

Enhancing Active Engagement in Virtual Classrooms: A Malaysian Higher Education Perspective

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Abstract: *All higher education institutions around the world now utilize virtual learning as their main learning method to protect their educational operations. The COVID-19 pandemic has been a major concern for many scholars regarding student engagement, as students struggle to adapt to online teaching and learning environments. The research team examined how virtual learning affects student engagement, leading them to develop methods to enhance student participation in virtual learning activities across Malaysian higher education institutions. The research team gathered data from Malaysian public and private universities, which appeared in the Times Higher Education World University Rankings 2021. The researchers distributed 389 questionnaires using simple random sampling, and respondents agreed to participate in the study. The research results demonstrate that virtual learning, which is essential for virtual classrooms, positively correlates with student engagement. The research results show new methods to encourage student participation in virtual learning activities, developed through three main themes: You Talk, Resource Pool, and Classroom Meet. The research results provide material that the Ministry of Higher Education and higher education institutions can use for their purposes.*

Keywords: Virtual Learning; Learner's Engagement; Higher Education Institutions; Learning Effectiveness; Resource Availability

1. Introduction

The COVID-19 outbreak in the year 2019 has had an exceptionally negative impact on the traditional education system worldwide. To maintain the current system of education, higher education institutions are embracing virtual learning (Bovermann & Bastiaens, 2020). Virtual learning methods have provided various alternatives for the management, planning, delivery, and monitoring of the entire education system. Educational institutions have recognized the quality of the learning process through the virtual system as equal in value to that achieved through the conventional system. Moreover, the delivery of course content through the virtual system is possible and may include both the theoretical aspects (recorded webinars, video lectures, conferences, etc.) and the practical aspects (recorded videos relevant to the courses) (Ibili, 2020). Meanwhile, the COVID-19 pandemic has raised concerns about student engagement in the learning process, as many educators have experienced difficulties adapting to virtual systems (Habeahan et al., 2022).

The field of instructional technology has undergone important changes during the last three years. The use of personalized learning methods helps educational content to become more diverse and better meet student needs (El-Sabagh & Hamed, 2020; Yang et al., 2013). E-learning enables students to learn at any time and from any place, leading to better academic outcomes (Chen et al., 2010; Lee et al., 2019). Higher education institutions have increasingly adopted adaptive e-learning technologies over the past few years.

Virtual learning has its benefits because users can access online systems to learn materials that they can easily obtain, handle, and use across different locations (Hu & Li, 2017). Virtual learning allows students to study at any time, leading to increased student engagement, which comprises two parts: active participation and study effort that led to academic success (Fatawi et al., 2020).

Virtual learning offers benefits to students and teachers, but it creates significant challenges for both groups. Students encounter multiple problems, including difficulty adjusting to new situations and maintaining interest, working together with others, and the learning space not meeting their needs, and some students take virtual learning flexibility as an automatic right (Coman et al., 2020). The level of satisfaction with virtual learning remains uncertain. Students experience satisfaction based on various factors, which include their interactions with other students, their relationships with teachers, their comprehension of course materials, their access to technology, their experience with the system, and the learning atmosphere (Tsai & Tsai, 2003). The teacher faces difficulties in engaging students in virtual learning and teaching activities.

Participation and engagement are essential components of the learning process, as learners' active involvement is crucial. Each student is required to be engaged and proactive; yet the level of engagement and proactivity in learning may vary among students. Engagement and liveliness are categorised as low, medium, and high. Teacher creativity is essential to fostering student engagement and active participation in the learning process.

People will have different levels of engagement. Active participation in school is a fundamental prerequisite for acquiring knowledge; a student who lacks engagement is less likely to succeed. Student achievement depends on their active participation which goes beyond following practices and using test results. Students who study with active participation experience academic growth through their natural curiosity and creativity, as well as through their social relationships with others. Student participation in the virtual realm will appear markedly distinct from the physical setting (traditional education) due to the absence of daily face-to-face interaction between teachers and students. Teachers should be able to sustain student engagement through a diverse range of methods. Students will develop their sense of responsibility for learning by examining perseverance concepts alongside self-improvement belief systems, as these concepts will help them become more actively involved in their studies.

2. Literature Review

2.1 Virtual Learning

Virtual distance learning is the term conventionally used to refer to this type of remote teaching and learning. In contemporary literature, virtual teaching/learning is often associated with concepts such as video conferencing, eLearning, long-distance learning, remote teaching/learning, virtual learning, and mobile learning. However, the general idea of virtual

tutoring/literacy is defined by a variety of concepts, such as activities carried out at a distance in both space and/or time (Bozkurt & Sharma, 2020).

2.2 Student Engagement (Dependent Variable)

Student engagement, according to Axelson and Flick 2010 defines both student participation and enthusiasm for learning, and their connection to educational settings, their academic institutions, and fellow students. Fletcher (2011) defines learner engagement as any enduring relationship students develop with educational institutions or the educational field itself. The measurement of student engagement in educational settings serves as an assessment tool that evaluates teaching effectiveness and the overall performance of schools, according to Fletcher (2011). Skinner and Belmont (1993) established a connection between student engagement and motivation by demonstrating that complete student engagement results from active participation in learning activities combined with positive emotional experiences. Students demonstrate active engagement in difficult learning tasks, take charge of their educational journey, show dedication through their efforts and focus, and maintain positive emotions, including enthusiasm, curiosity, and interest, throughout their educational experience. Student engagement, according to the Glossary of Education Reform 2016, describes how students demonstrate concentration, curiosity, enthusiasm, optimism, zeal, and eagerness to learn while they study, and their enthusiasm for acquiring new knowledge and advancing toward their educational objectives.

Barkley & Major (2020) utilized the terminology "passion" and "excitement" in their investigation to delineate student participation. Student engagement is explicated as a continual process and consequence resulting from the combined impact of motivation and active learning. In a contentious manner, Gibbs (2014) characterizes student involvement as the most recent phenomenon in the lexicon of higher education. Despite encompassing diverse facets, Gibbs' interpretation robustly buttresses its effect on student learning and institutional triumph.

The research conducted by Reschly and Christenson in 2012 and Christenson and Furlong in 2008, which Hu and Li used in their 2017 study, identified four different ways that students participate in virtual learning environments. The National Survey of Student Engagement NSSE functions as a measurement tool that academic institutions use to evaluate their success in student learning, according to Astin 1999 and other researchers who follow his work. According to Kuh 2009 the measure evaluates the effectiveness of both students and educational institutions.

Previous research shows that students who participate in school activities perform better on school tests than those who do not. Fall and Roberts (2012) demonstrate that students who take part in both educational and behavioral activities will achieve superior academic outcomes. Students who participate in academic and behavioral activities will decrease their risk of dropping out of high school because they achieve better academically. The way students engage with the curriculum material is a critical factor in their academic engagement. The students demonstrate higher cognitive and emotional commitment when they comprehend the task's importance. The research conducted by Manwaring et al. (2017), Joksimović et al. (2015), and Tomas et al. (2015) has validated this finding.

The teaching methods and systems that exist in traditional face-to-face classrooms cannot be directly applied to online learning environments. The development of these tools and strategies is necessary because virtual courses require different methods to address the absence of physical distance (Khan et al., 2017). Kennedy (2020) presents three perspectives on defining

'engagement' in virtual learning contexts and furnishes educators with counsel on augmenting student engagement in virtual learning. The three perspectives comprise a study of student involvement in virtual learning through an interactional framework, a study of student engagement through an interactivity framework, and an evaluation of student engagement from a learning design perspective.

Who bears the responsibility for establishing and sustaining a heightened level of student involvement? Educational institutions have been entrusted with a growing level of responsibility in this matter. To meet the needs of students who are fully engaged in educational activities, institutions and educational systems must employ effective instructional methods (Kuh, 2009).

The term engagement, as used in this extended definition, refers to two aspects: student learning activities and institutional support for students. The responsibility belongs to both learners and institutions to maintain high standards of student learning. Axelson and Flick (2010) state that students need to work hard to improve their knowledge and skills, while institutions must develop suitable learning environments.

The main purpose of Virtual Teaching and Learning (OTL) studies is to investigate how students participate in their activities through their interactions and discussions. The OTL process includes assessment and evaluation, feedback, and monitoring procedures.

Pereira et al. (2021) studied the use of technology to improve learning in virtual teaching and learning environments. The research conducted by Adedoyin and Soykan in 2020, Carrillo and Flores in 2020, Kabilan and Annamalai in 2022, and Kaur Sidhu et al. in 2022 explained multiple ways that technology helps students learn better in online teaching-learning environments. The researchers showed how technology should be used as a teaching tool in educational settings rather than treated as an exclusive solution. According to Bozkurt and Sharma, who published their findings in 2020, the objective of teaching through technology is the main purpose of both learning environments. The Community of Inquiry (CoI) model, developed by Garrison, Anderson, and Archer in 2001, served as the foundation for most research in this field.

The research studies demonstrate that meaningful learning within technology-based teaching environments, which researchers term computer-mediated learning, depends on three elements of the Community of Inquiry model, which include social presence, cognitive presence, and teaching presence (Carrillo & Flores, 2020; Kabilan & Annamalai, 2022; Pereira et al., 2021). Social presence describes how learners in a virtual classroom create social and emotional bonds, while others recognize their real-life identities. The virtual teaching-learning environment fosters cognitive presence, enabling learners to develop understanding through their reflective and dialogical activities. The teaching presence functions as a support element that assists social and cognitive presence through its content-based design and teaching and delivery methods used in virtual educational environments (Garrison & Arbaugh, 2007). The model demonstrates high relevance to the OTL school environment that researchers studied over the past two years. Research scholars from higher education institutions reported that the OTL teaching-learning process, which began during the lockdown period, has used up to 70% of new teaching methods to solve educational challenges they encountered.

Recent empirical evidence from Malaysia further strengthens this position. A study by Saro et al. (2025) at UNITAR International University demonstrated that purposeful, pedagogically aligned technology integration significantly predicts student engagement and improves virtual learning outcomes. Their regression findings indicate that technology itself does not automatically enhance engagement; rather, engagement improves when digital tools are strategically embedded within instructional design. This supports the present study's emphasis on examining structural factors that contribute to active participation in Malaysian virtual classrooms.

The standard delivery method for Virtual Teaching and Learning (OTL) includes both asynchronous and synchronous formats, and the combined use of these formats results in difficulties that hinder student participation. Students in higher education prefer synchronous OTL methods based on their immediate access to content, although both asynchronous and synchronous OTL methods deliver equal educational outcomes (Andrew et al., 2021; Brady & Pradhan, 2020). Researchers identify virtual educational environments as more challenging for developing student engagement than traditional classroom settings. The three types of student engagement, including behavioral, emotional, and cognitive dimensions of learning, are strengthened by four psychosocial constructs: self-efficacy, emotional responses, and a sense of belonging and well-being (Kahu & Nelson, 2018).

The current educational environment in Malaysian universities was established because all academic institutions ceased operations in March 2020. Local universities made substantial financial commitments, which helped boost student participation and reduce dropout rates, according to Abdullah, Arokiyasamy, Goh, Culas, and Manaf (2022). Universities created Teaching and Learning (TNL) programs that enable instructors to develop their skills in conducting effective online classes, according to Abdullah and colleagues (2022). The shift to online learning created unexpected problems for students, as they faced difficulties with their study spaces and communication systems, and lacked the skills needed to navigate the new educational system, according to the research by Nassr, Aborujilah, Aldossary, and Aldossary (2020).

2.3 User Friendliness (Independent variable 1)

The primary users of virtual learning platforms in higher education institutions are learners and instructors, as highlighted by Ifijeh et al. (2015). According to Rawashdeh et al. (2018), Canvas and Blackboard are the most favoured virtual education platforms among users, with communication tools such as Zoom, Teams, Google, and social media platforms like TikTok, Twitter (now known as X), and Facebook being widely used. Additionally, the effectiveness of Learning Management Systems (LMS) in facilitating synchronized communication between learners and instructors for virtual courses has been emphasized (Junior & Marquesi, 2009, as cited in Rawashdeh, 2021). Many higher education institutions have made significant financial investments in acquiring, installing, and managing virtual learning platforms to support and improve virtual learning and teaching (Ifijeh, 2015).

The Technology Acceptance Model, developed by Davis in 1989, provides a framework for examining how external factors affect students' acceptance of new technological advancements in their educational settings. Two essential components of TAM, perceived usefulness and perceived ease of use, are vital factors in determining how students intend to use virtual learning technologies, according to Davis (1989), as cited in Huang (2021). Students develop their attitudes toward technology acceptance through the Theory of Reasoned Action, which works alongside TAM, according to Fishbein and Ajzen (1975) and Davis (1989), as cited in

Huang (2021). The term "perceived ease of use," which people often use as a synonym for "user-friendliness," assesses how students perceive the learning and operational simplicity of new technology systems (Huang, 2021).

2.4 Course Design (Independent variable 2)

The philosophy and conceptual framework aimed at cultivating a more enhanced cognitive environment for students are commonly referred to as course design. As per Dee Fink (2010), the primary objective of course design is to provide students with greater learning opportunities in a setting that values and supports their intellectual progression. Enhanced engagement with course material tends to prompt higher levels of student involvement and initiative, consequently impacting learning outcomes. The design of a virtual learning course encompasses the arrangement, interface, evaluation methods, appraisal, and avenues for instructor-student communication. Moreover, Dee Fink (2010) underscored the importance of structuring and presenting educational components in an interactive learning format.

Innovative instructional design approaches within Malaysian higher education have begun to explore immersive virtual strategies to enhance engagement. For example, Abdul Latif and Kamrozzaman (2025) investigated a metaverse-flipped classroom model and reported increased student participation, collaboration, and intrinsic motivation within digitally mediated environments. Their findings highlight that course design that incorporates interactive spatial learning and peer collaboration can significantly enhance active engagement in virtual classrooms. This reinforces the argument that engagement is strongly shaped by pedagogical design rather than technological presence alone.

Activities and evaluations within courses are often intertwined with active participation, student collaboration, diverse learning preferences, time allocation, and positive outlooks. The degree to which students accept or decline professional obligations prior to the start of the semester commonly mirrors the level of student-faculty interaction and their receptiveness to assessment feedback. The delivery method for course materials should be systematically organized, foreseeable, and diverse (Shea et al., 2022, as referenced in Garrels & Zemliansky, 2022).

In their study, Mehta et al. (2017) underscored the critical role of course design in establishing an efficient virtual learning environment. Instructors are required to demonstrate readiness to dedicate substantial time and effort to crafting a virtual course. Many educators venturing into hybrid course instruction often feel compelled to extensively modify their courses to align with virtual learning standards (Mehta et al., 2017). To develop impactful courses, educators must possess a comprehensive understanding of the subject matter they intend to teach, given that virtual education transcends mere lecture delivery and student evaluation through quizzes and examinations.

2.5 Availability of Resources (Independent variable 3)

Learning resources are materials that can support learners in obtaining, documenting, and analyzing learning content. Within the realm of virtual education, a virtual learning resource is a material accessible through the World Wide Web. These resources may encompass HTML files detailing course objectives, tasks, lecture notes, or responses to queries from specific chapters. Illustrative exercises or assessments, audiovisual lectures, or documents containing hyperlinks to external webpages could all serve as illustrations. In the domain of virtual education, instructional materials are also pivotal in enhancing student involvement. Instructors employ a diverse array of instruments and exercises such as audiovisual presentations, virtual

discourse platforms, live streaming sessions, video-integrated assessments, independent quizzes, weekly and monthly tasks, prescribed readings, and references to other beneficial materials to stimulate student participation and optimize the learning process (Hew, 2016).

Numerous college students still lack the fundamental competencies and knowledge needed to independently navigate virtual learning platforms, a deficiency that could affect their engagement with academic coursework. A considerable number of students have been informed of the deficiencies associated with emergency remote learning, which include insufficient resources, substandard quality of instruction and educational content, unsupportive home-based learning environments, limited internet connectivity, mental health challenges, and minimal exposure to digital learning formats. Educators face similar challenges, compounded by escalating workloads, particularly when transitioning all traditional learning resources to digital formats (Fung et al., 2022).

2.6 Digital Literacy (Independent variable 4)

Digital literacy now includes the ability to search for electronic information, assess its quality, and manage all aspects of its use. People who use social media platforms, such as Facebook and YouTube, now require various digital literacy skills. People need basic digital literacy skills to achieve their goals and conduct their daily activities in today's interconnected virtual world.

Digital literacy enables teachers to enhance their professional development through virtual learning communities, taking into account the global economy and advances in computer technology (Li & Yu, 2022). Digital literacy requires a comprehensive understanding of both internet-use skills and the necessary digital technology competencies, according to some scholars (Shopova, 2014). Digital literacy provides people with opportunities for social interaction and professional development paths, which help them defend against virtual threats that harm their well-being, according to Helsper et al. (2020).

Digital literacy includes digital skills as its fundamental component. The learners develop multiple skills that help them understand various information sources and channels, build trust in the information they receive, and achieve greater control over their educational process. Digital literacy includes digital skills and advanced critical and evaluative competencies, which academic sources use to define media literacy (Vissenberg et al., 2022). Ferrari (2012) provides a comprehensive definition of digital literacy that encompasses the essential skills, attitudes, and competencies required for successful information acquisition, access, retrieval, storage, and organization. The focus requires users to apply technology and media resources through critical thinking and creative problem-solving while maintaining ethical standards to develop fresh insights (Shopova, 2014).

The integration of digital literacy with information literacy poses a challenge for educational institutions because it requires them to combine five distinct literacy types, including digital literacy, information literacy, data literacy, media literacy, and other literacy forms. Alexander et al. (2017) describe digital literacies as a combination of information literacy and media literacy competencies. Calvani et al. (2009) found that digital literacy functions as an assessment tool that measures both power and competence while enabling users to analyze data, choose materials, and evaluate them critically. The evidence demonstrates that digital literacy does not require specific procedures or job functions.

2.7 Indicators of Student Engagement

Cognitive, affective, and behavioral engagement comprise the three main dimensions of student engagement (Frederick et al., 2004; Frederick et al., 2016). Cognitive engagement is associated with student involvement in class activities, engagement in class activities, and student conduct. It can also be associated with the use of learning strategies and student comprehension. Affective engagement can be associated with students' attitudes toward the learning environment and toward peers and instructors, as well as with their feelings of belonging. Behavioral engagement overlaps with the other dimensions of engagement.

Traditionally, student engagement in the classroom has been characterized by specific behaviors that include students' persistent engagement in the process of learning, students' involvement in class activities, students' collaboration with peers, students' resolution of intellectual challenges, students' satisfaction with the process of learning, students' feelings of belonging in class, as well as students' enthusiasm for the process of learning (Güneş, 2014; Kahu, 2013; Burch et al., 2015; Hu et al., 2008; Abbott et al., 1998).

Research findings suggest that several variables affect the extent of student engagement in the virtual classroom. In a case study conducted in Uganda, Lazareva (2018) used a case study design in which the researcher interviewed 14 participants. The case study found that student engagement in the online classroom is primarily determined by two factors: the provision of scaffolding by competent students and the provision of encouragement by students who interact with them in the physical classroom. The case study also reported that student engagement in the online classroom could be determined by students' capacity to collaborate in problem-solving and learning. Additionally, the case study reported that student engagement in the online classroom could be determined by the availability of an internet connection, as well as the opportunity for less experienced students to participate in informal virtual classrooms where they can receive support from more experienced students during engagement.

2.8 Hypothesis Development

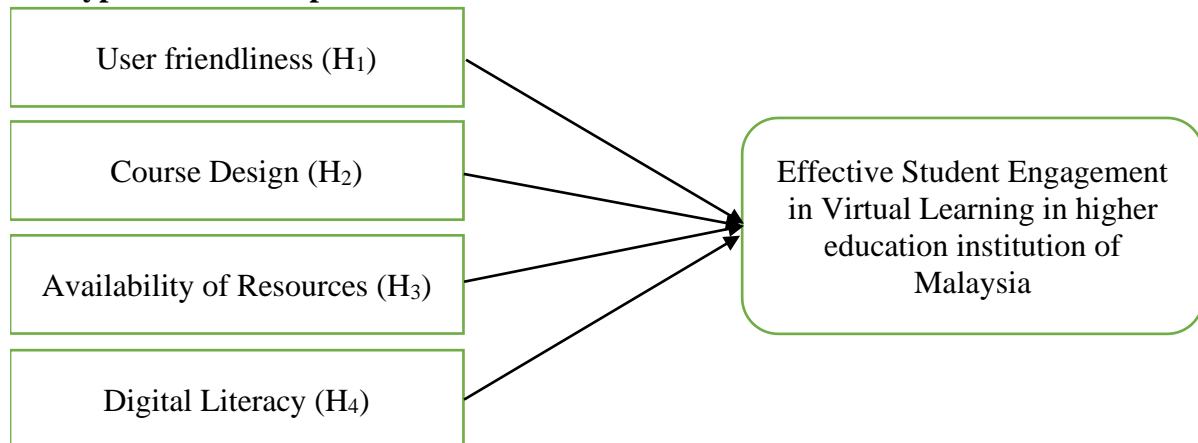


Figure 1: Factors that affect the students' engagement in virtual learning in a higher education institution in Malaysia.

Source: Developed by the researcher based on a previous study

H₁: User friendliness (UF) is a factor contributing to effective student engagement in virtual learning in higher education institutions in Malaysia.

The research conducted by Henderson et al. (2015) and cited in Ilin (2020) demonstrates that students face difficulties with virtual learning technology because these systems lack a user-

friendly design, requiring users to adapt their behavior to the existing system. Sun and Wang (2014), whom Lin (2022) cites, demonstrate that student needs can be addressed through technology development that uses a user-centered design approach to create better virtual learning environments. The research conducted by Lin (2022) showed that virtual learning platforms that provide access across multiple devices help students become more involved in their studies.

According to research conducted by Author Deka (2021), the system quality of virtual learning systems directly impacts student satisfaction. Pham Le and Do (2021) confirm that students achieve better learning outcomes when they find virtual learning platforms easy to use. Al-Kumaim et al. (2021) conducted a study that discovered that students with poor mental health experienced reduced engagement because they struggled to adapt to new virtual learning platforms, which created negative effects on their mental health and their ability to participate in school activities.

H₂: Course design (CD) of virtual learning is a factor contributing to effective student engagement in higher education institutions in Malaysia.

The second factor affecting student engagement in classrooms is course design. The research conducted by Adeyinka and Mutula (2010) and used by Mtebe and Raphael (2018) establishes course quality as the measure of virtual learning content that satisfies student requirements. The study conducted by Deka (2021) found that course design and content elements positively impact student engagement levels. The research conducted by Khlaif Salha and Kouraichi (2021) demonstrates that students become more engaged with high-quality digital content that educators developed for their courses. Deka (2021) established that student engagement in virtual learning environments results from both course content and design elements.

Tualualelei Burke, Fanshawe, and Cameron (2021) state that course design is a key factor in creating and maintaining student interest while advancing their educational development. The research conducted by Gedera (2014) and cited by Tualualelei et al. (2021) states that teachers select their virtual learning resources, as well as intellectual and physical materials. The study by Knight et al. (2014), cited by Tualualelei et al. (2021), indicates that technology use in educational environments depends on specific contexts, which determine its value through both design and functionality. To create effective teaching methods, course designers need to understand technological aspects, student needs, subject matter, and instructional design principles.

H₃: Availability of resources (AOR) of the factors that contribute to effective student engagement in virtual learning in higher education institutions of Malaysia.

The impact of resources on student engagement is the third variable to consider. According to Khlaif et al. (2021), the absence of technological tools negatively influences student engagement in remote learning. Bedenlier et al. (2020) highlighted the challenges related to the lack of home resources, equipment, and internet connectivity in ensuring fair and effective virtual education. Some students had to borrow resources, such as computers and internet access, from schools and other institutions, as noted by Chiu (2021).

Despite instructors assigning tasks that depend on broadband internet access, students reported being unable to complete assignments due to a lack of internet connection or computer access (Bedenlier et al., 2020). Disengaged students often cited a lack of cognitive readiness for virtual

learning, feeling inadequate in this environment (Bedenlier et al., 2020). The shift to emergency virtual education has further widened the digital divide, underscoring the critical importance of ensuring students have access to virtual resources during these challenging times. Chiu et al. (2021) emphasized that providing students with reliable technology and internet connectivity can enhance their academic engagement with professors and peers, ultimately promoting a sense of support and competence.

H4: Digital literacy (DL) influences effective student engagement in virtual learning at higher education institutions in Malaysia.

Digital literacy is the fourth factor affecting how students participate in their studies. Students possess a specific level of knowledge that enables them to use internet-based platforms and related technologies without any challenges, according to their digital skills assessment (Byungura et al., 2018, as cited in Werang & Leba, 2022). Researchers across different fields have established a direct relationship between digital literacy and student participation in academic activities. The researchers Sadaf et al. (2017) reported that students showed increased classroom engagement following the implementation of digital literacy programs in their learning environments. Classrooms that include digital literacy programs will increase student interest in their academic work. Educators view the implementation of digital tools across various student learning activities as an effective method for promoting student participation (Sadaf, 2017).

Digital literacy establishes better connections between real-world situations and academic materials, creating more opportunities for students to participate in activities. The incorporation of digital literacy into educational practices enables teachers to generate students' interest in topics they find boring or unappealing. Digital literacy enables students to connect their real-life experiences with the academic content that they learn in the classroom, according to Sadaf et al. (2017).

3. Methodology

3.1 Research Design

The design aims to answer which elements create successful virtual instruction for Malaysian higher education institutions. The research study employs a cross-sectional design to conduct its empirical investigation. The researchers conducted a questionnaire survey to collect data over a two-month period in 2024 to meet their research objectives. The researchers distributed the questionnaire to Malaysian students who were studying at postsecondary educational institutions.

3.2 Population and Sample

The study selected its target population from 389 respondents representing 1 107 834 people enrolled in public and private higher education institutions across Malaysia in 2022. The research employed simple random sampling, which involved selecting participants from multiple departments and faculties. The researchers used the Raosoft sample calculator to select 385 samples from the targeted population. The selection process for samples required respondents to possess a substantial understanding of virtual teaching activities at their educational institutions, which they needed to have actively participated in. The researchers distributed questionnaires to 400 respondents, of whom 375 returned completed questionnaires. The response rate reached 93.7 percent.

3.3 Measurement Items

A questionnaire was derived based on prior studies. Based on a review of the existing virtual learning and student engagement literature, 27 measurement items were developed to operationalize the recognized obstacles to CSR execution. Table 1 shows the measuring objects and their sources.

The researchers used two different instruments to gather necessary information for their study. First, this study relies on primary data collected through a structured questionnaire. The questionnaire consisted of three sections. Part A contained demographic information about the respondents, while Part B included questions on student engagement, and Part C included factors affecting virtual learning. The structured interview questions required respondents to choose their answers from a Likert-type scale which ranged between 1 (strongly disagree) and 5 (strongly agree). The researchers used these responses to evaluate all independent variables together with the dependent variable.

Table 1: Measurement Items

Constructs	Measurement items	Sources
Section A: Demographic Profile		Nabil Hasan Al-Kumaim, Abdulsalam K. Alhazmi , Fathey Mohammed , Nadhmi A. Gazem 4, Muhammad Salman Shabbir and Yousef Fazea (2021).
Section B: Student Engagement		Ladino Nocua, Andrea Catalina, Cruz Gonzalez, Joan Paola, Castiblanco Jimenez, Ivonne Angelica, Gomez Acevedo, Juan Sebastian, Marcolin, Federica, Vezzetti, Enrico(2021).
Section C: i. User-friendliness		Huang, C.H (2021) Khan, Mohammed, Arshad, Vivek, Mohammed Nabi, Kamalun, Mayssoon, Khojah and Muhammad Tahir (2021).
ii. Course Design		Dazhi Yang (2017); Norah Al-musharraf and Shabir Khahro (2016)
iii. Availability of resources		John Mark R. Asio, Ediric D. Gadia, Erlinda C. Abarintos, Darwin P. Paguio, Melner Balce (2021). Jiahua Zhou and Qiping Zhang (2021). Khalid M. Alabdul wahhab, Syed Yousaf Kazmi, Waqas Sami , Khaled Nasser Almujeel, Mohammed Hamed Alanazi, Khalid Falah Alanazi, Abdullah Meshal Moyana, Mohammad Shakil Ahmad, Tariq A. Alasbali, Fahd Al Alwadani(2021).
iv. Digital Literacy		John Hannon and Brian D'Netto(2007). Jeong-Bae Son, Sang-Soon Park and Moonyoung Park(2017).

Source: Compiled by the researcher

4. Result and Findings

4.1 Scale and Reliability

The questionnaire was pre-tested at one of the higher education institutions before it was distributed to actual respondents to assess reliability. Feedback received; correction made accordingly. Cronbach's alpha was used to assess the reliability of the total questionnaire, and all 5 items exceeded the conservative threshold of 0.70.

Table 2: Cronbach's Alpha-Reliability Test

Cronbach's Alpha	N of Items
0.74	5

4.2 Correlation Analysis

To quantify the degree and direction of relationships between two continuous variables, correlation analysis is used. A thorough correlation analysis between several variables, including "Digital Literacy (DL)," "Course Design (CD)," "Availability of Resources (AOR)," User Friendly (UF), and Student Engagement (SE), is shown in the table below.

Table 3: Correlations Analysis among variables chosen

	1	2	3	4	5
1. SE	-				
2. UF	0.28**	-			
3. CD	-0.65	0.34**	-		
4. AOR	0.61*	0.22**	0.12**	-	
5. DL	0.62*	0.19**	0.20**	0.85*	-

** Correlation is significant at the 0.01 level (1-tailed)

*Correlation is significant at the 0.05 level (1-tailed)

According to the correlation matrix above, "user friendliness," "course design," and "availability of resources" are significantly correlated with "student engagement in virtual learning." It also has a strong correlation to digital literacy. "UF" exhibits a noteworthy association with SE, AOR, and DL. It also has a moderate correlation with CD. "CD" is inversely correlated with SE while exhibiting a strong correlation with UF, AOR, and DL. There is a significant correlation between "AOR" and DL, CD, UF, and SE. The "DL" also showed strong correlations with AOR, UF, CD, and SE.

4.3 The Factors affecting virtual learning and Student Engagement (Regression results)

The regression model presented below, and the result of the analysis are shown below:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \epsilon$$

Where,

Y = Student engagement

X₁ = User Friendliness

X₂ = Course Design

X₃ = Availability of Resources

X₄ = Digital Literacy

Table 4: R² and ANOVA

R = 0.70^a

R square = 0.49

Adjusted R square = 0.44

Standard error = 0.55

ANOVA						
	Sum of Squares	Df	Mean Square	F	P	Remark
Regression	15.394	5	3.08	10.228	0.000 ^b	Significant (P<0.05)
Residual	16.256	54	0.30			
Total	31.650	59				

a. Predictors: (Constant), UF, CD, AOR, DL

The model's performance is summed up with pertinent analysis in the regression table above. The multiple correlation coefficient, denoted by R, has a range of -1 to +1. Given that .70 is captured at 0. It indicates that there is a good relationship between Student Engagement and UF, CD, AOR, and DL. The coefficient of determination is represented by the R square, which has a range of 0 to 1. Given that the R square value is 0.486, UF, CD, AOR, and DL account for 46% of the variation in the student engagement percentage. With an adjusted R of 0.439, only 44 percent of UF, CD, AOR, and DL are factors influencing virtual learning in Malaysian higher education institutions. The findings indicate that there exist additional factors that influence the efficacy of student engagement in virtual learning within Malaysian higher education institutions. The significant F value suggests that the independent variables are appropriate for examining effective student engagement. The variables in the model suitability are compatible.

Table 5: Coefficients Analysis

Model	Coefficients	Std Error	t Stat	P-value	Lower 95%	Upper 95%
<i>I (Constant)</i>	-1.34	1.73	-0.78	0.43	-4.83	2.12
<i>UF</i>	0.59	0.43	1.35	0.18	-0.28	1.45
<i>CD</i>	-0.33	0.12	-2.66	0.10	-0.57	-0.08
<i>AOR</i>	0.17	0.14	1.18	0.24	-0.13	0.46
<i>DL</i>	0.53	0.29	1.83	0.73	-0.05	1.10

a. Dependent Variable: SE

The hypothesis that UF positively influences student engagement in virtual learning by 0 point59 is rejected because the significance level is 0 point18 (>0 point05). Therefore, the hypothesis cannot be accepted. In other words, the UF is not relevant. Likewise, UF and DL are unacceptable since their significance levels (of 0 and 0 points, respectively) exceed 5 percent. But CD exhibits a negative sign that is significant at the one percent level (sig 0.10). This shows that only CD, out of the five variables, has any effect on students' participation in virtual learning. Therefore, virtual learning ought to be strategic in nature and guided by a vision from the university administration.

The model results mentioned above show how the tested elements contributed to identifying the variables influencing student engagement in virtual learning in Malaysian higher education institutions. Apart from CD, which indicates a negative impact, all variables in the regression model have a positive effect on the dependent variable, which is student engagement.

Table 6: Hypothesis Results

Hypothesis	Supported / Not Supported
H ₁ : User friendliness (UF) is a factor that contributes to effective student engagement in virtual learning at higher education institutions in Malaysia.	Is not a significant element or obstacle to the success of virtual learning and student participation. We found no significant correlation between user friendliness and student engagement in our multiple regression analysis. As we conducted additional research to support the lack of significance in the relationship between user-friendliness and student engagement, we discovered that respondents' demographic characteristics had a significant impact on the variables. For example, the relationship between user-friendliness and student engagement has been influenced by age group, gender, and study level. Supported
H ₂ : Course design (CD) of virtual learning is a factor contributing to effective student engagement in higher	Table 5 displays two values, including a negative value of 0.33 and an increased value of 0.01. The study shows that CD is a major factor affecting how students participate in their virtual learning activities. Management needs to record this information because it will affect their decision-making during upcoming strategic planning meetings. The research conclusions show that course design advantages student participation outcomes. Deka's (2021) research, which found a positive

education institutions in Malaysia.	correlation between course design and student engagement, supports this finding. The results of this study are supported by Khlaif, Salha, and Kouraichi (2021), who found that student engagement is positively related to digital content quality. Supported
H ₃ : Availability of resources (AOR) of the factor that contributing for effective student engagement in virtual learning in higher education institutions of Malaysia.	The ability to access resources does not prevent students from participating in virtual learning activities. The research results demonstrate that students engage more with their studies when educational resources are accessible. Khlaif et al. (2021) provide evidence supporting the results of this study. The study by Khlaif et al. (2021) shows that students fail to engage with virtual learning due to a lack of access to necessary technological devices. Students experience disconnection during virtual learning sessions, which prevents them from engaging in mental activities, according to Bedenlier et al. (2020). Supported.
H ₄ : Digital literacy (DL) influences effective student engagement in virtual learning at higher education institutions in Malaysia.	The DL variable does not engage students at Malaysian higher education institutions when they participate in virtual learning, according to Table 5. The research findings show that digital literacy helps students become more involved in their studies. Authors: Byungura and associates (2018), as referenced in Werang and Leba (2022), concur that there is a positive link between student engagement and digital literacy. Sadaf and associates. (2017) demonstrates in his research how a strong connection is made between digital literacy and the classroom setting. Howard et al. (2016) found through their research that the use of digital technology increases student involvement in academic activities.

5. Conclusion and Recommendations

5.1 Conclusion

The analysis tests variables separately to determine their relationship with the dependent variable. The analysis results provided complete support for the hypothesis. The study used multiple regression analysis to examine how the four independent variables combined to create different levels of student engagement. The analysis produced two new discoveries. User-friendliness is unrelated to student engagement, according to the first discovery. The second finding shows that multiple regression analysis yields a negative t-value for resource availability, indicating its detrimental impact on variability in student engagement.

5.2 Limitation

The research study faces its first obstacle because the sample size needs to be larger. The study examines only Malaysian university students. The questionnaire was sent only to the top 3 public and the top 3 private universities, respectively, based on the Times Higher Education World University Rankings, because the researchers used cluster sampling to select their target respondents. The target respondents' range had been limited, so the results could not represent all Malaysian university students, and the study lacked essential evidence to establish its validity. An even more accurate study could have been conducted if a larger sample size had been used.

The second study limitation arises from the ways respondents participated in the research. The research team used WhatsApp and Instagram to distribute the survey because they faced challenges reaching university students living in remote areas across Malaysia. The researchers needed to send multiple reminders to respondents because their work obligations prevented them from completing the survey. Some university students did not have time to carefully read and complete the survey because they were studying for final exams when it was distributed. The survey participants displayed a lack of urgency, leading them to provide dishonest answers. The study results depend on the responses that people give. The study results depend on the responses that people give. The study faces resource shortages as its primary obstacle. The internet contains numerous journals and articles that discuss our research, yet researchers face

challenges accessing high-quality publications because they must pay for them. The research team conducted the study without having full access to all available journal sources.

6. Conclusion

The chapter used earlier studies to confirm results that matched each tested hypothesis. The research produced two new results, which the researchers will treat as findings that contribute to this academic field. The study results were explained through the discussion of their implications. The researchers provided recommendations for future studies to address all study limitations.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this study.

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