

Assessing the Prospects and Challenges of Online Learning in Kenyan Public Universities: A Case Study of Masinde Muliro University of Science and Technology

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ABSTRACT

The increase in the number of internet users, the demand for education, and the widespread use of electronic devices among scholars have created a potential in online learning as an alternative to traditional education. This can be linked proper planning, clear online learning policies and trained personnel to facilitate the online learning process. Recent studies point to the possibility of African public universities adopting online learning more aggressively in the future than ever before. This study therefore outlines the opinions of lecturers, students and the management of Masinde Muliro University of Science and Technology regarding the prospects and challenges of online pedagogical infrastructure and how it affects learning in public universities. The study used a descriptive survey. Data was collected from a sample size of 682 which included students, members of faculty, and technical staff. The sample was selected using a stratified sampling technique. Data was collected using questionnaires and interview schedules. Analysis was done using frequencies, means, standard deviations, and regression analysis. The findings showed that mobile learning is the solution to online learning problems given its accessibility and availability amongst most learners. It also shows that online learning provides customized learning experiences in which learning is student-centered. The results from ordered logistic regression, ($Wald = 0.673, \chi^2_{(1)} = 2.767, p = 0.041$) showed that indeed challenges of use of online pedagogical infrastructure affects learning in public universities. This was confirmed by the analysis of interval data using simple linear regression in which the outcome for both faculty and students also were in line with the findings of logistic ordered regression, $F(1, 358) = 4.699, p < .05$. With one-unit increase challenges, learning in public universities decreases by .101, which was found to be a significant change, $t(358) = -2.168, p < .05$. Most of the respondents indicated that online learning makes learning more flexible and accessible. It provides learners with many options to select from. Finally, the outcomes show that online learning is more cost-effective than face-to-face programs.

Keywords: E-Learning, Learning Management Systems, Online infrastructure, Online learning, Pedagogy

I. INTRODUCTION

There are various ways in which technology has been integrated into the educational learning process. Computer based learning, Computer networks, online learning environments, social media are some key areas which supports technology enhanced learning. Drexel (2021) explains two key benefits associated with technology integration into the process of teaching and learning; assisting learners with different learning skills and to prepare the learners with the life skills. Not all the students have the capability to learn and retain information at the same level and speed. Some are slow learners and others are aggressive fast learners. The use of technology should therefore help to establish the difference in learner capabilities and thereby helping the teachers to attend to each learner in a unique way. The current study sought to unveil the benefits associated with online learning if well implemented by institutions.

Drexel (2021) further elaborates that technology integration in education has become its own form of literacy because of how often it is used in daily life activities. This is creating life skills to the learners so that they can use the technology the contexts outside the education domain. Many careers use applications like Microsoft Office or Google docs, with the learners interacting with these online collaboration tools in classroom setup, it builds in them the

confidence to continue using them anywhere else. This article further explains that technology can allow learners to be able to write, spell words and even do mathematical computation.

According to Grand-Canyon (2021), technology should increase productivity and creativity in which it allows the learners to access whatever resources they need and when they need them. Learners and teachers can keep calendars online, and the use of reminders can be employed in the Learning Management Systems. In effect all these can improve productivity thereby saving time, space, and mental effort. Automation and Future Focus are other benefits that can be realized by integrating technology in learning (Uppal, 2017). Automatic grading systems in LMS, teacher automation, and the use of artificial intelligence to determine learner capabilities have greatly impacted the education sector. Both the learner and the teacher greatly benefit from the role played by technology. Kevin and Costley (2022) observe that “technology is a powerful contributor to learning if it is used to deepen students’ engagement in meaningful and intellectually authentic curriculum”. Many learners have shown the advantages of using learning technologies in classroom setup especially in engaging the learners in critical thinking and problem solving.

Kashorda (2014) examined the experiences of pre-service teachers implementing technology in math lessons. The findings of his study cited interactivity as a key benefit of properly implemented online learning platform. He however found out that technology cannot change the perception and performance of learners in mathematics. Kevin & Costley (2021) to the contrary found out that given the individual learner differences, having a system that can be customized based on the needs of individual learning can enhance the perceptions towards individual subjects. Nwankwo (2015) and (Kooli, Zidi, & Jamrah, 2019) carried out studies on the student’s learning experience, perceptions, and attitudes. They found a positive change in the adoption of technology by the learners however, despite the benefits they cited, a negative attitude was registered by the teachers who were using the system. The teachers showed that they lacked necessary technologies to implement online learning.

Study by Snježana (2015) and Lane (2021) both found out that Open University of the United Kingdom and Athabasca University have provided relative cheap and quality education with 78% and 65% increment compared to other university offering on campus face-to-face education. This shows that online learning has the power to improve access to university education if properly implemented. This study will also seek the respondent’s opinion on whether online learning platforms have provided open access to education given the high demand of university education.

Acholi (2015) studied the implementation of Virtual Classrooms as a way of improving online learning. The students who used the implemented system performed better than those who did not use the virtual classrooms for learning. This pointed to the possibility that online learning with properly integrated virtual classrooms can help improve student’s performance. This is also supported by Salmon (2018) who found out that the use of online learning improves student academic achievement compared to those who were taught in face-to-face classes.

According to Mohammed (2020) users of online infrastructure particularly faculty members face numerous challenges while implementing online learning. The key challenges that he found out in his research included limited time required to develop e-learning content, inadequate interaction between students and faculty members, insufficient time for preparing online exams or assignments, lack of awareness regarding ways to integrate the software into teaching and finally inaccessibility of course notes and feedback about materials. Similarly, Kooli et al. (2019) found out that most faculty members do not have time to set and administer examinations, they found out that faculty members have other tasks assigned to them by the university hence no time to collaborate with learners in the online platform.

Inadequate user-support by the administration, limited interaction between the students and members of faculty, inadequate time for preparing online examination, inaccessible course notes and materials, and limited funds to pay fee and also to buy internet bundles to access online platform were some of the challenges that Sergey et al. (2021) identified as the major issues that affect implementation of the e-learning with regard to the academics line of the learners.

II. LITERATURE REVIEW

2.1 Prospects of Online Learning Infrastructure in Universities

Online education is associated with several benefits which can help in solving educational problems in developing countries. The future of education is to have education for all which is affordable and accessible. It is expected that online infrastructure should be able to improve academic performance of students, reduce the cost of

education, enhance knowledge retention, use smartphones to enable education on the move, enhance socialization and collaboration, improve teaching efficiency and to provide for customized learning experiences for the student.

According to Simamora et al. (2020), universities should prepare teachers and students with pedagogical readiness so that engage in qualitative teaching and learning experience with or without technology. Online learning integration helps in the realization of improved academic performance while keeping quality education (Salmon, 2018). He studied 389 JKUAT students, 64% of whom realized improved academic performance in comparison to those that did not use online learning infrastructure. Alholthi (2015) investigated impact of MOODLE on learning at Montana University using Solomon Four Quasi Experimental design to investigate effects on academic achievement. His finding showed that the students who used MOODLE registered high academic achievement than those who did not use MOODLE online learning platform. It is evident that using online learning infrastructure can improve academic performance. The current study will therefore relate on whether online infrastructure indeed improves academic achievement of student based on the lecturer's perspective.

Technology integration in education has become its own form of literacy because of how often it is used in daily life activities (Drexel, 2021). This is creating life skill to the learners so that they can use the technology the contexts outside the education domain. Many careers use applications like Microsoft Office or Google docs. With the learners interacting with these online collaboration tools in classroom setup, its confidence to continue using them anywhere in their daily operations and helps in knowledge retention. Papia (2016) also indicates that cognitive load can greatly be reduces if instructional materials are designed for online infrastructure use.

Based on the observation done by Grand Canyon University, USA, on technology integration in classroom setup the use of technology has benefits that improve university's competitiveness (Grand-Canyon, 2020). The finding of their study shows that technology can allow learners to be able to write, spell words and even do mathematical computation. Secondly, increases productivity and creativity in students and faculty members in which it allows the learners to access whatever resources they need and when they need them. Finally, it was determined from their study that education cost was evidently reduces because of the use of online learning platform. The present study will investigate the role of online infrastructure in enhancing productivity and creativity of its users.

2.2 Challenges of Online Pedagogical Infrastructures

There are many challenges to overcome while implementing e-learning in higher institutions of learning (Mohammed, 2020). Most online learning initiatives tend to fail entirely or partially due to various barriers to online learning in developing countries. Odebero (2015) indicated that despite successful implementation of MOOCs in developed countries, developing countries in Africa were still faced with many challenges. He further indicated that in Kenya, despite the guidelines to the Higher Education (HE) institutions by the Ministry of Education that 10% of all income in HE institutions to be invested in IT infrastructure, corruption consumed most of the financial resources allocated for such resources hindering successful implementation in all HE institutions.

The use of technology-based distance education has become popular among universities (Joseph, 2019). It has been seen as a promising cost-effective and an answer to the African problem of high demand of education with limited resources. For the African situation, these hopes have turned to be disillusionment because of the challenges that are related to IT digital infrastructure and economic situation for developing countries. Joseph (2019) further explains that even though developing countries in Africa still face challenges regarding online learning implementation, this dream has come true elsewhere in the developed nations.

2.3 Challenges to the Members of Faculty

Three major challenges affect implementation of online pedagogical infrastructure: academic challenges, technological challenges, and administrative challenges (Elsie, 2022). The challenges were investigated factoring the views of the faculty and students.

2.3.1 Academic Challenges

According to Mohammed (2020) users of online infrastructure particularly faculty members face numerous challenges while implementing online learning. The key challenges that he found out in his research included; limited of time required to develop e-learning content, inadequate interaction between students and faculty members, insufficient time for preparing online exams or assignments, lack of awareness regarding ways to integrate the software into teaching and finally inaccessibility of course notes and feedback about materials. Similarly, Marzilli et al. (2019) found out that most faculty members do not have time to set and administer examinations, they found out

that faculty members have other tasks assigned to them by the university hence no time to collaborate with learners in the online platform. These challenges if not addressed in time affects the implementation of online learning infrastructure hence delayed successful online learning.

2.3.2 Technological Challenges

Implementation of e-learning requires that the implementors to have the knowledge of the technology that they are using. Lack of technological skills have been noted by various scholars as a key challenge affecting successful online learning implementation (Hadullo et al., 2017 and Mohammed, 2020). Other than lack of requisite skills, other technological challenges identified by these scholars included insufficient technological equipment, inadequate technical support, limited necessary adaptive technology, technological background, unavailability of training courses provided by the institution and the complexity of the e-learning platform being used. Successful implementation of online learning requires that technological challenges are adequately addressed. These studies however did not recommend on how these challenges can be addressed to enable universities struggling with implementation avert the challenges.

2.3.3 Administrative Challenges

Online learning requires the support of the administration for its success to be realized (Aguti, 2015). Without this support, even if good technology is acquired by the institution, it might not serve its purpose. Some of the administrative challenges that have been identified included limited administrative support, problems with internet access, limited administrative encouragement, negative comments about e-learning, inadequate ICT and e-learning infrastructure provided by the management and finally incompetent administrators given charge of online learning department (Mohammed, 2020). Most public universities in Kenya have operated either with draft online learning policies which are not approved by their respective senate committees and therefore could not be circulated for use or with unclear policies regarding how activities in online learning should be conducted (George & Dorothy, 2016, Wamae, 2020). This greatly affects learning on these platforms leaving students and members of faculty even more confused in the process. A case study in Nigeria in which a student could not secure a job after graduating from an online program which was conducted without a clear policy to guide it (Shirley & Rodney, 2004). Findings by George and Dorothy (2016) shows that most Kenyan public universities are still struggling with administrative support guided by policies. This study will therefore seek to shed light on the post-covid 19 pandemic support of public university administrations.

2.4 Challenges to the Students

Students also face similar challenges that can be classified as administrative, academic, and technological challenges.

2.4.1 Academic Challenges

Inadequate user-support by the administration, limited interaction between the students and members of faculty, inadequate time for preparing online examination, inaccessible course notes and materials, and limited funds to pay fee and also to buy internet bundles to access online platform were some of the challenges that Mohammed (2020) and Sergey et al. (2021) identified as the major issues that affect implementation of the e-learning with regard to the academics line of the learners. Similarly, Colin (2022) on students' online challenges states that isolation, distractions, and poor time management are key issues that affect online learning amongst students. Two of the above studies were however conducted in private universities and could not be generalized to the challenges that students face in public universities regarding online learning. The studies were conducted in the post covid-19 pandemic and therefore will form a good comparison platform with the current study.

2.4.2 Administrative Challenges

Both students and faculty members are affected by the administrative challenges. Findings by Mohammed (2020) indicate that problems with internet access, negative comments about e-learning, and inadequate ICT and e-learning infrastructure are key challenges that affect students administratively. Technical support is one of the other challenges that administratively affect the implementation of online learning by the students. Alongside these challenges, administration needs to make online learning a priority to be able to meet the demands of the "digital native" learners whose understanding of use of technology is high compared to the previous generations (Gillet, 2017). Just as traditional face-to-face learning is supported by public universities, similar support should be given to

online learning to equate the quality of education online and physically. Willard (2022) however, states that most public universities in developing countries have not given online learning a feel and priority similar to classroom learning and therefore the challenges of online learning keep piling. Limited funding and resource availability could be limiting factors to successful implementation.

2.4.3 Technological Challenges

Not every learner has the technical know-how of using technologies that support online learning (Felix, 2021). Mohammed (2020) found that inadequate technology and software required for online learning access is a challenge for learners who may want to learn in personalized environments away from the university. Limited technical support by the faculty members and administrators affects how learners use online learning platform. This arises from the fact that the learners must learn by themselves how to use the technology and handle the challenges that arise because of them using it. Complicated software used for online learning, Inaccessibility of audio and video material, Portable Document Format (PDF) and PowerPoint was also a major challenge. Furthermore, inadequate training courses provided by the institution are a challenge to the learners since not all learners understand the proper operation of computer systems Mohammed (2020). A good online infrastructure for learning should be such that it is easy to use (Althothli, 2015). They argued that most institutions have good platforms but faced technological use challenges on the side of students given the fact that prior knowledge of computer use was insufficient. The learners therefore cannot successfully learn using the Learning Management Systems (LMS) amidst the challenges highlighted. The table below indicates the summary of these challenges.

III. METHODOLOGY

This study adopted a descriptive survey design using a case study. The data was collected from Masinde Muliro University of Science and Technology with a population of 7466 which included Students, Faculty, Management and ODEL staff. A sample of 682 respondents was obtained from the population using Stratified and Simple Random sampling. Data was collect using from faculty and Students using questionnaires, interview schedules, Content Analysis and observation. Face validity and content validity was to assess the accurateness of the data collection instruments. Reliability coefficient of .833 and .73 was obtained using Cronchba's measure of internally consistency for the students and faculty questionnaire. Qualitative data was analyzed using themes while quantitative data was analyzed using ordered logistic regression with the help of SPSS version 27.

IV. FINDINGS & DISCUSSIONS

4.1 Prospects of Online Pedagogical Infrastructure

The researcher sought to find out from students and lecturers the prospects of online infrastructure use and learning. A five-point Likert scale was used to get answers from the respondents. The mean, the standard deviation (SD) and the composite mean were also computed. A five-point Likert scale was used to ascertain the answer from the respondents. The result of the Likert is shown in Table 1 for the students' responses.

Table 1

Students and Lecturers Opinion on the Prospects of Online Learning Infrastructures.

	POTENTIAL ITEMS	SD	D	N	A	SA	Mean	Std
1	The use of online learning platform improves academic performance.	22(12.7%)	77(44.7%)	54(31.1%)	13(7.5%)	7(4%)	2.46	0.949
2	Online learning is affordable than traditional face to face learning	20(11.4%)	60(34.8%)	67(36.2%)	17(9.8%)	9(5.2%)	2.77	0.877
3	Mobile learning will help solve the problems on online learning infrastructure.	—	66(38.2%)	31(17.9%)	76(43.9%)	—	3.06	0.907
4	It is better work from home than from the university's physical environment.	4(2.3%)	44(25.4%)	84(48.6%)	34(19.7%)	7(4%)	2.98	0.842

5	Both theoretical and practical classes can be done online using the online infrastructures.	13(7.5%)	46(26.7%)	57(32.9%)	50(28.9%)	7(4%)	2.95	1.01
6	Gamification – the use of games to provide online learning can improve the attitude of learners towards online learning.	9(5.2%)	38(22%)	65(37.5%)	43(24.9%)	18(10.4%)	3.13	1.04
7	The retention of knowledge can be enhanced through online learning	4(2.3%)	46(26.6%)	35(20.2%)	67(38.8%)	21(12.1%)	3.32	1.066
8	Online learning will change the perception of learners towards university education.	4(2.3%)	53(30.6%)	61(35.4%)	48(27.7%)	7(4%)	3.01	0.918
9	Online learning enhances better understanding of content to learners	9(5.2%)	40(23.1%)	73(42.1%)	51(29.5%)	—	2.96	0.858
10	Student cooperation, self-discipline and sense of responsibility can be promoted by online learning in public universities.	4(2.3%)	44(25.4%)	65(37.6%)	60(34.7%)	—	3.05	0.834
11	Online learning aids understanding of graphs, maps, and internet-based resources.	11(6.4%)	39(22.5%)	88(50.9%)	26(15%)	9(5.2%)	2.9	0.913
12	Online learning caters for Students different learning styles.	16(9.2%)	32(18.6%)	65(37.6%)	44(25.4%)	16(9.2%)	3.07	1.087
13	Lecture's teaching efficiency is improved by online learning activities and processes	16(9.2%)	32(18.5%)	68(39.3%)	57(32.9%)	—	2.96	0.942
14	Online learning can aid the choice of technology related careers	18(10.4%)	25(14.5%)	54(31.2%)	62(35.8%)	14(8.1%)	3.17	1.015
15	Online learning infrastructure enables student collaboration and socialization	11(6.4%)	44(25.4%)	63(36.4%)	39(22.6%)	16(9.2%)	3.03	1.053
16	Online learning infrastructure allows customized learning experience	18(10.4%)	33(19.1%)	53(30.6%)	57(33.0%)	12(6.9%)	3.07	1.03
	Composite Mean and Std						2.99	0.96

Key: SD-Strongly Disagree, D-Disagree, N-Neutral, A-Agree, SA-Strongly Agree

The researcher sought to determine the prospects of online infrastructure and how they affect the learning of the students. From Table 1, the findings show that most of the respondents, 99(57.4%) strongly disagreed or disagreed that the use of online learning platforms improves academic performance of the students. This is contrary to the findings by Salmon (2018) in which 64% of the students investigated at JKUAT agreed that the use of Moodle online infrastructure improves academic performance. Similarly, Althothli (2015) investigated the impact of Moodle on learning at Montana University. He used the Solomon Four Quasi experimental method. His findings indicated that those who did not use Moodle for learning performed poorer in exams than those who used Moodle which still disagrees with the findings of the present study.

From the findings that most students 80 (46.2%) disagreed or strongly disagreed that online learning is affordable than traditional face-to-face learning while 26 (15%) agreed that online learning is affordable. This can be explained by the fact that the students do not have access to reliable internet and therefore the purchase of internet bundles becomes expensive. The students also indicated that the device for online learning is not easily accessible to them and therefore they consider online learning expensive. Contrary to these findings, study done by Grand Cayon University indicated that students who study via online learning platform incurs less tuition cost compared to regular fact to face students Grand-Cayon (2021). Furthermore, Snježana (2015) found out that the Open University of United Kingdom has reduced the cost of University Education by nearly half the cost while still offering quality education by adoption effective online learning. Having affordable internet and ensuring that the learners have necessary gadgets



for online learning can change the perception of learners and make online learning cost effective as it should be based on the previous studies.

On whether mobile learning will help solve the problems on online learning infrastructure, 76(43.9%) of the respondents agree, 31(17.9%) of the respondents were neutral and 66(38.2%) of the respondents disagree that mobile learning will help solve the problems on online learning infrastructure. This finding is supported by the fact that most students 230(64%) agreed that mobile phones are easily accessible to them (*see Table 1*). This is finding closely resembles findings by (Mohammadi et al., 2020) who found out that 74% of the students investigated preferred smartphone-based learning application that desktop applications or face-to-face learning activities. Findings by Salmon & Joanne (2022) show that the gaps in online learning can be harmonized by adopting mobile-based applications for learning. This implies that the students have interest on learning that can be facilitated by the mobile devices, the university should therefore ensure that the online learning platform (MOODLE) can be customized for mobile phone use.

On whether online learning infrastructure enables student collaboration and socialization, most respondents were undecided. This finding contradicts most studies (Terry, 2017; Mohammed, 2020; Lane, 2021) whose findings indicates that online collaboration and interaction is highly achievable in online learning in which students can interact and share irrespective of geographical locations. One respondent during an interview re-iterated that great interaction and collaboration is achievable through online learning;

“... When students' needs are met through online education, there is an increase in the amount of interaction and communication that takes place among them, as well as an improvement in their academic performance. In addition, using an online learning system helps save time and money while looking for materials, resources (such as paper and printer ink), and other expenditures. As a result, successful online education bestows more advantages in both the direct and indirect senses... IDI 05”

This implies that the students are unaware of the collaborative tools available or have not been trained on their use. Majority of the respondents also agreed that online learning infrastructure allows customized learning experience. This fact is supported by findings from one ODEL respondent who during an interview stated:

“.....most people want to study at their convenience and therefore is online learning is properly managed, the university will have the opportunity to offer many courses online and thereby becoming competitive. This will help solve the problem of those who are interested in learning while away from the university. This can only be achieved if the university prioritizes on the activities of e-learning (Souvik, 2022)....”

This finding contradicts the findings by Nwankwo (2015) and (Kooli et al., 2019) carried out studies on the student’s learning experience and perceptions, and attitudes of online course content and interaction respectively. They found out that there was a general negative attitude towards the implementation of the online learning platforms. Found out that indicated that hurried implementation of the online systems contributes to negative experiences by the students.

4.2 Challenges of Online Pedagogical Infrastructure

The study looked at three categories of challenges that online learning faces: Academic challenges technological challenges and administrative challenges.

Table 2
Academic Challenges of Online Pedagogical Infrastructure

Potential Items	SA	A	N	D	SD	Mean	Std. Dev.
Interaction between Students and Faculty Members. The faculty guide learners during active online learning sessions	51 (14.2%)	112 (31.1%)	36 (10.0%)	161 (44.7%)	-	3.15	1.143
Time Required to take online exams and Assignments. There is sufficient time allocated to complete online tasks and	-	66 (18.4%)	-	179 (49.7%)	115 (31.9%)	2.05	1.026

assignments by the course in-charge							
Reading Materials: The course learning materials can be accessed with a lot of ease and are simple to navigate	27 (7.5%)	236 (65.6%)	3 (0.8%)	94 (26.1%)	-	3.54	0.962

***Composite Mean and Std

2.913 1.0436

From the findings, most of the students indicated that course learning materials could be easily accessed and were not simple to navigate. Most students also indicated that time allocated to complete online tasks was not sufficient. Furthermore, limited interaction between faculty members and students, lack of feedback and inadequate training were cited as the academic challenges affecting both faculty members and students.

Table 3*Technological Challenges of Online Pedagogical Infrastructure*

TECHNOLOGY CHALLENGES FOR 2STUDENTS	SA	A	N	D	SD	Mean	SD
Availability of Technology at Home: I have a device to support online learning while at home.	-	141 (39.2%)	-	129 (35.8%)	90 (25.0%)	2.53	1.24
Availability of Technology at School : There is available technology at the university to facilitate online learning	-	94 (26.1%)	-	219 (60.8%)	47 (13.1%)	3.09	1.178
User management : The e-learning platform allows the student to manage his/ her personal information	68 (18.9%)	175 (48.6%)	-	94 (26.1%)	23 (6.4%)	3.48	1.24
Security of User Data: I am aware that my personal data are always protected while interacting via internet	-	103 (28.6%)	-	173 (48.1)	84 (23.3)	2.34	1.125
Collaborative learning : The online learning platform provides opportunities for students to accomplish tasks collaboratively	-	173 (48.1%)	30 (8.3%)	82 (22.8%)	75 (20.8%)	2.84	1.232
Interactive learning: The platform allows students to locate students and people of similar interests outside of their module, course, and year of study or institution.	1 (0.3%)	242 (67.2%)	38 (10.6%)	26 (7.2%)	53 (14.7%)	3.31	1.119
Bandwidth: the bandwidth provided by the university is sufficient for online learning.	-	82 (22.8%)	99 (27.5%)	70 (19.4%)	109 (30.3%)	2.43	1.145
Time Management: The platform allows students to plan, organize and manage the individual work according to their time and learning style	65 (18.1%)	170 (47.2%)	-	100 (27.8%)	25 (6.9%)	3.42	1.257
Learning tracking: The platform allows me to easily monitor my personal learning activities and gauge my level of achievements.	34 (9.4%)	130 (36.1%)	14 (3.9%)	182 (50.6%)	-	3.04	1.16
Use of e-portfolios: The system records student achievement using e-portfolios	-	152 (42.2%)	49 (13.6%)	69 (19.2%)	90 (25.0%)	2.73	1.243

Internet Connectivity: There is stable internet connectivity at home to facilitate online learning	26 (7.0%)	183 (50.8%)	-	151 (41.2%)	-	3.23	1.08
Technology Background: I can easily navigate through the online learning platform using my device	22 (6.1%)	156 (43.3%)	11 (3.1%)	145 (40.3%)	26 (7.2%)	3.01	1.172
Ease of Use: The e-learning platform is easy to use.	-	152 (42.2%)	25(6.9%)	102 (28.3%)	81 (22.5%)	2.69	1.23
***Composite Mean and Std						2.92	1.51

For technological challenges, we found there was inadequacy of necessary equipment like laptops, iPad and desktop computers, unreliable internet, inadequate technological background, and difficulty of use (for students) affected online learning at the university. Furthermore, inadequate technical support from ODEL staff also affected the effective use of online infrastructure for learning.

Table 4

Administrative Challenges of Online Pedagogical Infrastructure

ADMINISTRATIVE CHALLENGES FOR STUDENTS	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	Std Dev
Adequate ICT and Learning Infrastructure The University management has provided sufficient ICT devices to support online infrastructure. (Computers, Projectors, Tablets)	-	105 (29.2%)	-	183 (50.8%)	72 (20.0%)	2.38	1.106
University's Readiness to support Online Learning The university management readily offers support for online learning activities	65 (18.1%)	164 (45.6%)	-	106 (29.4%)	25 (6.9%)	3.38	1.268
Policy The university management has a policy regarding e-Learning that has been made available to all the learners	-	72 (20.0%)	-	188 (52.2%)	100 (27.8%)	2.12	1.032
Composite Mean and Std						2.63	1.135

For administrative challenges, the data showed that there is limited administrative encouragement and motivation to the online learning champions, limited involvement of schools in improving online learning, inadequate provision of learning, unclear online learning policy for both the students and faculty members.

The findings of the challenges were used to test the null hypothesis;

H_0 : *Challenges of use of online pedagogical infrastructure has no statistically significant influence on learning.*

The findings were documented in the tables below:



Table 5

ANOVA on challenges of infrastructure on learning

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	232.245	1	232.245	105.926	.000 ^b
	Residual	374.922	171	2.193		
	Total	607.168	172			
1	Regression	1.520	1	1.520	4.699	.031 ^b
	Residual	115.832	358	.324		
	Total	117.353	359			

a. Dependent Variable: Effects of Online Infrastructure on Learning

b. Predictors: (Constant), Challenges

Table 6

Coefficients on Challenges of Infrastructure on Learning

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1(faculty members)	(Constant)	.490	.540		.907	.366
	Challenges of online infrastructure	1.843	.179	.618	10.292	.000
1(students)	(Constant)	3.204	.129		24.854	.000
	Challenges of online infrastructure	-.101	.047	-.114	-2.168	.031

a. Dependent Variable: Effects of Online Infrastructure on Learning

The null hypothesis (HO₄) that *Challenges of use of online pedagogical infrastructure has no statistically significant influence on learning* was tested at 0.05 level of significance. Using faculty questionnaire, the overall model for lecturer respondents explains 38.3% variation of learning and it is significantly useful in explaining learning in public universities, $F(1, 171) = 105.926, p < .05$. With one-unit increase challenges, learning in public universities increases by 1.843, which was found to be a significant change, $t(171) = 10.292, p < .05$. Therefore at 5% level of significance the null hypothesis was rejected. This implied that the challenges of use of online infrastructure have statistically significant effect on learning in public universities. Using students' data; The overall model explains 21.3% variation of learning and it is significantly useful in explaining learning in public universities, $F(1, 358) = 4.699, p < .05$. With one-unit increase challenges, learning in public universities decreases by .101, which was found to be a significant change, $t(358) = -2.168, p < .05$. Therefore at 5% level of significance the null hypothesis was rejected. This implied that the challenges of online infrastructure affect learning in public universities.

Given that the data collected was ordinal in nature, an ordered logistic regression was conducted to ascertain whether indeed challenges of online pedagogical infrastructure affects learning in public universities and the results documented as shown in Table 7.

Table 7

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[LEARNING = 1]	-.537	.313	2.946	1	.038	-1.151	.076
	[LEARNING = 2]	1.771	.331	28.618	1	.000	1.122	2.420
Model 1	[CHALLENGES=1]	1.426	1.738	.673	1	.041	-1.981	4.833
	[CHALLENGES=2]	-.591	.481	1.509	1	.023	-1.534	.352
	[CHALLENGES=3]	-1.088	1.272	.732	1	.039	-3.581	1.405
	[CHALLENGES=4]	0 ^a	.	.	0	.	.	.



Model 2	[CHALLENGES=1] * pedagogical approaches * Institutional factors * Instructional Material design factors	-.043	0.005	.822	1	.0365	.000	0.004
	[CHALLENGES=2] * pedagogical approaches * Institutional factors * Instructional Material design factors	.015	0.001	1.942	1	.0163	-5.910E-6	0.003
	[CHALLENGES=3] * pedagogical approaches * Institutional factors * Instructional Material design factors	.085	.007	1.445	1	.0229	-0.005	.000
	[CHALLENGES=4] * pedagogical approaches * Institutional factors * Instructional Material design factors	-.068	.008	.622	1	.0430	-0.002	0.001

Link function: Logit.

a. This parameter is set to zero because it is redundant.

In Table 7, Model 1 shows the results without the effect of interaction (intervening variables). We take the exponent of the estimated coefficient to get OR i.e., $\exp(1.426) = 4.162$, $\exp(-0.591) = 0.554$, $\exp(-1.088) = 0.337$, $\exp(-0.043) = 0.958$, $\exp(0.015) = 1.015$, $\exp(0.085) = 1.089$, and $\exp(-0.068) = 0.934$. The odds of respondents on strongly agree (CHALLENGES=1) on online pedagogical infrastructure has no effect on learning was 4.162 (95% CL, -1.151 – 0.076) times that of disagree, a statistically significant effect, (Wald = 0.673, $\chi^2_{(1)} = 2.767, p = 0.041$). An increase on strongly agreeing in challenges of online pedagogical infrastructure was associated with a decrease in response on strongly disagreeing on the effect of online pedagogical infrastructure. Similar results can be explained for disagree, neutral and agree. Therefore at 0.05 level of significance, we reject the null hypothesis that, **Challenges of use of online pedagogical infrastructure have no influence on learning in MMUST**. This implies that indeed challenges of online pedagogical infrastructure affect learning in public universities.

Model 2 shows the results with the effect of interaction (intervening variables). The significant interaction terms indicates the slope of the assumed linear relationship between interaction variables (pedagogical approach factors, institutional material design factors and institutional factors) and challenges of online pedagogical infrastructure varies significantly between learning in public universities. The overall Wald for the challenges of online pedagogical infrastructure and interaction when the response was strongly agreeing is not significant (Wald = 0.822, df = 1, p = 0.365). The OR value is 0.958(95% CL, 0.00 – 0.004) which indicates that the odds of strongly agree on challenges of online pedagogical infrastructure decreases by 0.958 for each unit increase in interaction score. Similar results can be explained for disagree, neutral and agree.

Table 8

Test of Parallel Lines

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	694.328			
General	691.561	2.767	7	.906

Table 8 indicates that there may be some explanatory variables for which the ORs are not stable across different cumulative thresholds in relation to the response of challenges of online pedagogical infrastructure

($\chi^2_{(1)} = 2.767, df = 7, p = 0.906$).

V. CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

Online learning infrastructure has a positive association with learning, which means enhancing it can improve the learning process any public university. Online learning has been embraced at Masinde Muliro University of Science and Technology. However, the university needs to avail necessary resources that support online learning infrastructure to facilitate its learning processes. Despite having numerous prospects, there are also several challenges hindering the instruction from setting up a fully functional online learning infrastructure.

Challenges such as lack of administrative support, limited technological equipment, power fluctuations, and insufficient training should be resolved. Mobile learning stands a better opportunity to solve most challenges of online learning. Nevertheless, overall, the institution has done average work in establishing an online learning infrastructure and ensuring there is a directorate to manage it. Students and lecturers in the current study have a slightly positive attitude toward using online learning infrastructure, which is an improvement compared to similar findings from studies conducted before the emergence of Covid-19.

5.2 Recommendations

The study recommends that there is need for public universities to create partnership with the private sector to improve ICT infrastructure (hardware, software, and internet connectivity), build the necessary capacity, and standardize the online learning programs.

Mobile learning (m-learning) should be a focus for the university since most respondents indicated that smartphone devices are easily accessible to them, and they have confidence and skills in using it. Therefore, learning platforms customized for smartphone use should be considered appropriate for online learning. Policy makers need to formulate policies that promote online learning across universities locally and globally. Proper training on using the online learning infrastructure should be provided to faculty members and students to ensure they can use the available resources effectively and efficiently.

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