AN EXPLORATORY STUDY ON THE EFFECT OF PREDICTORS ON STUDENT SATISFACTION IN ONLINE LEARNING: EVIDENCE FROM A RURAL SECONDARY SCHOOL IN MALAYSIA

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Abstract

The adoption of online learning has revolutionized the teaching and learning processes and revealed some challenges in both the pedagogical and infrastructural aspects that directly impact students' satisfaction with online learning. While vital, there is limited empirical research that has explored the relationship between, quality of teacher, quality of technical services, and quality of the technical system and satisfaction of online services in a rural Malaysian school. This study examines these determinants using the DeLone and McLean IS Success Model, in which 125 students learning outside the classroom at SMK Lawas, Sarawak, responded to the study using an online self-administered structured questionnaire. The results indicate that the quality of teachers, the quality of services, and the quality of the technical systems are all significant predictors in determining student satisfaction in online learning environments. The Delone and McLean Model's extension provides valuable insights for policymakers and educators and lays the foundation for future studies in rural online education that can help develop effective teaching strategies.

Keyword(s): *Online Learning, Educational Technology, Quality of Teachers, Student Satisfaction, Structural Equation Modeling*.

INTRODUCTION

Online learning in the education system has greatly affected the teaching and learning process in recent years. The use of digital technology, Internet access and learning management systems have facilitated the shift towards more flexible and technology-based pedagogical models in educational institutions. With the implementation of digital education initiatives under Malaysia Education Blueprint 2013-2025, the usage of online learning platforms has also further boosted the accessibility and communication of education as well as the engagement of students in learning in Malaysia. Thus, e-learning has gained more significance in urban and rural education.

Student satisfaction is also an important metric for the effectiveness of online learning as it pertains to the perception of the quality of the teaching, the accessibility of the materials, the

interaction with the instructor, the support of the technology and the overall learning experience (Tan et al., 2021; He, Wang, & Lee, 2025). A high level of satisfaction has been consistently associated with increased motivation, academic success, student participation, and continued engagement (Sharif Nia et al., 2023; Hasan, Wahsheh, & Hassan, 2025), whereas dissatisfaction, primarily related to poor infrastructure, lack of feedback, or inadequate peer interaction, has been associated with decreased interest, motivation, and performance (Yu, Zheng, & Zhu, 2025). Furthermore, satisfaction is not only a reflection of the present but also a forerunner to future academic success and retention (Choi & Nadarajan, 2026; Sharif Nia et al., 2023), as it can be influenced by course design, cultural context and institutional readiness. Therefore, in the context of online education, increasing learner satisfaction should be based on three aspects: pedagogical quality, technological support, and opportunities for active engagement that will lead to both current effectiveness and future success in online education (He et al., 2025; Hasan et al., 2025).

A number of factors have been identified that affect student satisfaction in online learning environments. The most mentioned ones are teacher quality, service quality and technical system quality. Teacher quality is about the ability of the teacher to effectively present the lesson, give direction, communicate and interact with students in an online environment. The competence and support of the instructor in e-learning greatly affect the perceptions and satisfaction of the students (Al-Fraihat et al., 2020; He, Wang, & Lee, 2025; Hasan, Wahsheh, & Hassan, 2025). Service quality includes administrative support, responsiveness and learning resources. A smooth process and timely support are crucial for positive learning experiences (Sharif Nia et al., 2023; Tan, Kee, & Wee, 2021).

Technical system quality comprises Internet stability, platform usability, and system reliability. The satisfaction with online learning (Mansor et al., 2025; Yu, Zheng, & Zhu, 2025; Choi & Nadarajan, 2026) is affected by the stable infrastructure and user-friendly platforms. All of these factors work together to affect overall student satisfaction, which ultimately affects the motivation, engagement, and long-term academic persistence of students (Sharif Nia et al., 2023; Hasan et al., 2025).

Though there has been an increasing number of studies on satisfaction in online learning, some questions main unanswered. The existing studies are mainly university students and educational environment in the cities, while only a few studies have looked at the satisfaction with online learning among secondary school students, especially in rural areas (Fatimah et al., 2024), especially in Malaysia. The lack of reliable internet connectivity, poor digital infrastructure, and insufficient digital learning materials can also impact rural students' satisfaction with online learning (Fatimah et al., 2024; Fang et al., 2023). In this sense, conclusions that can be drawn from the findings of the higher education institutions may not be valid to show the experiences of rural secondary school students.

Further, the previous studies focus on the general evaluation of the learning satisfaction in online learning without specifically studying the synergic effect of teacher quality, service quality and technical system quality on the satisfaction of online learning students. These factors have been explored separately in the previous studies, but there is a scarcity of empirical evidence on the simultaneous influence of these factors on rural students' satisfaction in the context of secondary schools in Malaysia. This shows that there is a considerable gap in the literature that needs to be researched to gain a better understanding of the factors that affect the satisfaction of rural students in online learning.

Filling this gap is important because understanding the factors that influence satisfaction among rural students can help educators, school administrators and policymakers enhance the effectiveness of implementing online learning. Improved teacher quality, better education

services, and improved technical support systems can help to improve the learning experience and student outcomes, especially in rural schools.

Hence, the purpose of this research is to examine the effects of determinant factors on students' satisfaction with online learning. This study will focus on the effect of quality of teachers, quality of service, and quality of technical systems as of determinant factors on student satisfaction with online learning and contribute to the continuing debate on online learning.

LITERATURE REVIEW

Delone and Mclean Model

The DeLone and McLean Information Systems (IS) Success Model was first introduced in 1992 and updated in 2003. Information Quality, System Quality, Service Quality, Use, User Satisfaction, and Net Benefits are the six interrelated characteristics that make up this concept.

Several studies have used the DeLone and McLean Model, often in conjunction with the Technology Acceptance Model (TAM), to assess user satisfaction and the effectiveness of information systems, especially in e-learning settings. Al-Fraihat et al. (2020) on the other hand, combined the DeLone and McLean Model with the TAM in an empirical study for the effectiveness of e-learning systems. Similarly, Al-Samarraie et al. (2018) applied the same model to examine teachers' and students' satisfaction with continued e-learning. Both approaches were used by Ohliati and Abbas (2019) to assess the students' satisfaction on learning management systems. In addition, Achmadi and Oktivina (2021) investigated the influence of system, information and service quality on user satisfaction in e-learning system based on the model proposed by DeLone and McLean.

The DeLone and McLean (2003) model was selected because it explains the effect of quality factors influence user satisfaction with information systems. The quality of teachers in this study is represent as the competence and effectiveness of teachers, while the quality of service is defined as the provision of services to students, and the technical system quality is the reliability, availability, and ease of using the online learning platform. These constructs are applicable to the study of student satisfaction in a secondary school in a rural area in Malaysia. Thus, this model can be applied to the study of SMK Lawas' online learning to get a picture of variables that affect student satisfaction, which is very important for optimizing online learning.

Overall, the study is supported by the DeLone and McLean IS Success Model which provides a theoretical model for understanding the relationship between system, information and service quality and satisfaction in online learning among learners.

Student Satisfaction

Satisfaction is the overall sense of wanting to enjoy, happiness and ease felt by students during the lecture process both physically and mentally (Dubey and Sahu, 2021). The level of satisfaction of students, which can be seen from the extent of teaching and learning activities that meet the students' needs and preferences, is a key indicator (Khairusy and Febriani, 2023). Students want to be satisfied with online learning, which is dependent on the promptness of the teacher's response and the level of engagement and knowledge of the material (Landrum et al., 2021). Hwee Ling and Kan (2020) defined student satisfaction as the positive feeling and satisfaction students feel about their learning experience. This encompasses their satisfaction with the overall learning experience, the effectiveness of teaching, the nature of the services offered and the dependability of the technology utilized (Perera & Abeysekera, 2019).

The determinants of student satisfaction have been widely investigated and illustrate how the quality of services in higher education institutions is complex and varies from one setting to another. The study by Marlena et al. (2022) on the evaluation of service quality at the University of Surabaya revealed that the quality of online learning services and online infrastructure were the mediators that significantly influenced the level of student satisfaction. In the same way, in the college in Thailand and Indonesia, Darawong and Widayati (2022) examined the impact of the service quality components of teacher competency, dependability, responsiveness, and empathy on student satisfaction. Reliability was the top priority followed by responsiveness and efficiency in Thailand. However, in Indonesia, factors influencing the satisfaction shifted, which reflects the need for the cultural context to understand the satisfaction of the service. These findings are in line with Taghizadeh and Hajhosseini's (2021) study on the factors affecting satisfaction with blended learning in the Iran University of Science and Technology, which revealed that students' satisfaction with blended learning was significantly influenced by their attitudes, interactions, and teaching quality, with teaching quality being the greatest factor. This study also emphasized the importance of pedagogical knowledge of online learning.

Comparative studies, like comparing the learning outcomes of students with high frequency e-learning use and students without high frequency use, offer additional insight. At the University of Warwick, Al-Fraihat et al. (2020) found that the quality of the information, technical system, and the instructors had significant impact on student happiness, perceived utility, and system utilization. Furthermore, their study revealed that student satisfaction had a significant effect on the benefits of e-learning. Ohliati and Abbas (2019) found that the perceived ease of use, information quality, and service quality were the factors that influenced student satisfaction to a greater extent than system quality, usability, and communication quality in a private institution in Jakarta. The findings suggest that further investigation of the contextual factors is needed to gain deeper insights into student satisfaction in digital learning environments.

The current studies mainly focus on higher education institutions in urban areas; there is a lack of studies covering the rural context. This is particularly relevant for secondary schools, especially in the rural areas with less resources, where the infrastructure, instructional support and reliability of the systems is more acute. This study is designed to make a contribution to the limited research on the effectiveness of e-learning in rural education, by delivering information which can be used to inform targeted projects in similar settings to improve digital learning experiences.

Quality of Teacher

The quality of teaching significantly impacts students' satisfaction with online learning (Zheng et al., 2022). According to Fauth et al. (2019a), instructional skills, communication skills, responsiveness to student needs, and a desire to support are essential components of effective teaching. According to Fauth et al. (2019b), teacher quality in the context of online learning includes the capacity to modify instructional strategies for the digital setting, include students in interactive activities, communicate clearly, and give prompt, helpful feedback. Additionally, teachers need to know how to use e-learning platforms to provide curriculum, administer tests, and encourage student participation (Al-Fraihat et al., 2020).

To improve learning outcomes, teachers play a crucial role in sustaining student participation and engagement (Jiménez-Bucarey et al., 2021). Teachers that are well-versed in their subjects can communicate information more effectively, which improves student comprehension (Keržič et al., 2021). Teachers also require technological know-how in order to

use digital tools for communication, course delivery, and student assessment (Taghizadeh & Hajhosseini, 2021). The quality of teachers is a major factor in determining how satisfied students are with online learning, according to previous study. Enhancing instructors' technical proficiency and pedagogical approaches such as those that encourage active student participation is therefore essential (Darawong & Widayati, 2022).

In summary, student satisfaction with online learning is strongly influenced by the caliber of instruction. With a focus on teacher training, this study examines important elements such as technical skill, communication, and the capacity to design stimulating learning settings.
The following theory is put out in light of this.

H1: There is a significant relationship between the quality of teachers and student satisfaction in online learning at SMK Lawas.

Quality of Service

Service quality is one of the most important elements of online learning, as it indicates the quality of support that is provided to digital learning systems' learners. In the context of online learning, service quality is defined as the services offered to students such as technical support, answering their questions, and making resources available (La Rotta et al., 2020). According to the DeLone and McLean Information Systems Success Model, service quality is a different concept from system quality, which is related to the technical performance and functionality of the platform (DeLone & McLean, 2003). This framework has continued to be used in recent empirical studies to understand the relationship between online learning services and user satisfaction (Abbas & Munir, 2025; Atukunda et al., 2024).

In educational settings, service quality refers to the technical support, promptness of answering student questions, the ability to effectively address issues related to learning, and the availability of suitable learning materials. Limbu and Pham (2023) conducted a systematic review and identified service-related dimensions such as responsiveness and technical support as included in studies investigating student satisfaction with e-learning. Likewise, Effective support services allow students to navigate the online learning environment easily, access needed resources, and deal with and resolve issues promptly (Dollinger et al., 2020). The results highlight the significance of institutional support to facilitate students' participation in an online learning environment.

In light of these considerations, this study will assess service quality through specific elements, including teacher cooperation and approachability, prompt responses to student inquiries, and the overall user-friendliness of the online learning platform, all of which are expected to significantly influence student satisfaction. Thus, the following hypothesis is proposed.

H2: There is a significant relationship between the quality of service and student satisfaction in online learning at SMK Lawas.

Quality of Technical System

An important factor in assessing the efficacy of online learning environments is the technological system's quality. It includes the performance of digital tools used for engagement, like video conferencing software, the platform's dependability and stability, and the accessibility of learning resources (Liu et al., 2020). Furthermore, according to Al-Fraihat et al. (2020), technical system

quality encompasses important characteristics of an information system, such as dependability, adaptability, ease of use, intuitiveness, ease of learning, sophistication, and system reaction time. These qualities have a crucial role in determining user engagement and satisfaction, which in turn affect system adoption and, eventually, overall organizational success (Al-Okaily et al., 2021).

Reliability and smooth operation define a top-notch online learning platform, guaranteeing that technological issues like system lags or crashes do not impair the learning process (Li, 2021). Maintaining instructional quality and promoting successful teaching practices requires not just platform stability but also the correctness and applicability of course content, learning materials, and online resources (Legowo et al., 2019). To reach their full potential, even the most sophisticated systems need qualified teachers. Therefore, training instructors is essential to increasing the efficacy of online education. According to Brown et al. (2022), encouraging active student involvement and enhancing overall learning outcomes need providing teachers with the pedagogical tools and digital competences they need through focused training programs. In summary, an online learning environment's effectiveness is contingent upon both the system's technical excellence and the readiness and competence of educators to make successful use of these resources.

Overall, user satisfaction with online learning is strongly influenced by the technological system's quality, which includes engagement tools, dependability, and accessibility. To find opportunities for improvement, the opinions of students about the usefulness, dependability, and technological readiness of the course will be analyzed. Therefore, the following hypothesis is put forth.

H3: There is a significant relationship between the quality of the technical system and student satisfaction with online learning at SMK Lawas.

METHODOLOGY

As shown in Figure 1, a descriptive research design is the most appropriate for a quantitative study of students' satisfaction with the quality of online learning in Lawas secondary schools. According to the study's goals, it offers a thorough understanding of students' views of the online learning environment, focusing on a holistic picture rather than evaluating direct causal effects (Tan et al., 2021).

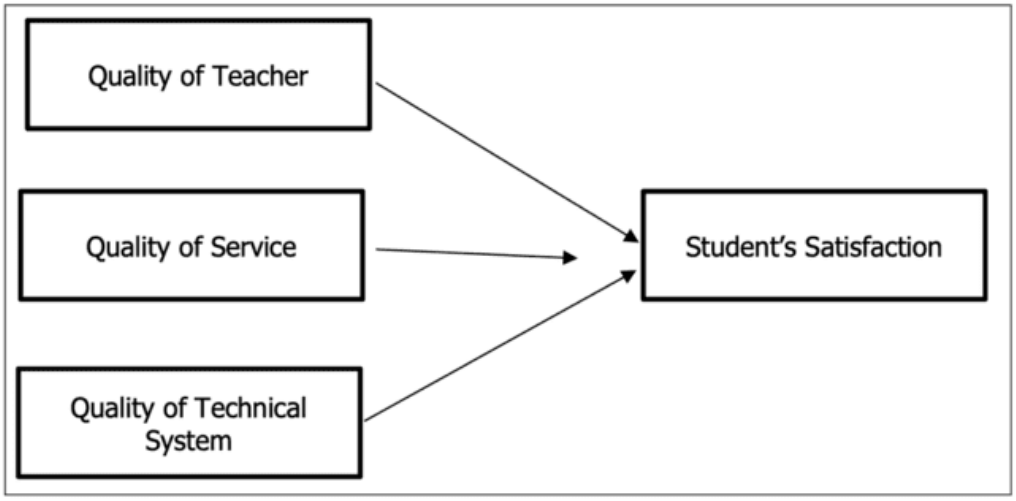

Figure 1: Theoretical framework

Population and Sample

The study's target group is approximately 206 students from SMK Lawas, Sarawak, who engage in online learning during extracurricular activities. These students come from a variety of demographic backgrounds. A minimum sample size of 119 students is needed for this investigation, according to the G*Power analysis. To increase precision, the researcher used 206 purposive sample of students, thereby contributing to the overall reliability and validity of the study's conclusions (Rahlin et al., 2023). This sampling was used after identifying students who had experience of online learning, to ensure that they could provide relevant information on student satisfaction with online learning. The next step was to use purposive sampling which involved selecting appropriate students who available and willing to take part in the study. This method proved useful for research in a rural school environment but might not be applicable to the general population of students in other schools.

Instrument Design

The researcher used a cross-sectional, structured questionnaire with a Likert scale style for this investigation. Six components comprised the questionnaire: One question was utilized for screening in Part A, and demographic data was gathered in Part B. with seven questions, Part C assessed the quality of teaching with six questions adapted from Darawong and Widayati (2022), Nor Shaid et al. (2021), and Taghizadeh and Hajhosseini (2021), Part D evaluated service quality with seven questions based on Darawong and Widayati (2022) and Taghizadeh and Hajhosseini (2021), Part E measured technical system quality with five questions, and Part F gauged student satisfaction with nine questions adapted from Darawong and Widayati (2022). Two languages were used, English and Malay, with back-to-back translation by two experts in Malay and English during pretest and face validity. All twenty responses from the pilot study among Form Four students were captured using a 5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree). The instrument's reliability, indicated by Cronbach's Alpha, was high for the Quality of Teaching (.903), Quality of Service (.842), and Quality of Technical System (.840). The data collection process involved administering this well-structured questionnaire to respondents in an organized manner to gather insights into online learning experiences.

Data Analysis

In order to investigate demographic traits of the respondents such as gender, age, ethnicity, internet accessibility, technology access, learning environment, and parental support frequency, analysis was carried out within the Statistical Package for the Social Sciences (SPSS) version 29 software and Smart PLS software after the gathered data had been coded and screened. There were two primary phases to the PLS analysis: the measurement model and the structural model. The reliability, discriminant validity, and convergent validity of the measurement model were examined. Path analysis was used to evaluate the hypotheses using a two-tailed test at a 5% significance level ($\alpha = 0.05$), and to test the suggested links in the structural model.

RESULTS AND DISCUSSION

Profile of the Respondents

A screening question about whether they had ever participated in online learning, as well as information on their address, gender, race, internet and technology accessibility, learning environment, and parental supervision during online learning (Table 1) was used to identify the respondents.

Table 1: Demographic information

Demographic Variable	Categories	Frequency	Percentage
Address	Bandar Lawas	24	19.2
	Lawas-Damit	5	4.0
	Merapok	44	35.2
	Others	2	1.6
	Punang	2	1.6
	Trusan	48	38.4
Gender	Female	68	54.4
	Male	57	45.6
Race	Cina	25	20.0
	Lunbawang	41	32.8
	Melayu	46	36.8
	Others	13	10.4
Accessibility to the internet	No connection	18	14.4
	Stable	46	36.8
	Unstable	61	48.8
Access to technology	A computer or laptop	44	35.2
	A computer or laptop and smartphone	4	3.2
	A computer or laptop, smartphone and a stable internet connection	16	12.8
	A smartphone	56	44.8
	A smartphone and a stable internet connection	5	4.0
Learning environment	At home	85	68.0
	At library	28	22.4
	Other	12	9.6
Parental support	Yes	104	83.2
	No	21	16.8

From the screen, 125 respondents out of 206 target samples completed the questionnaires, accounting for 81 percent of the response rate. Most of the students' houses are located in Trusan, with 48 respondents (38.4%), followed by Merapok, 44 respondents (35%), Bandar Lawas, 24 respondents (19.2%), Lawas- Damit, 5 respondents (4.0%), and Punang and others, 2 respondents (1.6%), respectively. Based on the table below, there are 68 female respondents (54.4%) and 57 male respondents (45.6%).

All these respondents were 16 years old. The respondents consisted of 25 Chinese people (20%), 41 respondents are Lunbawang (32.8%), 46 Melayu (36.8%), and 13 respondents of other races (10.4%). More than half of the respondents have an unstable internet connection. (48.8%), whereas 46 others have a stable internet connection (36.8%) and no internet connection (14.4%).

Most of the respondents have a smartphone (44.8%), (35.2%) only have a computer to access to technology, (3.2%) have both a laptop and a smartphone, (12.8%) respondents have a computer, smartphone and stable internet connection and only (5%) of respondents have a smartphone and stable internet connection. Most of the respondents join online learning from home (68%), at the library (22.4%), and at other places only (9.6%). As for parental support, more than half of the respondents have guidance from parents during online learning (83.2%), and the rest have no guidance or support from parents (16.8%).

Common Method Varian (CMV)

Common method variance (CMV) was evaluated in this work using full collinearity approaches and Harman's single-factor test.

Table 2: Result summary for reflective measurement model

Construct	**Item**	**Indicator Reliability**	**Convergent Validity**	**Internal Consistency Reliability**	
		Outer Loadings	**AVE**	**Composite Reliability**	**Cronbach's Alpha**
Quality of Teacher (QOT)	QOT1	0.795	0.616	0.805	0.792
	QOT2	0.859			
	QOT3	0.774			
	QOT4	0.703			
Quality of Service (QOS)	QOS1	0.859	0.689	0.851	0.849
	QOS2	0.82			
	QOS3	0.81			
	QOS4	0.831			
Quality of Technical System (TS)	TS1	0.826	0.64	0.741	0.718
	TS2	0.857			
	TS3	0.709			
Student's Satisfaction (SS)	SS1	0.756	0.617	0.856	0.843
	SS2	0.856			
	SS3	0.743			
	SS4	0.86			
	SS5	0.7			

The estimated common method variance, as determined by Harman's single-factor test, is 47.743%, which is below the generally recognized cutoff of 50%. All constructs have Variance Inflation Factor (VIF) values between 2.570 and 3.320. Although these values indicate considerable multicollinearity, they are below the threshold of 5, which is typically seen as acceptable in social science research, even though they are over 3 (Kim, 2019b).

As shown in Table 2, the constructs' internal reliability values ranged from 0.741 to 0.856, exceeding the minimum acceptable threshold of 0.7 and satisfying the suggested level established by Hair et al. (2011) and recommended in Rahlin, Jas, Fauzi, & Bahkia (2024). Quality of instruction had the lowest Average Variance Extracted (AVE) value in this study (0.616), followed by service quality (0.689), technical system quality (0.640), and student happiness (0.617). The construct exhibits good convergent validity when its AVE value is 0.50 or more, meaning it explains over 50% of the variance in its indicators. Fornell and Larcker (1981) state that significant convergent validity is indicated by an AVE value of 0.50 or greater.

Discriminant validity Heterotrait Monotrait (HTMT) Technique

In the HTMT method in Table 3, the assessment of discriminant validity indicated that all constructs were empirically distinct. The results satisfied the established discriminant validity criteria, indicating that each construct captures a unique aspect of the conceptual model. Therefore, the measurement model exhibited adequate discriminant validity, in line with Hensler et al. (2015), who stated that in lenient cases, a threshold below of 0.90 is used.

Table 3 : Discriminant validity using Heterotrait-Monomatrait (HTMT)

	QOS	QOT	SS	TS
QOS				
QOT	0.922			
SS	0.878	0.818		
TS	0.772	0.7662	0.642	

The R2 values for the variables of teacher quality, service quality, and technical system quality in relation to student satisfaction are 0.748, as shown in Table 4. They are deemed excellent for the structural model because all variables' R2 values are higher (Hair, 2021). In the current study, the structural model, path coefficients, and t-test values were used to test the hypothesis. Three hypotheses were tested to examine the variables affecting SMK Lawas students' satisfaction with online learning.

Table 4: Structural model assessment

Hypothesis	Relationship	Std. Beta (β)	Std. Error	t-value	p-value	Lower Limit (LLCI)	Upper Limit (ULCI)	Decision	R^2	F^2	Effect Size	VIF
H1	QOT → SS	0.262	0.093	2.803	0.03	0.107	0.409	Supported	0.748	0.105	Medium	2.587
H2	QOS → SS	0.478	0.084	5.701	0	0.351	0.627	Supported		0.273	Medium	3.332
H3	TS → SS	0.2	0.082	2.427	0.008	0.063	0.031	Supported		0.062	Medium	2.57

H1: There is a significant relationship between the quality of teachers and student satisfaction in online learning at SMK Lawas.

The results of H1 demonstrate that student satisfaction with online learning has a substantial impact on the quality of teachers (β=0.262; t-value=2.803; p=0.03). As a result, H1 shows results comparable to Donald and Hashim (2025) who, investigated digital education from the perspective of teachers in rural schools in Malaysia, where they found infrastructure, connectivity, and professional development to be significant challenges for implementation. This can be helpful for discussing the teachers' effectiveness as online teachers in rural schools. Likewise, Azizan et al. (2023) discovered that student–instructor interaction had a strong impact on satisfaction with online learning. The results indicate that the effective use of communication and active teacher participation are still crucial in the context of successful online learning.

This connection between the quality of teacher and student satisfaction in online learning is especially applicable in rural secondary schools like SMK Lawas in which students could face limitations in internet connectivity and access to digital resources. In this context, teachers' competence to give clear instructions, flexible learning materials, and regular academic guidance can assist students to cope with the difficulties of online learning. The study on secondary schools in Malaysia has also pointed out the distinction between school types in terms of engagement in online learning and external support (Jaafar et al., 2022). Other scholars also emphasized that teacher effectiveness in rural online learning should also be considered in the context of technological restrictions. Yap et al., 2024). Therefore, the quality of teachers should be considered an important factor in improving student satisfaction in rural online learning environments.

The results provide compelling evidence for the significance of high-quality teachers in online education. It is important to keep in mind that external factors, such as individual motivation and the classroom setting, which may change depending on the situation, can also affect student happiness. The importance of this relationship underscores the need for educators to participate in targeted professional development programs that enhance their ability to teach online. Institutions should invest in training that equips professors with the know-how to use digital technologies effectively, interact with students in virtual classrooms, and provide prompt feedback. These kinds of programs can create an online learning environment that is more encouraging and participatory, thereby enhancing learning outcomes and student satisfaction.

H2: There is a significant relationship between quality of service and student satisfaction in online learning at SMK Lawas.

The study shows that, with a strong path coefficient (β = 0.478), a high t-value (5.701), and a statistically significant p-value (p = 0.000), Quality of Service (QOS) is the most important factor influencing student satisfaction in online learning. Thus, H2 is accepted. Numerous studies have also demonstrated that the outcomes of hypothesis testing on the quality of services in online learning have a substantial impact on student satisfaction. The pandemic has expedited the shift to online learning, necessitating a re-evaluation of service quality criteria to account for online-specific factors. Student satisfaction has been affected in various ways by this shift, which has highlighted online education programs' advantages and shortcomings.

Prior studies have demonstrated that student satisfaction with online learning may be accurately predicted by quality of service. In their study of rural vs urban secondary schools in Malaysia, Yap et al. (2024) found differences in technical issues and the use of Google Classroom. Furthermore, researchers emphasize the need for proper support of online education in rural

areas. Consistent with this finding, Dangaiso et al. (2022) and Atukunda et al. (2024) revealed that the dimensions of e-learning quality, such as service quality, had positive significant relationships with student satisfaction with e-learning.

This finding can be compared with the study carried out by Batool et al. (2024) that investigated the information quality, system quality, service quality, and satisfaction of the online learning platform among students in the rural areas of Gilgit-Baltistan, Pakistan. Their research offers a valid comparison to the rural context because it includes quality dimensions that are part of the DeLone and McLean model. In a similar fashion, Azman et al. (2022) concluded that the learning materials and teacher–student interaction were valued by the school students in the rural Malaysian context, while connectivity issues were still a problem in the online learning context. The results indicate that service quality in rural schools should not be limited to providing access to online platforms, but should also involve responsive support, effective communication, and providing flexible support for students with access problems.

Some research supports this conclusion by showing that raising student satisfaction on online learning required improving service quality. To increase student satisfaction, these insights highlight the need for ongoing adaptation and development in online learning settings. On the other hand, Yeop Yunus, Kamarudin, Zachariah, and Md Zabit (2016) found no discernible effect on service quality in the northern region of Malaysia. This research implies that the organizational context and teachers' technological competence are more important variables in the effective adoption of digital learning platforms than the service's perceived excellence.

For educational institutions, particularly those in rural or resource-constrained places like SMK Lawas, this emphasizes the practical need to prioritize service quality. Student experiences can be greatly improved by investing in user assistance, effective communication channels, and ongoing system monitoring. Overall, the importance of service quality in ensuring the success of online learning is demonstrated by the substantial impact it has on student happiness. To enhance the outcomes of online education, institutions must provide top-notch customer service that meets students' needs, builds trust, and facilitates learning. This knowledge is essential for directing staff training, policy, and resource allocation, especially when it comes to adjusting to upcoming difficulties in digital education.

H3: There is a significant relationship between the quality of the technical system and student satisfaction with online learning at SMK Lawas.

The results reveal a significant positive relationship between the quality of the technical system and student satisfaction with online learning at SMK Lawas ($\beta = 0.2$, $t = 2.427$, $p = 0.008$). So, H3 is supported. Alshathry and Alojail (2024) corroborate this finding by pointing out that student satisfaction in online learning settings is significantly influenced by the technological system's quality. Reliability, responsiveness, usability, and general learning platform functionality are just a few of the aspects that make up system quality. Studies regularly show that students' views and satisfaction levels are greatly impacted by these technical features.

According to a study by Alkhawaja et al. (2022), for example, students' perceptions of the usefulness and intention to use e-learning systems are positively impacted by system quality, which in turn influences their actual use and satisfaction. In a similar vein, Achmadi and Siregar (2021) showed that user satisfaction with e-learning systems is strongly influenced by system quality as well as information and service quality. These results highlight how crucial a functional and approachable technical infrastructure is to raising student happiness. According to this conclusion, students' satisfaction with their online learning experience is expected to increase if technical system changes are made, such as enhancing platform dependability, user interface,

and accessibility (Leonnard, 2021). According to Hermosisima et al. (2023), the results' statistical significance ($p < 0.05$) emphasizes how crucial it is to make investments in strong technical infrastructure in order to maximize student outcomes in an online learning environment.

Furthermore, the COVID-19 epidemic has brought attention to how important system quality is for online learning. The quality of these systems is more important than ever because students are depending more and more on digital platforms for their education. Problems like poor response times, complicated interfaces, and system outages might make students frustrated and less satisfied (Rahlin et al., 2024). On the other hand, intricate or perplexing user interfaces can cause cognitive overload, which would increase student discontent. With the COVID-19 pandemic, this problem is especially important because of the sharp rise in the use of online learning platforms, which has put more strain on the technical infrastructure (Zainuddin & Halim, 2021).

In conclusion, one of the primary factors influencing satisfaction in online learning settings is the caliber of the technical system. To guarantee a smooth and fulfilling educational experience for students, educational institutions should place a high priority on the creation and upkeep of top-notch technical infrastructures. To satisfy the changing needs of online learners and promote successful educational results, investments in system dependability, UI design, and technical support are crucial.

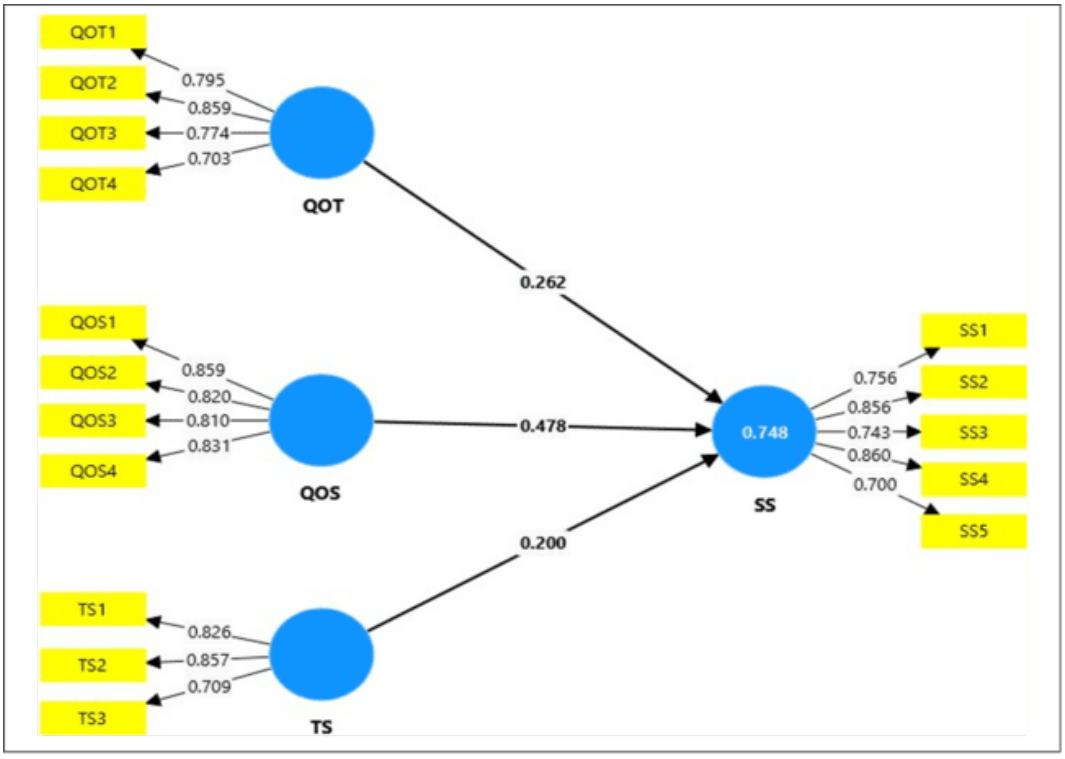

Figure 2: Structural model

Based on the given SEM diagram in Figure 2, the Structural equation modelling with the values inserted is:

$$SS=\beta 0+\beta 1 \cdot QOT+\beta 2 \cdot QOS+\beta 3 \cdot TS+\zeta \quad (1)$$

$$SS=0.262 \cdot QOT+0.478 \cdot QOS+0.2 \cdot TS+\epsilon$$

Here:

- $\beta 1$=0.262 is the path coefficient from QOT (Quality of Technology) to SS (Service Satisfaction).
- $\beta 2$= 0.478 is the path coefficient from QOS (Quality of Service) to SS (Service Satisfaction).
- $\beta 3$ = 0.2 is the path coefficient from TS (Technical Quality) to SS (Service Satisfaction).
- ϵ represents the error term accounting for the variance in SS not explained by QOT, QOS, and TS.

In sum, the results supported all three hypotheses. Specifically, there is a significant relationship between teacher quality, service quality, and technical system quality with student satisfaction. This indicates that these three elements are important in shaping students' overall online learning experience at the school. This study highlights the importance of Quality of Service (QOS), Quality of Technology (QOT), and Technical Quality (TS) in driving Service Satisfaction (SS), with significant implications for industries and communities. For industries, enhancing service and technological quality is crucial for improving customer satisfaction, while TS ensures equitable access. These findings align with SDGs 8, 9, 11, and 16, supporting sustainable and inclusive development. Future research should explore mediating factors such as digital literacy, conduct cross-sector comparisons, and further integrate sustainability metrics to better understand the drivers of student satisfaction with online learning.

This article advances education by analyzing the primary factors that influence student happiness in online learning, with an emphasis on technical system performance, teacher quality, and service quality. Along with offering helpful suggestions for improving online business education programs, it provides empirical insights into how these factors affect student engagement and satisfaction in virtual learning environments. It fills in the gaps in the body of research on the empirical connections between these elements and their effects on the entire virtual learning environment.

This study provides a thorough analysis of various aspects of online learning, including quality of teacher, quality of service, and quality of support system affect and satisfaction on online learning. The results aid in developing evidence-based tactics to enhance the effectiveness of online business education programs by leveraging well-known models, such as the Delone and McLean Information Systems Success Model.

Contribution of the study

This study contributes to the discourse on online learning by examining how teacher quality, service quality, and technical system quality influence student satisfaction in a rural secondary school in Malaysia. By applying the Delone and McLean IS Success Model, the research extends its relevance to secondary education contexts, which are often overlooked compared to higher education. The findings highlight the pivotal role of teacher competence in shaping satisfaction, the importance of service quality in ensuring smooth administrative and resource support, and the necessity of reliable technical systems for effective online delivery. Together, these determinants provide a holistic understanding of the effect of satisfaction on online learning that emerges in resource-constrained environments. The study offers theoretical value by adapting a well-established model to a new educational setting, and practical value by providing actionable insights for policymakers, administrators, and technology providers seeking to enhance online learning outcomes in rural schools.

From the above findings, two practical recommendations are recommended to increase student satisfaction with online learning in the rural context. First, schools in rural areas should ensure that the quality of services such as online learning platforms that teachers and students are using is reliable, easy to use, and accessible. Secondly, the school must solve issues related to the quality of the technical system by solving technical problems in time so as avoiding disruption in the online teaching process. Secondly, the school should take prompt action on technical problems, to reduce the interruption of the school's online teaching process and give students who have difficulties accessing the online learning platform the necessary teaching aids and an appropriate online learning environment.

Limitation

This study has three main limitations. First, the sampling and population were limited to one rural secondary school in Lawas, Sarawak, which restricts representativeness and reduces the ability to generalize findings to other schools or regions. Second, the measurement relied on self-reported survey data, which may be influenced by subjective perceptions and social desirability bias, limiting accuracy. Third, the study faces a generalization limitation, as results drawn from a localized context cannot be applied broadly across different educational levels or diverse settings without further validation.

Author Contribution

Nor Azma designed the introduction, provided input for overall structure and conceptualization of the article and research, and spearheaded the writing of the discussion. Data collection and data analysis were made by Murie anak Miggat. Xu Yanhong did the literature review and helped to write the manuscript.

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Ethics Statement

This study has been carried out in accordance with the guidelines for doing ethical research. All participants were informed about the study and confidentiality and voluntary participation were ensured.

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