Escaping the COVID-19 Pandemic with High-Speed E-Learning: Capabilities, Engagement, and Quality in Malaysian Higher Education

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Abstract

Despite growing optimism, the COVID-19 pandemic has overstayed with its new 'delta variant' sweeping across continents. Consequently, higher education institutions across the globe have strategically switched to e-learning platforms to escape the massive uncertainties triggered by the ongoing global pandemic. Hence, the attraction and engagement of millions of new e-learners towards technology-enabled virtual learning environments are highly dependent on critical factors such as quality of e-service, e-information, and e-system, etc., for e-learning success. To address these emerging challenges and to bridge the research gap, the present study empirically explored the effects of e-learning communication networks, including the quality of e-service, e-information, and e-system, on e-learning in Malaysian Higher Education. Notably, the mediating mechanism of e-learner's engagement in the processual and holistic model of e-learning quality was also examined. Drawing on study data of 450 e-learners and utilizing structural equational modeling (SEM), the findings established that e-learning quality is significantly influenced by e-service quality, e-system quality, and e-information quality, as mediated through e-learner's engagement. The study implications include new empirical evidence on boosting e-learning quality during the pandemic-induced global education crisis and identifying the critical drivers of communication technologies in higher education (i.e., quality of e-service, e-information, and e-system) to better interpret the changing ingredients of e-learner's engagement.

Keywords: COVID-19 pandemic, e-information quality, e-system quality, e-service quality, e-learning quality, and student's e-learning engagement

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Introduction

The significance of e-learning has been increased vividly with the revolution of information and communication technologies (Grebennikova et al., 2021; Taat & Francis, 2020). Globally, numerous educational institutes have implemented e-learning modules (Moubayed, Injadat, Shami, & Lutfiyya, 2020). Recently, COVID-19 has posed challenges to many walks of life (Jin et al., 2021), profoundly affecting the educational system (Vate-U-Lan, 2020). Therefore, due to the COVID-19 pandemic, educational activities are at stake (Dhawan, 2020). For instance, traditional means of learning have been affected globally during the COVID-19 pandemic to warrant the safety and health of the students (Syaugi, Munadi & Triyono, 2020).

In this scenario, educational institutes are direly in need of applying sustainable and effective alternatives such as e-learning systems (Chaudhary et al., 2020; Syaugi et al., 2020). With the rapid advancements in information and communication technology (ICT), such as personal computers and the internet (Li et al., 2021; Paulsen & McCormick, 2020), educational institutions have pursued e-learning or virtual learning opportunities COVID-19. Furthermore, these digital gadgets have enabled educational institutes to introduce online educational modules in times of pandemics (Hsu, Chen & Chiu, 2003). Besides the investment in e-learning programs, educational institutions are also working to make these programs effective to improve student satisfaction and performance (Tarhini, Hone & Liu, 2013).

Educational institutes implemented e-learning systems, but recent studies have found that the students' engagement in such programs is not at par with the expectations. Steam of recent literature thereby affirmed that the success of e-learning is contingent on student engagement (Rahman, 2021; Vate-U-Lan, 2020). Although educational institutions have made specific efforts to implement the e-learning module, they have failed to get the most benefits out of these programs for their students (Mehra & Omidian, 2012; Persico, Manca & Pozzi, 2014). The role of student engagement is essential in this regard. Student engagement can be referred to as the active involvement of the students in e-learning programs (Rahman, 2021).

Studies have indicated the positive and significant role of student engagement in determining the efficiency of e-learning (Diemer, Fernandez &Streepey, 2012; Ergun & Adibatmaz, 2020). One study reveals that enhancing E-learning capabilities is a teaching pedagogy that further augments the teaching-learning process. Going to deepen the deliberations on educational pedagogy, especially media education in India and the United Kingdom, (Gaur, 2013) asserts that curriculum design, faculty development, infrastructure, and proper execution of government policies for imparting media education remain essential for an effective teaching-learning process. Infrastructure also covers e-learning facilities.

Previous theoretical models such as SERVQUAL and informational management systems have also identified dimensions of quality e-learning, namely, system, service, and information quality (Alam et al., 2021; Udo, Bagchi & Kirs, 2011). These dimensions augment student engagement and thus increases the functional competencies of e-learning (Paulsen & McCormick, 2020; Xu, Chen & Chen, 2020). For example, communication technologies equipped with enrich functional service qualities such as integrated functions of student feedback can be more effective e-learning tools (Patel et al., 2020; Hsu, Chen, & Chiu, 2003).

Malaysia has had a significant expansion in the ICT sector over the previous few decades and prioritized e-learning systems during COVID-19. However, similar to other nations, different educational institutions in Malaysia are also suffered, and calls for researchers required attention towards e-learning quality. Moreover, student engagement is lacking, resulting in the decreased effectiveness of e-learning. This is a serious issue, especially in the current scenario of COVID-19, and it has been observed in other developing and underdeveloped countries (Rahman, 2021; Vate-U-Lan, 2020). Therefore, there is a need to grasp this problem and find the underlying issues so that they can be resolved at the earliest and the e-learning experience of students can be improved (Grebennikova et al., 2021; Xu et al., 2020). Many researchers have studied the aspect of quality of e-learning or virtual education concerning the effectiveness of e-learning. Still, the aspect of student engagement has been ignored in this regard. In addition, similar studies in the context of COVID-19 are rare, and thus more researches need to be conducted to address these issues (Dhawan, 2020; Chaudhary et al., 2020; Syaugi et al., 2020).

The Cognitive Theory of Multimedia Learning (hereafter CTML) identified that the individuals' information processing involves the distinctive perpetual filtration of the inwards information (Heng & Said, 2020). Thereby, when they receive information in different formats or visuals, they start strong inference based on their past experiences (Artman, 2020; Udo, Bagchi & Kirs, 2011). Thus, the effectiveness of the inward information (e.g., lecture) depends on these perceptual filters (Heng & Said, 2020). The current study validates the role of the perceptual filters in predicting the efficacy of the SERVQUAL factors. Theoretically, the SERVQUAL factors have established a role in determining the e-learning outcomes (Alsheyadi & Albalushi, 2020). However, the perception and engagement of the stakeholders have a paramount role that remains limited in past studies (Artman, 2020; Heng & Said, 2020). Applying the analogy from past studies, this research attempted to examine the influence of e-learning antecedents in Malaysia during the COVID-19 epidemic, including e-service guality. The present research aims to accomplish an improved overall understanding of the usage of information technology to augment the effectiveness of e-learning systems in the Malaysian context. This study contributes to the prior literature by providing significant and practical 365 implications for educational institutions. To accomplish this, the research underscores the role of student engagement that is a critical issue in determining e-learning effectiveness (Grebennikova et al., 2021). Hence, the study gives insight into the efficacy of an implemented system of e-learning. Additionally, the study has provided evidence from the understudied student perspective regarding the efficacy of e-learning systems.

Literature Review and Theoretical Framework

E-learning systems deliver a web-based environment that integrates numerous stakeholders with the assistance of the technology to facilities learning procedures (Ikhsan & Simarmata, 2021). The extensive accessibility and growth of the Internet e-learning ecosystems have been in practice, such as distance education (Kim, Wang & Roh, 2021). However, with the COVID-19 intensive spread, usage of these e-learning systems has been extended promptly across the globe (Dhawan, 2020). Plentiful research has found e-learning offers students a pliable and customized means to study (Heng & Said, 2020). Building on its utility under severe constraints of the COVID-19 pandemic, numerous technology-based e-learning systems have been implemented to endure educational activities (Vate-U-Lan, 2020). However, these systems have facilitated the students as a complete alternative to the conventional learning or educational system (Syauqi, Munadi & Triyono, 2020). Thus, theoretical questions have emerged about the far-reaching influence on e-learning quality during the COVID-19.

Extant research has applied numerous learning models to tap the antecedents of the e-learning quality, such as the technology acceptance model (Chang, Hajiyev & Su, 2017), the CTML (Heng & Said, 2020), and SERVQUAL updated theory (Cidral et al., 2018; Ikhsan & Simarmata, 2021). CTML and SERVQUAL were selected due to their fundamental postulations finest tap the current research objectives ad hypotheses. Mayer (1997) proposed the CTML (also named Dual-Coding theory) and presented tents based on the various rational and cognition models. The CTML highlights that individuals learn significantly from multi-media resources instead of using the words alone. The primary tents of the CTML delineate that information processing involves: (i) distinct dual channels, words and visual, (ii) respectively both channels have a limited capability, (iii) learning includes a vigorous procedure, and (iv) learning procedure involves the perceptual filters (Heng & Said, 2020; Udo, Bagchi & Kirs, 2011). Thereby, the past experiences and interaction with these channels determine the collection, managing, and incorporation of the inward information from the e-learning systems (Udo, Bagchi & Kirs, 2011). On the other, hand SERVQUAL advises the services factors that contribute to quality development (Alsheyadi & Albalushi, 2020). In the context of the learning context, this research proposed critical service-related factors such as

e-information (Cidral et al., 2018). Based on the CTML and SERVQUAL, we argue that the effect of such inward information (e.g., online lecture visual and verbal materials) is although beneficial. However, perceptual filters would serve as the undying mechanism to determine the e-learning quality. Given these premises, this research developed a model whereby student engagement has been proposed as the mediating factor. The next section will enlighten each hypothesis development in greater detail.

Quality of E-Service and E-Learning

In the context of the e-learning program, adequate service quality has been defined based on its responsiveness, applicable functionalities, trustworthiness, and manageable communication among service users (Demir, Maroof, Khan, & Ali, 2020; Alsheyadi & Albalushi, 2020). For example, the clarity of the voice or visual during the lectures is related to the service quality. Past research identified service quality and its operative features as the utmost effective parameters of an e-learning program (Chopra, Madan, Jaisingh, & Bhaskar, 2019). Literature examining the relationships between e-learning program's service quality attributes found that mainly the performance of the e-learning counts on the end-user satisfaction (Pearson, Tadisina & Griffin, 2012). Likewise, some descriptive studies advocated that the students described the quality of the e-learning program quality based on the three critical attributes, namely: (i) system quality, (ii) mentor involvement, and (iii) contents shared as supportive resources quality, and (iv) ICT's operative utility and overall service quality.

To this end, most of the attributes highlighted in this literature are related to service quality. Therefore, the service quality of the e-learning systems has been recognized as an established influencing antecedent of the e-learning program outcome (Pearson et al., 2012). Furthermore, the improved quality of the services positively influences the overall e-learning program (Pham, Limbu, Bui, Nguyen, & Pham, 2019). For instance, recent studies have found that the users of those communication technologies confirmed that they feel more satisfied. In contrast, services of ICT have fewer or no interruptions during the lectures. Therefore, the high eminence of services convinces the constant practice of an e-learning program. Instead, research has found the educational institutions deplete the usage of the electronic Learning Management Systems (eLMS) with declining service quality (Sharma, Gaur, Saddikuti, & Rastogi, 2017), and thus we hypothesized that:

H₁: E-service quality positively affects the quality of e-learning.

Quality of E-Information and E-Learning

In general, the e-information quality has been described as the value of the online content qualities base on their features such as ease of use (Kim, Wang

& Roh, 2021), graphical information, descriptions, and navigation (Patel et al., 2020). Literature has affirmed that the informational eminence of the eLearning system is determined by the perceptions of the users developed through the application and diffusion of informational features (Alsheyadi & Albalushi, 2020; Patel et al., 2020). Therefore, the information quality embedded within the e-learning management system can be measured through the perception level of gratification of students to the procedural and serviceability features (Kim, Wang & Roh, 2021). When e-learning takes place, students depend on explanations and visual assistance delivered through a learning management system or hosting applications (Al-Fraihat, Joy & Sinclair, 2020). Past studies suggest that consumers using digital services emphasize informational properties, including navigation, downloading content, and response time (Cidral et al., 2018).

In the context of e-learning, if learning management systems are equipped with properties such as vibrant guidelines to arrange the educational projects, it can be a perceived supportive system (Al-Fraihat et al., 2020). Therefore, it will be more supportive for the learning process and help students learn efficiently. In their research, Chopra et al. (2019) validated that measurement for information quality within implemented e-learning systems' is predicted by the accessibility and facilitation of e-learning systems. Prior theories of informational systems (see Kim, Wang & Roh, 2021; Patel et al., 2020; Pearson et al., 2012) also advocated that the attainment of the learning management systems is reliant on student's perceptions about the e-information quality offered by the such as facilitating learners with simplified content, procedures and accordingly we postulated that:

H₂: E-information quality positively affects the quality of e-learning.

Quality of E-System and E-Learning

The strategic aspects inducing the approval of e-learning between the students are helpfulness, teachers' abilities, perceived eminence of the e-learning management system, the shared content, and accessible procedural supports (Chau, Barria-Pineda & Brusilovsky 2017). Bauwen et al. (2020) noted that students assess the e-learning system's overall performance regarding the benefits, usefulness, response time, and simplified integrated features to receive academic content (Taat & Francis, 2020; Bauwen et al., 2020). Optimization of E-learning can occur if essential aspects are fulfilled in e-learning implementation. The effectiveness of e-learning includes elements of the organization's technology and human resource capacity.

Though every aspect has to some extent, influences e-learning, earlier research findings show that the organization and technological aspect mainly influenced the e-learning implementation (Chau et al., 2017; Priatna, Maylawati, Sugilar, & Ramdhani, 2020). Hence, system quality can be gauged based on the perceived usefulness, sustainable functioning, trustworthiness, 368

data sharing, and integrated feedback features (Taat & Francis, 2020). Furthermore, literature provides evidence that the technical mechanisms of a specific e-learning arrangement are reasonably influencing factors in determining the e-learning outcomes. Hence, the system integrated with expected quality good attributes, for example, e-learning systems with userfriendly attributes are perceived as a more suitable system by organizations, and consequently, it is postulated that:

 H_3 : E-system quality positively affects the quality of e-learning.

Quality of E-Service and Student's E-learning Engagement

Service quality denotes the eminence of the operative systems such as learning management or applications in providing smooth services (Pham, Vu, & Tran, 2020). The students utilize these services for diverse functions. For instance, the students access these systems to prepare the assignments and attain the subject-related materials (Patel et al., 2020). On the other hand, suppose students feel some procedural malfunctions such as slow downloading of the materials seems slow or facing problems in uploading the materials for the lecturers (Grebennikova et al., 2021). In that case, they can negatively perceive the services (Paulsen & McCormick, 2020). Therefore, better services of a learning system involve smooth functioning without posing any difficulty to its user. In verily, a learning management system integrates with better facilities without functional ability to enhance the student's engagement (Chopra et al., 2019; Pham et al., 2020).

Recently, innovative means have been implemented in e-learning, and online is evolving as the predominant phenomenon (Alsheyadi & Albalushi, 2020). Particularly during the COVID-19 pandemic, reliance on distance educational systems has been increased and diversified (Xu et al., 2020). Findings of the past studies suggested that service superiority was associated with student's engagement in e-learning systems (Daghestani et al., 2020), and we hypothesized that:

 H_a : E-service quality positively affects the student's e-learning engagement.

Quality of E-Information and Student's E-learning Engagement

There is ample evidence in the literature that information quality has a favorable role in engaging students in learning activities (Kim, Wang & Roh, 2021; Pearson et al., 2012). Recent studies revealed that the students use those learning platforms that provide them accessible and valuable e-resources by putting less effort (Patel et al., 2020). For example, e-learning platforms offering searching options and display guidelines for using the platform are more popular among students (Pearson et al., 2012). They usually prefer such platforms and feel at ease using the e-learning materials (Lwoga & Sife, 2018). Consequently, student engagement will be improved with the higher perceived practical utility of the e-learning platform.

The students' engagement was amplified due to better e-Information services offered by the learning management system (Kim, Wang & Roh, 2021). We draw from this assumption based on the past studies applying the SERVQUAL theory in e-learning practices (Pham et al., 2019). The SERVQUAL theory explained that the end-user perceives services based on the informational features of the learning management systems (Alam et al., 2021; Udo et al., 2011). Thus the quality of information delivery will influence the student engagement, and they may consider the evaluation of the informational features such as content design and abundance and accessibility are instances (Barhoumi, 2016) and the proposed hypothesis based on these findings is:

 \mathbf{H}_{s} : E-Information quality positively affects the student's e-learning engagement.

Quality of E-System and Student's E-Learning Engagement

Now-a-days, due to the expansion of mobile applications in higher education, e-learning systems intend to create a user-friendly system that can address the necessities of the students in a better way (Alam et al., 2021). The literature suggested that better service delivery can motivate students to participate in the learning process more actively (Udo et al., 2011). Some recent studies have detailed the basic needs and expectations of the student from e-learning (Farid, Ahmad, Alam, Akbar, & Chang, 2018). Among these expectations, students' motivation has been identified as the consequence of better communicative resource availability. The collaborations between students and teachers are reliant on the two-way feedback mechanism and interaction sessions. Unfortunately, some recent learning managements lack such features, affecting the communication process (Daghestani et al., 2020; Elkhateeb, Shehab & El-Bakry, 2019).

Therefore, the smooth collaboration required an efficient system that can support sharing opportunities instead of delayed responses. Therefore, those e-learning systems have been perceived as more favorable enabled with real-time computer-mediated communication. The literature suggested that it is necessary to fill the void prompted by COVID-19. Student engagement requires a more interactive e-learning scenario to overcome these learning constraints. Therefore, more reliable systems are required, such as the Agilebased approach carries a supportable and superior learning arrangement. Therefore, the system that can eliminate the disruption probabilities can create communication noise and lead to negative evaluation. Thus, the current study raises critical questions about the implemented system and how they perceive the systems implemented during the COVID-19. The Malaysian government is using advanced systems, and therefore, it is predictable that the perception about the e-system's quality would be positive, and we proposed the hypothesis that:

 H_{6} : E-system quality positively affects the student's e-learning engagement. 370

Student's E-Learning Engagement and Quality of E-Learning

E-learning platforms and procedures face numerous encounters. The primary challenge in this digital era is keeping the users enthused and involved (Czerkawski & Lyman, 2016). This required the customization of the e-learning systems and practices to encourage the students to get involved in the e-learning process (Moubayed et al., 2020). Empirical evidence relates the applied approach of e-learning with self-efficacy as a mediation variable (Kim, Hong, & Song, 2019; Xu et al., 2020). This means that perceived usefulness by students has a substantial affirmative effect on self-efficacy and practical use mediated by self-efficacy (Hussain, Zhu, Zhang, & Abidi, 2018; Rahmawati, 2019). The success of online learning depends on the characteristics that can address the expectations of the student from the online learning environments (Farid et al., 2018). Therefore, customization of the courses strategies that endorse interface, sharing, and interactivity in the e-learning system is significant to maintain student engagement (Czerkawski & Lyman, 2016; Kim et al., 2019; Moubayed et al., 2020). The modern systems are providing such characteristics, and we proposed the following hypotheses:

 H_7 : Student e-learning engagement positively affects the quality of e-learning. H_8 : Student e-learning engagement mediates the effects of (i) e-service quality, (ii) e-information quality, and (iii) e-system quality on e-learning quality.

Methodology

Sampling and Procedures

The study has employed a cross-sectional online survey technique to predict the impact and SERVQUAL dimensions on e-learning in Malaysia. The data has been collected from the 450 Malaysian students enrolled in the e-learning programs. The enrolled students have been chosen to get feedback based on their actual experiences and interaction with the e-learning systems. Therefore, the study has chosen the purposive sampling technique for receiving the appropriate data from the genuine stakeholders of the e-learning system. This sampling technique yielded valid and reliable responses from the target population of the study. Thereby, responses from the students practicing the e-learning can give authentic and generalizable results. Due to the COVID-19 pandemic, the questionnaires using Google Forms have been distributed online through email to the students. Once those agreed were requested to fill the online Google form questionnaire. A total of 500 forms were disseminated, and 450 responses were returned with 438 usable responses.

Measures

The e-service quality was measured using the four items adapted from Cidral et al. (2018). The participants read one sample item as follows: "The

responsible service personnel is always highly willing to help whenever I need support with the e-learning system." The e-information quality was measured using four items deducted from the work of Cidral et al. (2018). The participants read one sample item as follows: "The information provided by e-learning system is useful." In contrast, four items were used to measure e-system quality adopted from the literature (Cidral et al., 2018). The e-learning quality was measured using the four items adapted from Udo et al. (2011). Finally, four items were used to measure student engagement deducted from the literature (Diemer et al., 2012). All variables were measured on a 5-point Likert scale anchoring: 1= strongly disagree to 5= strongly agree.

Data Analysis Approach

The analysis has been conducted through statistical software, i.e., SPSS and AMOS. The SPSS has been used for various tests, including; (i) demographic analysis, (ii) descriptive analysis, and (iii) factor analysis. In contrast, AMOS has been used for confirmatory factor analysis and structural equation modeling (hereafter SEM) for hypothesis testing. The results obtained through the analysis of the collected data have been reported in the next section.

Results

Demographics

The demographic analysis of 438 respondents exhibited that there were 55.3% males and 44.7% females. Additionally, 43.4% of respondents were aged between 25 to 35 years, while 31.1% were aged below 25 years, 21.9% were aged between 35 to 45 years, and only 3.7% were aged above 45 years. Concerning respondents' education, 43.2% of respondents had bachelor's degrees, and 31.5% had master's degrees.

Descriptive Statistics

The descriptive analysis exhibited that the mean values for all the variables were above (>3) the threshold of normal distribution. In addition, the skewness values also indicate that the data has been statistically distributed normally (see Table 1).

	Mean	Std. Deviation	Skewness	S.E
ESerQ	3.2631	.98601	213	.117
EInfoQ	3.1925	1.20880	251	.117
StuEng	3.1884	1.05426	163	.117
ESysQ	3.5360	1.13969	267	.117
ELearn	3.3181	1.12131	290	.117

KMO and Bartlett's Test

The outcomes of Kaiser-Meyer-Olkin Measure (hereafter KMO) of sample appropriateness and Bartlett's Test of Sphericity exhibited acceptable KMO values for all variables. In a similar vein, the significance value of Bartlett's test remained below 0.05 that exhibited sample adequacy. Furthermore, the factor structure (see Table 2) was also in line with the theoretical dimensionalities of the constructs adopted for this study.

Rotated Component Matrix

In the rotated component matrix, the factor loading values associated with each indicator were found above 0.7. This indicates that the indicators used in this study exhibited satisfactory structure, and no cross-loading issue was observed (see Table 2).

	Factors						
	1	2	3	4	5		
SQ1 SQ2 SQ3 IQ1 IQ2 IQ3 QS1 QS2 QS3 QS4 SE1 SE2 SE3 SE4 EL1 EL2 EL3	.833 .858 .888 .870	.804 .880 .853 .814	.863 .896 .878	.736 .797 .794	.741 .716 .791		

Table 2.	Rotated	com	ponent	matrix
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Convergent and Discriminant Validity

The outcomes of convergent and discriminant validity analysis (see Table 3) exhibited acceptable values for the composite reliability (>0.80) and average variance extracted (>0.50). Moreover, the MSV estimates are all less than AVE values. All these factors indicate reliable and valid data as recommended in the literature (Raza et al., 2021; Zaiþ & Bertea, 2011).

Confirmatory Factor Analysis

The outcomes of the CFA exhibited the model fitness based on the extracted indices; $x^2/df = 2.967$, GFI= 0.947, IFI= 0.982, CFI= 0.927, and RMSEA= 0.047

that were within the threshold range. This indicates the fact that the model used in the study is fit.

	CR	AVE	MSV	SE	SQ	IQ	QS	EL
SE	0.914	0.727	0.378	0.852				
SQ	0.814	0.595	0.378	0.615	0.772			
IQ	0.924	0.803	0.615	0.341	0.317	0.896		
QS	0.929	0.765	0.333	0.457	0.577	0.266	0.875	
EL	0.925	0.805	0.615	0.483	0.492	0.784	0.410	0.897

Table 3. Validity statistics

Hypothesis Testing

The study applied the SEM technique, and the results obtained through AMOS.23 have been presented in Table 4. The results of the SEM exhibited that e-service, e-information, and e-system quality all have a significant and positive influence on e-learning. This means that with the increase in one percent of e-service, e-information, and e-system quality; e-learning will be increased by 10.1%, 62.2%, and 12.2%, respectively. While it is also clear from the table 4 that the mediating impact of student engagement is also significantly positive in the study (see Table 4 and Figure 2).

Table 4. Structural equation modeling

Total Effect	ESysQ	EInfoQ	ESerQ	StuEng
StuEng	.188**	.159**	.389**	.000
ELearn	.128*	.645**	.178**	.145**
Direct Effect	FSvsO	FlnfoQ	FSerO	StuEng
StuEng	.188**	.159**	.389**	.000
ELearn	.101**	.622**	.122**	.145**
Indirect Effect	ESysQ	EInfoQ	ESerQ	StuEng
StuEng	.000	.000	.000	.000
ELearn	.027**	.023**	.057**	.000



Figure 2. Structural model of e-learning quality

Discussion

The study intended to explore the influence of three dimensions of quality of e-learning, i.e., e-information guality, e-system guality, and e-service guality, on e-learning quality in Malaysia, along with the mediating impact of student engagement in this regard. Therefore, during COVID-19, whereby student engagements are the ultimate objectives of every educational system, it will be interesting to understand how they perceive the implemented strategies based on the SERVQUAL model. The study contributed by verifying the facades presented in the SERVQUAL model. In doing so, eight hypotheses were developed to examine to what extent programs implemented during the COVID-19 pandemic have been perceived positively or not. The first hypothesis (H_{c}) was that e-service quality could significantly influence e-learning quality. Thus, the hypothesis was accepted as per the results obtained by the analysis of the collected data. If better services are provided in the background of information technology, better e-learning will take place. Similar results were obtained in the past literature (Kristanto, 2017). The second hypothesis (H_{a}) was that einformation quality has a substantial connection with e-learning, and this hypothesis was also accepted as per the study results.

The better the eminence of the information in e-learning programs vields a positive evaluation of the e-learning quality. This outcome is in line with the past study of Chang, Hajiyev, and Su (2017). The third hypothesis (H₂) postulated that e-system guality has a significant relationship with elearning quality. The results have also validated this hypothesis. Thus, it implies that if the overall system involved in the e-learning procedure is improved, the effectiveness of e-learning will be increased. The results are consistent with similar studies in the literature (Salloum, Al-Emran, Shaalan, & Tarhini, 2019). Similarly, drawing an analogy from the CTML theory, the study postulated three hypotheses $(H_4, H_5 \text{ and } H_6)$ that features (e.g., diverse learning material, etc.) of the implemented system would directly influence student engagement. The results affirmed that the e-learning system with the integration of sophisticated features can result in favorable appraisals (Alsheyadi & Albalushi, 2020). The results of the hypothesis (H_{-}) exhibited that the appraisals of the stakeholders can directly influence the perceived quality of the e-learning. This result validates that stakeholders' engagement functions as the determinant of the overall perception. To this end, higher engagement with the system can be achieved through the better interaction capabilities of the inward information (e.g., services). This, higher level of engagement, in turn, would determine the stakeholder's (e.g., students) assessments about the quality of the implemented systems. Finally, the following (H_a) is based on the significant mediating impact of student engagement on the relationship between SERVQUAL factors and e-learning effectiveness. The mediating impact of student engagement has been found. This result has verified the previous assumption of the CTML that supports the role of the perpetual filters. This implies that the quality of the e-learning system is a function of student engagement in the e-learning process. Therefore, effective e-learning ICT tools rely on the improved stakeholders' involvement, such as student engagement. These outcomes align with the past studies (Lavrov, Pasko, Tolbatov, & Barchenko, 2017). These results can be better elucidated in the context of CTML theory that emphasizes the augmentation of the embedded features of the channels designated for information sharing (Udo, Bagchi & Kirs, 2011). In case of the e-learning, the results advocated that high-speed e-Learning can be vielded by involving multiple sources (channels). As a result of the better-quality capabilities can seek more student engagements. For instance, the interaction of the students with the advanced capabilities of the system (SERVQUAL) can produce more involvement. The CTML also asserted that individuals learn considerably more from the multi-sources (Heng & Said, 2020). in this standard, the institutions using the diverse learning channels with advance platforms can enhance the learning quality of the higher education during pandemic.

Conclusion

To achieve the study's objectives, the data was collected from the students enrolled in e-learning programs. Moreover, results also indicated that the mediating impact of student engagement is significantly positive in the study. Based on the given results, the quality of e-learning programs should be improved by focusing on the quality of service, information, and learning system in the educational institutions during COVID-19. In addition, the data showed that the engagement of students was determined by the quality characteristics of the SERVQUAL model. Overall, this is essential research for the current education sector, administration, and policymakers to upgrade their service quality features based decisions. This research was conclusive and has notably produced some insights into the e-leaning quality for students. The overview for e-learning in Malaysian higher education was identified.

Furthermore, enhanced engagement levels induced motivation among students and resulted in increased students' participation. Therefore, the study concludes that other nations that are implementing e-learning programs must give particular emphasis on refining the services. The results indicated that e-learning quality enhances the academic experience of students, as well as e-learning. This study, therefore, underlines the variables that contribute to the efficiency of e-learning with the student engagement in e-learning. For example, they must revise the content delivery and guidance mechanism after revisiting the existing systems critically.

Moreover, this study recommends that the available e-resources must be evaluated by the end-users (students). Therefore, there should be descriptive workshops concentrating on the IT-related issues and communication elements that must be considered. For example, how do the 376

users evaluate the e- information services as easy to use. Thus, educational institutions must have online sessions with students to get their inputs. This whole practice can improve the efficiency of their e-learning programs during COVID-19.

Study Implications and Limitations

The current study has the theoretical implication that it will provide the information and literature to the researchers regarding the quality of e-learning and its subsequent impact on the effectiveness of e-learning. They will also be able to find the limitations of the study and will contribute towards the improvement in the study. The practical implication of the study is primarily for the educational institutions that are providing e-learning facilities and programs. As far as the limitations are concerned, the study is limited to Malaysia, and other countries must also be considered in the future. Moreover, in the future, more indicators of quality must be taken in addition to the current three indicators so that the scope of the study can be increased.

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