-learning services need to produce more creative and visual materials to build an enjoyable learning process for students. The influential determinants of E-learning intentions are Perceived Usefulness, Perceived Ease of Use, Attitude, Subjective Norm, Self-Efficacy, and Facilitating Conditions (Lockee, 2021). This implies that E-learning platform providers should take into account the functionality of the E-learning systems so that learners feel that these systems are more useful to support their learning progress compared with traditional learning methods (Law, Lee, & Yu, 2010; Sánchez & Hueros, 2010). Also, universities and organizations that are using E_learning systems need to take specific actions to ensure the use of the E-learning system is effortless and this requires ensuring that their facilities and infrastructures are readily and easily accessible and tailored to students' demands (Lee, Hsieh, & Chen, 2013). It is crucial for the online materials and resources to be comprehensive and clear and attract the user's attention. This could be achieved by using diverse measures of self-assessment such as quizzes, puzzles, creative assignments with instant feedback, and innovative ways of knowledge and learning outcome assessment that could easily be reached by the learner on the online platform (Mathieson, 1991). Therefore, there needs to be an increase in the over-

all success level by investing in the contents presented by the system. Based on the findings related to total effects in the present study, it is possible to develop a sequence of actions to increase a student's intentions to use an E-learning system.

Conclusion

Although Gender, Age, E-learning Experience, and Technology Innovativeness were hypothesized to have moderating effects on the direct effect of Perceived Usefulness of E-learning on the Attitude (Ngafeeson & Sun, 2015) and direct effect of Perceived Ease of Use on the Attitude (Ngafeeson & Sun, 2015); in the final model, Age and E-learning experience remained as the significant moderators of such effects as has been also documented in previous studies (Abdullah & Ward, 2016; Al-Gahtani, 2016). Computer Anxiety has negative impacts on Behavioral intention to use online platforms which is in line with previous studies (Chang et al., 2017) while all of the other effects on Behavioral Intention are positive.(Chang et al., 2017; Cidral et al., 2018) This study found that enjoyment has the strongest effect on Perceived Usefulness and Perceived Ease of Use of thai students to use E-learning systems. This implies that Universities with E-learning services need to produce more creative and visual materials for students to build an enjoyable learning process for Students. This study fills the gap in the limited theoretical understanding of E-learning adoption in Thailand. New theoretical findings related to moderating effects, direct, indirect, and total effects are used to discuss important practical implications of the findings.

Limitations and Future Research

Some shortcomings should be considered in the interpretation of the results of the present study. Although this study employs variables from prior studies where their definitions and measuring instruments are already established and have shown satisfactory face and content validity, we could not conduct concurrent validity assessment since the actual data is not available from previous studies. Besides, the validity and reliability constructs that are reported in the present should be cautiously used in the different settings. Further studies are recommended to examine the different model variables, moderators, groups, and participants in different countries. Furthermore, studies from the perspective of the E-learning platform providers addressing the logistical and sociocultural issues are recommended.

Authors' Contribution

MAD is the person involved in developing the concept, design, collection of data, interpretation, writing of the present manuscript.

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