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Maneuvering through E-Learning Platform: An Evaluation of Open Distance and E-learning in Higher Education Institutions in Uganda

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Abstract

To foster the continuity of learning for Higher Education Institutions (HEIs) during the COVID-19 pandemic, the Uganda National Council of Higher Education approved Emergency Open Distance and eLearning (ODeL). Clarke International University (CIU) was among the first HEIs to receive approval. This survey aimed to evaluate the ease of maneuvering on the e-learning platform at the CIU. A cross-sectional study was conducted to survey 485 students between December 2020 and January 2021. Of the 485 participants, 79.8% (387) maneuvered quickly through the e-learning platform. The odds of maneuvering through the E-learning platform increased with Information Communication Technology (ICT) and E-Learning support (aOR,3.2:95%CI, 1.3-7.2), ability to self-enroll to the platform (aOR5.4:95%CI, 3.1-9.4), ODeL training and orientation (aOR,2.7: 95%CI, 1.5-4.8) and ownership of a computer/ smartphone (aOR 7.4: 95% CI, 2.2-25.2). Successful maneuvering can be bolstered through access to e-learning tools, such as computers and smartphones, ICT support, and adequate ODeL training and orientation for students to the e-learning platform.

Keywords: Maneuvering, E-learning platform, Higher education institution, ODeL, Uganda

Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has caused an unprecedented disruption in health professional education and healthcare systems worldwide (Alsoufi et al., 2020). However, instructors must deliver lectures safely while ensuring the integrity and continuity of the medical education process. In recent years, higher education institutions (HEIs) have come to terms with the fact that education, as traditionally delivered, cannot be sustained in the era of post COVID-19 pandemic.

In sub-Saharan Africa, as in other countries, there should be support and enthusiasm for providing valid solutions to reduce this disruption, such as online training and virtual clinical experiences (Alsoufi et al., 2020). In Libya, the most commonly proposed methods include scheduled live online video lectures with interactive discussions, and the utilization of several different programs or self-study, online recorded lectures made available online for medical students at each university. More than 60% of the students had ease of access and navigation on the platform.

In Uganda, the National IT Survey 2017/2018 found that 65.3 % of the households owned a radio, 21.8% owned a television set, 5.9% had access to a computer at home, 10.8% of households owned a household telephone, and 10.8% of all households had at least one member who had internet access. Overall, 70.9% of all individuals owned a mobile phone (Twesigye, 2020). One of the pivotal roles of the Quality Assurance Office (QAO) at the Clarke International University (CIU) is to ensure continuous enhancement of and adherence to quality standards by monitoring and evaluating all activities related to teaching and learning. In line with the Uganda National Council of Higher Education (NCHE), CIU like many other HEIs, has embraced approved emergency Open Distance and eLearning (ODeL) strategies for teaching, learning, assessment, and research supervision for all its continuing students.

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This study adopted a Technology Acceptance Model (TAM: Davis,1989), an information systems theory, to understand whether students who have been introduced to new technology can accept and use it considering constructs of perceived ease of use, perceived usefulness in the form of learners, and information technology aspects.

Problem Statement

The COVID-19 pandemic exacerbated the learning crisis, resulting in more than 60 percent of the world's learners, around 1.5 billion students, being unable to attend school in over ten countries. COVID-19 created a shift from learning face-to-face in the classroom to adopting distance learning and virtual teaching methods. Currently, most institutions in Uganda have embraced blended learning in the post-COVID-19 era. According to Hammouri (2018), there is perceived ease of use, system quality, information quality, and computer self-efficacy in using e-learning platforms. Ugandan universities implemented measures to enhance access to home study kits, such as smartphones, tablets, and desktop computers. They also ensured sufficient internet access and provided training on online teaching and learning for both students and academic staff. (Kaliisa & Picard, 2017).

Nevertheless, challenges persist, encompassing students' limited familiarity and proficiency in navigating e-learning platforms, insufficient access to ICT tools, high internet expenses, and connectivity issues. These factors continue to impact students' satisfaction with utilizing e-learning methods. This study evaluated the factors associated with maneuvering through an e-learning platform at the Clarke International University (CIU).

Research Objective

The overall objective of this study is to evaluate the factors associated with maneuvering through an e-learning platform among students at Higher Education Institutions in Uganda. The specific objectives are to (1) establish the student-based factors associated with maneuvering on e-learning platforms among students in higher education institutions. (2) Determine faculty-based factors associated with maneuvering on an e-learning platform among higher education institution students. (3) Assess institutional-based factors associated with maneuvering on e-learning platforms among students in higher education institutions.

Literature review

E-learning has been well recognized as mainstreaming in health sciences education (HSE) – medical, dental, public health, nursing, and other allied healthcare education–. Still, the role of e-learning and its effect on learners' performance or enhancing their learning has not been well debated (Regmi, 2020). Educational institutions are increasingly adopting and implementing online learning programs. Within this context, pertinent literature authored by various scholars regarding the elements constituting an e-learning environment (student-based, instructor-based, and faculty-based) were reviewed.

Student-Based Factors Associated with Maneuvering on E-Learning Platforms among Students in HEIs.

Access to technology, communication, computers, and Internet self-efficacy are learner components that can affect student satisfaction in an online environment. According to Hung et al. (2010), confidence in online communication and ease of navigation on e-learning platforms are vital in addressing problems in online studying environments. In addition, Al-Adwan et al. (2021) explained that confidence in online communication and ease of navigation on e-learning platforms are vital factors in the timely completion of assignments in online studying environments.

Proficiency in digital literacy is crucial for the effective adoption of e-learning. In their research titled "Understanding the Effect of e-learning on Individual Performance: The Role of Digital Literacy," Mohammadyari and Singh (2014) highlighted that digital literacy significantly

enabled the utilization of e-learning. The study specifically indicated significant relationships: digital literacy affecting users' performance and effort expectations, performance expectations influencing users' intentions to continue using Web 2.0 tools, and continuance intention affecting performance. Scholars have postulated that improved supercomputer use with confidence in Internet use leads to positive student satisfaction and improved performance. For example, the Moodle platform used in e-learning is designed to offer interactions through discussion forums, and marks are attached to each discussion post to encourage e-learners to interact with each other and with the instructor. According to Violante and Vezzetti (2015), all interactive forms of virtual learning can enhance the implementation of e-learning. In addition, through a qualitative review, Bekele (2010) revealed that the ease of learner engagement on online platforms was a major factor that supported students' satisfaction.

Although the Internet remains the primary source of virtual education in any setup, Bolliger and Halupa (2012) found that 84 learners in doctoral programs in their first year of online studies were anxious to use the Internet and electronic devices to undertake the course. Kaushik and Agrawal (2021) reported analogous findings while examining the impact of technology readiness on e-learning adoption. Their research indicated that individuals showcased positive attitudes toward the e-learning approach. Nonetheless, they also expressed discomfort in using the newly introduced e-learning platforms.Yet, the Internet is the primary source of virtual education in any setup. The ease of learner participation in online learning is often related to the percentage of grade weights assigned to the discussions (Jiang & Ting, 2000). Taylor (2002) investigated students' participation patterns in accessing and contributing to online discussions and whether these participation patterns influence academic achievement. He named the three groups as follows: workers, proactive participation group; lurkers, peripheral participation group; shirkers, parsimonious participation group. According to a study by Abdulla and Elmansoury (2021) in Libya, the most commonly proposed methods include scheduled live online video lectures with interactive discussions and the utilization of several different programs or self-study online recorded lectures made available online for medical students at each university; over 60% of students had ease in accessing and navigating on the platform. Access to smartphones has also been documented as a critical component in enabling e-learning. In their study exploring smartphone use among undergraduate STEM students during COVID-19, Mella-Norambuena and Colleagues (2021) reported that students used smartphones the most during discussion forums.

Faculty-based Factors Associated with Maneuvering on an E-learning Platform among Students in HEIs.

Educators, faculty support staff, researchers, and instructional designers are tasked with understanding the pedagogical implications of online learning. Educators are encouraged to serve as facilitators of learning rather than sole distributors of content knowledge (Leung, 2002). Technology-enhanced interactive e-learning platforms allow learning to be individualized, enhance collaborative learning, and realign the educator's role from disseminating to facilitating the learning process (McCoy et al., 2015). Research demonstrates that e-learning surpasses traditional educator-led methods by enhancing learners' adaptability to various learning styles, fostering intuitiveness, and consequently leading to heightened motivation and improved performance. Research demonstrates that e-learning surpasses traditional educator-led methods by enhancing learners' adaptability to various learning styles, fostering intuitiveness, and consequently leading to heightened motivation and improved performance (Gray & Tobin, 2010). Alnagar (2020) made predictions on the following variables: instructor attitude and response, ease of maneuvering on the online platform, the flexibility of course offered in an e-learning environment, assessment diversity, online course flexibility, quality classroom interactions and internet, type of program offered,

workshops, and explanations provided by the e-learning instructors as predictors or influencers of timely completion of online assignments. However, Al-Nefaie (2015) argues that in Saudi Arabia, for example, the instructor's attitude towards the e-learning system does not influence access and navigation on the ODeL platform. Hurtado et al. (2011) argued the opposite, and indicated that faculty members play a vital role in the identification and training of the next generation. Through their study, 117 students from higher education institutions were interviewed. They reported how interacting with faculty enabled them to gain access to resources that helped them achieve their educational goals and better navigate through the e-learning platform.

Institutional-based Factors Associated with Maneuvering on an E-learning Platform among Students in HEIs.

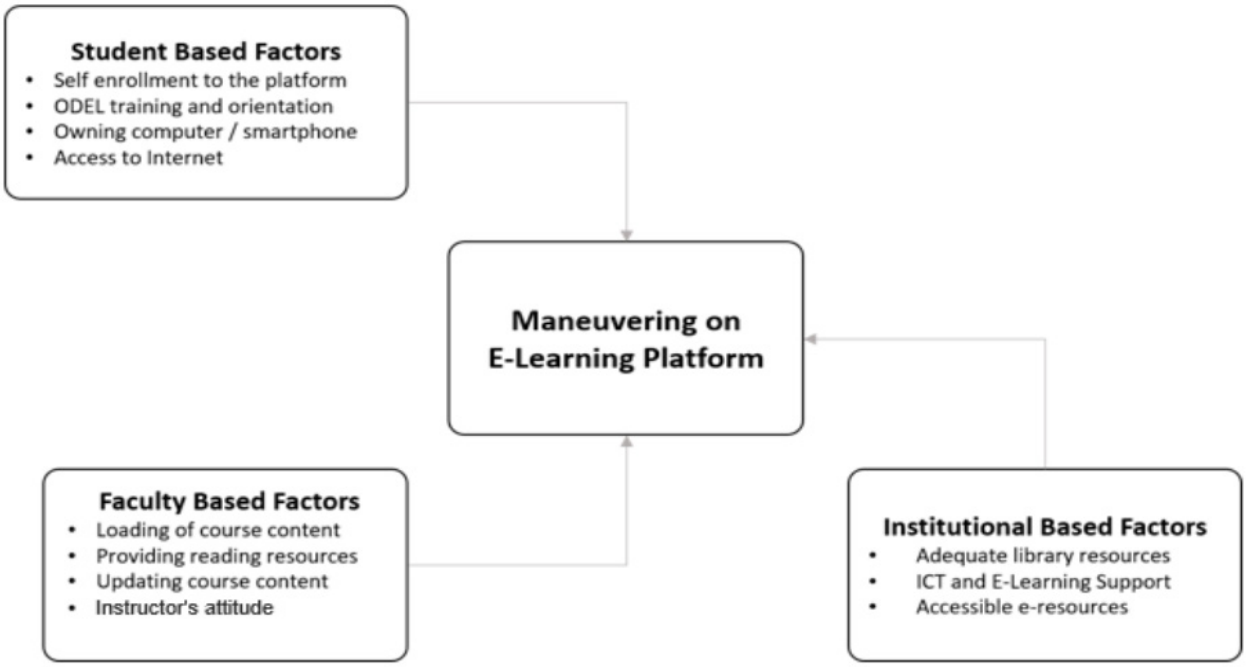
Institutional factors, such as system functionality, content features (technological environment), social interactions, and collaborative learning (social environment), affect the perceived usefulness of blended learning. However, Al-Nefaie (2015) argues that in Saudi Arabia, the instructor's attitude towards the e-learning system does not influence access and navigation on the ODeL platform for better implementation of e-learning. In Uganda, the interactivity sub-dimension of online studying should inform the education sector to make evidence-based decisions when designing an open and distance learning environment (Bashir, 2019). Alnagar (2020) made predictions on the following variables: instructor attitude and response, ease of maneuvering on the online platform, the flexibility of course offered in an e-learning environment, assessment diversity, online course flexibility, quality classroom interactions and internet, type of program offered, workshops, and explanations provided by the e-learning instructors as predictors or influencers of Online teaching and learning.

The use of contexts for effective e-learning in medical education has been reported as an area that warrants further research (McCoy et al., 2015). Given the importance of curriculum integration in medical education, it is hypothesized that blended learning can serve as an effective teaching and learning strategy to foster the integration, application, and relevance of basic sciences to clinical contexts, with enhanced online teaching and learning. However, for blended learning to be effective in medical education, it is important to understand the factors that influence ODeL implementation.

Nortvig et al. (2018) noted that online studying, including ease of navigation on online platforms, has achieved a greater impact in the education industry. However, Al-Nefaie (2015) argued that in Saudi Arabia, the instructor's attitude towards the e-learning system does not influence the implementation of e-learning. In Uganda, the interactivity sub-dimension of online studying should inform the education sector to make evidence-based decisions when designing an open and distance learning environment (Bashir, 2019). Alnagar (2020) made predictions on the following variables: instructor attitude and response, ease of access and maneuvering on the online platform, the flexibility of course offered in an e-learning environment, assessment diversity, online course flexibility, quality classroom interactions and Internet, type of program offered, workshops, and explanations offered by the e-learning instructors as predictors or influencers of Online teaching and learning.

Figure 1

Conceptual Framework



Note: Conceptual Framework developed by the authors.

The conceptual framework above shows the relationship between the dependent variable (maneuvering of e-learning platform) and the independent variables faculty-based (availability of course content, availability of reading resources, and updated course content: student (self-enrollment on the platform, training, orientation, owning computer or smartphone, Internet access), and institution-based factors (adequate library resources, Information Communication Technology(ICT) and e-learning support, and accessible e-learning resources).

Methodology

Study Design

This quantitative cross-sectional study was conducted between December 2020 and January 2022 with 485 students at a private University in Uganda. The study setting was chosen because Clarke International University (CIU) was among the first 21 institutions of higher learning in Uganda to be accredited for online teaching and research supervision during the COVID-19 pandemic. The CIU also has a history of implementing e-learning and boasts of both e-learners and traditional face-to-face students, who were all integrated into the e-learning system during the lockdown.

Sampling

The total number of continuing students enrolled in the ODeL platform (Learning Management System) was 730. A structured questionnaire was sent to all 730 students via email, explaining the aim of the study and seeking consent. A total of 485 students consented to participate in the study, providing a response rate of 66.4%. The questionnaire was distributed via a Google survey form, without capturing students' emails, to ensure a degree of anonymity.

Data Collection

We collected quantitative data using a smart survey from continuing students on factors associated with maneuvering through the e-learning platform during the lockdown. This enabled easy questionnaire distribution and collection of reliable data in real time**.** Prior to data collection, the questionnaire was pre-tested at Cavendish University, which revealed that the student factors, ability to self-enroll on the e-platform, and ODeL training and orientation were significantly associated with ease of maneuvering on the E-platform. Unique identifiers, such as emails and names of students, were not captured to ensure confidentiality of the data. The structured questionnaire evaluated the student, faculty, and institutional factors.

Data Analysis

In the univariate analysis, we computed the frequencies and percentages for categorical data. In the bivariate analysis, we compared differences in maneuvering through the e-learning platform with categorical independent variables using the chi-square test for larger cell counts 5>; otherwise, Fisher's exact test was employed for smaller cell counts<5. The level of statistical significance was set at less than 0.15 to avoid residual confounding.

In the multivariate analysis, we computed both unadjusted (crude) and adjusted odds ratios with corresponding 95% confidence intervals using modified binary logistic regression analysis with robust error variance for all statistically significant variables in the bivariate analysis. The Statistical Package for Social Sciences (SPSS) version 20 was used to analyze the data.

Ethical Considerations

This study was reviewed and approved by the Clarke International University Research Ethics Committee (CIU REC number: Clarke-2021-140). Informed consent was obtained from the selected participants, access to data was restricted to the study team, and data were safely secured on a password-protected computer accessible only to the data analyst. In addition to using unique codes in the questionnaire, data on personal identifiers, such as names and physical addresses, were not collected**.**

Results

General Characteristics of the Participants

Of the 485 respondents, 32.1% were from the Institute of Allied Health Sciences (IAHS), 32.1% were from the Institute of Public Health and Management (IPHM), 25.3% were from the School of Nursing and Midwifery (SONM) and 2.3% were from the School of Business and Applied Technology (SoBAT). The highest proportion of respondents, 36.2% (176/485), was in their first year of study. Overall, 387(79.8 %) participants maneuvered easily through the e-learning platform.

Of the 485 respondents, 395 (81.4%) reported that course content was available on the e-learning platform, 402 (82.8%) reported availability of reading resources, 401 (82.7%) accessed updated course content, (82.7%), 387 (79.6%) received ICT and E-learning support, and 418 (86.1%) received ODeL training and orientation. In addition, 472 (97.3%) accessed e-resources, 435(89.6%) were able to self-enroll on the platform, and 399 (82.2%) owned computers or smartphones.

Differences in Maneuvering through the ODeL Platform with Student, Faculty and institutional-related Factors

Table 1 compares the differences in maneuvering through the ODeL platform with student-, faculty-, and institutional-related factors. Our data show that the following student factors were associated with maneuvering through the ODeL platform: ability to self-enroll on the e-platform (<0.001), ODeL training and orientation (<0.001), ownership of computers or smartphones (<0.001), and Internet access (<0.001). The faculty factors that were significantly associated with maneuvering through the ODeL platform were access-loaded course content (p= 0.040), availability of reading resources (p= 0.002), and updated course content (p= 0.008). The statistically significant institutional factors

were: adequate library resources (<0.001), ICT and E-learning support (<0.001), and accessible e-resources (<0.001).

Table 1

Binary Analysis of Factors Associated with Maneuvering on the E-Learning Platform

Variable	Maneuvering on E-learning Platform		P-value
	Easily maneuvered on the E-learning Platform N (%) 387 (79.8%)	Didn't easily maneuver on the E-learning Platform N (%) 98 (20.2%)	
Student-based factors			
Self-enrolment to the platform		32 (10.4)	<0.001*
Yes	277 (89.6)	66 (37.5)	
No	110 (62.5)		
Received ODeL training and orientation			
Yes	285 (86.1)	46 (13.9)	<0.001*
No	102 (66.2)	52 (33.8)	
Own computer/ smartphone			
Agree	323 (82.2)	70 (17.8)	<0.001*
Disagree	20 (48.8)	21(51.2)	
Neutral	44 (86.3)	07 (13.7)	
Access to Internet			
Agree	196 (82.7)	41 (17.2)	<0.001*
Disagree	56 (61.5)	35 (38.5)	
Neutral	135 (85.9)	22 (14.1)	

Faculty-based factors			
Loading course content			
Agree	350 (81.4)	80 (18.6)	0.040*
Disagree	24 (64.9)	13 (35.1)	
Neutral	13 (72.2)	05 (27.8)	
Providing reading resources			
Agree	314 (82.8)		
Disagree	33 (62.3)	65 (17.2)	0.002*
Neutral	40 (75.5)	20 (37.7)	
		13 (24.5)	
Updating course content			
Agree	316 (82.7)		
Disagree	29 (69)	66 (17.3)	0.008*
Neutral	42 (68.9)	13 (31)	
		19 (31.1)	
Institutional-based factors			
Adequate Library resources			
Agree	239 (38.9)	46 (16.1)	<0.001*
Disagree	54 (62.1)	33 (37.9)	
Neutral	94 (83.2)	19 (16.8)	
ICT and E-learning support			
Agree	227 (79.6)	58 (20.4)	<0.001*
Disagree	49 (36.6)	28 (36.4)	
Neutral	111 (90.2)	12 (9.8)	
Accessible E-resources			
Agree	219 (97.3)	36 (2.7)	<0.001*
Disagree	67 (62)	41 (38)	
Neutral	101 (82.8)	21 (17.2)	

**P-value significant at 0.05*

Factors Associated with Ease of Maneuvering on the E-learning Platform

The odds of maneuvering on E-learning platform increased with ICT and E-Learning support (aOR,3.2:95%CI, 1.3-7.2), ability to self-enroll to the platform (aOR5.4:95%CI, 3.1-9.4), ODeL training and orientation (aOR,2.7: 95%CI, 1.5-4.8) and ownership of a computer/ smartphone (aOR 7.4: 95% CI, 2.2-25.2).

Table 2

Multivariate Analysis of Factors Associated with Ease of Maneuver on the E-learning Platform

Variable	COR [(95%CI]	AOR [95%CI]
Student-Based Factor		
Self-enrolment to the platform		5.4 (3.1-9.4) *
Yes	5.2(3.2-8.4) *	1
No	1	
ODeL Training and Orientation		
Yes	3.2 (2.0-4.9) *	2.7(1.5-4.8) *
No	1	1
Own computer/ smartphone		
Agree	6.6(2.4-18.0) *	7.4 (2.2-25.2) *
Disagree	1.4 (0.6-3.2)	1.5 (0.5-4.2)
Neutral	1	1
Access to Internet		
Agree	1.3(0.7-2.3)	1.2(0.6-2.4)
Disagree	3.8 (2.1-7.1) *	2.1 (0.9-4.3)
Neutral	1	1
Variable	COR [(95%CI]	AOR [95%CI]
Faculty Based Factor		
Loading course content		
Agree	0.6 (0.2-1.7)	1.1(0.3-4.6)
Disagree	1.4 (0.4-4.8)	1.4(0.3-7.5)
Neutral	1	1
Providing reading resources		
Agree	0.6 (0.3-1.3)	0.8 (0.3-2.0)
Disagree	1.9 (0.8-4.3)	2.2 (0.7-7.4)
Neutral	1	1
Updating course content		0.5 (0.2-1.2)
Agree	0.5 (0.3-0.8)*	0.3 (0.1-1.0)
Disagree	0.9 (0.4-2.3)	1
Neutral	1	
Variable	COR [(95%CI]	AOR [95%CI]
Institutional Based Factors		
Adequate Library resources		
Agree	0.9 (0.5-1.7)	0.9 (0.4-2.2)
Disagree	3.0 (1.6-5.8) *	1.3 (0.6-3.1)
Neutral	1	1
ICT and E-learning support		
Agree	2.4 (1.2-4.6) *	3.2(1.3-7.2) *
Disagree	5.3 (2.5-11.3) *	1.6 (0.6-4.1)
Neutral	1	1
Accessible E-resources		
Agree	0.8 (0.4-1.4)	0.5 (0.2-1.1)
Disagree	2.9 (1.6-5.4) *	1.9(0.8-4.2)
Neutral	1	1

Note: *Significance codes at 5% level: p<0.001***, p<0.01**, p<0.05*.*

Discussion

This study aimed to foster continuity of learning by determining the factors associated with ease of maneuvering on an e-learning platform. The data showed that 79.8%had ease of maneuvering through the E-learning Platform. The results aligned with a study conducted by Abdulla and Elmansoury (2021) in Libya. Their research reported factors such as scheduled live online video lectures, interactive discussions, and providing various self-study resources through recorded online lectures for medical students at each university. Furthermore, 60% of students found the platform easy to access and navigate.

This study shows some significant factors related to the maneuvering of the e-learning platform, including the availability of course content (p=040). This is in line with a study by Violante and Vezzetti (2015), who reported that all interactive forms of virtual learning have the potential to enhance the implementation of e-learning. The current study showed that ownership of a computer or smartphone and access to the internet greatly influenced the maneuvering of the e-learning platform. According to Mella-Norambuena and Colleagues (2021), the highest smartphone usage among students is noted during engagement in discussion forums indicating the vital role of access in bolstering student engagement with e-learning.

In this study, self-enrollment was significantly associated with maneuvering of e-learning implying some level of self-sufficiency and confidence. However, a study conducted by Bolliger and Halupa (2012) revealed that 84 learners enrolled in doctoral programs during their first year of online studies experienced anxiety regarding the use of the Internet and electronic devices for their coursework. This apprehension persisted despite the internet being the primary source for implementing virtual education and navigating the e-learning platform. Another study by Kaushik and Agrawal (2021) reported that while students had positive attitudes towards the eLearning approach, discomfort in using the newly penetrated e-learning platforms was also found. This amplifies the need for training and orientation of students before and during interactions with eLearning platforms. The influence of technology readiness and digital literacy on the adoption of eLearning is well documented. Our results indicate that training and orientation can substantially influence maneuvering through the eLearning platform. Mohammadyari and Singh (2014) reported that digital literacy facilitates the use of e-learning and should be considered when examining the impact of the latter on students' performance.

Conclusion

A substantial number of students can maneuver on e-learning platforms. The student factors significantly associated with maneuvering through the ODeL platform were ability to self-enroll on the e-platform, ODeL training and orientation, ownership of computer or smartphone computer, and access to the Internet.

The faculty factors that were significantly associated with maneuvering through the ODeL platform were access to loaded course content, availability of reading resources, and updated course content. Statistically significant institutional factors were adequate library resources, ICT and E-learning support, and accessible e-resources. Successful maneuvering is bolstered through access to e-learning tools such as computers and smartphones, ICT support, and adequate ODeL training and orientation of students to the e-learning platform. Finally, the multivariate analysis revealed that maneuvering on the e-learning platform increased with ICT and E-Learning support, the ability to self-enroll in the platform, ODeL training, and orientation and ownership of a computer/smartphone.

Several recommendations have been made based on these findings. First, regarding student factors associated with maneuvering on the e-learning platform, students should endeavor to attend institutional ODeL training and orientations. Students are also encouraged to visit the platform and use the different services to become acquainted. Successful maneuvering on e-learning platform can be bolstered through

investing in the internet

Regarding faculty factors, online instructors should endeavor to set up more assignments, update content, and utilize forums and discussions on the platform. Further research should be conducted to include students from other disciplines.

Lastly, the institution should ensure that enabling policies are in place while also maintaining continuous training (for both students and faculty) on maneuvering through the ODeL platform. In addition, the institution should make ODeL training and orientation compulsory for all students.

This study has two limitations. The first limitation relates to generalizability; the study was conducted at only one institution of higher learning, so the results may not be generalizable to higher education institutions in Uganda. Second, since the study utilized a cross-sectional design, we could determine associations rather than causation. Further research using more robust methodologies is required.

References

Abdulla, D. R., & Elmansoury, M. (2021). *Online problem-based learning (pbl) during coronavirus pandemic*: trial at the Libyan International Medical University.

Al-Adwan, A. S., Albelbisi, N. A., Hujran, O., Al-Rahmi, W. M., & Alkhalifah, A. (2021). Developing a holistic success model for sustainable e-learning: *A structural equation modeling approach. Sustainability,* 13(16), 9453. https://doi.org/10.3390/su13169453

Alsoufi., A, Alsuyihili., A, Misherghi., A, Elhadi., A (2020). Impact of the COVID-19 pandemic on medical education: *Medical students' knowledge, attitudes, and practices regarding electronic learning.* PLOS ONE.https://doi.org/10.1371/journal.pone.0242905

Alnagar, D. K. F. (2020). Using artificial neural networks to predict student satisfaction in e-learning. *Am J Appl Math Stat*, *8*(3), 90-5.

Al-Nefaie, S. (2015). Investigating factors influencing students' attitude and performance when using web-enhanced learning in developing countries: *The case of Saudi Arabia(Doctoral dissertation, Brunel University London).* http://bura.brunel.ac.uk/handle/2438/12163

Bashir, K. (2019). Modeling E-Learning Interactivity, Learner Satisfaction and Continuance Learning Intention in Ugandan Higher Learning Institutions. *International Journal of Education and Development Using Information and Communication Technology*, 15(1), n1.

Bekele, T. A. (2010). Motivation and satisfaction in internet-supported learning environments: A review. *Journal of Educational Technology & Society, 13*(2), 116–127.

Bolliger, D. U., & Halupa, C. (2012). Student perceptions of satisfaction and anxiety in an online doctoral program. *Distance Education, 33*(1), 81–98.

Davis, F. D. (1989). *A technology acceptance model for empirically testing new end-user information systems: Theory and results* (Doctoral dissertation, Massachusetts Institute of Technology).

Gray K. & Tobin J. (2010). Introducing an online community into a clinical education setting: a pilot study of student and staff engagement and outcomes using blended learning. *BMC Medical Education 10*(1):6

Hung, M.-L., Chou, C., Chen, C.-H., & Own, Z.-Y. (2010). Learner readiness for online learning: Scale development and student perceptions. *Computers & Education, 55*(3), 1080–1090.

Hurtado, S. et al. (2011) '"We do science here": Underrepresented students' interactions with faculty in different college contexts', *Journal of Social Issues, 67*(3), 553–579.

Jiang, M., & Ting, E. (2000). A study of factors influencing students' perceived learning in a web-based course environment. *International Journal of Educational Telecommunications, 6*(4), 317–338.

Kaliisa, R., & Picard, M. (2017). A systematic review on mobile learning in higher education: The African perspective. *TOJET: The Turkish Online Journal of Educational Technology*, *16*(1).

Kaushik, M. K., & Agrawal, D. (2021). Influence of technology readiness in adoption of e-learning. International Journal of Educational Management, 35(2), 483-495.

Leung W. C. (2002). Competency based medical training: review. *British Medical Journal 325*(7366):693–696.

Mella-Norambuena, J., Cobo-Rendón, R., Lobos, K., Sáez-Delgado, F., & Maldonado-Trapp, A. (2021). Smartphone use among undergraduate STEM students during COVID-19: An opportunity for higher education?. Education Sciences, 11(8), 417.

McCoy, L., Pettit, R., Lewis, J., Bennett, T., Carrasco, N., Brysacz, S., Makin, I., Hutman, R. & Schwartz, F. (2015). Developing Technology-Enhanced Active Learning for Medical Education: Challenges, Solutions, and Future Directions. *Journal of Osteopathic Medicine, 115*(4), 202-211. https://doi.org/10.7556/jaoa.2015.042

Mohammadyari, S., & Singh, H. (2015). Understanding the effect of e-learning on individual performance: The role of digital literacy. Computers & Education, 82, 11-25.

Nortvig, A. M., Petersen, A. K., & Balle, S. H. (2018). A literature review of the factors influencing e-learning and blended learning in relation to learning outcome, student satisfaction and engagement. *Electronic Journal of E-learning*, 16(1), pp46-55.

Regmi, K., & Jones, L. (2020). A systematic review of the factors–enablers and barriers–affecting e-learning in health sciences education. *BMC medical education, 20*(1), 1-18.

Taylor, J. C. (2002). *Teaching and learning online: The workers, the lurkers and the shirkers.* Paper presented at the 2002 Conference on Research in Distance & Adult Learning in Asia.

Twesigye., J (2020). *COVID-19 Educational Disruption and Response*: Rethinking e-Learning in Uganda. Konrad, Adenuer Stiftung. https://www.kas.de/documents/.

Violante, M. G., & Vezzetti, E. (2015). V*irtual interactive e-learning application: An evaluation of the student satisfaction.* Computer Applications in Engineering Education, *23*(1), 72–91.

Twesigye., J (2020). *COVID-19 Educational Disruption and Response*: Rethinking e-Learning in Uganda. Konrad, Adenuer Stiftung. https://www.kas.de/documents/.

Violante, M. G., & Vezzetti, E. (2015). V*irtual interactive e-learning application: An evaluation of the student satisfaction.* Computer Applications in Engineering Education, *23*(1), 72–91.

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