



Online Delivery and Assessment of Engineering Courses: The Neglected Student Learning Time

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ABSTRACT

BACKGROUND & CONTEXT

Following the COVID-19 pandemic, reliance on online education has grown due to its convenience and flexibility. Students now spend more time on online videos, projects, and assessments than the Student Learning Time (SLT) set for traditional face-to-face courses. This mismatch has raised concerns about measuring student workload accurately in online contexts and its implications on student well-being and academic performance, potentially hindering Malaysia's blended and innovative learning goals outlined in the Malaysian Education Blueprint 2013–2025 (Higher Education).

PURPOSE OR GOAL

This study investigates how online teaching and learning impact engineering students' workload, academic performance, and learning experience, emphasising the need for a structured SLT framework to maintain a manageable academic burden.

APPROACH OR METHODOLOGY

Using Carroll's Model of School Learning, a mixed-methods approach analysed time-related factors. Data were gathered from engineering undergraduates at two private Malaysian universities via a survey, covering both pre-pandemic face-to-face and post-pandemic online learning experiences.

OUTCOMES

Students showed favourable attitudes towards both synchronous and asynchronous modes, as reflected in higher engagement during live sessions and greater self-directed learning in asynchronous modes, but reported heavier workloads and more demanding assessments online.

CONCLUSIONS

This study highlights the need for a comprehensive SLT framework in online learning to foster deep learning and support academic success. Though focused on Malaysian engineering students, the findings could be a reference to educators, HLI and accreditation bodies of other disciplines or countries.

KEYWORDS

Online engineering courses; Online teaching and learning; Online assessment; Student learning time; Workload.

Introduction

Background

The COVID-19 pandemic compelled Higher Learning Institutions (HLIs) globally to suspend traditional face-to-face instruction, shifting rapidly to online teaching and learning. In Malaysia, this sudden transition prompted both educators and students to depend heavily on digital platforms to sustain academic continuity. Although the Malaysian Ministry of Higher Education (MoHE) had already encouraged the integration of blended learning, online teaching, and alternative assessments as early as 2018 (Ministry of Higher Education Malaysia, 2018), the adoption rate remained limited due to a lack of urgency. However, the pandemic served as a catalyst, pushing HLIs to adopt online and hybrid teaching and learning (T&L) models as practical contingency measures (Tang et al., 2021). In the post-pandemic era, the implementation of online and hybrid learning approaches continues to gain momentum, not only as a backup during emergencies but also for their flexibility and convenience, particularly during festive seasons and unforeseen disruptions. Course instructors have had to adapt their pedagogical and assessment strategies, while students continue to navigate the challenges of engaging with digital learning environments (Lapitan et al., 2021). Across Malaysia and many other countries, synchronous virtual classrooms and asynchronous pre-recorded lectures have become mainstream, gradually displacing traditional classroom models.

In engineering education, which traditionally emphasises content-heavy, design-oriented, and hands-on learning (Liew et al., 2020; Asgari et al., 2021), the shift to online platforms presents both opportunities and challenges. Studies have highlighted the positive impact of online project-based learning, web-based flipped classrooms, and active online learning strategies on student outcomes (Martinez et al., 2020; Peramunugamage et al., 2020; Chilukuri, 2020). Nevertheless, various challenges continue to affect the quality of online education. These include limited internet access, insufficient preparation time for online materials, inadequate digital literacy, and a lack of online teaching and assessment competencies among educators and students (Kebritchi et al., 2017; Kamarudin, 2020; Sani, 2020).

Moreover, the shift to digital learning environments has psychological implications. Students may experience reduced motivation and support compared to face-to-face learning environments, potentially hampering their academic development (Whitelock et al., 2015; Bawa, 2016; Travers, 2016; Baltà-Salvador et al., 2021). For instance, Son et al. (2020) reported that U.S. college students faced increased academic workload and test difficulty during the pandemic, along with insufficient instructor support. Similarly, Widyanti et al. (2020) found that Indonesian students perceived e-learning as mentally taxing due to overwhelming information and a lack of guidance on navigating online resources.

In response to these challenges and the evolving educational landscape, hybrid learning has become increasingly prevalent in Malaysian universities. Following the Movement Control Order (MCO), the set of COVID-19 restrictions implemented by the Malaysian government, this flexible approach has gained institutional support. In March 2023, the MoHE announced that 95 bachelor's degree programmes across 19 public universities would adopt a flexible hybrid learning model for the 2023/2024 academic session. Under this initiative, students primarily attend lectures during their first and final years, minimising physical campus presence during intermediate years. This strategy aims to enhance flexibility, meet diverse student needs, and reduce the overall cost of tertiary education (Jaayne Jeevita, 2024).

Student Learning Time in Engineering Education

The Malaysian Qualifications Agency (MQA), the statutory body responsible for quality assurance in higher education, defines academic load as follows: “*One credit hour is equivalent to 40 notional learning hours, accounting for the semester system and the availability of average students' learning hours across various activities, including guided, independent, and non-face-to-face learning*” (MQA, 2011). These learning hours comprising both contact (face-to-face) and non-contact (non-face-to-face) components, are collectively referred to as Student Learning Time (SLT). This concept is widely adopted by HLIs in Malaysia and has been formally incorporated into the Engineering Accreditation Council Malaysia's (EAC) standards for accrediting undergraduate engineering programmes (Engineering Accreditation Council, 2024).

SLT provides a structured framework for student workload, especially for conventional face- to-face learning modes (MQA, 2011). For example, students are generally expected to spend 1 to 2 hours on self-study for each hour of lecture, and approximately 10 to 20 hours in preparation for a three-hour examination. However, guidelines for estimating student workload in online courses remain limited (Phillips et al., 2016). The urgency brought about by the COVID-19 pandemic forced HLIs and educators to rapidly transition to online teaching, often without sufficient consideration for SLT. To date, comprehensive guidelines or frameworks outlining SLT for online teaching, learning, and assessment activities are still lacking.

While many studies have highlighted key challenges in online education such as technological limitations, communication gaps, pedagogical shifts, and assessment concerns (Kebritchi et al., 2017; Kamarudin, 2020; Sani, 2020), the specific relationship between online T&L pedagogies and student workload in engineering education has received little attention. According to Bawa (2016), online learning environments are largely self-directed, relying heavily on students' ability to manage their academic responsibilities. Beer (2019) similarly observes that in online learning contexts, students are often required to engage in sustained, independent study, making continual progress by utilising the digital materials and resources provided without frequent, direct instructor intervention.

Appropriately structured workload and adequate time allocation for various forms of online T&L and assessment activities are crucial to achieving intended learning outcomes and sustaining academic performance (Carroll, 1963; Biggs, 2003). This consideration becomes even more significant in light of the increasing adoption of online and hybrid learning modes after the COVID-19 pandemic.

Conceptual Framework

John B. Carroll's (1963, 1989) Model of School Learning has significantly influenced educational theory for decades. The model identifies five variables affecting academic achievement, three of which are time-related (Figure 1). Carroll emphasised the importance of time as a critical learning resource, a view supported by Chambers (1992), Lam et al. (2012), and Smith (2019), who found that students' academic performance is closely linked to the time allocated for learning. Karjalainen et al. (2008) also noted that greater time allocation encourages deeper learning, applicable in both face-to-face and online settings.

Unlike traditional classrooms, online learning offers students flexibility to engage with content at their own pace (Mansor & Ismail, 2012). However, this flexibility complicates the measurement of SLT, making it harder to ensure that workload aligns with credit hours. Carroll (1963, 1989) cautioned that poor time management could hinder academic progress and affect

national education goals, such as those outlined in the Malaysian Education Blueprint 2013– 2025 (Ministry of Education Malaysia, 2013).

Workload and motivation are common challenges in online learning. Whitelock et al. (2015) observed that students who struggle to keep pace with course requirements are more likely to drop out, highlighting the link between excessive workload and attrition. Instructors also face difficulties in estimating appropriate study hours for online activities. Similarly, Dutton et al. (2001) and Bawa (2016) linked low retention rates to motivation issues, particularly in constructivist learning environments where students must independently solve complex problems. These findings highlight the need for educators to balance workload with intended learning outcomes (Biggs, 2003).

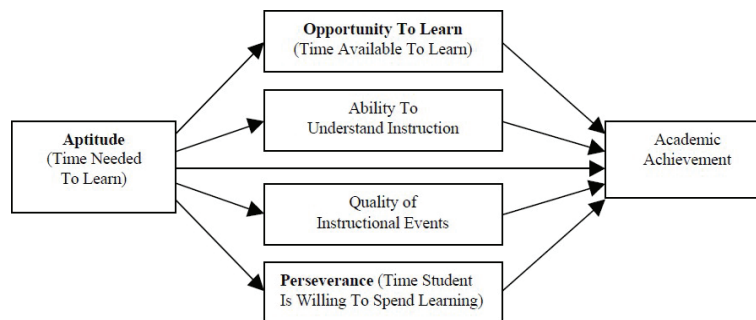


Figure 1: Carroll's (1963, 1989) "Model of School Learning"

This study investigates the impact of online T&L and assessment on Malaysian engineering students' learning experiences during the COVID-19 pandemic. The goal is to evaluate the need for a specific SLT framework for online activities and assessments to better quantify engineering students' workload.

The following are the research questions for this study:

- RQ1: How do online T&L and assessment affect the workload of engineering students?
- RQ2: How do online T&L and assessment affect engineering students' academic performance?

Carroll's model (1963, 1989) forms the basis of the conceptual framework for this study, highlighting the importance of sufficient and well-structured learning time for academic success (Figure 2). A heavy perceived workload often leads to surface learning, which can hinder learning outcomes and reduce student satisfaction. Conversely, well-designed online assessments can foster meaningful learning and enable students to demonstrate the intended outcomes (Biggs, 2003).

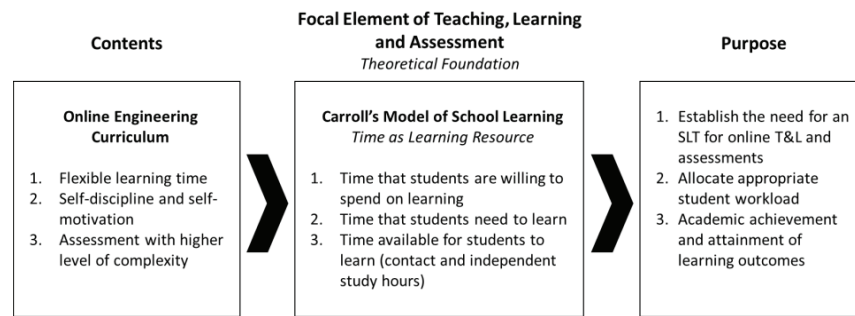


Figure 2: The conceptual framework for this study

Methodology

This study adopted a mixed-methods approach, integrating both quantitative and qualitative data collection and analysis to explore students' perspectives on online T&L and assessments. A structured survey was administered to engineering undergraduates in their final two years of study at two private universities in Malaysia. All 94 participating students had experience with both face-to-face and online learning environments.

The survey was designed to gather insights on several dimensions of online education, including assessment complexity, workload, academic performance, and learning preferences. To capture the contrasts between physical and online learning modes, the survey employed a simplified three-point Likert scale. Additionally, two open-ended questions were included to explore students' preferred online learning styles and their perceptions of workload differences across the two learning modalities.

The survey was distributed through social media platforms, including Facebook and WhatsApp, using a Google Form. Quantitative responses were analysed using descriptive statistics, primarily in the form of percentages. Qualitative responses were examined to extract recurring themes, offering deeper insights into students' experiences and preferences in online learning environments.

Results and Discussion

The survey results were based on voluntary responses from 94 undergraduate engineering students, comprising 68.1% male and 31.9% female participants. To ensure confidentiality, respondents were anonymised using labels R1 to R94. Most respondents were in their third (57.0%) or fourth year (43.0%) of study. Importantly, all had experienced a sudden transition from face-to-face learning to online instruction following the COVID-19 pandemic and the closure of HLIs in March 2020. The findings are discussed in relation to the two research questions outlined earlier, focusing on students' perceptions of online teaching and learning, assessment, and workload.

Students' Perspectives on Online Learning Mode

Online T&L can be delivered either synchronously or asynchronously. Synchronous sessions involve real-time interaction via tools such as video conferencing, live webinars, virtual classrooms, and chat platforms, allowing students to engage, ask questions, and receive immediate feedback despite not being physically present (Lapitan et al., 2021; Jamalpur et al.,

2021). In contrast, asynchronous learning relies on tools such as email, discussion forums, and pre-recorded lectures, typically hosted on a Learning Management System (LMS). This mode allows students to learn at their own pace and access materials at any time, providing greater flexibility (Malik et al., 2017).

Survey results showed that 54.3% of respondents preferred synchronous e-learning, while 45.7% favoured the asynchronous mode. This slight preference for live instruction reflects the desire for real-time interaction and structured learning, which some students find more motivating and engaging. However, the asynchronous format appealed to those with higher self-discipline and independent learning habits.

The preference for synchronous learning was strongly supported by students who valued live interactions with instructors and peers. Respondents indicated that real-time sessions encouraged active participation and reduced procrastination:

"It is easier to ask and discuss questions with the professors, and we are more active."
– R24

"[We] Can get the information instantly [in synchronous mode], but not after few days via emails or MS Teams [in asynchronous mode]." – R27

"The vibe (synchronous atmosphere) is helping with the learning. It is actually helping with our time management, we tend to accumulate recorded videos and struggle to watch and learn from the videos" – R47

"It is more interactive. Questions can be asked on the spot too. Students will be 'force' to attend the class which is good to prevent students from procrastinating their studies. Recorded video might give an impression to students that they can re-watch it during their free time and this in fact may cause negligence which delay their studies." – R52

Others emphasised that live classes provided clearer explanations and more engaging delivery than pre-recorded sessions:

"I like real time live as professors can explain more in advanced rather than [in] recorded video. If something [I do] not understand [in recorded video], it will just pass on without any clarification." – R16

"Because some important knowledge will be not included in the recording video and thus I will prefer online learning based on real time mode so that I will not miss out any important info for my academic." – R18

"[I] feel more attach to class. Pre-recorded video tends to be boring, and usually less information will be provided by the professors." – R44

"If it is a recorded video, lecturers tend to be very fast in teaching (no pause asking if students are OK or can follow). Besides, if students ask questions in the meeting chat when the recorded video is being played, most lecturers won't pause the recorded video to answer the question immediately. When the lecturers finished playing the recorded video, only he come back to the questions and by then, lecturers are not sure which part students are asking about (not efficient). In live lectures online, at least some lecturers would go slower while making sure students understand and they would answer student's questions almost after the student ask the question." – R69

Despite this, several students appreciated the flexibility offered by asynchronous learning. They valued the ability to study when most focused, pause and rewind videos, and manage their own pace:

"It saves us time as we can fast forward the video clip. In addition to that, recorded clips give us the freedom to watch and study whenever we want" – R26

"I would have my own time that feel like wish to study and specifically during that time I could absorb the knowledge faster and more efficiently. Especially during night time, I could learn things faster. However most of the class are during day time which caused me day dreaming in the class." – R30

"I get to pause the video, and get a better understanding on the knowledge delivered. Also, I have the choice to study at my convenience." – R36

One participant (R92) highlighted that limited interaction with the professors has put asynchronous classes at a disadvantage:

"We can keep on replay the video if we not understand or we are missed out. Next, we can set the speed of the video according to our own speed. However, the only disadvantage is we can't ask at the moment if we have some problem on the topic."

These varying preferences align with Carroll's (1963, 1989) model of academic learning time, which identifies three key time-related factors: perseverance (motivation and time a student is willing to invest), aptitude (time needed to learn), and opportunity to learn (time actually available for learning). Students preferring synchronous learning often benefited from external structure and real-time interaction (linked to perseverance), while those choosing asynchronous learning exhibited higher autonomy and self-regulation (related to aptitude and opportunity to learn). For example, themes like "struggling to watch recorded videos" and "slow or fast teaching pace" illustrate how mismatches between preferred learning style and delivery mode can impact engagement and performance. Table 1 summarises the emerging themes and student perspectives on both learning modes, reflecting their varying needs, motivations, and self-directed learning abilities.

Table 1: Emerging themes on the advantages and disadvantages of synchronous and asynchronous learning modes

Synchronous	Asynchronous
Enhanced interaction between instructor and peers	Promotes flexibility to learn at own pace and time
Immediate response from instructor	Delayed response from instructor
Comprehensive explanations by instructor	Less information and clarifications from instructor in recorded video
Encourages students' active participations and promotes interactive activities	Limited interaction with instructor
Helps students' time management	Students struggle to watch and learn from videos
Students feel more attached to classroom discussions	Students regard as boring input
Slower teaching pace	Fast teaching
Prevent students from procrastinating studies	

Students' Perspectives on Online Assessments

Figure 3 illustrates students' perceptions of academic workload in an online learning environment. A significant portion (68.1%) reported that their workload increased compared to traditional face-to-face learning. In contrast, a small group (12.8%) felt that online classes and assessments reduced their workload, citing benefits such as time and cost savings and less emphasis on rote memorisation of theoretical concepts. Nevertheless, as shown in Figure 4, the majority (86.2%) found online assessments more difficult than those conducted in physical classrooms. This increased difficulty was largely attributed to the higher complexity of online test formats.

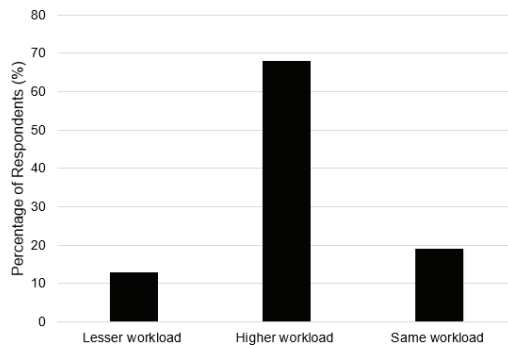


Figure 3: Student perception of workload in online learning environment

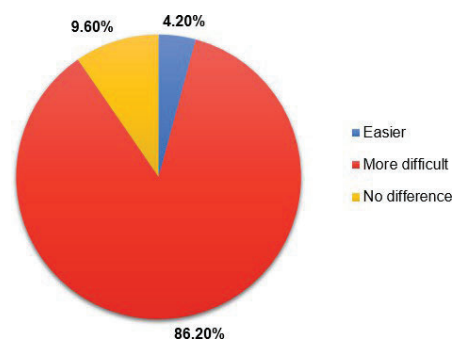


Figure 4: Student perception of complexity level of online assessment compared to assessment administered in physical setting

According to Guangul et al. (2020), remote assessments introduced several challenges for HLIs and educators, particularly regarding academic integrity, infrastructure limitations, the effective coverage of learning outcomes, and ensuring student commitment to completing assessments. These issues align with findings in the present study, which highlight that many Malaysian HLIs lack comprehensive policies or standardised guidelines for online teaching and assessment. As a result, course instructors are often given discretion to design assessments that uphold academic integrity. This has led to the frequent use of open-ended questions and diverse assessment components such as combining written reports with online presentations, to minimise opportunities for dishonesty.

Kearns (2012) also noted that online learning often involves a greater number of formative and summative assessments compared to traditional classrooms. This is to ensure continuous engagement, as students are more likely to complete tasks that contribute to their grades. The same author emphasised that instructors must evaluate these tasks to maintain student motivation and participation. Several respondents in this study voiced concerns about the increased frequency and complexity of online assessments:

"Assignment given is almost every week compared with face to face class. I hardly have time for myself." – R25

"Even though online learning has less things to memorise in preparation for final assessment, the amount of assignments increases per subject. The weightage of assignments also increases. The level of difficulty for final assessment conducted online increases too. Students even have to do extra reading amid the final assessment"

which lead to less time for answering the questions. Thus, to do well, students have to do a lot of preparation for online learning.” – R53

“Since it's open ended examination or quiz, some of the answers of questions require more research, as the answers will need to be quite up-to-date to the current research papers that are available. As most of the examinations in my university are time restricted (3 hours), it really raise the difficulty to complete all the questions within time frame given while providing the answers that require longer time of research effort.” – R11

“As compared to physical study, the final exam is easier and basically simple theory and calculation. However, during online assessment, we are having open book test which the question will definitely be harder. In order to score well in online assessment, I need to read more external sources rather than referring to the syllabus. Besides, assignments were having a higher weightage and I need to pay more attention into it.” – R31

Table 2 summarises the recurring themes regarding the perceived advantages and disadvantages of online assessments. Themes linked to the benefits of online assessments appear to align with perseverance, a factor in Carroll's (1963, 1989) Model of School Learning that reflects student motivation and the time they are willing to invest in learning. Students viewed online assessments as promoting independent learning and the development of self- directed study habits. Conversely, the drawbacks students noted such as increased workload and time constraints, relate more closely to opportunity to learn, another factor in Carroll's model. Students felt that online assessments were often more demanding and time-consuming, requiring extensive preparation and more effort than assessments in conventional face-to-face environments.

Table 2: The emerging themes related to online assessments

Advantage	Disadvantage
Online final exam requires less need for memorisation of theoretical concepts	Higher complexity and require greater preparation
Students are engaged in more research for better conceptual understanding	Higher students' workload with greater number of assessments
Students are more independent and seek more external resources to complete their online assessments	Need for students to do extra preparation for online assessments
	Open book online assessment requires more time allocation

Student Perspectives on Preparation Time for Online Assessments

This study explored how students perceived the time required to prepare for online assessments compared to traditional classroom assessments. As shown in Figure 5, there was no marked difference in overall responses regarding preparation time. However, a slightly higher proportion of students (33%) reported spending more time preparing for online assessments. This observation aligns with findings by Jamalpur et al. (2021), who noted that students generally dedicated more hours to online learning during the COVID-19 pandemic compared to conventional classroom settings.

In the present study, the authors suggest that this increase in preparation time may reflect greater self-motivation among students, stemming from the independent nature of online learning. This interpretation is supported by Song and Bank (2016), who observed that students were often driven by a desire to seek out online resources that satisfied their intellectual curiosity. Such intrinsic motivation is known to enhance engagement and foster self-directed learning.

Interestingly, the findings indicate no significant correlation between perceived workload and preparation time, implying that the time students spend preparing is more closely tied to individual learning aptitude than to task volume alone. This supports Carroll's (1963, 1989) assertion that aptitude influences how much time a learner requires to master a given task.

Student Perspectives on the Impact of Online T&L and Assessments on their Academic Performance

To evaluate how time-related variances may influence academic achievement, this section explores students' views on how online T&L and assessments have affected their academic performance. The impact of online learning on student outcomes has become a pressing concern for policymakers, HLIs, and educators, particularly in light of the widespread shift to digital learning environments.

Student engagement in online learning is often supported by digital tools such as virtual chats, online discussion boards (e.g., Blackboard) (Korkofingas & Macri, 2013), and gamified e- learning platforms (Pakinee & Puritat, 2021), which aim to enhance participation and learning outcomes. However, findings from this study revealed that only 31.9% of respondents felt their academic performance had improved in the online learning environment. An equal proportion reported no significant change in their grades compared to traditional face-to-face learning. Conversely, a slightly higher percentage (36.2%) indicated a decline in their academic results, as shown in Figure 6.

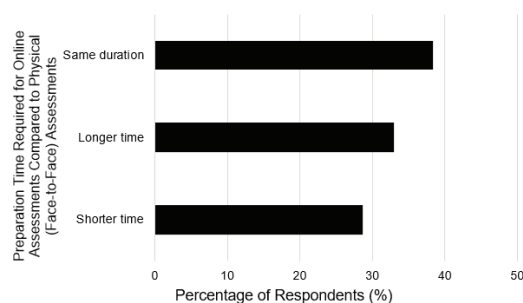


Figure 5: Preparation time invested by the respondents to prepare for online assessments compared to traditional classroom assessments

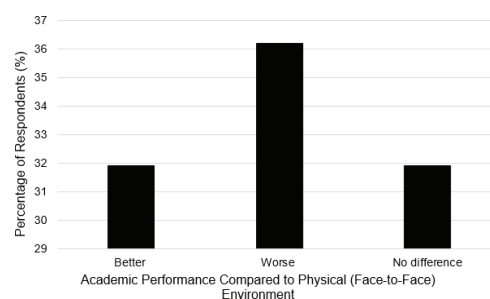


Figure 6: The difference between student's academic performance in online environment (T&L and assessment) and physical (face-to- face) setting

There is evidence from Korkofingas and Macri (2013) that increased time spent engaging with online course materials can positively influence learning outcomes and academic performance. However, this study found no clear relationship between preparation time and academic achievement in an online setting. It is likely that students' perceptions of heavier

workloads and the higher complexity of online assessments contributed to a decline in academic performance.

According to Carroll's Model of School Learning (1963, 1989) (Figure 1), effective learning is determined by three main factors: perseverance (the time a student is willing to invest in learning), aptitude (the time required to learn), and opportunity to learn (the time available to engage in learning). A student's willingness to participate in online learning may be affected by external commitments such as part-time jobs or family responsibilities. Therefore, perseverance plays a crucial role in this model. To support effective learning, students must be given sufficient opportunities for both guided and independent study. However, estimating the appropriate SLT for online learning remains a challenge. Unlike face-to-face setting, quantifying SLT in an online context especially across various types of teaching and assessment methods is more complex. This may partly explain the variation in student performance between traditional and online learning environments.

Conclusions

This study offers valuable insights into the implementation of online engineering education, particularly within the Malaysian higher education landscape where many institutions are expanding their investment in digital learning platforms. The findings suggest that the shift from traditional face-to-face instruction to online teaching has resulted in increased SLT and academic workload for engineering students. This heightened burden, coupled with more complex assessments, appears to have had a negative effect on students' academic performance. The results highlight the importance of a more structured approach to assigning SLT for different online T&L activities and assessments. Aligning SLT with course credits and intended learning outcomes is essential to ensure students are not overwhelmed. To facilitate this, the authors recommend developing a standardised SLT framework to guide workload estimation, online course delivery and online assessment planning more effectively. However, it is important to note a limitation of this study: the findings are based on a relatively small sample of engineering students from selected institutions. As such, the results may not be fully generalisable to all engineering programmes or student populations. Despite this, the insights gained may still serve as a useful reference for educators, academic leaders, and accreditation bodies in other disciplines or regions aiming to improve the design and delivery of online education.

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