Amplifying Student E-Learning Impact on Academic Performance in Higher Education

Mona Fairuz Ramli[1,*], Ahmad Shabudin Ariffin[1], Aidil Syah Putra[2]

1   Faculty of Business & Science Management, Kolej University Islam Perlis,02000, Kuala Perlis, Perlis, Malaysia
2   Faculty of Teaching and Training, University of Muhammadiyah Tangerang, Banten, 15118, Indonesia

ABSTRACT

Current research investigates the impact of students' E-Learning Attitudes (ELA), Digital Readiness (DR), and Academic Engagement (AE) on their academic performance in higher education. An online questionnaire survey was conducted among students using the networks created by the research teams. These networks encompassed academic staff from diverse Malaysian private as well as public universities. These academic staff were directed to share the survey link with their undergraduate students through WhatsApp or email. Two hundred eighty-six (286) valid surveys were collected from students at six public and private university campuses in Malaysia that offer courses and have used E-learning for at least one semester as part of COVID-19. Contrary to previous debates and studies, the outcomes of employing structural equation modeling through PLS 4.0 revealed a positive as well as substantial effect with regard to E-learning platforms on students' academic performance. These findings hold broader implications for policymakers in higher education, researchers as well as educators, particularly in terms of considering the potential incorporation of social media tools within higher education, especially in developing nations. This research suggests that educational institutions embrace change by aligning the goals of both students and instructors to establish a constructive and encouraging online learning atmosphere. This will foster active academic participation and enhance students' academic achievements.

Keywords:

Digital readiness; E-learning attitude; student academic engagement; student academic performance; higher education

1. Introduction

In recent years, higher education establishments have consistently displayed a keen interest in improving students' academic achievements by incorporating innovative technologies that provide novel approaches to imparting and generating university-level education taken from previous studies [1-3]. Technological advancements within higher education can serve as a valuable tool in enhancing students' involvement in campus life, fostering interactions between faculty members and students' study by [4, 5]. In the Industrial Revolution 4.0 era, students primarily used the internet for communication and academic activities, showcasing their digital literacy skills. This ability is termed "self-directed learning readiness," where students independently initiate, execute,

and assess their learning processes without external assistance study by [6]. Malaysia experienced a rise in the number of individuals who have completed their education in 2021 by 4.7%, totaling 5.61 million students as opposed to 5.36 million in 2020. Concurrently, a notable increase of 5% in the proportion of graduates who have successfully obtained employment resulted in a cumulative total of 4.57 million individuals taken from the previous data [7]. The aforementioned statement serves as a strong indication of the effectiveness with regard to Higher Education Institutions (HEIs) in producing a significant cohort of graduates who have effectively secured work throughout the year 2021. Nevertheless, a disturbing issue emerges from the increased unemployment rate among individuals who have completed their education, which presently stands at 4.1%. Notwithstanding the capacity of tertiary education establishments to produce a substantial quantity of individuals who have completed their studies, the issue of effectively addressing the career prospects of these graduates continues to be a topic of utmost importance. Moreover, to tackle inefficiencies in the labor market, the government aims to reach an employability rate of 86.7% for higher education graduates by 2025 [7].

At the commencement of their academic journeys, university students, often considered digital natives, are introduced to E-learning platforms on campus to enhance their academic performance. Nonetheless, past studies on students' viewpoints on E-learning have yielded inconsistent findings regarding its ability to predict academic achievement. Earlier research into students' proficiency in E-learning has highlighted an inadequacy in their preparedness for achieving academic milestones in Digital Readiness (DR) studies by previous scholars [8, 9].

Conversely, several studies have indicated that there might not be a relationship or even a negative association between E-learning readiness as well as factors such as E-learning courses as well as Grade Point Average (GPA) [2, 10]. Similarly, the use of technology and student GPA also exhibited no clear positive link, as can be observed from the results of [11, 12], especially among students who engage with campus E-learning environments to varying extents. The variability in results could be ascribed to the varying degrees of students' digital competencies, engagement, and additional attributes such as attitudes, motivations, confidence, and perspectives regarding the utilization of university E-learning tools for academic purposes has been acknowledged by Ammade and Rahman [13].

According to previous research [14], the factors that influence academic achievement in E-learning at the university level have been investigated. Furthermore, the authors discovered that Academic Engagement (AE) and DR influenced student adoption of E-learning and their attitudes, impacting their academic achievements. Another study by Werfhors *et al.,* [10] stressed the effect of digital divinity in online education and emphasized the importance with regard to students' Information and Communication Technology ICT skills in creating a conducive learning environment. However, this finding was impacted by the unforeseen shift from traditional classrooms to online learning due to the pandemic. It is evident that this shift presented significant challenges for institutions, educators, and students alike.

Research indicates that active engagement contributes to enhanced academic output by increasing student learning as well as happiness, as highlighted by [15]. Internal elements, such as effort, attitude, personality, drive, and self-confidence, affect students' participation, as supported by the study [14]. It also happens that online learning cultivates expertise in pedagogical subjects and uses digital tools and communication technologies from previous studies [15]. This encourages technology integration within traditional classroom settings. This form of education can effectively complement other instructional methods and streamline pedagogical decision-making, as highlighted by [16, 17].

The adoption of online education could potentially widen the gap in digital skills among students and exacerbate the generation gap between older and younger people, with the former favoring conventional teaching methods and the latter being more proficient with technology. Consequently, the present research sought to examine how DR, student AE, and attitudes toward E-learning are interrelated and how they collectively influence students' academic achievements in the realm of higher education.

1.1 Research Background and Hypotheses

Referring to the extended empirical literature, this study emphasizes three initial factors: DR, E-learning Attitude (ELA), and AE. These factors will be explained by learning theory as a research framework for Student Academic Performance (SAP). In this research, [14] E-learning theory, rooted in cognitive science, is employed to investigate the integration of technology in online education. The theory highlights the importance of developing educational technology that minimizes unnecessary cognitive load and effectively handles inherent limitations. It addresses the role of connectives in technology and the potential for effective learning. Online learning has emerged as a popular trend in education, allowing teachers and students to adjust to evolving learning methods.

1.1.1 Digital readiness and student academic performance

DR among university students can be characterized as possessing the necessary technological knowledge, skills, attitudes, and proficiencies to effectively utilize digital technologies in order to fulfill educational goals and meet the expectations associated with higher education [15, 16] pointed out that the DR among higher education students, together with its impact on socio-emotional experiences, underscores the necessity for providing support to students to help them navigate the challenges posed by E-learning. In this study, DR for university students included purposeful utilization with regard to digital skills for academic tasks. It also involved cultivating competence in digital media through active engagement, critical assessment of digital culture, as well as skilful application of information literacy strategies in academic pursuits. This concept is a noteworthy link between students' E-learning encounters and academic accomplishments. As a result, we formulated the subsequent hypothesis:

H1: Digital Readiness (DR) significantly affects Student Academic Performance (SAP).

1.1.2 E-learning attitude and student academic performance

ELA may be defined in this research as the degree to which student perceive their behaviour as favourable or unfavourable in E-learning proposed by [17]. Previous findings suggest that students generally possess positive attitudes toward E-learning [18] and discovered a positive relationship that exists between students' attitudes towards E-learning as well as students' DR for academic achievement.

In light of the increased utilization with regard to E-learning technologies due to the pandemic, another key aspect emphasized in the existing literature is the significance of learners' favorable or unfavourable perceptions and attitudes toward E-learning. These perspectives are crucial in influencing the achievement of desired learning outcomes, as shown by previous studies [19-21].

Sánchez and Karaksha [12], advocate that harbouring positive attitudes concerning E-learning greatly enhances the likelihood of learners embracing this novel educational approach [22, 23]. Consequently, users' attitudes can lean towards positivity if the traditional education system aligns well with the requirements and characteristics of the undergraduates, or they may veer towards negativity if students struggle to adapt to a computerized learning system [24]. Consequently, put forward the following hypothesis:

H2: E-Learning Attitude (ELA) significantly affects Student Academic Performance (SAP).

1.1.3 Digital readiness and academic engagement

DR among university students signifies their grasp of technology-related knowledge, attitudes, skills as well as competencies required to effectively utilize digital technologies to fulfill educational objectives and meet the standards of higher education distinct study [16, 25]. Althubaiti *et al.,* [2] suggest that heightened internet usage among students is linked to improved DR for AE. Technological advancements in higher education can enhance students' active participation within the campus environment, facilitating engagement with educators and fellow students [26]. DR for college students involves literacy skills, active participation in digital culture, and information literacy strategies for academic work, enhancing their E-learning experience as well as academic achievement [10, 11]. Handel *et al.,* [16] suggest that students who are not prepared with regard to digital learning could be deficient in the necessary skills and tools for engaging in remote digital courses. Moreover, they may experience increased stress and loneliness, leading to disengagement from online classes. The study, therefore, hypotheses that:

H3: Digital Readiness (DR) significantly affects student Academic Engagement (AE).

1.1.4 E-learning attitude and academic engagement

Students' ELA can be assessed through surveys or questionnaires designed to measure their perceptions, beliefs, and attitudes toward E-learning. This may include questions about their comfort level with technology, perceived usefulness of E-learning, and overall attitudes toward online learning experiences. On the contrary, student AE may be assessed through various indicators, such as active participation in discussions and activities, class attendance, completion of assignments, and overall academic performance.

In a related study, the substantial impact of motivation, favorable outlook, and active engagement in academic tasks on achievement in mathematics and science are notably significant studies by [13, 25]. Suppose the examination reveals a noteworthy positive association between ELA and student AE. This implies that students with more positive attitudes regarding E-learning are more inclined to engage actively in their educational endeavors. Moreover, the regression analysis indicates that ELA significantly predicts student AE. In that case, it indicates that ELA substantially impacts students' level of AE, even when considering other potential factors that may influence engagement. These findings would offer important insights for educators and institutions in creating and executing effective E-learning programs. If ELA is shown to significantly influence student AE, initiatives can be undertaken to encourage positive attitudes regarding E-learning among students. This could result in enhanced engagement and improved academic outcomes in the E-learning setting. Furthermore, possessing DR for AE, characterized by "technology-related skills, knowledge, attitudes as well as proficiencies for effectively utilizing digital technologies to

fulfill educational objectives and meet higher education expectations," is essential for enhancing university students' learning outcomes and experiences. Subsequently, the study posits the hypothesis that:

H4: E-Learning Attitude (ELA) significantly affects student Academic Engagement (AE).

1.1.5 Academic engagement and student academic performance

Student engagement can be described as the degree to which students engage actively in educational tasks that directly contribute to achieving desired learning objectives [27]. Conversely, low levels of AE may have a negative impact on SAP. When students are disengaged or lack motivation, they may struggle to stay focused, miss out on important learning opportunities, and may not perform at their full potential. AE is critical to foster self-regulated learning, where students take charge of their learning journey, establish goals, as well as track their progress. When students are engaged and committed to their education, they are more inclined to proactively seek assistance, when necessary, apply effective study strategies, and persevere in the face of challenges, which further enhance their academic performance. In this study, engagement during online learning pertains to students utilizing digital platforms to fulfill their online course requirements, support their offline coursework, and establish virtual interactions such as participating in online discussions or seeking guidance [28].

The connection between AE and student academic achievement holds considerable importance and has been extensively established in educational studies. Multiple research endeavors have consistently demonstrated a favorable association between strong AE and enhanced academic performance. As stated by [15, 29], a statistically noteworthy positive correlation exists between academic performance and students' engagement in learning. The phrase "students' academic engagement" refers to a commitment to or active involvement with regard to the academic learning process throughout a student's entire educational journey [30, 31]. Therefore, the following hypotheses are generated:

H5: Students' Academic Engagement (AE) significantly affects Student Academic Performance (SAP).

1.1.6 Academic engagement mediates the relationship between DR, ELA, and SAP

AE serves as a mediating factor in the relationship between students' academic performance and DR. DR refers to students' preparedness and proficiency in using digital technologies for educational purposes. When students are digitally ready, they possess the necessary skills to effectively utilize digital tools and resources, positively influencing their AE. Engaged students are motivated to actively participate in digital learning environments and use various online resources and interactive platforms [32, 33]. Apart from that, AE also plays a part in narrowing the gap between DR and academic performance [26]. Engaged digitally ready students tend to approach their studies with enthusiasm and dedication, investing more effort and perseverance in their academic pursuits. This positive attitude can improve academic performance and outcomes, as a previous study by [25]. Additionally, AE facilitates self-regulated learning among digitally ready students. Engaged students take ownership of their learning process, set goals, as well as monitor their progress, effectively utilizing digital tools for organization and time management.

In conclusion, AE and DR are interconnected, with one reciprocally influencing the other. Students who possess both DR and AE are better equipped to leverage the benefits of digital technologies, leading to enhanced learning experiences and improved academic performance. By

promoting DR and AE, educators can establish an effective learning environment that equips students for success in the digital age [34]. Hence, academic students' engagement serves as an essential mediating effect on academic performance between ELA and DR. Hypotheses 6 and 7 are stated as follows:

H6: Students Academic Engagement (AE) mediates the relationship between Digital Readiness (DR) and Student Academic Performance (SAP).

H7: Student Academic Engagement (AE) mediates the relationship between E-learning attitudes and Student Academic Performance (SAP).

2. Methodology
2.1 Data Collection and Sample

The study employed a cross-sectional approach and utilized anonymous, voluntary, and self-administered surveys. The participants included consented undergraduate students ranging from Year 1 to Year 4 and interns from public and private universities across various states. Specifically, online questionnaires were employed to obtain information from full-time students enrolled in various HEIs across the country. Due to the challenges presented by the COVID-19 crisis, an online survey was deemed the most appropriate method with regard to data collection. The survey link was disseminated via social media platforms such as Facebook as well as WhatsApp, prompting students to engage in the research and help achieve the required responses sample. Additionally, the data were obtained using convenience sampling, a technique chosen for its advantages such as cost-effectiveness, swift data collection, and its established usage in previous similar studies.

Several preceding research have also employed convenience sampling to collect data pertaining to these variables [15, 29]. In total, 315 questionnaires were acquired from the participants, of which 286 were deemed valid and utilized for the subsequent data analysis. Furthermore, the data collection process adhered to ethical guidelines and standards. Before starting data collection, explicit informed consent was collected from individuals who voluntarily participated in the research. Correspondingly, participants were assured of the confidentiality concerning their responses and were informed that the data collected would be used solely for academic research purposes.

Among the 286 participants engaged in the online survey, the findings indicated that 36.4% were men while 63.6% were women. With regards to age distribution, 72.7% of respondents are within the age range of 20 to 24 years, 18.2% were between 25 and 28 years, and 9.0% were 29 years or older. Moreover, approximately 92.3% of the participants were enrolled in undergraduate programs, while 17.7% were pursuing postgraduate programs.

2.2 Measure

Regarding the measurement scales used to assess constructs, this study utilized existing research to create the questionnaire. In particular, the ELA scale was constructed with four items adapted from prior sources [35]. Moreover, seventeen items were utilized to assess DR in relation to the study [36]. Additionally, an eleven scale was employed for assessing engagement based on the study [37]. Finally, eleven items were adapted [38] to measure academic performance. The survey assessed all the adapted items using a seven-point Likert scale, ranging from strongly disagree (1) to strongly agree (7). To confirm the reliability of the chosen measurement scales, Cronbach's alpha was computed for each scale based on a preliminary sample of 30 participants.

Once the internal consistency of items within each construct was verified, the main data collection phase was initiated. Additionally, content validity was confirmed by presenting the questionnaire to three academic experts from selected HEIs in Malaysia. Minor adjustments were made based on their recommendations.

2.3 Data Analysis

In this study, the chosen methodology was Partial Least Squares-Structural Equation Modeling (PLS-SEM), which was employed to evaluate the connections between variables. This encompassed relationships among latent variables as well as with observable indicators. The selection of Smart PLS was particularly recommended due to its suitability for intricate models when the sample size is limited. The regression outcomes were generated through 10,000 bootstrap samples, and hypotheses were evaluated at a significance level of 5%. The PLS-SEM approach comprises two main stages: first, an exploration of the measurement model, followed by an analysis of the structural model by scholars such as [39, 40]. The structural model analysis is carried out when the specifications of the measurement model ensure that the constructs display acceptable indicator loadings, convergent validity, Composite Reliability (CR) as well as discriminant validity. Path coefficients and their relevance are evaluated as part of the structural model evaluation. These evaluations are listed below.

2.3.1 Analysis result

As the data collection process depended on a single source, we implemented measures to evaluate the potential presence of Common Method Bias, as suggested by [41, 42]. This involved conducting a test for full collinearity, wherein each variable was individually regressed against a shared variable. A common variable value of ≤ 3.3 signified that our data did not display significant bias originating from a single source. Our analysis showed that the VIF values were below 3.3, suggesting that the issue with regard to single-source bias was an insignificant concern in our dataset, as indicated in Table 1.

Table 1
Full collinearity testing

AE	DR	ELA	SAP
1.48	3.08	2.78	2.53

[1]Note: AE = Academic Engagement, DR = Digital Readiness, ELA = E-Learning Attitude, SAP = Student Academic Performance

2.4 Measurement Model

This study was utilised utilising a 2-step approach to examine the model established suggested by [43]. First, the measurement model was assessed to ensure the validity as well as reliability with regard to the employed instruments in accordance with the principles outlined by [44, 45]. Following this, the structural model was executed to evaluate the formulated hypotheses.

In assessing the measurement model, we analyzed the loadings, Average Variance Extracted (AVE), as well as CR. Here, the loadings were considered satisfactory when they were ≥ 0.5, while the AVE values and CR values should both be ≥ 0.5 and ≥ 0.7, correspondingly. As indicated in Table 2, all AVE values exceeded 0.5, and all CR values surpassed 0.7. Hence, the loadings were also deemed acceptable, with just a couple of instances having loadings slightly below 0.708 [44]. We

have two second-order constructs, specifically DR and AE. Validity and reliability assessments were also conducted for the second-order construct of student AE, as presented in Table 3. The findings demonstrate that the second-order measurements are confirmed to be reliable and valid.

Table 2
Measurement model concerning the first order constructs

First order construct	Loading	AVE	CR
Digital tool application	0.707-0.861	0.653	0.882
Digital application usage	0.833-0.938	0.804	0.925
Digital Awareness	0.902-0.925	0.84	0.941
Information seeking skill	0.920-0.946	0.872	0.953
Information seeking behavior	0.896-0.942	0.858	0.960
Interaction engagement	0.759-0.864	0.676	0.912
Applied Engagement	0.854-0.945	0.820	0.958
Global oriented engagement	0.812-0.889	0.742	0.945
Self-Discipline engagement	0.788-0.890	0.699	0.942
E-learning attitude	0.894-0.926	0.852	0.958
Student Academic performance	0.778-0.919	0.781	0.973

Table 3
Measurement model regarding the second order constructs

Second order constructs	Indicator	Loadings	AVE	CR
Digital readiness	ISB	0.917	0.761	0.941
	ISS	0.859		
	DMA	0.785		
	DAU	0.901		
	DTA	0.893		
Student academic engagement	SDE	0.921	0.855	0.959
	IE	0.894		
	SAE	0.936		
	GOE	0.946		

In step 2, we assessed the discriminant validity using the Heterotrait-Monotrait (HTMT) ratio correlation criterion proposed by [46], which was then updated by [47]. Here, the values of HTMT must adhere to a stricter criterion of ≤ 0.85 or a more lenient criterion of ≤ 0.90. As shown in Table 4, all HTMT values were under 0.85. Therefore, we can infer that the participants acknowledged the nine constructs' distinctiveness. In conjunction, the results of both these validity assessments affirm the reliability as well as validity with regard to the measurement items.

Table 4
Discriminant validity (HTMT)

No.	Construct	1	2	3	4
1.	Digital readiness				
2.	Student Academic engagement	0.546			
3.	E-learning attitude	0.787	0.477		
4.	Student Academic engagement	0.852	0.568	0.826	

2.4.1 Structural model

In line with the recommendations from [44, 48], this study utilized assessments of multivariate skewness and kurtosis. The results demonstrated that the data collected did not conform to

multivariate normality, as indicated by Mardia's multivariate skewness (β = 60.0, p < 0.01) and Mardia's multivariate kurtosis (β = 298.56, p < 0.01). Therefore, in line with the recommendations by [49], the path coefficients, along with standard errors, p-values as well as t-values, were reported for the structural model. This was achieved through a resampling bootstrapping procedure using 10,000 samples, as detailed by Cheah *et al.,* [45]. Additionally, in light of the concerns raised by [50] concerning the limitations with regard to p-values as the sole measure for hypothesis testing, a combination of criteria, which includes p-values, effect sizes as well as confidence intervals, was employed. The criteria utilised to evaluate the established hypotheses are summarized in Table 5, while the structural model, is shown in Figure 1.

Table 5
Hypothesis testing direct effects

Hypothesis	Relationship	Std beta	Std error	t-value	P value	BCILL	BCIUL	Decision
H1	DR -> SAP	0.3	0.049	6.112	0	0.222	0.384	Supported
H2	ELA -> SAP	0.612	0.045	13.604	0	0.536	0.684	Supported
H3	DR -> EA	0.405	0.077	5.237	0	0.27	0.526	Supported
H4	ELA -> EA	0.153	0.08	1.908	0.028	0.021	0.286	Supported
H5	EA -> SAP	0.113	0.033	3.47	0	0.06	0.168	Supported

[1]Note: R^2 values of 0.75 are deemed significant, 0.5 as moderate, as well as 0.25 as weak, of which higher values demonstrate higher levels of predictive accuracy.
[2]Note: 95% CI with a bootstrapping of 10,000.
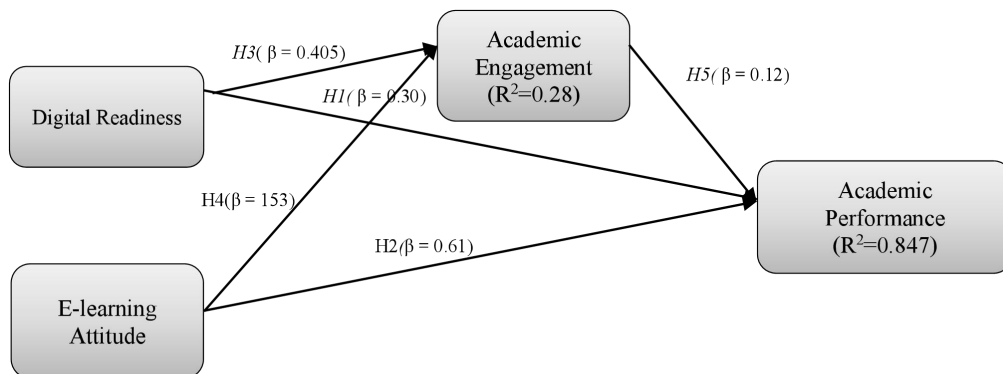
Fig. 1. Structural Model

Initially, the two predictors were analyzed in relation to EA. The R^2 value was 0.28, indicating that these predictors accounted for 28% of the variance in EA. Both DR (β = 0.405, p < 0.01) and ELA (β = 0.153, p < 0.01) showed positive relationships with EA. Therefore, H3 and H4 were supported. Next, we examined the effect with regard to EA, DR, and ELA on SAP, with an R2 of 0.847, which indicates that EA, ELA, and DR explain 84.7% of the variance in SAP. These were supported for H1, H2, and H5.

Subsequently, the mediation hypotheses were evaluated using the approach outlined by [51]. The indirect effect was assessed through bootstrapping. A significant mediation is inferred if the confidence interval does not encompass 0, indicating a meaningful relationship. As presented in Table 6, Digital Readiness, Academic Engagement and Student Academic Performance (β = 0.046, p< 0.05) was significant. These supports (H6), E-Learning Attitude, Academic Engagement and Student Academic Performance (β = 0.1017, p< 0.05). Note that the bias-corrected 95% confidence intervals also did not encompass the value of 0, affirming our results. Consequently, hypothesis H7 was also not supported.

Table 6
Hypothesis testing indirect effects

Hypothesis	Relationship	Std beta	Std error	t-value	P value	BCILL	BCIUL	Decision
H6	DR -> EA -> SAP	0.046	0.015	3.098	0.001	0.025	0.075	Supported
H7	ELA -> EA -> SAP	0.017	0.012	1.446	0.074	0.003	0.043	Not supported

[1]Note: 95% CI with a bootstrapping of 10,000

3. Results

This study investigated how DR, SAP, ELA, and AE are connected among undergraduate students in higher education. The study sought to reveal the factors affecting students' academic experiences, particularly during their shift to an E-learning environment. It achieved this by investigating how DR, ELA, as well as academic performance interacted, with ELA and DR serving as mediators for academic performance. The outcomes suggest that E-learning platforms significantly contribute to students' academic achievements in higher education. This observation aligns with past studies that have emphasized a positive association between ELA and academic performance, as noted by [52, 53]. However, it is crucial to acknowledge that these outcomes could potentially be influenced by factors like students' DR and AE. Subsequent research could delve into the precise mechanisms through which E-learning platforms impact academic accomplishments and could also identify approaches to bolster students' DR and AE within E-learning environments. A previous study performed by [26] reveals that higher AE levels are associated with stronger academic performance and rising graduation rates. The research discussion examines the results and understands the hypothesis explaining the relationship between the constructs.

In order to achieve this goal, the Smart PLS estimator was performed to analyse the data. Here, the study's first hypothesis is the relationship between SAP and DR. The findings were portrayed to be positive and significant. Therefore, the results support (H1) positively. Therefore, this study is aligned with a previous study [27]. The study conducted by [54] affirms that the learner has a digital skill benefit and that it will enhance academic achievement. Next, H2 is also supported because it demonstrates a positive relationship between ELA and SAP. The current study's results agree with those of [12, 53, 55]. These scholars documented that an escalation in positive attitudes toward E-learning corresponded with an augmentation in academic motivation. Thus, [56] pointed out that improvements in internet connection quality as well as having access to a computer were linked to more positive attitudes among medical and nursing students towards E-learning. Note that these results underscore the importance of establishing a framework that ensures equitable opportunities, sufficient technological resources, and readiness for both students as well as educators to utilize E-learning effectively and attain desired levels of success.

H3 is also positively supported, as a significant relationship exists between DR and AE. Continued with the next hypothesis about the relationship between AE and ELA, this relationship is positive and significant. The findings indicated that learners exhibited a consistent and favorable stance toward E-learning due to their awareness of its advantages and potential to enhance their learning experiences and yield positive improvements in their academic outcomes [15, 57]. Past experience as well as accumulated knowledge, further reinforced their inclination to view E-learning activities positively and favorably for their learning purposes. Past studies [34, 58] additionally mentioned that students who possess a positive attitude and regard online education as a favorable conduit are more inclined to persevere in their studies and attain enduring success. Therefore, the present study's findings also support H4. Similarly, the findings indicate a substantial correlation between AE and SAP, affirming the validity of H5. Subsequently, the following hypothesis postulates that students' AE acts as a mediator in the association between DR and SAP.

Hence, the hypothesis is substantiated by the outcomes with regard to the present study. The concluding hypothesis confirms that Academic Student Involvement plays a substantial mediating role in the relationship that exists between ELA and SAP.

In summary, this study offers insights into how educational institutions can effectively engage students within an online learning environment. There may be several elements underlying student participation, but based on the current situation, only a few significant aspects should be considered. The current study investigated five critical aspects affecting student involvement in E-learning. The outcomes will provide valuable guidance for educational institutions in shaping their curricula. Specifically, in the scope of this study, the key determinants of E-learning that significantly impact academic performance among distance learning students in Malaysia encompass ELA, DR, and AE. Notably, AE was identified as a mediating factor in the relationship between the drivers of AE and the learning achievements of distance learning students in Malaysia.

3.1 Implication of the Study

The current research examines university students' viewpoints on E-learning amidst the ongoing COVID-19 pandemic. The study reveals students' inclinations toward E-learning, showcasing their appreciation for the autonomy it offers in terms of interacting with instructors and peers. Moreover, it allows them to engage with study materials at their own convenience and within their preferred timeframe. The accessibility of study resources emerges as a significant driving factor for students' E-learning choices. Furthermore, the study highlights how the accessibility facilitated by E-learning technology contributes to the development of a favorable attitude among students toward this mode of learning.

This outcome is based on DR, ELA, students' AE, and E-learning academic performance. The research confirms the DR of E-learning, such as students being able to upload and download study media from any geographical location, which is impossible in the case of conventional face-to-face learning. Moreover, the research demonstrates a parallel educational experience to traditional in-person classroom instruction, as students perceive E-learning to be comparable to learning in a physical classroom setting. Nonetheless, unlike past research performed by [22], this study demonstrates a significant surge in the popularity of E-learning in Saudi Arabia, with students showing a strong inclination towards online learning tools for communication with peers and educators. Additionally, given the lack of in-person interactions, students have readily embraced digital technology for their learning needs. Consequently, it is essential to implement measures aimed at enhancing the quality with respect to E-learning, especially during the COVID-19 pandemic, to facilitate more effective learning outcomes for students.

Students' AE completely mediates the link between DR and ELA, leading to positive student achievement and academic success. In terms of E-learning theory, this study explains that student knowledge of and competencies in digital skills and a positive attitude towards technology's difficulty will improve student academic achievement. According to some experts, failure to enhance pupils' digital skills typically indicates a failure to learn [19]. As evident from the preceding discourse, the application of E-learning theory principles alongside its design concepts has the ability to improve the efficacy of learning. Therefore, E-learning theory holds value for educators in crafting impactful courses and researchers seeking insights into the mechanisms of successful learning facilitated by technology.

Therefore, this study also shows that student readiness and positive attitudes toward digital learning benefit an HEI in bringing innovative teaching and learning methods. Thus, this investigation's outcome contributes to a deeper understanding with respect to factors that

contribute to student E-learning academic performance. These findings have proven that higher education in developing countries can also perform quality teaching and learning using technology.

4. Conclusions

As evident from the aforementioned discussion, applying theoretical E-learning principles, coupled with its design strategies, has the potential to foster effective learning. Thus, the theoretical underpinnings of E-learning can serve as a valuable tool for educators to create impactful courses and for researchers to comprehend the dynamics of successful learning through technology. E-learning revolves around creating educational technology that optimizes learning by reducing unnecessary cognitive strain while efficiently managing essential cognitive demands at levels suited for students. The task of designing appropriately challenging assignments can be daunting for educators, but E-learning aids in comprehending how cognitive load can be categorized and harmonized with design principles to enhance effective learning through technology. E-learning stands as a learning approach that benefits both students and educators [3, 59]. Research outcomes underscore the necessity for various enhancements and actions to fully harness the advantages of E-learning. Despite E-learning being increasingly implemented, further research is warranted, particularly concerning its application in specific subject domains. A robust body of positive evidence is essential to demonstrate the merits of E-learning and justify the allocation of resources toward its implementation within university settings.

In conclusion, this study provides evidence that E-learning platforms possess a beneficial effect on students' academic achievement in higher education. The findings emphasize the significance of addressing students' DR and AE to enhance academic success in E-learning settings. These results are important for educators, higher education policymakers, and academics, indicating that institutions should develop positive and supportive E-learning environments that align with the goals of both students and instructors. Institutions can stimulate AE and increase students' academic accomplishment by doing so.

Acknowledgement

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