Post COVID-19 Analysis of the Status of online Infrastructure use by Public Universities in Kenya: The Case of Masinde Muliro University of Science and Technology

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ABSTRACT

The COVID-19 pandemic brought about a lot of interference in learning institutions. Universities were not spared by this pandemic, and this brought about a need to reconsider modes of learning which had all along been face-to-face. Online learning has proved itself as a promising instructional medium as well as a prime area for researchers to investigate its effectiveness on learning and pedagogy. COVID-19 provided an avenue to explore the use of technology in learning given that learning institutions were closed indefinitely. Online infrastructure refers to the hardware, software, and internet availability in learning institutions that promote distance education or e-learning. This study sought to establish the status of online pedagogical infrastructure in public universities with a focus on Masinde Muliro University of Science and Technology (MMUST). The study adopted a descriptive survey design. The study population comprised of staff and students of MMUST. Stratified sampling was used to get a sample size of 682 respondents from a population of 7690 using Yamane's formula. Data was collected using questionnaires, interviews, Learning Management System content analysis, and observations. Cronbach alpha coefficient of internal consistency was used as a reliability measure where alpha (α) = 0.833 obtained indicated the tools were reliable. Data collected was descriptively and inferentially analyzed. The findings show that online infrastructure has statistically significant effects on online learning in public universities ($t = 27.175$, $p < 0.05$) for students and $t = -1.015$, $p>0.05$ for lecturers. Nevertheless, findings showed that the available online pedagogical infrastructure in MMUST was not sufficient to facilitate online learning. Additionally, the findings indicate that the majority of the students and lecturers did not have access to the necessary online infrastructure. There was lack of a clear policy guidelines for online learning. These findings also showed that MMUST has inadequate requisite ICT infrastructure and skills to enhance the successful implementation of online learning. The study, therefore, recommends a need for public universities to create partnerships with the private sector to improve ICT infrastructure to build the necessary capacity and standardize online learning programs. It further recommends that Institution Policymakers need to formulate policies that promote effective online learning across universities.

Keywords: COVID-19, E-Learning, Learning Management System (LMS), Online Infrastructure, Online Learning, Pedagogy
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I. INTRODUCTION

Online learning infrastructure is a term that has been frequently used as a synonym of e-learning (Athabasca, 2021). In the current study, it has been used with reference to the hardware, software and internet availability in higher learning institutions that promote distance education or e-learning. Online learning has proved itself as a promising instructional medium as well as a prime area for researchers to investigate its effectiveness on learning and pedagogy (Churchil, 2011). Universities have been on the verge of adopting current technological approaches to learning and delivery of knowledge. COVID-19 provided universities with an avenue to explore technology use in learning given the social distance restrictions that were put in place by the government (Khadiza & Meher, 2022). Universities need to invest in technologies that can support learning online.

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. 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 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.

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, Sviatlana, E., Kasiet, & gulnara (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.

According to Aguti (2015), unless an institution reaches a certain level of technology excellence, trying to implement online learning with limited or unavailable facilities can be a rushed revolution that cannot materialize. Studies on online learning in the post COVID-19 era have indicated that higher learning institutions are faced with several challenges related to the availability of necessary equipment and resources to facilitate online learning. Most of the challenges are associated with financial constraints, limited technical skills, instructional material design skills, lack of operational e-learning policies, inadequate support to both students and lecturers using online learning platform, inadequate time for developing online learning resources, insufficient facilities, and a general lack of interest from both the students and the lecturers(Edith, 2015). Given such challenges, it is impractical for public universities to achieve successful online learning. This study therefore has sought to determine the status of online pedagogical infrastructure in the post COVID-19 era at Masinde Muliro University of Science and Technology (MMUST).

1.1 Problem Statement

Technological innovations have revolutionized learning, thereby providing many promises and opportunities (Ellie, 2018). Despite this, universities are faced with challenges that leave the stakeholders dissatisfied when such promises and opportunities cannot be realized. During the COVID-19 pandemic, it was realized that most learning institutions lacked the capacity to conduct online learning (Khadiza & Meher, 2022). This led to delayed learning due to lack of online infrastructure. Masinde Muliro University of Science and Technology is on the verge of setting up online infrastructure with the view to implementing online learning. However, it has not been exempted from challenges affecting educational technology adoption. The drawbacks witnessed are indicators to challenges of applying online infrastructures to facilitate e-learning. This study therefore sought to investigate the status of online pedagogical infrastructure at MMUST.

1.3 Objectives

This study was guided by the following objectives:
    (i) To establish the status of online pedagogical infrastructure in the university
    (ii) To determine the effects of using online pedagogical infrastructure on learning

II. LITERATURE REVIEW

Online infrastructure also commonly referred to as web application infrastructure or web infrastructure refers to the physical hardware, software, transmission media, and Internet connectivity that allows different users to communicate while separated by distance (BitPipe, 2021). The online infrastructure includes computers, Internet servers, cloud storage, web servers, Internet network equipment, and infrastructure software (software as a service). According to Alan, Paul, and Brian (2016), while choosing a suitable online infrastructure for eLearning, any learning institution needs to consider the

following: the need for online learning, policy development by the university or organization, structural and organizational issues, the system design, various supporting technologies, hardware and software components, interface designs, human resources, expertise, implementation decision making and the training of both students and lecturers.

George et al. (2017) carried out a study whose finding indicated that in the last decade, online learning systems have witnessed an increase in research and usage. The post COVID-19 era studies have also revealed that higher learning institutions tried to adopt online learning with very limited success (Hussain, 2016). Mason and Rennie (2006), Zin(2000) in their studies conducted in Britain, all found out that there is a challenge of educational infrastructure in African Higher learning institutions which are greatly affected by the unavailability of financial resources. This has derailed the acquisition of online learning infrastructures and therefore makes many institutions not consider online learning as an option for teaching. They also questioned the security of online learning platforms and safety of online users' details.

Mpofu et al. (2012) conducted a study in Zimbabwe which showed that 97.5% of the lecturers using online learning platform had no experience or training in online learning. Effective online learning demands that the teaching staff and the technicians must be properly trained to be able to avert the challenges of online learning. Without these skills, online learning poses greater challenges. A study conducted in Makerere University (MAK), Business School – Makerere, Kampala International University and the Islamic University in Uganda by Kasse and Balunywa (2013) assessed implementation of online learning in these institutions. These universities were picked because they were ranked high in terms of population, quality, and technology adoption. The study findings showed that online learning platforms were only used as a means of posting learning materials, with limited use in terms of conducting assessment, discussion, and effective learning. These universities had major technical and infrastructural incompetence crowned by attitudinal challenges by both lecturers and students.

Walimbwa (2018) conducted a study in three East African Universities; University of Dar es Salaam (Tanzania), University of Nairobi (Kenya) and Makerere University (Uganda). He observed that despite the rapid growth of online learning in developed countries and some developing countries, East African Universities were yet maximizing the potential of online learning. Lack of skills, insufficient trained manpower, lack of harmonized online learning policies, and unreliable internet were some of the limiting factors of e-learning implementation.

Odhiambo (2020) carried out a study at United States International University (USIU) and Jomo Kenyatta University of Agriculture and Technology (JKUAT) to compare the use of Moodle and WebCT platforms for online learning by the two universities with a focus on usability and interactivity. The findings showed that the use of variety of media like audio-visual graphics improves online learning which were not being used by the two universities in their online learning platforms. He further indicated that learner difference is a key factor to consider when designing materials to be used for online learning. The study was conducted because of the low acceptance and usage of online learning platforms by the two universities.

Mohammed (2020) conducted a study which found that the teaching staff agreed that there are a lot of challenges that they face in implementation of online learning. Some of the key challenges that he found included; lack of time required to develop e-learning content, lack of interaction between students and teaching staff, lack of time for preparing online exams or assignments, lack of awareness regarding ways to integrate relevant software into teaching, inaccessibility of powerpoint/pdf/data projection during lectures and finally inaccessibility to course notes/feedback about online materials.

From the reviewed literature it is evident that online learning faces a myriad of challenges which hinder its implementation. Most studies found the challenges to center around lack of finances for acquisition of online infrastructure, lack of skills for development, use and maintenance of online infrastructure, limited time for for content preparation and assessment, and unclear online learning policies. Few studies have so far focused on status of online pedagogical infrastructure in the post COVID-19 period.

III. METHODOLOGY

The study adopted a descriptive survey design. It examined the availability of relevant hardware, software and internet used by the University for Online learning; the confidence of students in using these technologies; and the role of management in providing support for online infrastructure use. The study population comprised of staff and students of

MMUST whose total number was 7600. Stratified sampling was used to get 397 students, 210 lecturers, 20 Odel Staff, 55 university management staff that formed a sample size of 682 respondents.

Primary data was collected using four research tools: in-depth interviews, questionnaires, observation guide and content analysis guide for the online learning platform. Two separate questionnaires were used: Survey Instruments for Students (SIS), Survey Instruments for Lecturers(SIL). Three interview guides were used to obtain data from Lecturers, ODEL technicians and Management. Observation guide was used to carry out nonparticipant observation as the students use the platform for learning. Content analysis was used to analyze the various components of the online learning platform.

The data collected was analyzed using frequencies, percentages, and standard deviations. Inferentially, correlation, T-Test, ANOVA and regression were used. Results were presented in tables, pie charts, and bar graphs.

IV. RESULTS

This research sought to determine the status of online pedagogical infrastructure in public universities in the post COVID-19 period.

4.1 Availability of Technology for Learning

The respondents were asked to state the availability of technology both at home and at the university. The results are as indicated in Figure 1.
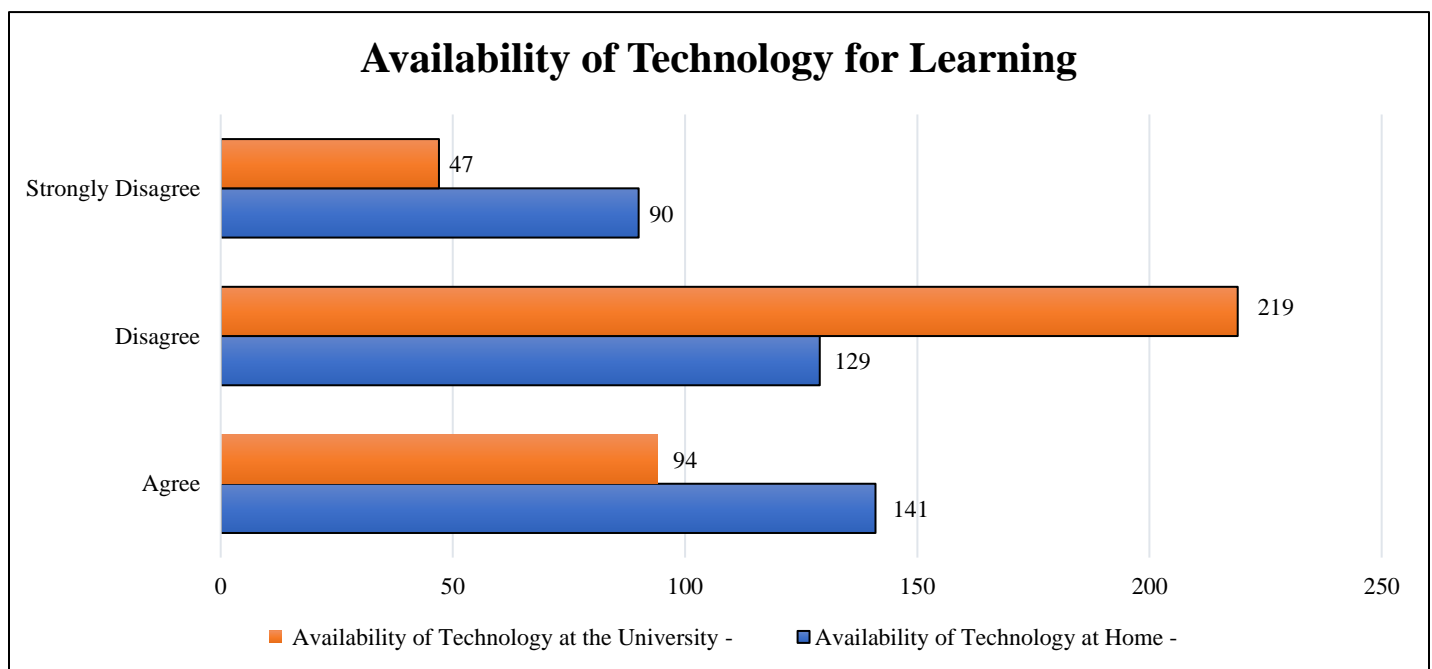

Figure 1
Availability of Technology at Home and University as reported by Students

From Figure 1, it can be observed that students have more access to technology at home rather than at the university. This is evident by 141 students who agreed that they have technology at home compared to 94 students who agreed that they have same technologies at the university. Similarly, 266 students disagreed that they have technology at the university to support indicating a general lack of technology. This supports that findings by Mohammed (2020) who also cited a general lack of technology at the university to support online learning. The same question was posed to lecturers and the results are as indicated in Figure 2.
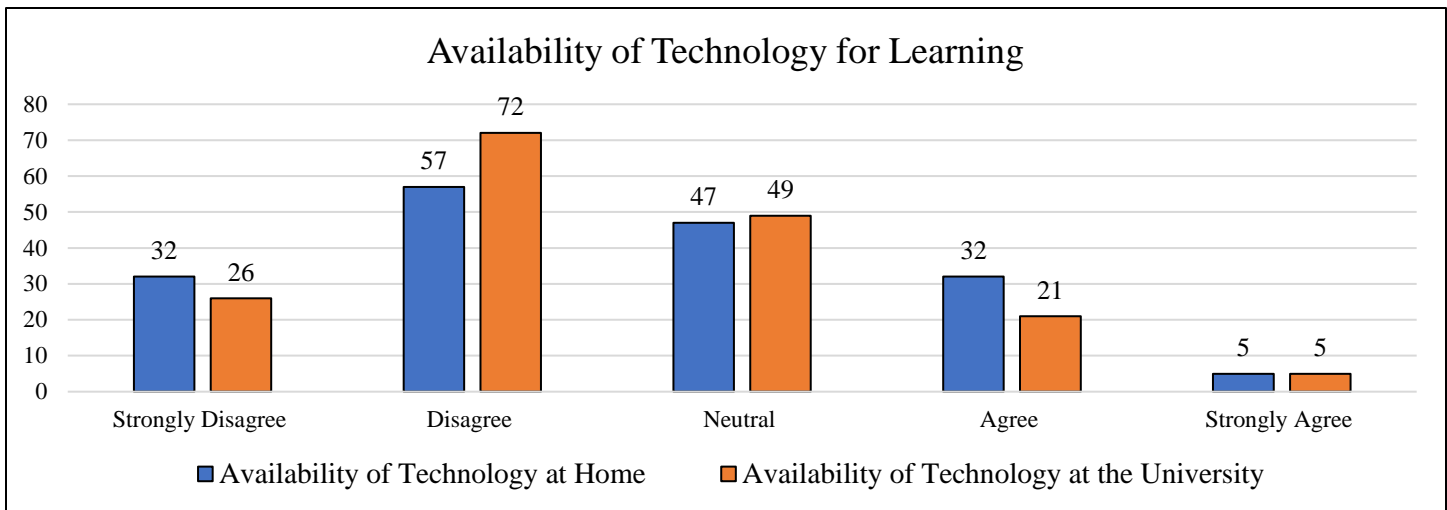
Figure 2
Availability of Technology at Home and University as reported by Lecturers

From Figure 2, it can be observed that lecturers have more access to technology at home rather than at the university. A total of 98 lecturers disagreed to having sufficient technology at the university while only 27 lecturers agreed that the university have sufficient technology. This collaborates findings by the students in Figure 1 and similarly collaborates the findings by Mohammed (2020). This indicates that the university has a limited online infrastructure for use by both students and lecturers. The observations in figures 1 and 2 imply that rolling out e-learning in universities might be a challenge due to the limited available technology for use in online learning. Similar conclusions were made by (Alham, 2021). The respondents indicated to have more access to technology in other places rather than at the university. This could imply that the university is yet to acquire adequate online infrastructure to implement online learning.

4.2 Accessibility of Online Infrastructure
The respondents were asked to indicate their level of access to various online infrastructure. Their responses ranged from strongly agree to strongly disagree and are as presented in Table 1.

Table 1
Students' Response on Accessibility of Online Infrastructure

Potential Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	Std.
Internet	-	142(39%)	-	103(29%)	115(32%)	2.47	1.297
Laptops	-	172(48%)	-	159(44%)	29(8%)	2.96	1.052
Printer	43(12%)	60(17%)	-	193(53%)	64(18%)	2.51	1.288
Smartphone	-	230(64%)	42(12%)	88(24%)	-	3.39	0.854
Ipad	32 (9%)	81(24%)	26(7%)	161(45%)	54(15%)	2.67	1.241
Tablet	23(6%)	111(31%)	25(7%)	155(43%)	46(13%)	2.75	1.203
Radio	66(18%)	195(54%)	-	75(21%)	24(7%)	3.57	1.197
Television	17(5%)	177(49%)	14(4%)	124(34%)	28(8%)	3.09	1.154
Desktop Computer	-	102(28%)	25(7%)	177(49%)	56(16%)	2.48	1.063
Composite mean and Std						**2.589**	**1.0329**

From the results in Table 1, 142 (39%) of the students agreed that they have access to the internet while 218(61%) disagreed. This however contradicts findings by (George & Mutisya, 2017) who indicated that an average of 50% of Kenyan university students have access to stable internet. The mean score was 2.47 with a standard deviation of 1.297 which shows that most respondents agreed that the internet is not easily accessible. The item mean was below the composite mean of 2.589 indicating a negative influence on the composite mean. The standard deviation for the item was also above the composite value of 1.0329 indicating a wider spread in response for the item than the variable. On whether laptops are easily accessible at home, 172(48%) agreed that the laptops are easily accessible from home while 188(52%) disagreed. BitPipe(2021) similarly found out that computers were general inaccessible to learners. The mean score was 2.96 with a standard deviation of 1.052, which shows that most respondents agreed that the laptops are not easily accessible. The item mean was above the composite mean of 2.589 indicating a positive influence on the composite mean. The standard deviation for the item was above the composite value of 1.0329 indicating a wider spread in response for the item than the variable. The results in table 1 imply that access to necessary technology to effect online learning was a challenge for the students.

4.3 Use of Online Infrastructure

The researcher sought to find out from students whether they use the listed online infrastructure. 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 2.

Table 2
Students' Response on the Use of Online Infrastructure

Potential Items	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	Standard Deviation
Internet	65(18%)	181(50%)	-	90(25%)	24(7%)	3.48	1.231
Laptop Comp.	48(13%)	186(52%)	-	113(31%)	13(4%)	3.40	1.164
Desktop Comp.	66(18%)	151(42%)	-	117(33%)	26(7%)	3.32	1.293
Smartphones	65(18%)	179(50%)	-	91(25%)	25(7%)	3.47	1.240
Ipad	-	247(69%)	56(15%)	-	57(16%)	3.37	1.089
Tablet	65(18%)	179(50%)	-	92(26%)	24(6%)	3.45	1.257
Printers	67(19%)	173(48%)	-	94(26%)	26(7%)	2.05	1.026
Composite Mean and Std. Dev.						3.22	1.186

In Table 2, the results show that majority, 246(68%), of the respondents agreed that they used internet while 114(32%) disagreed. The mean score was 3.48 with a standard deviation of 1.231 which shows that most respondents agreed that they have used internet. The item mean was above the composite mean of 3.22 indicating a positive influence on the composite mean. The standard deviation for the item was above the composite value of 1.186 indicating a wider spread in response for the item than the variable. This finding supports (Khadiza & Meher, 2022) who also indicated that there is high internet usage among most university students. On the use of laptop computer, 234(65%) agreed that they have used laptop computer while 126(35%) disagreed. The mean score was 3.40 with a standard deviation of 1.164 which shows that most respondents agreed that they have used laptop computers. The standard deviation for the item was below the composite value of 1.186 indicating a smaller spread in response for the item than the variable. This is similar to findings by Odhiambo (2020) who also found out that even though most students lack computing devices, they have skills to use them based on their past interractions.

The results also showed that 217(60%) of the respondents agreed that they have used desktop computers while 143(40%) disagreed. The mean score was 3.32 with a standard deviation of 1.293 which shows that most respondents agreed that they used desktop computers. The standard deviation for the item was above the composite standard deviation of 1.186 indicating a wider spread in response for the item than the variable. On the other hand, 244(68%) of the respondents agreed that they have used smartphones while 116(32%) of the respondents disagreed. The mean score was 3.47 with a standard deviation of 1.240 which shows that most respondents agreed that they used smartphones. The item

mean was above the composite mean of 3.22 indicating a positive influence on the composite mean. The standard deviation for the item was above the composite value of 1.186 indicating a wider spread. This implies most students have access to smartphones and have the skills to use them if online learning is properly integrated for their use. Salmon and Joanne (2022) similarly indicated that to achieve education on the move, there is need for adoption of m-learning as an alternative to computer-based learning given the ease of access. This makes it possible for them to embrace online learning whenever it could be rolled out. This is in line with Allan et al (2019) who indicate that there is a divide between the digital natives and digital residents with regard to online infrastructure use.

4.4 Confidence in using MOODLE

The study asked the participants to state whether they feel confident enough to study on their own in e-learning, which helped in assessing the status of online infrastructure in the institution. Findings of the study are as indicated in Figure 3.
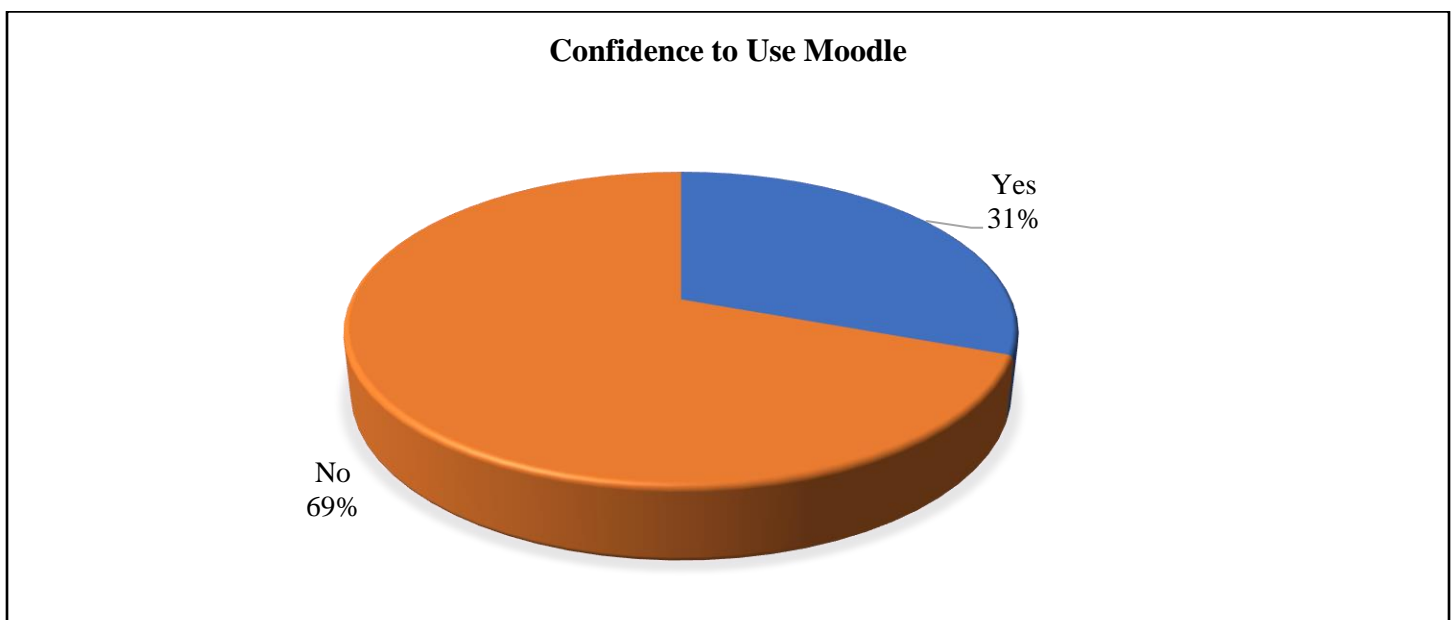

Figure 3
Confidence to Study on Your Own in E-Learning

The findings reported that 31% (123) of the respondents indicated that they were confident while 69% (274) were not confident enough to use MOODLE on their own for e-learning. This goes further to imply that students being a young generation are more confident to use technology for various activities including learning (Drexel, 2021)

4.5 Duration of Using MOODLE e-learning platform at MMUST

The study asked the respondents to indicate the duration they have used MOODLE e-learning platform at MMUST. The responses are as presented in Figure 4.
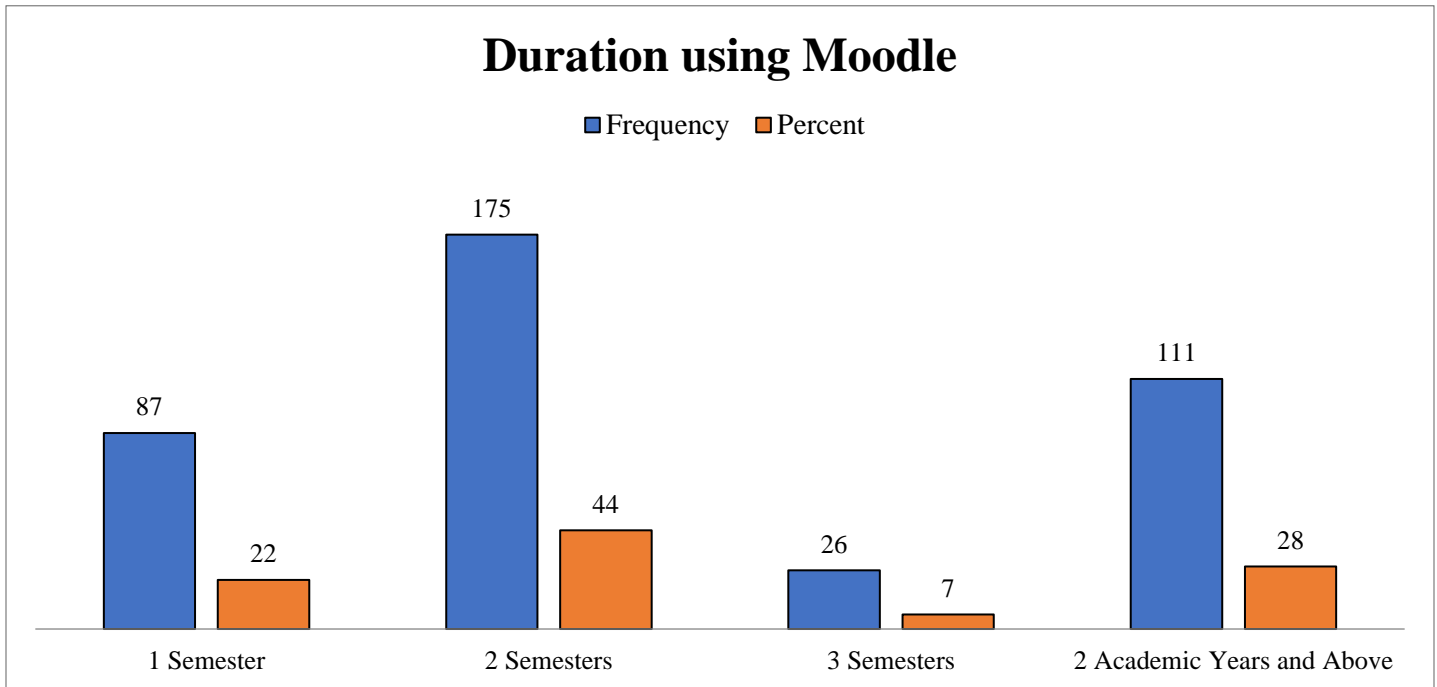
Figure 4
Duration of using MOODLE

Majority of the respondents 175 (44%) reported to have used the MOODLE e-learning platform at MMUST for 2 Semesters, 87 (22%) claimed to have used the platform for only 1 semester while 26 (7%) and 111 (28%) have used the e-learning platform for 3 Semesters and 2 Academic years respectively. This implies that even though learners exhume confidence in using Moodle and have access to technology at home, their use of MOODLE in the university is limited due to limited online infrastructure in the university. This could mean that only a few programs have been rolled out for e-learning in MMUST. This could be that the only time MMUST use MOODLE was during the pandemic. This is in line with the findings of (Alham, 2021) which indicated that there was higher adoption of e-learning in 2021 by universities and other higher learning institutions due to the COVID 19 pandemic.

4.6 MOODLE Examination
The participants were asked to state whether they had taken an examination online using MOODLE, which aimed at determining the status of online infrastructure used by the university. Findings of the study are as indicated in Figure 5 below.
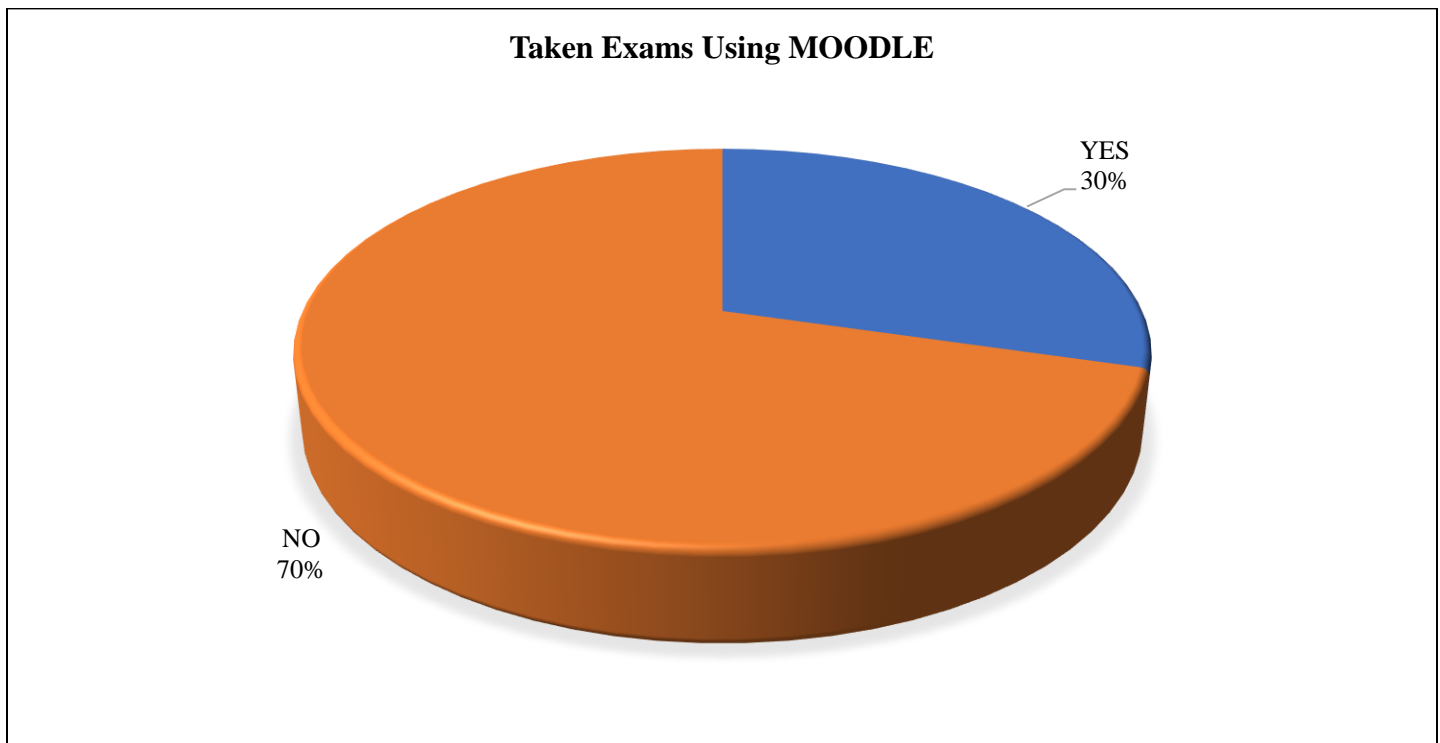
Figure 5
Taken Online Exams using MOODLE.

From Figure 5, 119 (30%) of the students reported to have taken an examination online using MOODLE while 70% (278) have never used MOODLE to do online examinations offered at the university. This implies that even though they are confident in using the platform, they learnt on the MOODLE platform for at most 2 academic years, they have not sat for any examination online. This points to the fact that despite the availability of the MOODLE platform, it has not been customized to effectively facilitate online examination and assessment. Similar sentiments were made by (Aguti, 2015) and (Drexel, 2021) citing in their findings that online examinations need to be properly proctored to be able to achieve a full dynamic learning program.

4.7 Effect of Online Pedagogical Infrastructure on Learning

The study sought to investigate the effect of the available online pedagogical infrastructure on learning at Masinde Muliro University of Science and Technology (MMUST). To establish this, a simple linear regression analysis was used. The following null hypothesis was tested at 0.05 level of significance.

H_{o1}: Use of Online Infrastructure has no effect on Learning.

The results are shown in Table 3.

Table 3a

Model Summary on Online Infrastructure Use on Learning

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1(students)	.821ᵃ	.673	.673	6.672
1(lecturer)	0.77	.346	.378	5.089
a. Predictors: (Constant), Online Infrastructure				
b. Dependent Variable: Learning in Public Universities				

Table 3b

ANOVA on Online Infrastructure Use on Learning

Model		Sum of Squares	Df	Mean Square	F	Sig.
1(students)	Regression	23040.311	1	23040.311	738.470	.000ᵇ
	Residual	11169.619	358	31.200		
	Total	34209.931	359			
1(lecturers)	Regression	26.676	1	26.676	1.030	.312ᵇ
	Residual	4428.712	171	25.899		
	Total	4455.387	172	Total	4455.387	172
a. Dependent Variable: Learning in Public Universities						
b. Predictors: (Constant), Online infrastructure						

Table 3c

Regression Coefficient on Online Infrastructure Use on Learning

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1(students)	(Constant)	-4.497	2.236		-2.011	.045
	Online infrastructure	.687	.025	.821	27.175	.000
1(lecturers)	(Constant)	28.388	1.285		22.100	.000
	Online infrastructure	-.210	.207	-.077	-1.015	.312
a. Dependent Variable: Learning in Public Universities.						

In Table 3a-c, using data from students' responses, a linear regression model was fitted to explain Learning in public universities on online infrastructure. All the assumptions of regression analysis were met. The overall model explains 67.3% variation and it is significantly useful in explaining Learning in public universities, $F (1, 358) = 738.470$, $p < .05$. With one-unit increase in online infrastructure, learning in public universities increases by .687, which was found to be a significant change, $t = 27.175$, $p < .05$. Therefore at 5% level of significance the null hypothesis was rejected. This implied that there is an effect between online infrastructure and learning in public universities. On the other hand, data from lecturers' responses was fitted to explain Learning in public universities on online infrastructure. All the assumptions of regression analysis were met. The overall model explains 34.6% variation and it is not significantly useful in explaining Learning in public universities, $F (1, 171) = 1.030$, $p > .05$. With one-unit increase in online infrastructure, learning in public universities decreases by .210, which was not found to be a significant change, $t = -1.015$, $p > .05$. Therefore at 5% level of significance the null hypothesis was accepted. This implied that there is no effect between online infrastructure use and learning in public universities.

From these findings, the opinion of lecturers and students differed significantly. This implied the great digital divide between the two generations. While lecturers feel that technology has no effect on learning students' fee otherwise. (Zozie, 2020). Online infrastructure was viewed favorably by students as the best tool that can enhance the delivery of instruction and self-paced learning, which is Learner centered. However, lecturers disagreed, indicating that they prefer face to face teaching. Students indicated a positive attitude towards accepting online infrastructure as a tool to be used for

learning while, lecturers demonstrated a mixed reaction on the adoption of online infrastructure for learning citing various challenges with use of online learning infrastructure.

V. CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusion

Online infrastructure can be one of the best strategies to be adopted for teaching and learning if well implemented. Public universities have not fully implemented online learning as a mode of pedagogy. This has been caused by the inadequate online learning equipment's, unreliable internet bandwidth, outdated and inadequate software and an un-upgraded LMS in the university. The T-test statistics points to a negative effect on lecturers while students have a positive effect. Students are willing and comfortable to embrace online learning however, lecturers prefer face-to-face learning as shown by the statistics ($t = 27.175$, $p < 0.05$) for students and ($t = -1.015$, $p > .05$) for lecturers. The status of online infrastructure available in MMUST is inadequate to implement online learning effectively. The university has an approach to establishing an efficient online infrastructure for learning, this has hampered online learning in uninspired the university making most lecturers to revert and prefer traditional face to face teaching. For successful online learning to be achieved, there is need for the institution to provide suitable environment where all the necessary resources are adequately provided.

5.2 Recommendation

It is therefore highly recommended that further studies with a focus on both private and public universities can be conducted to form a more concrete and effective plan for creating blueprints and policies for e-learning strategies. Lecturers should have continuous in-service training on emerging technologies so that the technophobia should not prevent such lecturers from using the online learning platform. The universities should set aside funds whose priorities are setting up a functional online learning infrastructure in the universities to enable the implementation of state-of-art hardware, softwares, research, awareness creation, capacity building and attitude change. This will facilitate ease in uptake of online learning. Before students can join universities, it should be mandatory that the students have a tablet, laptop computer, iPad to reduce the lack of necessary gadgets for learning. The government should make it a possibility through the higher education loans board to provide the students with computer loans that are payable upon employment. The university senate should approve the online learning policy and ensure that this is circulated to all the relevant stakeholders for proper guidance on online learning.

REFERENCES

Aguti, B. (2015). *A model to Facilitate Effective E-learning in Technology Enhanced learning environments within Universities*. Southampton SQ17, United Kingdom: Southampton University Press.

Alham, A. (2021). *Opportunities and Challenges of E-Learning in North America*. Dakota, USA: South Dakota State University, USA.

Allan, D., Paul, L., & Brian, S. (2019). Developing an Infrastructure for Online Learning. In D. Allan, *Effects of Online Infrastructure on Academic Achievements* (pp. 276-279). Manitoba, Canada: Red River College University Press.

Arun, G., & Vrishali, S. (2021). E-Learning in India: Wheel of Change. *International Journal of e-Education, e-Business, e-Management and e-Learning, 13*(9), 234-247.

Athabasca, U. (2021). *The History of Athabasca University*. Alberta: Accessed on [29/12/2021] from: https://www.athabascau.ca/aboutau/history.html.

BitPipe, S. (2021). *Internet Infrastructure Reports*. Accessed at: https://www.bitpipe.com/tlist/Internet-Infrastructure.html on [14th December, 2021].

Churchil, D. (2011). Web 2.0 in education: a study of the explorative use of blogs with a postgraduate class. *Innovations in Education and Teaching International, 48*(2), 149-158. https://doi.org/10.1080/14703297.2011.564009

Drexel. (2021, June 12). *The Benefits of Online Education in a Virtual Classroom*. Retrieved from https://drexel.edu/soe/resources/student-teaching/advice/benefits-of-online-and-virtual-learning/

Edith, H. (2015). *Insecurity in Kenyan Universities results into more students' deaths*. Nairobi: Retrieved from: https://www.reuters.com/article/us-kenya-security-college-idUSKBN0MT0CK20150403 [Accessed on 19th Feb. 2022].

Ellie, W. (2018, Aug. 14). *Life Long Learning Matters.* Retrieved from Cornerstone University: https://www.cornerstone.edu/blog-post/ten-ways-your-smartphone-can-help-you-learn/

George, L., & Mutisya, D. (2017). Status of e-learning in Public Universities in Kenya. *International Review of Research in Open and Distance Learning, 17*(3). https://doi.org/10.19173/irrodl.v17i3.2235

Hussain, A. R. (2016). *Infrastructure Requirements for E-learning Implementation and Delivery*. https://blog.commlabindia.com/elearning-design/infrastructure-for-elearning.

Joseph, M. (2019). Challenges of Educational Digital Infrastructure in Africa: A tale of Hope and Disillusionment. *Journal of African Studies and Development,* 59-63. https://doi.org/10.5897/JASD2019.0539

Kasse, J. P., & Balunywa, W. (2013). "Assessment of e-learning utilization by a section of Ugandan Universities: Challenges, Success factors and way forward." International Conference on ICT for Africa (pp. 565-569). Harare, Zimbabwe: ICT for Africa.

Khadiza, B. N., & Meher, N. (2022). Students' attitude towards online education system: A comparative study between Public and Private Universities in Bangladesh. *Journal of Social, Humanity, and Education (JSHE),* 167-183. https://doi.org/10.35912/jshe.v2i2.860

Mason, R., & Rennie, F. (2006). *Elearning: The Key Concepts*. Oxon, UK: Routledge Press. https://doi.org/10.4324/9780203099483

Mohamed, A. (2018). *The Role and Function of Theory in Online Education Development and Delivery*. Athabasca: Athabasca University Press.

Mohammed, N. (2020). The challenges and Prospects of Using e-learning among EFL Students in Bisha University. *Arab World English Journal (AWEJ), 11* (1), 124-137. https://doi.org/10.24093/awej/vol11no1.11

Mpofu, V., Samukange, T., Kusure, L. M., Zinyandu, T. M., Denhere, C., Huggins, N., & Sithole, F. (2012). Challenges of virtual and open distance science teacher education in Zimbabwe. *International Review of Research in Open and Distributed Learning, 13*(1), 207-219. https://doi.org/10.19173/irrodl.v13i1.968

Odhiambo, O. O. (2020, April 20). *Comparative Study on the e-learning platforms used in Kenyan Universities; Case Study of Jomo Kenyatta University of Agriculture and Technology (JKUAT) and United States International University (USIU)*. Retrieved from https://su-plus.strathmore.edu/bitstream/handle/11071/3261/Comparative

Sergey, K., Sviatlana, V., E., A., Kasiet, M., & gulnara, A. (2021). "Learning Path of Distance Education in Regional Universities: Challenges and Opportunities." XIV International Scientific Conference "INTERAGROMASH 2021".

Walimbwa, M. (2008). "Integrating e-learning in teaching and research in upcoming East African regional Universities." Paper presented at the meeting CNIE Banff. Alberta, Canada: Alberta Canada Press.

Zinn, K. L. (2000). *Computer-Assisted Learning and Teaching*. Chichester, UK: John Wiley and Sons Ltd.

Zozie, P. A. (2020). *Integrating e-learning technologies into conventional teaching and learning in the school and higher education system with scarce resources: A case study of Mzuzu University*. London: University of Glasgow.