



## Research article

# The impact of satisfaction, and autonomous learning strategies use on scholastic achievement during Covid-19 confinement in Malaysia

Lilian Anthonysamy<sup>a</sup>, Parmjit Singh<sup>b,\*</sup><sup>a</sup> Faculty of Management, Multimedia University, Persiaran Multimedia, 63100, Cyberjaya, Selangor, Malaysia<sup>b</sup> Faculty of Education, Universiti Teknologi MARA, Puncak Alam, 42300, Kuala Selangor, Selangor, Malaysia

## ARTICLE INFO

## Keywords:

Covid-19 lockdown  
Satisfaction  
Self-efficacy  
Interactive engagement  
Study environment  
University students

## ABSTRACT

The purpose of this study is twofold. Firstly, this study seeks to better understand students' learning experience, through scholastic achievement and secondly, this study analyses students' use of autonomous learning strategies, namely satisfaction, self-efficacy, social interactive engagement and study engagement in digital learning amidst the Covid-19 lockdown. While Malaysia grapples with a growing number of Covid-19 cases, the underlying toll of the pandemic has hit the youth hard with many mental health concerns and this has affected their learning. The nurturing of autonomous learning strategies especially during the Covid-19 confinement is critically needed to assist this vulnerable group. Although there is a plethora of studies given students' use of autonomous learning strategies towards scholastic achievement during the Covid-19 lockdown internationally, studies in the Asia region are still rudimentary. This study investigated 316 university students from targeted universities in Malaysia. Responses were gathered from an online survey. Data were analysed using Partial Least Squares-Structural Equation Modelling (PLS-SEM), a second-generation multivariate statistical approach to assess the outer model and inner model that displays the relationships between the constructs. The results of this case study reported that student interactive engagement ( $\beta = 0.348$ ,  $t = 5.45$ ) and study environment ( $\beta = 0.314$ ,  $t = 4.81$ ) have a significant impact on students' scholastic achievement during the lockdown. Remarkably, new insights are uncovered in this paper revealing no relationship between self-efficacy and satisfaction with students' scholastic achievement. Possible explanations surrounding why satisfaction and self-efficacy were suppressed by the lockdown are discussed. The outcomes of this study provide key insights that may assist students to condition their minds to use autonomous learning strategies in digital learning to enhance their scholastic achievement.

## 1. Introduction

On March 11, 2020, the World Health Organisation (WHO) declared Covid-19 as a 'pandemic'. Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. This pandemic has challenged the community of Higher Education Institutions (HEIs) which resulted in universities being shut down globally, forcing 1.2 billion learners to transition into remote digital learning [1]. Digital learning refers to a synchronous and asynchronous learning environment that uses a computing device and Internet

\* Corresponding author.

E-mail addresses: [lilian.anthonysamy@mmu.edu.my](mailto:lilian.anthonysamy@mmu.edu.my) (L. Anthonysamy), [parmjit378@uitm.edu.my](mailto:parmjit378@uitm.edu.my) (P. Singh).

<https://doi.org/10.1016/j.heliyon.2022.e12198>

Received 15 June 2022; Received in revised form 29 July 2022; Accepted 30 November 2022

2405-8440/© 2022 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

technologies [2]. For many of these institutions, faculty members and students were suddenly thrust into an uncharted, unplanned, unwanted, and fraught experiment of remote digital learning during this Covid-19 confinement. They faced the effect of the sudden shift from face-to-face learning to digital learning which has now become commonplace in the higher education learning setting. In line with this notion, many HEIs have expressed their concern over the student's scholastic achievement, especially for those who do not have proper Internet access and connectivity during the Covid-19 confinement [3]. In the aspect of scholastic achievement, there have been mixed findings where several authors reported an increase in students' scholastic achievement during Covid-19 [1,4], and several scholars revealed a decrease in students' scholastic achievement [5,6]. Furthermore, the 2020 Global Benchmark Study on the State of Student Success and Engagement in Higher Education Report stated that American students are falling behind in their studies by 70%, students in the Asia Pacific region by 75%, and students in Europe, the Middle East, and Africa region by 65% since the start of the pandemic [6]. A possible reason for this is that students around the world surveyed during Covid-19 lockdowns have reported increased stress, anxiety, and worries, as well as boredom, frustration, and a lack of motivation [7,8]. Malaysia has an estimated population of approximately 33 million. As of July 11, 2021, Malaysia reported 87,841 cases, 742,297 recovered cases, and 6158 death cases (Ministry of Health Malaysia, 2021). The Covid-19 incidence in Malaysia is reported to be highest among youths aged 20–29 years [9]. While Malaysia grapples with a growing number of Covid-19 cases, the underlying toll of the pandemic has hit the communities hard as many people struggle with job insecurities and mental health concerns. Youth are considered vulnerable people with many mental health concerns [10,11].

Students who were falling behind in their studies the most were from the Asia Pacific region. According to this, although there has been a plethora of studies on students' scholastic performance during Covid-19 globally, very few empirical studies surrounding this phenomenon in the context of Asia have been published. Literature dedicated to understanding how Asian students' satisfaction and use of autonomous learning strategies in digital learning during the Covid-19 lockdown has impacted their scholastic achievement is still under development [12–14]. For example, [15] discovered that learners in Indonesia had poor skills related to learning autonomy. Likewise, previous research has found similar findings whereby university students in other Asian countries exhibit limited use of autonomous learning strategies [16–19]. It could be postulated that autonomous learning autonomy was not yet common among Asian students.

The unfolding of the Covid-19 pandemic has demonstrated a great impact on the trajectory of learning around the world, where autonomous learning is seen to be the new norm now and post-pandemic. Students have experienced changes in their learning habits and routine. Autonomous learning strategies are critical to the successful implementation of autonomous learning goals and the development of student's ability and motivation for autonomous learning. Previous research has shown that autonomous learning improves students' grades and academic performance. According to some studies, autonomous learning strategies have a significant impact on student's academic achievement and learning performance [20,21]. According to the researchers, students who have strong autonomous learning skills are more likely to succeed in both classrooms and online learning [22,23]. According to one study by Xie [24]; the experimental group using autonomous learning strategies outperformed the control group using live broadcast and recorded video learning materials. As a result, autonomous learning strategies are positively related to improved student performance. These studies and the development of appropriate learning strategies are especially important in the COVID-19 pandemic to ensure good performance in e-learning environments [24,25]. Autonomous learning involves not only the motivation to take charge of one's learning but also the ability to do something beneficial independently [26]. O'Malley and Chamot [27] developed three types of autonomous learning strategies, namely metacognitive strategies, cognitive strategies, and social-affective strategies. While many kinds of research have examined cognitive and metacognitive strategies, there is still a dearth of research investigating autonomous social-affective strategies during Covid-19 confinement [28,29]. Social-affective strategies are self-motivating strategies driven by a different set of mental and behavioural mechanisms. These strategies assist students to attain emotional resilience to improve their learning capacities. Examples of social-affective strategies include self-efficacy, interactive engagement, and study environment. Self-efficacy refers to students' perception and belief of their ability to confidently complete tasks assigned to them. As such, students' learning beliefs can influence their scholastic achievement [30]. Student engagement is the degree of attention, interest, and dedication that students display when they are learning. Student engagement gives a glimpse of students' motivation and learning progress as learning improves when students are inquisitive, interested, and inspired. Student engagement online is paramount to successful learning [31]. Moreover, students' study environments should be organised, quiet, and relatively free of visual and auditory distractions. Successful learners are sensitive to their physical learning environment, adjusting as deemed necessary to create conducive learning spaces [2]. Moreover, to measure students learning experiences in digital learning, their satisfaction is known to be an important element as they are the ones receiving the services. Satisfaction with students learning experiences emphasizes the recognition of organising and coordinating academic and social activities [13].

The current study contributes to the body of knowledge examining COVID-19's impacts on the higher education market. Few studies have examined how the distressing COVID-19 context may influence university students' learning strategies. Investigating the connections between students' learning strategies and the impact of COVID-19 on their performance capacity is crucial in addition to the aforementioned goals. The study's context will also help expand the body of literature on the area of Asian students as recent studies have confirmed that Asian students continue to demonstrate poor levels of autonomy in their learning. Thus, this study seeks to better understand students' learning experiences through the use of autonomous learning strategies, specifically satisfaction, self-efficacy, social interactive engagement, and study engagement and its impact on their scholastic achievement in digital learning amidst the Covid-19 lockdown.

### 1.1. Research questions

With these nuances under consideration, this research study aims to answer two main research questions.

RQ1: To what extent does students' satisfaction positively predict their scholastic achievement in digital learning during the Covid-19 confinement.?

RQ2: To what extent does students' self-efficacy positively predict their scholastic achievement in digital learning during the Covid-19 confinement?

RQ3: To what extent does students' interactive engagement positively predict their scholastic achievement in digital learning during the Covid-19 confinement?

RQ4: To what extent does students' study environment positively predict their scholastic achievement in digital learning during the Covid-19 confinement?

To answer these research questions, the study examines students' satisfaction through their experience in digital learning as a result of the Covid-19 lockdown and explores the potential impact of different autonomous learning strategies on the scholastic achievement of students.

## 2. Literature review

### 2.1. Context of digital learning during the Covid-19 pandemic

The COVID-19 pandemic has shifted the education sector away from physical education and toward e-learning and internet platforms. E-learning is not a new concept in the HEI system. It was used before the pandemic, but not on a large scale. Nevertheless, educators grappled with online digital delivery when the Covid-19 lockdown took place. Although generally, many students adapted fast to the new ways of learning, the change to digital learning was a new experience. As the education sector seeks alternatives to lockdown and home quarantine, video and teleconferencing platforms have gained significant traction. Google Classroom, Zoom, Webex, and Microsoft are all part of the platform. These technologies enable the HEI community and the general public to improve teaching and learning. Since the learning environment was digitalized, Higher Education Institutions (HEIs) had to consider the elements involved in the digital learning ecosystem such as instructors, students, teaching materials, and technology. Therefore, HEIs around the world adjusted their curricula by adopting relevant technologies and systems, prepared learning and staff resources, set systems and infrastructure, and established new teaching protocols, to name a few.

### 2.2. Social-affective strategies in digital learning

Several scholarly pieces of research revealed that autonomous learning involves self-motivated strategies to drive a smooth learning progression [18,26,32]. Social-affective strategies are the displayed behaviour during learning activities that involves self-motivation, cooperation, and communication, among others [26]. Social-affective strategies have been found to exhibit positive correlations with students' scholastic achievement [33].

#### 2.2.1. Self-efficacy

Self-efficacy is a social-affective learning strategy that involves the ability of an individual to confidently execute their tasks with controlled emotions necessary to succeed in a particular situation [34]. In the learning context, self-efficacy can have an impact on student learning behaviour and motivation [2]. Self-efficacious students have a motivated mindset and can display the right learning behaviour by eliminating unwanted emotional reactions, resulting in less academic stress [35]. On the contrary, students who are low in self-efficacy do not have much confidence in their ability to achieve and tend to see tasks as difficult or give up easily when setbacks happen. Past studies have demonstrated a strong linkage between self-efficacy and students' scholastic achievement [30,35]. Individuals with high self-efficacy have overall high self-esteem which indirectly affects the perception and individual awareness of their ability [36]. Although it is a known fact that self-efficacy in the academic context is believed to be one of the most important non-intellective predictors of achievement [30], it is important to test this construct again to examine how this construct works with academic achievement amidst the Covid-19 confinement.

#### 2.2.2. Social interactive engagement

For tertiary education, student engagement is recognised as an important yardstick and indicator of the quality of the student experience. Trowler [37] defines engagement as involvement in an activity that requires cognitive activities and feelings which result in measurable outcomes. In a digital learning context, students' attitudes and choices may be greatly affected by social-interactive engagement, including factors such as social connections and interactions with educators and peers. Effective online student engagement occurs from these three interactions: learner-to-learner interaction, learner-to-content interaction, and learner-to-instructor interaction [38]. Many studies showed that there is a significant positive effect between student engagement and scholastic achievement [12,23,39]. Interestingly, literature has reported that students who preferred face-to-face learning demonstrated lower engagement in their online classes which resulted in poor achievement [12,39].

### 2.2.3. Study environment

Since the Covid-19 lockdown, students have been required to take online classes from a different location instead of their regular classrooms. This led students to adapt to the new study environment to study and take on their online classes. The physical condition of the study environment is important because a healthy, comfortable, and conducive environment can help improve students' performance [18]. A private space may help to decrease the noise level perceived by the students and, it may also help to improve their academic performance while taking online classes at home. Research has shown that the study environment does have a significant impact on students' scholastic achievement because an ergonomically designed study area for online classes, such as quiet space, and temperature-controlled rooms, to mention a few, can help improve the students' scholastic achievement [40]. Unfortunately, many home study environments are not conducive enough to focus on studies as they are often shared spaces [8]. A global study reported that more than half of students did not have a quiet place to study [7].

### 2.2.4. Satisfaction

Student satisfaction is an important indicator that cannot be measured through course evaluations and grades. In the context of a digital learning setting, the degree of student satisfaction during the lockdown plays a vital role as student satisfaction is a success indicator of digital learning. When satisfaction is manifested in students' feelings, their attitude towards the learning activities is positive. A positive perception of technology tends to affect students' satisfaction with the course in a digital environment. There are noticeable discrepancies in student satisfaction levels between online and in-person classes. One study reported that 62.9% of students were more satisfied with online teaching than the face-to-face method, and 92.9% of students reported that were more enthusiastic about online learning than traditional learning [41]. Another study found by Tratnik [42] indicated that students who took the course in person were typically more satisfied with the course on several dimensions than their online counterparts. Students in this study displayed high dissatisfaction when they experienced barriers to online classes. For example, when students could not ask their lecturer questions during online classes, experienced limited internet access, and had difficulties with online group discussions [5]. Several other studies described a high-level dissatisfaction among students as most of them were dissatisfied with the implementation of virtual learning mode during the pandemic and still preferred face-to-face delivery [5,43,44]. Nevertheless, some researchers reported a positive attitude towards the change during the pandemic indicating that students adapted fast to digital learning [1,40].

Since Covid-19 has caused the largest online movement in the history of education, it is paramount to examine the level of student engagement, self-efficacy, student study environment, and satisfaction with the scholastic achievement of students during Covid-19 confinement. Such context presents an opportunity to examine these constructs given that autonomous learning strategies are a crucial layer of importance during learning. In light of the aforementioned, the following hypotheses were constructed to examine the relationship between satisfaction, self-efficacy, engagement, environment, and scholastic achievement.

**Hypothesis 1 (H1).** Satisfaction positively predicts the scholastic achievement of university students in digital learning during the Covid-19 confinement.

**Hypothesis 2 (H2).** Self-efficacy positively predicts the scholastic achievement of university students in digital learning during the Covid-19 confinement.

**Hypothesis 3 (H3).** Student interactive engagement positively predicts the scholastic achievement of university students in digital learning during the Covid-19 confinement.

**Hypothesis 4 (H4).** The study environment positively predicts the scholastic achievement of university students in digital learning during the Covid-19 confinement.

## 3. Method

### 3.1. Design of the study

This research adopted a positivist philosophy and deductive approach because it develops the hypothesis based on existing theory and formulates the research approach to test it. This study employed a survey research design approach involving university students from several large higher education institutions in urban areas in Malaysia as measured by physical infrastructure, faculty and staff, and student enrollment. Despite criticism, self-report instruments are still considered important instruments in the study of educational psychology research [45]. This study aims to examine students' experience and views about digital learning through the influence of satisfaction, self-efficacy, engagement, and environment on university students' scholastic achievement during the Covid-19 lockdown. Survey research was employed because it can accurately and systematically describe a population, situation, or phenomenon.

### 3.2. Sampling frame

The unit of analysis was university students located in urban areas in the central region of Malaysia. Data was gathered from a single university. However, with 35 campuses in Malaysia, this university has the largest student population in Malaysia. Only the central region of Malaysia was studied for this study. Malaysia's central region includes the state of Selangor as well as the federal territories of Kuala Lumpur and Putrajaya. Since there is no campus in Putrajaya, the students were chosen from all campuses in the central region which includes three campuses from Selangor and one campus from Kuala Lumpur. Convenience sampling was used because it draws from a source that is easily accessible to the researcher or those in charge of the assessment. The sample size was

calculated using G power software using a significance level of 0.05 with a confidence level of 95%. The G Power software which is based on the complexity of the framework suggested a minimum sample of 129. Nevertheless, it has been suggested that the sample size rule of thumb should be more than 200 [46]. Moreover, Saunders et al. [47] argued that a sample size of 300 is sufficient to represent a large population. Since there is no specific rule of thumb for sample size, any sample of more than 300 was considered sufficient. The finalised instrument was created using a Google Form and distributed to the targeted sample through electronic channels. Ethical considerations before data collection are pertinent to research ethics in data collection. It refers to the ethical practices of how data is collected, stored or shared. Thus, for this research, a formal written request was acquired before administering the survey. Ethical approval from the Research Ethics Committee (REC) from UiTM [REC/11/2021 (MR/896)] and informed consent from participating respondents was obtained for the research. Consequently, the finalised instrument was then distributed to the targeted sample through a web-based method in May 2021.

### 3.3. Instrumentation and constructs

The questionnaire items were adapted from multiple validated sources from Hung et al. [48]; Abramanka [49] and Sun et al. [50] accordingly to explore students' perceived views on online learning and teaching. The dependent variable of the study comprised subjective measures of scholastic achievement that were measured using a ten-point scale based on a composite score from perceived items in the questionnaire. In this questionnaire, a total of 36 items were used to assess satisfaction, self-efficacy, social interactive engagement, study environment and scholastic achievement. A 10-point Likert scale was used to increase accuracy. The 10-point survey scale gives a much broader spread of the options to the customers and yields clear indicative results.

The four independent components that can be used to predict outcomes are: (i) satisfaction with online learning, (ii) online learning self-efficacy, (iii) social interaction involvement in online learning, and (iv) online learning environment. This survey was conducted online using a survey technique due to the current Covid-19 scenario (i.e., [surveymonkey.com](https://www.surveymonkey.com)). Students were asked to rate the item responses for these variables on a ten-point Likert scale (1 being extremely low and 10 being very high) in order to convey their opinions. By soliciting the helpful opinions of three subject-matter experts, the content validity of the instrument was once again confirmed. Before the data-gathering procedure, all of their opinions were considered.

### 3.4. Data analysis technique

Partial Least Squares-Structural Equation Modelling (PLS-SEM), a second-generation multivariate statistical approach was employed to analyse the outer model, also known as the measurement model (the interaction between the latent variables and their observed indicators) and inner model, also known as structural relationships (the associations between the independent variable and dependent variable) in the same data analysis. This statistical technique can explain the relationship between multiple variables and can examine a series of dependent relationships simultaneously. Moreover, the application of this analysis would determine the measurement error to be analysed and factor analysis to be combined with hypotheses testing. The operationalisation was performed for the independent constructs, namely satisfaction, self-efficacy, social interactive engagement, and environment, and if these variables can lead to scholastic achievement online during the Covid-19 confinement. The questionnaire that was developed in this study was based on extant literature with scales adapted from prior validated sources to ensure that a comprehensive list of measures was included [48,49,51].

## 4. Results

### 4.1. Data cleanup and preparation

A total of 382 students responded to the questionnaires. The questionnaires did not suffer from missing values because all items in the web survey form were set to 'required'. The gender split was 39.0% (N = 149) male pupils and 61% (N = 233) female students. According to the level of study, there were 57.9% (N=221) degree-seeking students, 27.2% (N = 104) diploma students, and 14.9% (N = 57) postgraduate students. These students represented 37.2% (N = 142) and 62.8% (N = 240) respectively from the science and non-science fields. The data from the questionnaires were then exported to SPSS to run an outlier analysis using Mahalanobis Distance. Outliers happen when respondents answer the questionnaire in an extreme manner. Thus, outliers must be identified and removed before running PLS-SEM [52]. Out of the 382 data records, 63 outliers were identified and removed. Therefore, 319 cleaned data were used to analyse in SmartPLS 3.0.

Before the data were analysed in SmartPLS, the normality of data was assessed using multivariate kurtosis Mardia's coefficient evaluation instead of univariate normality. The results of the normality assessment where Mardia's multivariate kurtosis ( $\beta = 36.08$ ,  $p < 0.001$ ) indicated that the data distribution was non-normal. The cut-off value for kurtosis is  $\pm 7$  [53] where values beyond the cutoff points give the researchers a green light to proceed with SmartPLS which is a non-parametric software. Taking this into account, the PLS approach was therefore considered more applicable for this study. Since PLS-SEM does not assume the data to be normally distributed, it relies on a nonparametric bootstrap procedure to test coefficients for their significance [52].

### 4.2. Measurement model assessment

The reliability and validity of constructs are measured to ensure their inclusion suitability in the path model. To evaluate the

convergent validity of reflective constructs, the outer loadings and average variance extracted (AVE) were evaluated. The rules of thumb to accept factor loading of items vary across the literature. This study considered accepting factor loading of 0.6 and above with an AVE value of  $>0.6$  [54]. Additionally, Table 1 show all AVE values achieving the desired value of 0.5 and higher [52].

Although the traditional criterion for internal consistency is Cronbach Alpha (CA), recent research -reported that it is more appropriate to apply composite reliability as a measure of internal consistency reliability due to the limitations of Cronbach Alpha. The CA assumes that all indicators are equally relevant to the configuration, the items are not weighted, so the CA is less accurate, sensitive to the number of items in the configuration, and internally consistent. It tends to underestimate reliability [55]. The recommended and acceptable composite reliability value is between 0.70 and 0.90 [55].

Subsequently, to assess the extent to which the indicators are empirically different from other constructs, HTMT (Heterotrait-Monotrait) ratios were employed to evaluate the discriminant validity among indicators [55]. Table 2 shows the HTMT values obtained and as observed, they were all below 0.85 [56] and 0.90 [57], indicating that no issue of discriminant validity was found.

#### 4.3. Structural model assessment

After evaluating the measurement model, it was then proceeded with testing the path model for significance which requires the application of bootstrapping routine. Therefore, with a suggested of 5000 bootstrap samples [52], the path coefficient assessments are performed and presented in Table 3. The constructs of engagement and environment were found to have a t-value  $\geq 1.645$ , with a 0.05 level of significance. The path coefficient ( $\beta$ ) values showed that the most important predictor is engagement ( $\beta = 0.348$ ), followed by environment ( $\beta = 0.314$ ), satisfaction ( $\beta = 0.129$ ), and lastly self-efficacy ( $\beta = 0.004$ ).

The coefficients of determination ( $R^2$ ) were also evaluated primarily for prediction purposes. In general,  $R^2$  values of 0.25, 0.50, and 0.73 for target constructs are considered weak, medium, and substantial, respectively [58]. The  $R^2$  value was 0.508, suggesting that 50.8% of the variance in scholastic achievement can be explained by the studied constructs. Therefore, from a prediction standpoint, one might consider the model in this study to be parsimonious.

## 5. Discussion

This research investigated the use of autonomous learning strategies among university students and their overall learning experience during the Covid-19 confinement after the sudden shift from face-to-face learning to digital learning at one of the universities in Malaysia. Although university students are expected to be proactive and engaged when they are online, literature seems to suggest that university students around the world are falling behind on their studies by more than 60% [6]. The hypotheses developed in this study have contributed towards answering the research questions. Overall, the results from the study suggest that two (2) out of four (4) constructs, namely student interactive engagement and environment have a positive relationship with scholastic achievement with their t-values above 1.645 at 95% confidence, while satisfaction and self-efficacy have no relationship with students' scholastic

**Table 1**  
Indicator reliability analysis.

Construct	Item	Loading	AVE	CR	VIF
Satisfaction	I am satisfied with the online learning platform being used currently	0.772	0.662	0.899	1.911
	I am satisfied with the influence of online learning on my understanding of the subject matter	0.821			2.456
	The knowledge I gained from online learning was as good as face-to-face learning.	0.843			2.515
	I will gladly take another online course.	0.785			2.192
Self-Efficacy	I like the idea of online leaning.	0.845	0.733	0.832	2.411
	I feel confident in performing the basic functions of online platform	0.864			2.736
	I feel confident in my knowledge and skills of online platform.	0.883			3.156
	I feel confident in using online platform to effectively communicate with others.	0.872			3.014
Engagement	I feel confident in- using the Internet (Google, Mozilla Firefox) to find or gather information for learning.	0.811	0.667	0.809	2.235
	I feel confident in studying to operate in online platform.	0.847			2.503
	I acquire knowledge through interacting with other students during online learning.	0.780			2.365
	I acquire useful knowledge through interacting with my lecturers during online learning.	0.828			2.638
	I am fully engaged in online learning to learn more than what is required of me.	0.805			2.741
	I am interested to do online learning as there is lots of interaction and engagement activities.	0.853			3.157
Environment	Online learning is a great platform to communicate with others.	0.814	0.721	0.811	2.479
	I learn online in a comfortable physical environment.	0.892			3.060
	I know in what place I can learn the most efficiently when learning online.	0.841			2.289
	I set my online learning environment in a place where I have minimal distractions.	0.866			2.563
Scholastic Achievement	I am very comfortable with my online study environment.	0.793	0.675	0.812	1.601
	My grades are better when I use online platform compared to face to face.	0.867			2.890
	I have a better exam pass rate when I use online platform as compared to face to face resources.	0.852			2.596
	My individual work at university is better after I learn using online platform.	0.833			2.186
	My group work at university is better after I learn using online platform.	0.693			1.586
	My academic performance has improved since using online platform.	0.851			2.347

Note: SA23 was deleted due to low loading.



**Table 2**  
Discriminant Validity Evaluation using Heterotrait-Monotrait ratios.

	Scholastic Achievement	Engagement	Environment	Satisfaction	Self-Efficacy
Scholastic Achievement					
Engagement	0.67				
Environment	0.555	0.795			
Satisfaction	0.745	0.752	0.64		
Self-Efficacy	0.722	0.811	0.725	0.78	

**Table 3**  
Hypotheses testing.

Hypothesis		Std Beta	Std Error	t-value	p-value	Decision
H1	Satisfaction - > Scholastic Achievement	0.129	0.073	1.776	0.076	Not Supported
H2	Self-efficacy - > Scholastic Achievement	0.004	0.057	0.050	0.96	Not Supported
H3	Engagement - > Scholastic Achievement	0.348	0.064	5.45**	0.00	<b>Supported</b>
H3	Environment- > Scholastic Achievement	0.314	0.065	4.81**	0.00	<b>Supported</b>

Note: \*\*p < 0.05.

achievement.

Although it was hypothesized in this study that there is a positive relationship between the constructs of student satisfaction and scholastic achievement during the Covid-19 confinement, the findings showed that satisfaction has a negative relationship with students' scholastic achievement. Thus, H1 was not supported. One possible explanation is that it was a significant challenge for many Higher Education Institutions (HEIs), particularly for educators and students who were new to online or digital learning. Many educators lacked sufficient knowledge, and there was a lack of guidance and support on how to engage or conduct interactive lectures online, resulting in unsatisfactory learning experiences [44]. Another study found similar results, with students expressing high dissatisfaction with digital learning during Covid-19. Dissatisfaction could be expressed as a result of a lack of access to resources or technological requirements, resulting in disconnected students [5]. Another possible reason for the negative relationship is that students were not prepared for the sudden change of learning mode which made them have a strong inclination towards face-to-face courses leaving students dissatisfied with the implementation of virtual learning mode during this pandemic lockdown [43]. Contrariwise, Gonzalez and associates found that students with a positive mindset were able to leverage the Covid-19 confinement to improve their learning strategies and form good learning habits, thus improving their learning experience [23]. This finding postulates that students who can condition their minds with the right motivation can progress forward in their learning smoothly. Furthermore, educators and management of the higher education institutions need to constantly engage with students to understand their difficulties and challenges to add more value to student learning.

Although prior research appears to indicate a positive relationship between students' self-efficacy and academic achievement [30, 35], the results of this study indicate the opposite. With this, H2 was not supported. The fact that high self-efficacious students can demonstrate better academic achievement because they are aware of their ability makes this finding particularly intriguing [59]. The study's findings are consistent with other findings in the literature that show how the learning environments of students can affect their self-efficacy perceptions and academic performance outcomes [30]. According to a study conducted in Australia, students who are enrolled in classes during the COVID-19 outbreak run the risk of having negative effects on their subject grades and academic self-efficacy. Due to the effects of COVID-19-related changes, university students might also hold particular beliefs about their ability to perform. Students felt that the modifications made to their learning environment as a result of COVID-19 had a negative effect on their ability to perform well [30]. However, among the possible explanation for this negative finding is the high emotional stress among students during the Covid-19 lockdown. In Malaysia, with perils mounting by the effects of the Covid-19 confinement, university students are facing even more challenges in learning, such as maintaining concentration, managing their learning, and organising their learning without the usual support from their lecturers [2]. A leading newspaper in Malaysia revealed that approximately 30% of young adults in Malaysia facing increased pressure and varying degrees of anxiety due to the pandemic [60]. Higher anxiety levels are associated with more negative emotional expression and lower academic self-efficacy among students [61]. Furthermore, another study revealed that university students are frequently overconfident in their self-efficacy beliefs [62]. One possible explanation for this negative finding is that, in the face of the pandemic, students' perceptions of the COVID-19's potential effects and their decisions regarding how to approach their academic work were influenced by their self-efficacy beliefs. This finding also suggests that university students lack the use of learning strategies because they rely heavily on the educators for guidance and support. This may indicate that university students lack self-regulation. This new finding offers initial evidence of the low self-efficacy suppression among university students in Malaysia. Educators can play a role in boosting students' self-efficacy with credible communication, support, feedback, and guidance.

Student engagement in this study was found to be the most important predictor of students' scholastic achievement during the lockdown period. As a result, H3 was shown to be true. The finding from this study resonates with the findings from the literature where student engagement is positively linked with students' scholastic achievement [12,63]. Students invest their time and energy in learning when they are engaged. As a result, student engagement affects how they learn and how well they do in school. For instance, Lin and colleagues' research from 2017 found that students' satisfaction and perceived progress were significantly influenced by their level of engagement with the course material. The three relationships between learners—learners to learners, learners to content, and learners to instructors—are what lead to effective online student engagement, according to prior research [38]. Based on the findings of this study, it was observed that learner to learner produced the highest mean score ( $M = 6.2$ ), followed by learner to instructors ( $M = 6.1$ ) and learner to content ( $M = 5.3$ ). This reveals that students engage most with their peers. Is it postulated that, peers produce more new knowledge and more accurate diagnostic tests of their own answers. With digital learning being a complex process that involves participation through interaction and engagement, supportive learning implements should be provided [64]. Therefore, stimulating student interaction and engagement through technology is a critical element in digital learning. Thus, the results from this study suggest that educators need to find meaningful ways to engage with students. However, there is a bigger need to improve and increase students' engagement activities online to improve the student's overall learning experience. Examples include using emerging, immersive technology, virtual reality, video, and collaboration tools that can provide instant feedback, peer comments, and feedback loops. The use of technology will help provide flexibility and a clear understanding of student learning types. For example, learning management system designers need to think carefully about how to ensure high interactivity between students, their peers, and educators and to further emphasise the mobility feature of the learning management system and university portals. Apart from technology assistance, psychological well-being is also crucially vital to ensure the engagement activities that are conducted by the educators are well received by the students [6]. An interesting study by Poot et al. [65] discovered that students who engaged with course content by generating their own potential test questions outperformed students who did not generate test questions, even when prior knowledge was controlled for. Subsequently, it is postulated that students who generate their own potential exam questions are said to have increased their self-confidence and engagement with the course. This type of involvement may have a greater impact on academic performance. This is to ensure successful online learning through learning activities and social-interactive engagement.

During the lockdown restrictions as a result of Covid-19, the study environment plays an important role. Although many students were fortunate to be able to create their learning spaces within their homes to learn during Covid-19, some were not. During the pandemic, students were relocated to a home environment where many did not have suitable study conditions, such as a quiet place and digital equipment with access to (high-performance) Internet, which is essential for effective online study [66]. As a result, having a computer or access to one, the necessary software, a webcam, and a stable (and fast) Internet connection were infrastructure issues during the pandemic. Nevertheless, previous research found that the greater the students' prior knowledge and experience with digital media, the easier the transition to e-learning. The finding of this study is consistent with the finding of Realyvásquez-Vargas and researchers where the study environment does influence students' scholastic achievement [40,67]. According to Awang and colleagues' research, family support is an important factor in the new environment adaptation process [67]. As a result, because most online learning takes place at home, parents are crucial in ensuring that learning takes place in a conducive environment. Although a structured environment is desired for effective learning, in some households with many occupants, it becomes increasingly difficult for students to create their private learning spaces, leading them to have an unfavourable study environment at home. This is worsened if students reside in rural and remote areas as they may face additional challenges such as poor Internet connectivity or having to share computer devices with other siblings. Having said that, Malaysia is still struggling with its Internet speeds and wider coverage compared to the neighbouring countries. Therefore, Higher education institutions should be more supportive to students who are living in poor economic conditions by creating learning spaces for students.

## 6. Implications of the study

Understanding how students learn in an online autonomous learning environment relies heavily on their use of autonomous learning strategies. During the COVID-19 pandemic crisis, this context was put to the test. The pandemic has created an unprecedented and complex situation, forcing students and educators to adjust to abrupt educational changes. This theoretical implication from online learning lenses can provide a revitalised understanding of how students adapt to the use of autonomous learning strategies that revolve around students being responsible for their learning progression. Another viewpoint that would provide different theoretical implications is the finalised model would provide a lens on the primary finding of the study which revealed that the two constructs that play the most important role in students' academic achievement during the lockdown are student engagement and study environment. This study acknowledges that student engagement activities enable students to actively engage in learning by thinking, talking, and interacting with course content, other students in the course, and the instructor. As a result, engaged students achieve better learning outcomes such as academic success, improved social-emotional well-being, and stronger bonds with their school and peers. Furthermore, the home study environment influences how well students learn and absorb new information. Comfort, noise, lighting, and colour can all have an impact on student's learning abilities, as these distractions or inadequate working environments at home can seriously impede learning. As a result of this research, it is suggested that the home learning environment plays an important role in students' academic progress.

In a practical viewpoint, the findings of this study help higher education institutions better understand the autonomous learning strategies that could potentially help educators implement online learning. As a result, higher education institutions must ensure that educators receive adequate training in technological literacy in order to organise online activities that encourage student engagement. Although instructional designers may create models and methods to increase student activity in online classes, a lack of interaction



with teachers and peers can create learning barriers. As a result, online learning classrooms must be designed to encourage student communication in order to create a healthy and positive environment for them. Educators should also communicate in a way that encourages student enthusiasm while alleviating feelings of isolation and loneliness.

## 7. Limitations and future research directions

This study presents several limitations. Firstly, this study may be limited in scope and depth as it only considered only four constructs. Therefore, future studies should consider other different cultural dimensions in learning such as emotional resilience, students' participation, demographic variables, and student retention, and attendance to measure its relationship with the scholastic achievement and overall learning experience of students. Secondly, the study's context was Malaysia's central region. Hence, this study was unable to incorporate data from other study contexts in Malaysia. As a result, future scholars are advised to conduct this research in a different context, which may include other types of universities. Furthermore, the various regions of Malaysia should not be overlooked, as this study only focused on the central region. Students from different areas may have different educational perspectives due to cultural differences. As a result, it is critical to examine respondents from various geographical locations. Future research can also look into adaptive strategies and best practices to keep students engaged during online and remote instruction in the context of the teaching and learning process and to provide guidelines to enhance these processes for future learning.

## 8. Conclusion

The objective of this research was to examine how satisfaction, self-efficacy, engagement, and environment influence the scholastic achievement of university students during the Covid-19 pandemic. This study seeks to better understand students' learning experience and to analyse their use of autonomous learning strategies in digital learning during the Covid-19 lockdown. It was evident that student interactive engagement and environment plays an important role in students' scholastic achievement during the lockdown. However, this was not the case for satisfaction and self-efficacy, where this study reported no link with students' scholastic achievement. This study is important because autonomous learning strategies are critical to online learning. Based on the results of this study, it can be postulated that when students change their learning habits by utilising more autonomous learning strategies, this might lead to an improvement in their scholastic achievement. A successful online course may benefit greatly from a positive learning environment. It takes more than just fostering a great learning environment for students to feel motivated and engaged. An ideal learning environment should promote connections between students and the course material and instructors, as well as a feeling of support and open communication.

## Declarations

### *Credit author statement*

Lilian Anthonysamy: Analysed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper. Prof Dr Parmjit Singh: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

### *Funding statement*

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### *Data availability statement*

Data will be made available on request.

## References

- [1] G.R. El Said, How did the COVID-19 pandemic affect higher education learning experience? An empirical investigation of learners' academic performance at a university in a developing country, *Advances in Human-Computer Interaction* (2021), <https://doi.org/10.1155/2021/6649524>.
- [2] A. Lilian, K. Ah-Choo, H. Soon-Hin, Investigating self-regulated learning strategies for digital learning relevancy, *Malaysian Journal of Learning and Instruction* 18 (1) (2021) 29–64.
- [3] M.A. Fauzi, E-learning in higher education institutions during COVID-19 pandemic: current and future trends through bibliometric analysis, *Heliyon* 8 (5) (2022), e09433, <https://doi.org/10.1016/j.heliyon.2022.e09433>.
- [4] S. Iglesias-Pradas, A. Hernández-García, J. Chaparro-Peláez, J.L. Prieto, Emergency remote teaching and students' academic performance in higher education during the COVID-19 pandemic: a case study, *Comput. Hum. Behav.* 119 (2021), <https://doi.org/10.1016/j.chb.2021.106713>.
- [5] M. Selvanathan, N.A.M. Hussin, N.A.N. Azazi, Students Learning Experiences during COVID-19: Work from Home Period in Malaysian Higher Learning Institutions, *Teaching Public Administration*, 2020, <https://doi.org/10.1177/0144739420977900>.
- [6] Infrastructure, State of Student Success and Engagement in Higher Education: 2020 Global Research Study and Trends, 2020, pp. 1–43. Retrieved from, <https://www.instructure.com/canvas/resources/insights/student-success-engagement-higher-education-research-study-trends>.
- [7] A. Aristovnik, D. Keržič, D. Ravšelj, N. Tomaževič, L. Umek, Impacts of the COVID-19 pandemic on life of higher education students: a global perspective, *Sustainability* 12 (2020) 1–34, <https://doi.org/10.3390/su12208438>.
- [8] A. Patricia Aguilera-Hermida, College students' use and acceptance of emergency online learning due to COVID-19, *International Journal of Educational Research Open* 1 (2020), 100011, <https://doi.org/10.1016/j.ijedro.2020.100011>.

- [9] Disease, C., & Report, S. (2021). Malaysia, 2019(April), 1–6. Retrieved from file:///C:/Users/MU038186/Downloads/COVID19\_sitrep\_MYS\_20210411\_final (1).pdf.
- [10] July 10 D. Murad, Are Malaysian Women Facing an Increased Risk of Suicide? the Star, 2021, <https://www.thestar.com.my/news/focus/2021/07/11/are-malaysian-women-facing-an-increased-risk-of-suicide>.
- [11] A. Abdulkadir, Is the lockdown important to prevent the COVID-19 pandemic? Effects on psychology, environment, and economy-perspective, *Annals of Medicine and Surgery* 56 (2020) 38–42, <https://doi.org/10.1016/j.amsu.2020.06.010>.
- [12] J. Lee, H. Lim, J. Allen, G. Choi, Effects of learning attitudes and COVID-19 risk perception on poor academic performance among Middle school students, *Sustainability* 13 (10) (2021) 5541, <https://doi.org/10.3390/su13105541>.
- [13] G. Kasalak, M. Dağyar, University student satisfaction, resource management and metacognitive learning strategies, *Teachers and Curriculum* 20 (1) (2020) 73–85, <https://doi.org/10.15663/tandc.v20i1.343>.
- [14] N. Kapasia, P. Paul, A. Roy, J. Saha, A. Zaveri, R. Mallick, B. Barman, P. Das, P. Chouhan, Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal, India, *Child. Youth Serv. Rev.* 116 (2020) 105–194, <https://doi.org/10.1016/j.chilyouth.2020.105194>.
- [15] A. Cirocki, S. Anam, P. Retnanigdyah, Readiness for autonomy in English language learning: The case of Indonesian high school students, *Iran. J. Lang. Teach. Res.* 72 (2) (2019) 1–18.
- [16] J.H. Zhao, P.Z. Wu, G. Liu, *Guidance for Teachers: Online Education during COVID-19 Pandemic*, Center for Higher Education Research, Southern University of Science and Technology, Shenzhen, 2020.
- [17] N.H. Hj Ramli, M. Alavi, S.A. Mehrinezhad, A. Ahmadi, Academic stress and self-regulation among university students in Malaysia: mediator role of mindfulness, *Behav. Sci.* 8 (1) (2018) 12, <https://doi.org/10.3390/bs8010012>.
- [18] Lilian Anthonysamy, Ah-Choo Koo, S.-H. Hew, Self-regulated learning strategies and non-academic outcomes in higher education blended learning environments: a one decade review, *Educ. Inf. Technol.* 25 (5) (2020) 3677–3704, <https://doi.org/10.1007/s10639-020-10134-4>.
- [19] A. Lilian, Formulation of self-regulated learning strategies framework for digital learning for lifelong learning, *Asian Journal of Research in Education and Social Sciences* 4 (1) (2022) 24–32.
- [20] E. Panadero, J. Broadbent, D. Boud, J.M. Lodge, Using formative assessment to influence self- and Co-regulated learning: the role of evaluative judgement, *Eur. J. Psychol. Educ.* 34 (3) (2018) 535–557, <https://doi.org/10.1007/s10212-018-0407-8>.
- [21] P.H. Winne, Theorizing and researching levels of processing in self-regulated learning, *Br. J. Educ. Psychol.* 88 (1) (2017) 9–20, <https://doi.org/10.1111/bjep.12173>.
- [22] J. Broadbent, Comparing online and blended learner's self-regulated learning strategies and academic performance, *Internet High Educ.* 33 (2017) 24–32, <https://doi.org/10.1016/j.iheduc.2017.01.004>.
- [23] T. Gonzalez, M.A. de la Rubia, K.P. Hincz, M. Comas-Lopez, L. Subirats, S. Fort, G.M. Sacha, Influence of COVID-19 confinement on students' performance in higher education, *PLoS One* 15 (10) (2020), e0239490, <https://doi.org/10.1371/journal.pone.0239490>.
- [24] Z. Xie, Effectiveness of autonomous learning materials for students during the COVID-19 pandemic: a case study of the Daxie second elementary school in Ningbo, Zhejiang, China, *Science Insights Education Frontiers* 6 (1) (2020) 613–624, <https://doi.org/10.15354/sief.20.or023>.
- [25] T. Ariebowo, Autonomous learning during COVID-19 pandemic: students' objectives and preferences, *Journal of Foreign Language Teaching and Learning* 6 (1) (2021), <https://doi.org/10.18196/ftl.v6i1.10079>.
- [26] S. Zulaihah, R. Harida, Autonomous learning strategy of the successful nontraditional students. *ELTIN JOURNAL, Journal of English Language Teaching in Indonesia* 5 (2) (2017) 71, <https://doi.org/10.22460/eltin.v5i2.p71-84>.
- [27] J.M. O'Malley, A.U. Chamot, *Learning Strategies in Second Language Acquisition*, Cambridge University Press, Cambridge [England, 1990].
- [28] J.S. Barrot, I.I. Llenares, L.S. del Rosario, Students' online learning challenges during the pandemic and how they cope with them: the case of the Philippines, *Educ. Inf. Technol.* (2021), <https://doi.org/10.1007/s10639-021-10589-x>.
- [29] P. Chakraborty, P. Mittal, M.S. Gupta, S. Yadav, A. Arora, Opinion of students on online education during the COVID-19 pandemic, *Human Behavior and Emerging Technologies* 1–9 (2020), <https://doi.org/10.1002/hbe2.240>.
- [30] K. Talsma, K. Robertson, C. Thomas, K. Norris, COVID-19 beliefs, self-efficacy and academic performance in first-year university students: cohort comparison and mediation analysis, *Front. Psychol.* 12 (2021), 643408, <https://doi.org/10.3389/fpsyg.2021.643408>.
- [31] L.Y. Tay, S.S. Lee, K. Ramachandran, Implementation of online home-based learning and students' engagement during the COVID-19 pandemic: a case study of Singapore mathematics teachers, *Asia-Pacific Education Reseachers* 30 (2021) 299–310, <https://doi.org/10.1007/s40299-021-00572-y>.
- [32] K.A. Buvozt, F.J. Powell, A.M. Solan, G.J. Longbotham, Exploring emotional intelligence, learner autonomy, and retention in an accelerated undergraduate degree completion program, *New Horizons in Adult Education & Human Resource Development* 22 (3) (2008) 26–43. Retrieved from, <http://search.proquest.com/docview/194674935?accountid=25704>.
- [33] R. Ma, R.L. Oxford, A diary study focusing on listening and speaking: the evolving interaction of learning styles and learning strategies in a motivated, advanced ESL learner, *System* 43 (2014) 101–113, <https://doi.org/10.1016/j.system.2013.12.010>.
- [34] A. Bandura, *Self-efficacy: toward a unifying theory of behavioral change*, *Psychol. Rev.* 84 (2) (1977) 191–215.
- [35] M. Verešová, L. Foglová, *Academic Self-Efficacy, Approach to Learning and Academic Achievement*, 2018, <https://doi.org/10.5772/intechopen.70948>.
- [36] K.S. Hendricks, The sources of self-efficacy: educational research and implications for music, *Update Appl. Res. Music Educ.* 35 (1) (2016) 32–38 (5) (PDF) University Students' Self-efficacy in Online Learning due to COVID-19. Available from: [https://www.researchgate.net/publication/348682540\\_University\\_Students&apos;Self-efficacy\\_in\\_Online\\_Learning\\_due\\_to\\_COVID-19](https://www.researchgate.net/publication/348682540_University_Students&apos;Self-efficacy_in_Online_Learning_due_to_COVID-19). (Accessed 28 June 2021).
- [37] V. Trowler, Student engagement literature review, *The Higher Education Academy* 11 (2010) 1–15. Retrieved from, <http://www.lancaster.ac.uk/staff/trowler/StudentEngagementLiteratureReview.pdf>.
- [38] F. Martin, D.U. Bolliger, Engagement matters: student perceptions on the importance of engagement strategies in the online learning environment, *Online Learn.* 22 (1) (2018) 205–222.
- [39] Aguilera-Hermida, College students' use and acceptance of emergency online learning due to COVID-19, *Int. J. Educ. Res.* 1 (2020), <https://doi.org/10.1016/j.ijedro.2020.100011>.
- [40] A. Realyvásquez-Vargas, A.A. Maldonado-Macías, K.C. Arredondo-Soto, Y. Baez-Lopez, T. Carrillo-Gutiérrez, G. Hernández-Escobedo, The impact of environmental factors on academic performance of university students taking online classes during the COVID-19 pandemic in Mexico, *Sustainability* 12 (21) (2020) 1–22, <https://doi.org/10.3390/su12219194>.
- [41] W. Elshami, M.H. Taha, M. Abuzaid, C. Saravanan, S. Al Kawas, M.E. Abdalla, Satisfaction with online learning in the new normal: perspective of students and faculty at medical and health sciences colleges, *Med. Educ. Online* 26 (1) (2021), <https://doi.org/10.1080/10872981.2021.1920090>.
- [42] A. Tratinik, Student satisfaction with an online and a face-to-face Business English course in a higher education context, *Journal Innovations in Education and Teaching International* 15 (1) (2017) 1–10.
- [43] A. Aiman, Improve online learning for pupils still stuck at home, say activists, Available at: <https://www.freemalaysiatoday.com/category/nation/2020/06/11/improve-online-learning-for-pupils-still-stuck-at-home-say-activists/>, 2020. (Accessed 16 June 2020).
- [44] A. Bozkurt, I. Jung, J. Xiao, et al., A global outlook to the interruption of education due to COVID-19 pandemic: navigating in a time of uncertainty and crisis, *Asian Journal of Distance Education* 15 (1) (2020) 1–126.
- [45] B.A. Greene, Measuring cognitive engagement with self-report scales: reflections from over 20 years of research, *Educ. Psychol.* 50 (1) (2015) 14–30, <https://doi.org/10.1080/00461520.2014.989230>.
- [46] J.F. Hair, C.M. Ringle, S.P. Gudergan, A. Fischer, C. Nitzl, C. Menictas, Partial least squares structural equation modeling-based discrete choice modeling: an illustration in modeling retailer choice, *Business Research* 12 (1) (2018) 115–142, <https://doi.org/10.1007/s40685-018-0072-4>.
- [47] M. Saunders, P. Lewis, A. Thornhill, *Research Methods for Business Students*, Schneider, W., & Artelt, C. (2010), Pearson Education Limited, Harlow, 2016, <https://doi.org/10.1007/s11858-010-0240-2>. Metacognition and mathematics education.

- [48] M.-L. Hung, C. Chou, C.-H. Chen, Learner readiness for online learning: scale development and student perceptions, *Comput. Educ.* 55 (3) (2010) 1080–1090.
- [49] V. Abramenka, Students' motivations and barriers to online education, Available from: <https://scholarworks.gvsu.edu/cgi/viewcontent.cgi?article=1775&context=theses>, 2015.
- [50] P.C. Sun, R.J. Tsai, G. Finger, Y.-Y. Chen, D. Yeh, What drives a successful eLearning? An empirical investigation of the critical factors influencing learner satisfaction, *Comput. Educ.* 50 (4) (2008) 1183–1202.
- [51] P.C. Su, R.J. Tsai, G. Finger, Y.-Y. Chen, D. Yeh, What drives a successful eLearning? An empirical investigation of the critical factors influencing learner satisfaction, *Comput. Educ.* 50 (4) (2008) 1183–1202.
- [52] J.F. Hair, G.T. Hult, C.M. Ringle, M. Sarstedt, *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Sage, Los Angeles ; London ; New Delhi ; Singapore ; Washington DC ; Melbourne, 2017.
- [53] M.A. Memon, H. Ting, T. Ramayah, F. Chuah, J.-H. Cheah, A review of the methodological misconceptions and guidelines to the application of structural equation modelling: a Malaysian scenario, *Journal of Applied Structural Equation Modeling* 1 (1) (2017), <https://doi.org/10.1002/9781444316568.wiem02051> i–xiii.
- [54] B.M. Byrne, *Structural Equation Modelling with AMOS: Basic Concepts, Applications, and Programming*, third ed., Routledge, New York, 2016.
- [55] J.F. Hair, J.J. Risher, M. Sarstedt, C.M. Ringle, When to use and how to report the results of PLS-SEM, *Eur. Bus. Rev.* 31 (1) (2019) 2–24, <https://doi.org/10.1108/EBR-11-2018-0203>.
- [56] R.B. Kline, Convergence of structural equation modeling and multilevel modeling, in: M. Williams, W.P. Vogt (Eds.), *Handbook of Methodological Innovation in Social Research Methods*, Sage, London, 2011, pp. 562–589.
- [57] A. Gold, A. Malhotra, A. Segars, Knowledge management: an organizational capabilities perspective, *J. Manag. Inf. Syst.* 18 (2001) 185–214.
- [58] J. Cohen, *Statistical Power Analysis for the Behavioral Sciences*, second ed., Lawrence Erlbaum Associates, Publishers, Hillsdale, NJ, 1988.
- [59] K.D. Multon, S.D. Brown, R.W. Lent, Relation of self-efficacy beliefs to academic outcomes: a meta-analytic investigation, *J. Counsel. Psychol.* 38 (1) (1991) 30–38, <https://doi.org/10.1037/0022-0167.38.1.30>.
- [60] 31 January L.R. Sheng, Mental health matters, *The Star. StarEdu* (2021) 1.
- [61] I. Alemany-Arrebola, G. Rojas-Ruiz, J. Granda-Vera, Á.C. Mingorance-Estrada, Influence of COVID-19 on the perception of academic self-efficacy, state anxiety, and trait anxiety in college students, *Front. Psychol.* 11 (2020), <https://doi.org/10.3389/fpsyg.2020.570017>.
- [62] K. Talsma, K. Norris, B. Schütz, First-year students' academic self-efficacy calibration: differences by task type, domain specificity, student achievement level, and over time, *Stud. Succ.* 11 (2020) 109–121, <https://doi.org/10.5204/ssj.1677>.
- [63] H. Mizani, A. Cahyadi, H. Hendryadi, S. Salamah, S. Retno Sari, Loneliness, student engagement, and academic achievement during emergency remote teaching during COVID-19: the role of the god locus of control, *Humanities and Social Sciences Communications* 9 (1) (2022), <https://doi.org/10.1057/s41599-022-01328-9>.
- [64] C. Wang, W.T. Tseng, Y.L. Chen, H.F. Cheng, Classroom interactions in the target language: learners' perceptions, willingness to communicate, and communication behavior, *Asia-Pacific Education Researcher* (2019), <https://doi.org/10.1007/s40299-019-00492-y>.
- [65] R. Poot, R.A. De Kleijn, H.V. Van Rijen, J. van Tartwijk, Students generate items for an online formative assessment: is it motivating? *Med. Teach.* 39 (3) (2017) 315–320, <https://doi.org/10.1080/0142159X.2017.1270428>.
- [66] D. Keržič, J.K. Alex, R. Pamela Balbontín Alvarado, D.D. Bezerra, M. Cheraghi, B. Dobrowolska, A.F. Fagbamigbe, M.E. Faris, T. França, B. González-Fernández, L.M. Gonzalez-Robledo, F. Inasius, S.K. Kar, K. Lazányi, F. Lazár, J.D. Machin-Mastromatteo, J. Maróco, B.P. Marques, O. Mejía-Rodríguez, A. Aristovnik, undefined, *PLoS One* 16 (10) (2021), e0258807, <https://doi.org/10.1371/journal.pone.0258807>.
- [67] M.M. Awang, F.M. Kutty, A.R. Ahmad, Perceived social support and well being: first-year student experience in University, *Int. Educ. Stud.* 7 (13) (2014), <https://doi.org/10.5539/ies.v7n13p261>.