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An Integrated Framework of Online Learning Effectiveness in Institutions of Higher Learning

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Abstract: In the early stages of adopting online learning, both learners and teachers displayed resistance, but the COVID-19 pandemic has forced a widespread shift to digital learning. To facilitate this transition, there is a growing focus on highlighting the effectiveness of online learning, which directly impacts learning outcomes. This study investigates online learning effectiveness through an integrated framework that considers online assessment practices and online course design as independent variables, with online learning support as a moderating variable. Understanding the effectiveness of online learning is crucial as hybrid learning becomes the "new norm" in education, combining online and offline methods for teaching the digital generation. Using a quantitative research design involving 232 students at Universiti Kebangsaan Malaysia, the study found that online assessment practices and course design significantly influence students perceived learning outcomes in an online learning environment. Additionally, online learning support positively moderates this relationship. These findings offer a comprehensive perspective on how online assessment practices, course design, and support systems contribute to the quality of higher education in Malaysia amidst evolving educational practices.

Keywords: *Online assessment practices, online course design, online learning support, perceived online learning.*

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Introduction

Online learning has become a major component of education globally and has transformed how education takes place at different levels and contexts. The COVID-19 pandemic definitely plays an essential role in accelerating the formalisation of online learning in the education system. Many discussions in the literature assume that the online learning approach is an emerging concept since it is tied to the application of technology (Bates, 2018) in the learning process, and therefore innovation and technological advancement would reinvent the concept of online learning. Recent definitions of online learning also expand the scope to include accessibility, connectivity, flexibility, and variability of interactions (Moore et al., 2011).

Online learning permeates the education system as the outcome of the COVID-19 pandemic has positively and negatively impacted learners and teachers. As mentioned by Grishchenko (2020), the most affected by online learning are economically deprived individuals and those living in rural areas because of restricted access to digital technology due to financial constraints and limited infrastructure. Widespread use of online learning during the pandemic has shown us that consistent access to digital technology is crucially important (Ramdan et al., 2020), especially for online education. Students with limited access to digital technologies, and those with little knowledge of online tools are having difficulty adjusting to online education. Ali and Al Dmour (2021) indicate that online learning is largely dependent on various

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online tools and online connectivity. The strength of online connectivity is paramount in making online classes accessible and reliable, and the speed relies upon the capacity of the servers to accommodate the number of students enrolled.

Since technology is an important element that defines online learning, learning effectiveness cannot be measured using the commonly important elements in the traditional learning context. The effectiveness of the online learning approach needs to be assessed from a more comprehensive perspective, including course design, assessment practices, and learning support specifically designed to suit the online learning pedagogy. For example, in the context of online assessment, there are inherent disadvantages especially in providing personalised engagement (Cook & Steinert, 2013) and ensuring students' integrity in answering the questions. On the other hand, the need for stable connectivity is also paramount to ensure that the learning session is not interrupted by technicalities, and student unfamiliarity with the online examination system and the rigidity of the technological setting may also limit the ability of online assessment mechanisms (Khan & Khan, 2019). Interestingly, a study by Spivey and McMillan (2014) in the US has shown that online and offline approach in students' assessment has no significant difference in terms of performance and effort. This conclusion indicates that online assessment is as effective as the traditional approach, and the convenience it offers may be leveraged to expand the ability of the education system to promote lifelong learning in building an educated society.

This research aims to investigate the perceived learning outcomes of online learning using an integrated framework that includes online assessment practices, online course design as independent variables and online learning support as the moderating variable. The research objectives include examining the positive relationship between online assessment and course design on learning effectiveness and the moderating effect of online learning support that strengthens the relationship between the two independent variables to online learning effectiveness. Understanding these relationships is pertinent to constructing effective mechanisms and processes for generating positive outcomes from online learning. The findings of this research will strengthen the transitional process of embedding online learning into the conventional education system. The integration of online tools and processes will not dilute the quality of the education system but provide flexibility of delivery that will reinforce the curriculum design. This will, therefore, enhance the education sector to maintain relevancy and quality in a technology-driven environment.

Literature Review

Online learning has become the mainstream approach that replaces face-to-face learning during the COVID-19 pandemic and is progressively being endorsed to complement the traditional learning approach with the application of online teaching and learning platforms. Previous studies have highlighted the advantages of online learning compared to conventional methods. In terms of cost, online learning is acknowledged to reduce operating costs in Institutions of Higher Learning (IHL) since it can cater to a larger number of students compared to the limited size of the physical classroom. In turn, online programs can be offered at a lower price, thus giving a financial advantage in terms of tuition fees (Nguyen, 2015). In addition, online learning provides the lecturer with more space and room for strategies in course delivery by allowing media diversity, such as videos, artificial intelligence (AI), and online quizzes, and open the doors for creativity in delivering the subject (Muhtadi et al., 2021). Nevertheless, previous studies also identified several disadvantages of online learning, such as the integrity of online learning assessment, especially with the introduction of ChatGPT, which allows students to manipulate AI-based applications to their advantage. Despite this, there is also evidence of positive outcomes of online learning, such as findings by Zheng et al. (2021) that reported dentistry students who embraced online learning in the US performed better than students under traditional face-to-face approach, thus suggesting that online learning can be more effective based on student performance.

In line with the advancement of digital technology, online learning is widely accepted and preferred by the digital generation. Integrating both learning mechanisms, i.e., hybrid learning will provide a fulfilling atmosphere of learning that offers students transformative experiences and provides educators avenues to be innovative in educating their students (Tseng et al., 2013). While prior research is mainly concentrated on the effectiveness of online learning to the student (e.g., Zheng et al., 2021), our study extends the body of research by focusing on three main aspects of a learning process that include online assessment practices, online course design and online learning support - something that has been predominantly neglected by studies in the past.

In the online environment, course design must incorporate necessary innovation that is aligned with current technologies (Liang & Creasy, 2004). Learning strategies need to be reinvented to build rapport with online participants and to achieve collaborative learning; various instructional designs, such as kinesthetic, audio, and visual (Gaytan & McEwen, 2007), need to be embedded in the process of delivery. The effectiveness of online learning also depends on the quality of online learning support. In this instance, Rotar (2022) suggests that peer and mentoring support is crucial in ensuring strong collaboration and interaction between students and peers. Moreover, the study also emphasised the critical role of instructors in bonding a meaningful relationship with the students. The interaction of all parties in the learning process, i.e., teachers, learners, and peers, will eventually develop a caring and conducive environment in the teaching and learning setting (Jones, 2010). In addition, the support system needs to be established by the institution in the form of assembling support services, training on online tools for students and teachers (Rotar, 2022) and providing a secured and interactive Learning Management System (LMS) as the platform for teaching and learning activities.

Online assessment is a hassle-free mechanism designed to replace traditional paper and pencil examinations. According to Joshi et al. (2020), online assessment eliminates the need for an examination hall, printing question papers, and the cost of traveling for students and invigilators. Online assessment is the solution for the challenging situation for example during the COVID-19 pandemic since it can cater to a huge number of students in different locations, with objective and prompt feedback (Whitelock & Watt, 2008). Nevertheless, this mechanism is plagued with several shortcomings, such as academic integrity, hackers, viruses, costly technology investment, and training for the staff and teachers (Joshi et al., 2020; Sim et al., 2004). In the context of online assessment, the learning objectives must be supported by suitable measurement, and the intended outcome must be outlined clearly by the instructor (Gaytan & McEwen, 2007). This is a challenging task in the online environment since effective assessment should encompass the critical thinking components to be tested on the students (Marshall, 2003; Razak et al., 2022).

The rapid adoption of online learning driven by the pandemic has challenged the ability of IHL to retain quality control measures to maintain the quality of tertiary-level education. In other words, academic integrity is the greatest challenge, especially in the midst of making hybrid learning the mainstream mode of learning. The continued application of remote learning and the inability to control the students' environment posed a challenge to higher education providers (Rodchua et al., 2011). There is strong evidence that cheating and integrity violations are becoming rampant in today's classrooms (Yahaya et al., 2022). Many studies are focused on explicating the issue of academic integrity, which shows the heightened concern of academics and industries about the quality of human capital produced by the education system.

The issue of online assessment is more critical if the university system is projected to implement hybrid learning in the future. Hybrid learning has become a highly fertile study area, and it has been examined from various perspectives (Olapiriyakul & Scher, 2006). Many research studies have shown that it is more successful than the conventional face-to-face approach, resulting in the fast development of hybrid courses at many universities. In the study by Twigg (2003), 19 out of 30 hybrid learning initiatives improved student learning, and this indicates the potential of hybrid learning to offer transformative experiences by combining innovative digital and online tools in the learning process. The inclusion of online learning in the traditional face-to-face approach allows educators to be creative in delivering course content in dealing with the new generation of students (Tseng et al., 2013). However, hybrid learning also needs to be given attention in relation to security issues, scalability of solutions, and humanisation of the delivery system to improve the outcomes (Li et al., 2021). For example, students concerned about the security of their examinations are more inclined to cheat during online assessments since they can do so simply; students who do not cheat may be demotivated owing to their results compared to others (Ali & Al Dmour, 2021). Hence, the issue of assessment needs to be given appropriate attention to ensure a strong structure of online components is in place to complement traditional face-to-face engagement.

Underpinning Theory

There are various learning theories in online learning, among all, the three most popular theories are Behaviourism, Cognitivism, and Social Constructivism. The behaviourist theory (Walker, 1984) focuses on how students behave while learning, which is observable from their actions, attitudes, and physical expressions. Next is the Cognitivism theory (Kirshner & Whitson, 1997), which is based on the concept of mind and considers cognitive elements as the most important element in learning that mainly focuses on what happens in the occurrence of environmental stimulus and student response. In other words, the cognitive processes of the mind, such as motivation and imagination, are among the important elements of learning. Finally, the social constructivism (Vygotsky, 1978) theory emphasizes collaborative learning. This theory is built upon the belief that every learner will experience cultural development twice; first at the social level, then followed by the individual level.

Among these three theories, the cognitivism perspective provides a way to describe the learning aspects of a particular approach to learning. In this study that focuses on online learning, the unique features of this method need to be assessed in terms of effectiveness to understand the structural elements of this approach. Hence, applying digital technologies and multimedia in learning involves three important cognitive processes: selecting, organizing and integrating. The cognitive process involves selection and organization of verbal and visual information to yield a text-based and image-based understanding of the events. This is followed by integration, where the learner builds connections between corresponding events in the verbal-based and the visual-based knowledge (Mayer, 2020).

Perceived Learning Outcomes

Perceived learning outcome encompasses the assessment of learning attainment at the conclusion of students' educational experiences (Yunusa & Umar, 2021). According to Alavi et al., (2002, p. 406), perceived learning is defined as "*changes in the learner's perceptions of skill and knowledge levels before and after the learning experience*". It denotes an individual's subjective judgment about the construction of knowledge and understanding (Rovai, 2002), or in other words individual's opinions and perspectives in relation to the acquired learning. As has been found by Fredericksen et al. (2000), students who believe they have understood the course materials exceptionally well are more inclined to be actively engaged in online classes. Scholars have argued that student learning outcomes serve as a vital reflection of the educational process effectiveness (Kurucay & Inan, 2017). Therefore, it is incumbent for teachers to evaluate how

students perceive their learning to enhance the quality of online courses in terms of course design, delivery, and evaluation. The understanding is fairly important because by improving students' online learning experiences, the performance outcome would signify the quality of the course (Alavi et al., 2002). Consequently, learning outcomes that are assessed through measures such as achievement grades (e.g., Eom et al., 2016; Rockinson-Szapkiw et al., 2016) and other academic performance indicators such as credits, or learners' self-reported perceptions of their learning achievements (Eom et al., 2016) can reflect the process and structure embedded in the learning system. In this study, perceived students' learning outcomes are assessed based on achievement grades, and academic performance indicators.

Online Assessment Practices

Online assessment is an assessment that is conducted using technology and online platforms that require internet access (Wibowo & Novitasari, 2021). According to Akimov and Malin (2020) online assessment can be an alternative medium to assess student's performance and can also be used to complement conventional assessments. However, its application requires a more continuous and systematic approach to conducting assessments compared to the traditional mechanism that can be used as the ultimate measure of students' performance. After all, online assessment is more cost-effective and environmentally friendly, as it does not require printing and paper handling (Khairil & Mokshein, 2018). With the advent of information technology, more tools are being developed and made available for the construction of online assessments, such as Google Forms, Edmodo, Kahoot (Wibowo & Novitasari, 2021) blackboard learn and lockdown browser (Ali & Al Dmour, 2021). Moreover, online assessment has its own merit in terms of score reliability and efficiency in terms of time, effort and costs (Shraim, 2019). Time independence (Carvalho et al., 2022) and place independence, measuring higher level skills, lower level of exam anxiety and more qualified assessment tools are also positive sides of online assessment (Şenel & Şenel, 2021). Supporting this, Torris et al. (2022) found that online collaborative learning develops student knowledge and skills (Torris et al., 2022). However, online assessment presents challenges to both teachers and students through the increased workload, plagiarism, and cheating (Meccawy et al., 2021), lack of physical interaction, technical malfunctions, and exam reliability and validity (Abduh, 2021). Therefore, the requirement for an effective assessment in an online setting is crucial in ensuring that the learning process is conducive for learning. Hence, the proposed hypothesis for this study is:

H1. There is a positive relationship between online assessment practices and perceived learning outcomes

Online Course Design

Effective course design plays a crucial role in shaping student's attitudes and success in a course (Baldwin, 2019). However, according to Steen (2008), designing online learning courses can be challenging due to the absence of a one-size-fits-all approach. The fundamental aspect of an online course lies in organising learning activities that help students to achieve specific learning outcomes (Carr-Chellman & Duchastel, 2000) by balancing learning goals, learner differences, and the learning environment (Clark & Mayer, 2008). Hence, designing activities or tasks for online courses requires a concoction of approaches (synchronous, asynchronous, online, offline) and clear communication, along with an appropriate level of difficulty, relevance to real-world contexts, and accessibility for all students (considering factors like stable internet connection, printing facilities, and resource access). Despite extensive discussions, there is no conclusive evidence that illustrates the connection between the specific design of a course and student-level outcomes, thus posing a challenge for IHL to choose effective online course design options (Benson, 2003; Jaggars & Xu, 2016). Therefore, in this study, the relative importance of four online course designs and instructional features suggested by Jaggars and Xu (2016) in influencing students' course learning outcomes i.e., (a) organisation and presentation, (b) learning objectives and assessments, (c) interpersonal interaction, and (d) use of technology are measured to gauge perceived learning effectiveness. Hence, the proposed hypothesis for this study is:

H2. There is a positive relationship between online course design and perceived learning outcomes

Online Learning Support

Peer support, institutional support, instructor-support

Online learning support is suggested in the literature as an important factor responsible for the association between online assessment practices and perceived learning outcomes (Lee et al., 2011). Perceived learning support refers to the understanding to a learner that supports from various aspects such as course design, interaction with teachers and peer students, and learner autonomy (Paechter et al., 2010) play critical roles in the process of learning. In the online learning setting, there are various types of support that can be categorised into three components: peer support, institutional support and instructor support (Wei et al., 2023).

Online peer to peer support is focused on the usage of the online platform to assist individual self and others. Prescott et al. (2020) suggested that peer support can be delivered in many ways; financially, emotionally, physically and socially. Institutional support is organisational based support that encompasses tangible and intangible aspects such as facilities, equipment, personnel, services and expenditures involved in creating and maintaining e-learning outcomes. The support can be extended beyond the classroom which includes a range of strategies and programs that facilitate the process of

learning and post-learning, such as life and career planning, financial assistance, learning outcomes evaluations, course delivery processes, student support systems, and partnerships with academic and industry (Council of Adult and Experiential Learning, 2000).

Instructor support is essential because instructors play a significant role in determining students' well-being through their positive influence on students' psychological state of development (Nielsen et al., 2017). Based on previous work on social support, the positive effects of instructor support on student's subjective well-being are based on two justifications. First, as a learned and respected person, instructors can be motivating and inspiring, thus enabling them to provide socio-emotional assistance through comfort, caring, encouragement, empathy, and/or sympathy (Sarason et al., 1994). Secondly, instructors are expected to equip students with course material and other learning resources to the recipient, including practical advice to deal with issues related to study. All these will inevitably develop resistance among the students to thrive in the challenges of being a student.

Online assessment practice is an assessment that is conducted using technology and online platforms that require internet access (Wibowo & Novitasari, 2021). According to Akimov and Malin (2020) online assessment is an innovative assessment and can be used complementary to the conventional assessment. Essentially, interactions between teachers and learners through different channels such as discussion forums, peer-review tasks, or group work will lead to the construction of knowledge. Social connections and communication provide a platform for learning to spur and grow. According to Hew (2016), learning aspects such as pedagogical, social, managerial, and technical, which contribute to the construction, processing, and enhancement of knowledge, as well as engaging participants in learning can also be provided via online (Hew, 2016). In other words, both conventional and online approaches can benefit from online platforms by engaging in mutual interactions through discussion forums, peer-review feedback, cooperation in group work, and exchanging individual information via online platform that will enhance learning performance (Abd Aziz et al., 2021; Huisman et al., 2018; Kurucay & Inan, 2017; Ramdan et al., 2021). As these studies concluded, both learner-learner and learner-instructor interactions have a positive impact on learning that is measured based on greater learning outcomes. Based on previous work, online learning support may serve as a moderator between online exam practice and perceived learning outcomes. The proposed hypothesis for this study is:

H3. Online learning support moderates the positive relationship between online exam practice and perceived learning outcomes, such that the relationship is stronger when the level of online learning is low

The research framework of this study encapsulates the objective to investigate the relationships between online assessment and perceived learning outcomes, online course design perceived learning outcomes, and the moderating effect of online learning support to the direct relationships as shown in Figure 1.

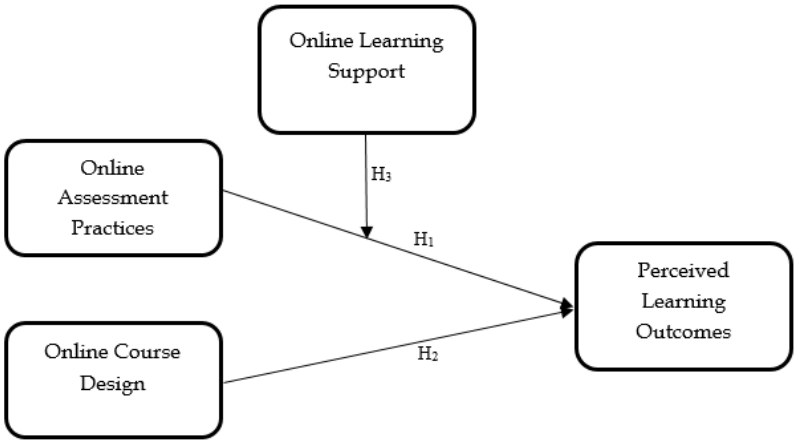

Figure 1. Conceptual Framework

Methodology

Sample and Procedures

The online questionnaire survey approach was utilised to collect data at the individual level from those who had participated in online learning when the country was affected by the COVID-19 epidemic. The respondents comprised students at Universiti Kebangsaan Malaysia (UKM), a Malaysian public university. The data was collected during a five-month period using a purposive sampling approach. Each respondent received a set of questionnaires that included an open letter outlining the objectives of the study, confidentiality, and consent to participate, as well as item questions about the factors being examined. Out of 237 responses received, only 232 respondents were found to be eligible for this study. Multivariate analysis involving regression is employed to test the significance of the relationships that allows the evaluation of direct and indirect relationships simultaneously. Preliminary data analysis found no outliers and the data

set fulfilled the multivariate assumptions of normality, linearity, and homoscedasticity. Therefore, the 232 cases are sufficient for performing multiple linear regression analytic approaches, including PROCESS Macro (Cohen, 1988).

In terms of demography, 81.9 percent of the respondents are female, with an average age between 21 and 22 years old (60.3 percent). According to the respondents' academic education level, the majority of the respondents (41.8 percent) graduated from the matriculation program as their entry point, and the majority of them are in their first year of university study (48.3 percent). Most students are from the Bachelor of Business Administration programme (49.1 percent).

Measurement and Common Method Bias

The instruments employed in this investigation were validated and frequently used in prior studies. Online assessment practice was measured based on 12 question items using a 5-point Likert scale from strongly disagree (1) to strongly agree (5) by Shraim (2019). Online course design and online learning support are measured by 8 question items, while perceived learning outcome is measured by 4 question items taken from Tsang et al. (2021). This section uses a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7).

For validity and reliability, content validity was confirmed by four experts to ensure that the measurement items were suitable for the study's setting. Face validity was achieved with the participation of six learners to determine the comprehensibility of the questions, the amount of time to answer the survey, and the usability of suitable jargon and language. The Cronbach's alpha on 50 samples is .70, and as proposed by Hair et al. (2010) the data achieved good reliability. In terms of common method bias using Harman's single factor testing, the single factor test explains for 30.2% of the variation, which is less than 50%, and this indicates that there is no bias in this study (Adam et al., 2022; Podsakoff et al., 2003; Ramdan et al., 2022; Samsudin et al., 2022).

Findings/Results

The results of multiple linear regression analysis show that the value of R^2 is .623. This indicates that 62.3 percent of the difference in perceived learning outcome (dependent variable) can be accounted for by the two independent variables of online assessment practice and online course design. As indicated in Table 1, the *F* value (188.843) achieved shows that the perceived learning outcome is significantly influenced by at least one of the two independent factors (online assessment practice and online course design) in the research model.

Table 1. Results of Multiple Linear Regression Analysis (Model Summary & ANOVA)

Model	*R*	R^2	Adjusted R^2	Std. Error of the Estimate
1	.789	.623	.619	.91908
	F			***p***
	188.843 ***			.000

Note: ***significant at α = .001

Following this, the results in Table 2 show that the two independent variables tested, namely online assessment practice and online course design, have a significant influence on perceived learning outcome (*p*-value <.001). With standardised beta values of β =.331 (p <.001) and β =.250 (p <.001), respectively, online assessment practice and online course design have a positive influence on perceived learning outcomes. As a result, the data demonstrates that both variables, i.e., online assessment practice and online course design have a significant impact on the perceived learning outcome of students in online learning settings. Therefore, H1 and H2 are supported.

Table 2. Results of Multiple Linear Regression Analysis (Coefficients)

Model	Independent variables	Standardised Beta	*t*	*p*
1	Online assessment practice	.331***	5.598	.000
	Online course design	.515***	8.719	.000

Note: Dependent variable: perceived learning outcome *** significant at α = .001

In moderation analysis, this study used the PROCESS Macro Model 1 approach to confirm the moderating influence of online learning support on the relationship between online assessment practice and perceived learning outcomes (Hayes, 2018). With 5000 bootstrapping samples at 95% confidence interval, online learning support has substantially and favourably modified the association between online assessment practice and perceived learning outcomes (.1318, p < .001). As presented in Table 3, the moderating hypothesis of H3 is supported.

Table 3. Result of Moderating Effect

Model	DV: Perceived Learning Outcome							
	Coefficient	**SE**	***t***	**LLCI**	**ULCI**	***F***	R^2	ΔR^2
Online Assessment Practice x Online Learning Support	.1318	.0665	19.811	.0007	.2628	138.8750***	.8039	.6463

* $p < .05$, *** $p < .001$

To further support the moderation findings, the slope test was also performed. The result shows that the indirect relationship between online assessment practice and perceived learning outcome through positive online learning support becomes stronger when the level of online learning support is high compared to when the level of online learning support is low (See Figure 2).

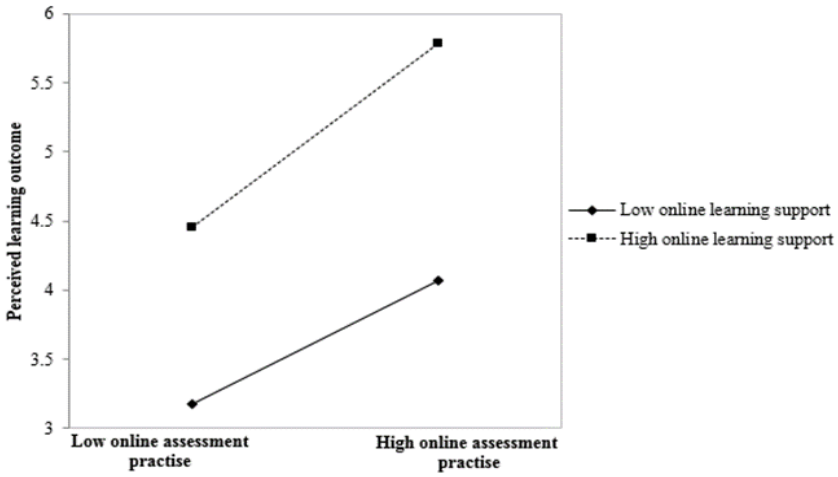

Figure 2. Moderating Effect of Online Learning Support on the Relationship Between Online Assessment Practice and Perceived Learning Outcome

Discussion

The purpose of this study is to examine online assessment practices and online course design in predicting perceived learning outcomes among students at Universiti Kebangsaan Malaysia (UKM), as well as the role of online learning support as a moderator. The findings show that both predictors have significant effects on perceived learning outcomes. The positive relationship suggests that online assessment practices and online course design will lead to effective learning, and this is measured based on perceived learning outcomes at the end of the learning process. However, the course design and assessment practices need to be supported with online learning support that encompasses peer support, institutional support, and instructor support. The findings show that the support needed for effective learning to happen requires the combination of all stakeholders in the process of learning: fellow students, the education provider as well as the teacher for effective learning to take place. The results correspond to previous findings in the context of Malaysia that show a lack of learner control and self-directed learning is the challenge faced by the online learning environment (e.g., Chee et al., 2022; Chung et al., 2020). The need for peer support is especially important when learners control, and self-directed learning is essential for online learning effectiveness. Thus, it is important to IHL to shift the focus on mainly infrastructure through investing in software and hardware, but also to invest in human capital, especially teachers and trainers, to ensure that the ecosystem of online learning supports effective learning. Peer support which is often neglected is also one component that needs to be established for effective learning to happen.

Previous findings have suggested that adaptation of the structure of teaching to the environment and target learners are important to achieve effective learning (Gillis & Krull, 2020). As well as in the case of online learning, complete adaptation of the education system must happen to achieve learning objectives. Obviously, students who are concerned about academic performance will independently work to enhance their competencies and abilities in response to new learning technologies, however the other influencing factors of online learning must also change in relation to the changing mode of learning. Hence, in line with the cognitive processes such as choosing, organising, and integrating information among teachers and students in an online setting, the integration of course design, assessment and support must also take place. This is crucial to guarantee that students achieve the learning objective in an online setting (Al Mamun et al., 2020). The findings of this study are also consistent with previous studies on online assessment practices which involve digital and multimedia technology applications that require a process of selection, organisation, and integration to achieve the best-perceived learning outcome (e.g., Şenel & Şenel, 2021; Shraim, 2019; Torris et al., 2022).

The fact that course design must also be developed incongruent with the mode of delivery is also presented in the findings. The changing attitudes and behaviors among learners need to be taken into consideration in the course design to ensure students can remain attentive to the learning process. A recent study suggested that prolonged viewing of video lectures or attending real-time video class meetings may lead to Internet cognitive fatigue that affect learning effectiveness. Moreover, distraction and reduced focus due to independent learning and recurring problems of Internet usage and network may affect student online learning performance (Shao et al., 2022).

The findings from this study also revealed that online learning support has a substantial positive function as a moderator. Interestingly, this confirms the role of peer support, institutional support, and instructor support in enhancing learning effectiveness in an online setting. This conclusion is consistent with previous research that suggests the importance of integrated support when new pedagogy is being applied in a learning process (e.g., Hew, 2016; Huisman et al., 2018). Based on social learning theory, Bandura (1971, as cited in Ferrer et al. 2022) suggests that an integrated online learning support will ensure students' engagement in the online learning process in the absence of physical interaction. Understanding students' requirements for adequate learning support is essential in today's changing times that require online learning. In reality, it is critical to discover online learning support that can assist students, particularly IHL students, in achieving successful learning. As a result, this study fills the void by suggesting the critical components that need to be enhanced for the efficacy of online learning.

Theoretically, this study adds to the learning and education literature by investigating the importance of online learning support among students for learning effectiveness. The findings from the research framework involving online assessment practices, online course design, and online learning support provide an understanding of the learning process in today's environment. Practically, this study aids education management, particularly IHL, in designing and implementing successful online learning policies. With the emerging trend of IHL to achieve inclusivity and long-life learning, hybrid and online modes are becoming a favorite platform for both learners and teachers. To maintain quality in the process of delivery and assessment of the learning, efficient implementation requires a strong ecosystem for the online environment. Thus, the study's findings have shown that online learning support is vital to ensure efficient delivery, learning, and assessment to obtain positive perceived learning outcomes among students during the online learning process. In other words, the application of online learning requires changing policies to streamline the processes involved in online setting. This may include embedding proctoring technology during examinations, IT readiness requirements for student entry, and IT-related pedagogy training for the teachers. Learning implementation should involve all stakeholders, such as academic and student affairs management, infrastructure caretakers, and academicians, to provide a conducive environment for online learning.

Conclusion

The COVID-19 epidemic has compelled changes to the learning approaches, and this study presented a deeper understanding of the learning process. Studies have shown that new teaching and learning methods have an impact on students, both positively and negatively. Since students and teachers are accustomed to the traditional techniques of instruction, sudden change can cause shock and resistance to adapt to a new or different structure. However, the results demonstrate that new approaches, such as online learning, can have positive outcomes with a comprehensive transformation of the learning structure that involves course design and assessment practice. Furthermore, the online learning support component has bolstered the use of online assessment practice and perceived learning outcomes to support students in improving their learning effectiveness.

Recommendations

The constraints of online learning must be addressed to ensure effective learning can be achieved as the educational landscape moves into technology-based pedagogy. Previously, online learning is seen as a mode of delivery, but the Covid 19 episode has transformed online learning into becoming the platform for curriculum development, delivery, and assessment. The extensive role of online ecosystem in education is still a fertile ground for future research to understand the interaction of various factors in learning effectiveness. Thus, future research can expand the sample size by incorporating different universities in different level of education and in different settings. Another aspect that limits the findings is the cross-sectional approach, and therefore, future studies can explore a longitudinal approach to gain a better understanding and a more accurate composition of factors to achieve learning effectiveness. The use of qualitative or mixed methodologies are applauded to give a deeper understanding of the challenges in online learning and teaching environment. Finally, future researchers can investigate other aspects that might improve perceived learning results, such as technological ability, technology attitude, and ambidexterity.

Limitations

Some study limitations have been noted in this investigation. Although this study used a purposive sampling strategy, the results have limited generalisation since this study exclusively focuses on the Malaysian population. Furthermore, this study employs a cross-sectional approach thus unable to offer a comprehensive picture of the cause-and-effect connection for the components investigated. Furthermore, this study uses quantitative surveys as a research method and focuses primarily on certain elements in predicting perceived learning outcomes.

Ethics Statements

The participants were given preliminary information about the study conducted on the front page of the survey questions and there was no compulsion to answer the questions given by the researcher.

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Conflict of Interest

The authors declare no conflict of interest

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Authorship Contribution Statement

Abdullah: Focused on writing-original draft preparation and data collection. Ramdan: Prepared conceptualization, resources and formal analysis. Ngah: Writing—review and editing. Yin: Methodology and data collection. Shokory: Conducted validation and data collection. Fuad: Managed project administration and data collection. Yonus: Supervision and data collection. All authors have read and agreed to the published version of the manuscript.

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