

Bridging the Digital Divide: Building Sustainable E-Learning Systems for University-Level Education in Developing Countries like Bangladesh in a Post-Pandemic Analysis

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Submission	: 08/02/2025
Revision	: 25/06/2025
Acceptance	: 22/07/2025

Abstract

The objective of this study is to evaluate the efficacy of e-learning systems in developing countries with a specific focus on the Perceived Usefulness, User Satisfaction, and System Usage. This study employed a quantitative technique to collect data from students enrolled in several educational institutions in Bangladesh. The dataset, consisting of 254 observations, was analyzed using Partial Least Squares (PLS) - based Structural Equation Modeling (SEM). The study unveils that e-learning System Use, Perceived Usefulness, and Perceived User Satisfaction have a substantial impact on the effectiveness of the e-learning system in Covid-19 pandemic. This research significantly advances academia by filling gaps in understanding post-pandemic e-learning effectiveness in developing countries. From a managerial perspective, it helps focus on implementing strategic interventions, making investments, and adopting user-centric techniques. Overall, it promotes policies that enhance digital inclusion and quality education, which is in line with SDG 4 (Quality Education). This study integrates the Delone and Mclean (D&M) model with the Technology Acceptance Model (TAM) in order to assess the efficacy of the e-learning system during the covid-19 pandemic. It is worth noting that no prior studies have employed SEM utilizing PLS to assess the effectiveness of e-learning systems in the context of a developing nation like Bangladesh, making this study a pioneering contribution to the field of higher education.

Keywords - Perceived Usefulness, E-Learning System Use, Perceived User Satisfaction, Covid-19 Pandemic, Higher Education



The Chittagong University
Journal of Business Administration
Volume 36, 2022, pp. 33-54
© Faculty of Business Administration
University of Chittagong
ISSN: 2219 - 4843

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1. Introduction

The ubiquitous nature of the internet has revolutionized educational landscapes, propelling distance and electronic learning's (e-learning) evolution from mere concepts to widespread realities (Butnaru et al., 2021). While the potential of e-learning has been acknowledged for decades, with research documented as early as 2001 (Adnan and Anwar, 2020, Al-Fraihat et al., 2020, Al-Shargabi et al., 2021), the world was abruptly pressed into a mass online education experiment by COVID-19 (Szopiński, 2023, Bao, 2020). This rapid adoption has ignited a surge in research interest, particularly focused on the effectiveness of e-learning in emerging countries.

The sudden shift to online education globally due to the pandemic highlighted e-learning's crucial role in sustaining education amid unforeseen crises (Bao, 2020, Beaunoyer et al., 2020). However, students' diverse reactions to its effectiveness have been documented, with some merit while others faced difficulties (Ali et al., 2023, Eli-Chukwu et al., 2023, Szopiński, 2023). As traditional in-person classes resume (Abdelfattah et al., 2023, Szopiński, 2023), e-learning's potential as a future coping mechanism remains largely unaddressed. Most research focuses on developed nations, neglecting challenges unique to emerging contexts-limited technology access, inadequate infrastructure and inexperience with online platforms complicate learning (Alam et al., 2023, Islam et al., 2023b, Ullah et al., 2023). For many, sporadic electricity or unreliable internet pose constant barriers (Ullah et al., 2023). Overcoming these obstacles demands coordinated efforts and effective e-learning solutions.

The gap in such a significant domain of knowledge enhances the need for more thorough investigation of the effectiveness of e-learning in developing countries like Bangladesh. Specifically, the researchers aim to investigate the elements that influence the efficacy of e-learning platforms as a means of coping with the post-pandemic era for users, namely students in Bangladesh. Thus, the study addresses the following question: *How do perceived usefulness, perceived user satisfaction, and e-learning system use affect the e-learning system's effectiveness?* An expansive perspective that incorporates many aspects of users and the system could deliver valuable knowledge to improve e-learning to effectively help students in times of crises and normal functioning.

In developing economies, such as Bangladesh, scholars argue that students face major challenges in regards to acquiring reliable internet and inexpensive and accessible equipment to support the efficiency of e-learning villages (Ullah et al., 2023, Alam et al., 2023, Humida et al., 2022). In addition to this, the lack of literacy in utilizing effective digital teaching methods and implementing a successful online learning strategy impedes the potential of e-learning programs (Alam et al., 2023, Humida et al., 2022). Despite the barriers, e-learning offers a captivating possibility to cross the educational divide in developing nations. Moreover, the unavailability of capable and experienced educators at the rural level has already been reported, which is a major concern for the wider reach of quality education (Wang et al., 2019). This study employs a novel approach to assess e-learning system effectiveness in emerging country contexts.

This research offers several novel contributions to better understand the effectiveness of e-learning systems in developing nations. Firstly, this research is one of those few investigational studies that have combined the Delone and Mclean (D&M) (DeLone and McLean, 1992) model and the Technology Acceptance Model (TAM) (Masrom, 2007) for measuring the effectiveness of the e-learning system in the context of developing countries. Second, it will provide policymakers and stakeholders with a picture of the current e-learning situation in developing countries and allows them to rethink and redesign to increase the success rate. Third, it will help the students of emerging countries like Bangladesh to adopt the current technology-based culture of the modern world through an effective e-learning system, which will further progress the attainment of sustainable development goal (i.e., SDG 4) (Kanowski et al., 2019). Finally, it will provide a post-covid perspective regarding the effectiveness of the e-learning system which was introduced for the first time in most developing countries at a massive scale, in accompanying and complementing, if not replacing, the traditional teaching methods in the post-pandemic era.

The rest of the study is structured as follows. The succeeding section presents the theoretical background of this study and the study hypotheses. The methodology adopted for conducting this research with scientific measurements is transpired in section three. Section four offers the results of the analyses. Section five evaluates and compares the analyses' findings in light of extant literature. Section six presents a summary of the whole research. Finally, this

article concludes with a brief discussion of the implications and contribution of this particular study, as well as an acknowledgment of limitations and suggestions for future research endeavors.

2. Theoretical background and hypotheses development

E-learning has undeniably transformed higher education globally, particularly at universities, as various studies corroborate the considerable advantages it affords (Al-Fraihat et al., 2020, Milićević et al., 2021, Zardari et al., 2021). The COVID-19 pandemic accelerated the compulsory adoption of the e-learning system in global education (Adnan and Anwar, 2020). The obligatory embrace of e-learning posed challenges to the quality of the online education system and learners' satisfaction, which is a fundamental component of a robust education system (Islam et al., 2023a). Hence, theoretical insights are essential to comprehend the effectiveness of e-learning systems. Addressing the controversial benefits and challenges of e-learning from the prior literature, this study focuses on variables such as "perceived usefulness," "e-learning system use," and "e-learning satisfaction" to thoroughly assess the effectiveness of e-learning in the context of a developing country.

Several theories have been used to measure particular technologies, including the TAM, Task-Technology Fit, Theory of Planned Behavior (TPB), and Unified Theory of Acceptance and Use of Technology (UTAUT); nevertheless, these models heavily concentrate on the pre-adoption stages and do not entirely assess the technology's performance (Bölen, 2020). In the realm of e-learning, the TAM integrated with the Integrated Device Technology (IDT) and TPB (Bölen, 2020). However, D&M theory—introduced in 1992—stands out as a productive model for measuring the efficacy of e-learning systems (Platt et al., 2014). Originally designed for assessing technology influence in the information system sector, the D&M theory has gained substantial attraction in the field of e-learning (Chopra et al., 2019). This study utilizes a combination of the D&M theory with the TAM to examine the study variables. TAM is used to analyze the perceived usefulness and e-learning systems use, specifically referring to the intention to use in the original model. On the other hand, the D&M theory is utilized to evaluate the perceived user satisfaction.

2.1 Perceived usefulness and e-learning system use

The concept of perceived usefulness concerns one's belief that applying an innovation will amplify performance (Davis, 1989). Within e-learning, this implies that learner's acceptance of e-learning platforms will assist achieving educational objectives. Whether or not a system is used relies on properly judging its benefits. Research denotes that perceived usefulness plays a pivotal role in swaying the purpose to apply a system (Ramadiani et al., 2019, Zhou, 2017). When users see a system as helpful, it encourages continued usage (Dash and Chakraborty, 2021, Salloum et al., 2019). Those who view e-learning as a valuable educational instrument tend to form a positive attitude towards it (Abdullah and Ward, 2016, Salloum et al., 2019). This positive attitude, subsequently, shapes the purposes of both learners (Rizun and Strzelecki, 2020) and instructors (Sangeeta and Tandon, 2021) to actively take part in and keep online learning activities (Ullah et al., 2023). Therefore, the researchers hypothesize that:

H1: Perceived usefulness has a positive and significant effect on e-learning system use.

2.2 Perceived usefulness and perceived user satisfaction

Perceived user satisfaction refers to a learner's contentment with the entire e-learning experience, encompassing the information presented and the ease of use. In the context of e-learning, this translates to a student's overall satisfaction with the platform. Research suggests a strong connection between perceived usefulness and user satisfaction (Daneji et al., 2019, Maryanto and Kaihatu, 2021). When an e-learning system effectively assists students in achieving their learning goals (perceived usefulness), their overall satisfaction with the platform naturally increases (Bharati, 2003). This useful connection is further supported by research such as (Ullah et al., 2023) who discovered that students taking more virtual classes, likely owing to perceiving their usefulness, communicated higher satisfaction with them. Correspondingly, Ramadhan et al. (2022) underscore the constructive impact of perceived usefulness on user satisfaction in e-learning environments. Thus, the researchers hypothesize that:

H2: Perceived usefulness has a positive and significant effect on perceived user satisfaction.

2.3 Perceived usefulness and effectiveness of the e-learning system

While user satisfaction impacts adopting and using e-learning platforms (Aguilos and Fuchs, 2022, Hamid et al., 2016), perceived usefulness also plays a pivotal role (Dubey et al., 2023, Panigrahi et al., 2021). Students are more likely to meaningfully engage with systems when they find a system helpful for learning, which is essential for e-learning effectiveness. Notwithstanding these other factors, perceived usefulness powerfully anticipates perceived effectiveness. A system seen as unhelpful may struggle to engage learners or achieve its educational aims regardless of how it is built or how students are instructed to interact with it. User views on usefulness strongly influence judgments of effectiveness. Therefore, the researchers hypothesize that:

H3: Perceived Usefulness has a positive and significant effect on the effectiveness of the E-Learning System.

2.4 E-Learning system use and the effectiveness of e-learning system

E-learning systems are touted for their ability to transform education into a more efficient and effective format (Rezvani et al., 2022, Rupere and Jakovljevic, 2021, Tawafak et al., 2023). However, for this effectiveness to be realized, the system itself needs to be valuable and provide a positive user experience (Cheng, 2020, Daneji et al., 2019). Simply put, a system needs to be perceived as useful to encourage repeat use. Henceforth, Panigrahi et al. (2021) argue that the perceived effectiveness of an e-learning system hinges on how much students actually use it. Studies have shown that students in developing countries who criticize e-learning as less effective than traditional methods are also those who tend to use the available e-learning systems less frequently (Awad et al., 2022, Isaac et al., 2019). This suggests a connection between system use and perceived effectiveness. Based on this evidence, the researchers hypothesize that:

H4: E-Learning System Use has a positive and significant effect on the effectiveness of the e-learning System.

2.5 Perceived user satisfaction and the effectiveness of e-learning system

According to Amsal et al. (2021), the effectiveness of e-learning systems is linked to user satisfaction. This observation is aligned with the findings of Prasetyo et al. (2020), Yunusa and Umar (2021), who found that user

satisfaction with a system influences their intention to use it, which in turn determines its effectiveness. Interestingly, the relationship between user satisfaction and e-learning effectiveness appears to be reciprocal (Cheng, 2020, Daultani et al., 2021). This means satisfaction can influence effectiveness, and vice versa. Seddon (1997) in D&M theory emphasizes on the user's perception when evaluating a system's effectiveness. In other words, if users find the system satisfying, they are more likely to perceive it effective. Based on this, this research proposes:

H5: Perceived User Satisfaction has a positive and significant effect on the effectiveness of the E-Learning System.

The relationships mentioned in this section allowed the researchers to conceptualize a theoretical framework, which is illustrated in Figure 1.

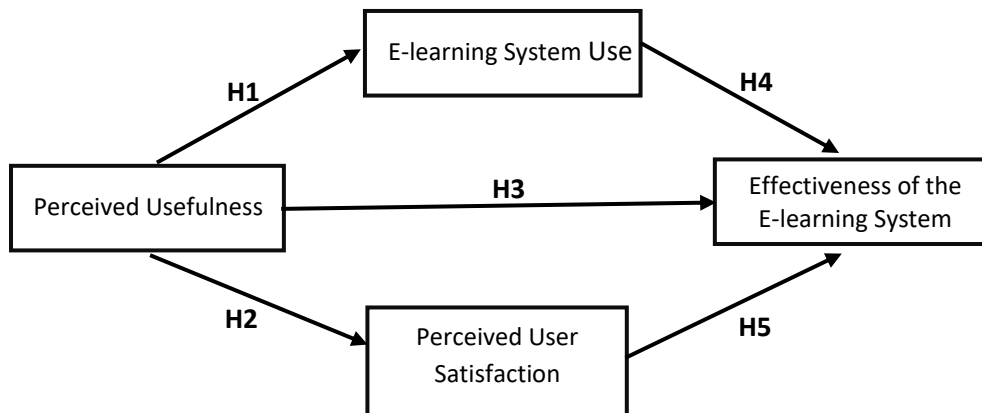


Figure 1. Proposed Research Model

3. Methodology

3.1 Research design

The primary objective of this research is to assess the efficacy of the e-learning system in emerging nation, such as Bangladesh. Embracing a positivist perspective, the researchers select a quantitative research paradigm characterized by a deductive approach. Utilizing a convenience sampling approach, data were systematically collected from business students across

diverse universities in Bangladesh, encompassing public, private, national, and open institutions. Out of the 400 distributed questionnaires, 254 responses were deemed usable, resulting in a commendable response rate of 64%. The selected number of respondents is well-justified, taking into account the specificities of the e-learning context (Ullah et al., 2023) and the requirements for subsequent analyses. The utilization of partial least squares structural equation modeling (PLS-SEM) in the study deems a sample size exceeding 200 as sufficient (Chin, 2010, Nitzl, 2018).

3.2 Participants' information

Among the 254 respondents, a majority (54.7%) were aged between 21 and 23 years. In terms of gender distribution, females constituted the predominant respondents, accounting for 59.1% of the total. Regarding the geographical distribution of universities, 39.8% were situated in rural areas, while 60.2% were in urban areas. When classifying universities based on type, respondents were drawn from public, private, national, and open institutions, with a noteworthy 76.8% representing public universities (refer to Table 1). The study meticulously adheres to the pre-established inclusion criteria, focusing exclusively on business students from multiple universities in Bangladesh who were actively engaged in online semesters, covering both classes and assessments.

Table 1. Demographic information of the participants

Aspects	Details	Frequency	Percentage (%)
Age	18–20 years	22	8.7
	21–23 years	139	54.7
	24–26 years	82	32.3
	27–29 years	11	4.3
Gender	Female	150	59.1
	Male	104	40.9
Location	Rural	101	39.8

	Urban	153	60.2
	Public	195	76.8
University (Type)	Private	50	19.7
	National	8	3.1
	Others	1	.4

Source: Authors own calculation, 2024

3.3 Measurement and scaling

The questionnaire has been designed with two sections. Section 1 incorporated questions pertaining to demographic and participant profile information, covering aspects such as age, gender, environment, and type of university. Section 2 focused on collecting data related to the study's constructs. The items in each section were adapted from prior studies. A five-point Likert Scale, ranging from 5 (strongly disagree) to 1 (strongly agree), served as the measurement tool for operationalizing perceived usefulness (PU), perceived user satisfaction (PUS), e-learning system use (ESU), and the effectiveness of the e-learning system (EOE). The survey was structured around four constructs, with a total of 14 items. Perceived usefulness included 3 items (Ouajdouni et al., 2022), perceived user satisfaction comprised 4 items (Ouajdouni et al., 2022), e-learning system use encompassed 4 items (Ouajdouni et al., 2022), and the effectiveness of the e-learning system involved 3 items (Butnaru et al., 2021).

3.4 Analytical technique

The researchers analyzed the data using PLS-SEM, a variance-based technique that proved superior to simple regression. PLS-SEM examines the entire model comprehensively, accounting for all connections rather than emphasizing only individual link (Azim et al., 2019, Uddin et al., 2019). This holistic view considers how each construct relates to others, capturing the fuller context. Additionally, PLS-SEM applicability for investigating non-normal data adds appeal (Hair et al., 2022). Our examination unfolded in two distinct phases - an initial appraisal of the measurement model to ensure the credibility and soundness of each indicator (Hair et al., 2022), followed by scrutiny of the structural model to assess coefficients of determination (R^2), predictive relevance (Q^2), effect size (f^2), and model fit. To rigorously test the hypotheses, this research carried out a Bootstrapping process

producing 5000 random samples at a 5% significance threshold. The analysis aimed to provide nuanced insight into interrelated factors while maintaining the complex nature of human behaviors.

3.5 Method bias and response bias

Preventive measures were undertaken to address common method bias issues. Harman's single factor test assessed the common method variance (CMV) of the 14 items used in the study, revealing that the single factor accounted for 38.75%, below the recommended threshold of 50%. Consequently, CMV is not deemed problematic in the context of this study (Podsakoff et al., 2003). Furthermore, a comprehensive collinearity test, indicating VIF values well within the required range of 3.3, was conducted (Kock and Lynn, 2012). To mitigate response bias, respondent confidentiality was prioritized. Participants were assured of the voluntary nature of their participation, the anonymity of their identifiable information, and the option to withdraw their response at any time.

4. Analysis and findings

4.1 Measurement model

The researchers examine the Cronbach's alphas and composite reliability (CR) scores for each variable to determine its reliability, as well as the average variance extracted (AVE) and heterotrait-monotrait ratio for convergent and discriminant validity respectively. Cronbach's alpha and CR are acceptable because all the scores exceed the minimum cut off value of 0.70 (Hair et al., 2019, Hair et al., 2022), as shown in Table 2. Likewise, the AVE values of all constructs

ranged from 0.529 and 0.582 that also fulfils the recommended criteria, i.e., ≥ 0.50 (Hair et al., 2019). After confirming convergent validity, the researchers proceed to verify discriminant validity using HTMT ratio (Henseler et al., 2015). All constructs in this model, as shown in Table 3 are discriminant valid because all HTMT values are less than the cutoff, i.e., < 0.85 (Henseler et al., 2015).

Table 2: Evaluation of Measurement Model

	Item	Loadings	a	CR	AVE
Perceived Usefulness	PU1	0.789	0.807	0.886	0.722
	PU2	0.878			
	PU3	0.878			
E-Learning System Use	EU1	0.719	0.716	0.822	0.536
	EU2	0.699			
	EU3	0.706			
	EU4	0.801			
Perceived User Satisfaction	PUS1	0.841	0.889	0.923	0.751
	PUS2	0.868			
	PUS3	0.884			
	PUS4	0.873			
Effectiveness of E-learning System	EOE1	0.733	0.800	0.884	0.719
	EOE2	0.909			
	EOE3	0.892			

Table 3: Discriminant Validity (HTMT Ratio)

	PU	ESU	PUS	EOE
PU				
ESU	0.406			
PUS	0.736	0.394		
EOE	0.792	0.448	0.766	

Note: PU = Perceived Usefulness; ESU = E-Learning System Use; PUS = Perceived User Satisfaction; EOE = Effectiveness of E-learning System

4.2 Structural model evaluation

Figure 2 states the structural model evaluation. The researchers applied the bootstrapping process to examine the proposed hypotheses in our model (Hair et al., 2019). In particular, 10000 bootstrap samples were used to establish the significance of the paths. Moreover, Table 4 indicates that the model's explanatory power (R^2) was 0.516, which is regarded as a significant explanatory power (Cohen, 2013). This suggests that the three constructs together accounted for 51.6% of the variance in EOE. Furthermore, the research model exhibited sufficient predictive relevance, as evidenced by the predictive relevance (Q^2) value being greater than zero (Hair et al., 2019). Finally, the effect size (f^2) of ESU on EOE was minimal, but PU and PUS had a medium influence on EOE (Cohen, 2013).

Table 4: Hypotheses Testing

Hypo.	Relationships	Beta (β)	Std. Dev	T values	P Values	Decision	f^2	R^2
H1	PU -> ESU	0.311	0.060	5.197	0.000	Supported	0.107	0.516 (EOE)
H2	PU -> PUS	0.630	0.041	15.529	0.000	Supported	0.658	
H3	PU -> EOE	0.362	0.082	4.418	0.000	Supported	0.162	Q^2
H4	ESU -> EOE	0.106	0.044	2.399	0.016	Supported	0.020	0.319 (EOE)
H5	PUS -> EOE	0.389	0.068	5.706	0.000	Supported	0.185	

The testing results indicate that all hypotheses H1: $\beta=0.311$, p-value=0.000; H2: $\beta=0.630$, p-value=0.000; H3: $\beta=0.362$, p-value=0.000; H4: $\beta=0.106$, p-value=0.016; and H5: $\beta =0.389$, p-value=0.000) were supported (see Table 4). Therefore, perceived usefulness, perceived user satisfaction, and the use of an e-learning system have been found to have a substantial impact on its efficacy in developing nations such as Bangladesh. In particular, perceived usefulness has the most notable effect on effectiveness of e-learning, followed by perceived user satisfaction and e-learning system use. In particular, perceived usefulness exerts the greatest impact on the effectiveness of e-learning followed by e-learning system use and perceived user satisfaction in that order.

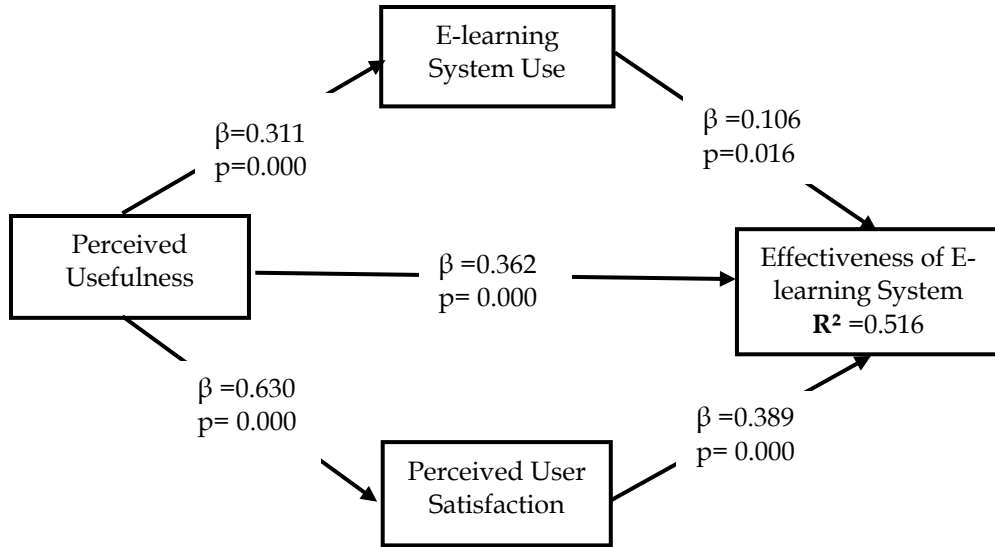


Figure 2. The structural model with the path estimates

5. Discussions

The widespread application of e-learning systems is already acknowledged in the scholarly discourse (Goh et al., 2020, Mastan et al., 2022, Mseleku, 2020). The COVID-19 pandemic not only expedited the adoption of this particular technology but also established it as a response mechanism for continuing academic activities amidst future pandemics and calamity situations (Liu and Yu, 2023). However, studies conducted during the COVID-19 pandemic recorded mixed reactions regarding the effectiveness of such systems (Ali et al., 2023, Butnaru et al., 2021, Encarnacion et al., 2021, Siddiqua, 2023). Motivated by this research gap and significant impact in attaining SDG 4, this research adopted a quantitative perspective.

Hypothesis 1 posits that perceived usefulness of the e-learning system has a positive and significant impact on its use. Existing research has previously confirmed that the perception of usefulness is crucial in influencing the desire to use a new technological system. (Davis, 1989, Hamid et al., 2016, Rezvani et al., 2022). Supporting this evidence, the analyses conducted for this research revealed that there is a significant positive impact ($\beta=0.311$, $p\text{-value}=0.000$) of

perceived usefulness on the use of the e-learning system. Put simply, the results indicate that, during the post-pandemic period, students in Bangladesh prioritize seeing usefulness as a crucial factor for repeatedly utilizing e-learning systems. Hence, while creating an efficient e-learning system, it is crucial to prioritize its perceived usefulness.

According to the second hypothesis, one's level of satisfaction is positively affected by their perception of how valuable something is. In the case of the e-learning system, studies conducted by, for instance, Amsal et al. (2021), Widjaja and Widjaja (2022) argued that the usefulness of this type of learning can positively impact the students' satisfaction level. Consistent with earlier research, this study found a substantial effect ($\beta=0.630$, $p\text{-value}=0.000$) of perceived usefulness on perceived user satisfaction. Findings indicate that students in impoverished nations are more content and eager to utilize e-learning systems when they see them as advantageous, even in the post-pandemic period. Hence, when developing an effective e-learning system, it is imperative to take into account user satisfaction.

In hypothesis 3, in the realm of e-learning, it is assumed that perceived usefulness directly impacts on the effectiveness of e-learning. The result ($\beta=0.362$, $p\text{-value}=0.000$) indicates that the hypothesis is supported, aligning with previous research (Sewandono et al., 2023, Almaiah and Alyoussef, 2019). Perceived usefulness, therefore, is the most significant aspect for assuring the effectiveness of e-learning as it has both direct and indirect influence on the efficacy of e-learning through the e-learning use and user satisfaction.

This research also reinforces the claims regarding the impact of e-learning system use and the effectiveness of such systems in hypothesis 4. Previous studies have already corroborated that with increasing application and usage of this method of learning and teaching, the perceived effectiveness is increased among the students (Awad et al., 2022, Isaac et al., 2019). The analyses undertaken for this study demonstrate that the use of e-learning systems can have a substantial and favorable influence ($\beta=0.106$, $p\text{-value}=0.016$) on the efficacy of the system for students in developing nations. This finding indicates that consistent use is key to an e-learning system's efficacy. Hence, the objective of an effective e-learning system should be to motivate users to engage in continuous and recurrent use.

The last hypothesis posits that the efficacy of e-learning is influenced by the perceived user satisfaction. Previous studies, for example, the ones conducted by Aguilos and Fuchs (2022), Davis (1989) suggested that perceived user satisfaction and effectiveness of any new technology or method are strongly correlated. Additionally, Dubey et al. (2023), Panigrahi et al. (2021) argued for the aptitude of students' satisfaction in positively influencing engagement and active participation during online sessions and with assigned tasks, eventually impacting the efficacy of these sessions. This research also supports their claims, based on the result that shows a significant relationship ($\beta = 0.389$, p -value=0.000) between perceived user satisfaction and effectiveness in the application of the e-learning system.

6. Conclusion

The COVID-19 pandemic has affected all sectors in such a way that businesses are forced to look for an online alternative for shifting their processes from traditional systems; and the education sector is also a part of this drastic shift. However, the students of developing countries have not yet fully coped with e-learning, and the system's effectiveness is still questionable in these countries. This conceptual research proposes a model that includes the e-learning system's perceived usefulness, the usage of the system, the perceived satisfaction of its users and their impact on the system's effectiveness. The study provides an understanding of the student's perception regarding this system from a developing country's perspective, which will assist the university administration and policymakers in developing an alternative to the traditional learning/teaching system. It will contribute to understanding the factors affecting the effectiveness of the e-learning system in a developing country like Bangladesh. Administrators and policymakers can successively upgrade the e-learning system according to the needs of the students, increasing their satisfaction level and usage of the system, which will eventually affect the effectiveness of the e-learning system.

6.1 Implications of the study

This research will add value to the current literature by estimating the effectiveness of the e-learning system during the Covid-19 epidemic in developing countries like Bangladesh. The study has three managerial implications. First, the university administration can understand how to

ameliorate the e-learning system's usage by offering the necessary resources and support to the students of a developing country because the usage of the e-learning system is significantly connected with its effectiveness. Second, the university administration and technical support can create a user-friendly e-learning system for the students of developing countries by understanding their needs and requirements, which can become an alternative to the traditional learning system in the future and contribute to the development of these less privileged students. Finally, it can assist the policymakers of higher education institutes in implementing new rules and procedures to encourage e-learning system usage among the students of developing countries. If some changes are brought to the educational system to confirm a flexible shift to the e-learning system from the traditional system, the e-learning system's use and users' satisfaction will rise, ameliorating the system's effectiveness. The study findings can deliver valuable suggestions for policymakers, designers, inventors, and investigators, which will help them understand the key aspects related to the effectiveness of the e-learning system.

6.2 Contribution of the study

This empirical research contributes to academia in several ways. First, this research addresses a research gap in comprehending the effectiveness of e-learning systems in developing countries, as perceived by the students in the post-pandemic era. It will act as a strong foundation for the research focusing on studying the voluntary application of the mentioned system. Second, by integrating the D&M and the Technology Acceptance Model (TAM), the research offers a new scientific framework to assess the impact of perceived usefulness, perceived user satisfaction, and e-learning system use on its effectiveness. This framework will provide a comprehensive understanding of the dynamics at play in a developing country context. Finally, this research will contribute to global discussions on post-pandemic education while highlighting the role of effective e-learning systems in addressing educational challenges and fostering sustainable development across the globe.

6.3 Limitations of the study

The study contributes to the existing knowledge in several ways and offers insightful understanding concerning the effectiveness of the e-learning system. Nevertheless, this study has some limitations that could not have been avoided.

Firstly, the researcher gathered data only from Bangladesh university students, which indicates country biases. Therefore, to avoid such biases, studies can be conducted from a cross-cultural viewpoint in similar or different contexts in the future. Secondly, the present sample size can't be analyzed in other software except for SEM-PLS software. Future researchers can improve the sample size to better understand the effectiveness of the e-learning system. Thirdly, the study does not include all the variables available in the Delone and Mclean (D&M) model. Finally, there are huge criticisms against using cross-sectional data, as it collects data only once. To address the cross-sectional data issue, longitudinal data or multiphase surveys can be employed to overcome the generalizability data. Future researchers can consider the other variables to increase the findings' generalizability.

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