

Effectiveness of Moodle in the Learning of Introductory Physics During COVID-19 Pandemic: A Case Study at the University of Zambia

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Abstract:- Electronic learning (E-learning) has become a popular method globally because of the advancements in communication, networking, and broadcast technologies. Not many studies have been carried out on the effectiveness of E-learning tools specifically using Moodle (Modular Object-Oriented Dynamic Learning Environment) platform during the COVID-19 pandemic in the developing countries. This paper presents the findings of an initial study that was undertaken to examine the students' level of knowledge towards E-learning using Moodle platform during the lockdown period in Zambia. It also aimed to assess the perception of students on the use and effectiveness of Moodle platform, a widely used open-source Learning Management System (LMS) in the learning of Introductory Physics. The study showed that the knowledge about E-learning among the Introductory Physics students at the University of Zambia is high (23%), medium (40%) and low (30%). The study results also indicate that despite Moodle's great potential, majority of the students (81%) who responded in the study mainly used it to access repository course materials. Different factors such as lack of internet access in some remote areas, network issues, cost, lack of training and enforced use of E-learning may have contributed to the negative perception on the effectiveness of Moodle for learning. The results of the study form a strong foundation for a more effective use of Moodle for teaching and learning of Introductory Physics and possibly other subjects.

Keywords:- E-learning, Moodle, Student's Perception, COVID-19

I. INTRODUCTION

The COVID-19 pandemic has affected the education sector worldwide and has impacted over 90% of the student population of the world [1]. The education institutions in affected countries are trying to confront the challenges brought about by the pandemic by engaging in diverse modes of technology to effectively disseminate knowledge to their students. The University of Zambia (UNZA) started online lectures through various E-learning platforms to ensure continuity of learning. The University of Zambia had already implemented the Moodle platform before the COVID-19 pandemic. However, the level of interaction among students and instructors using the platform were limited since the university followed the conventional method of face-to-face teaching. Due to the temporary lockdown of conventional educational mode, the University of Zambia adopted Moodle

as the primary E-learning platform for the delivery of lectures in undergraduate courses.

E-learning platforms represent systems which provide integrated support for six different activities: creation, organization, delivery, communication, collaboration, and assessment [2]. Several studies have reported the advantages of using E-learning platforms [3-5] and among them the Moodle is considered as the most used E-learning platform in higher education [6-8] ensuring their access only to enrolled students [9]. This platform allows the dissemination of learning materials among geographically dispersed students through synchronous and asynchronous communication.

In this study an attempt has been made to assess the perception of the students towards E-learning and on the use and effectiveness of Moodle platform in learning Introductory Physics during COVID-19 pandemic lockdown. In Zambia, studies [10] have been conducted to assess perception of students towards E-learning using other platforms but no study has been carried out to assess the use and effectiveness of Moodle in the learning of Introductory Physics at UNZA. The assessment of first year student's perception and knowledge towards E-learning is especially important as it would determine whether the students effectively use E-learning as this is the only option for them during COVID-19 pandemic.

II. RESEARCH METHODOLOGY

A. Sample Size Calculation

The University of Zambia has a total of 765 students registered for Introductory Physics course. This is a compulsory introductory course that is taken by students who want to pursue any Bachelor of Science degree at UNZA.

The sample of this research is calculated by using Taro Yamane formula [11] with 95% confidence level which is given as follows.

$$n = \frac{N}{1 + Ne^2}$$

where n = sample size required, N = population of the study and e = degree of error expected (0.05).

The sample size calculation yielded 262.66 students. To obtain reliable data, the sample size has been rounded to 263 students.

B. Data Collection Method

This study used a Cross-Sectional design through an online survey and was conducted at the University of Zambia. A sample size of 263 students was purposively sampled and google form questionnaires were used to collect data. Microsoft Excel 365 was used to analyze the data and descriptive statistics was used to report frequencies and percentages of student's level of knowledge of E-learning, the usage, effectiveness, and challenges of learning Introductory Physics using Moodle platform.

III. ETHICAL CONSIDERATION

Ethical values were considered in this study by obtaining an approval letter from School of Natural Sciences, University of Zambia. Consent was also obtained from the participants after explaining the importance of the study to them. Anonymity of the participants was maintained throughout the study.

IV. RESULTS

This section presents results on the perception of students on E-learning, use and effectiveness of Moodle platform for Introductory Physics lectures amidst COVID-19 pandemic at the University of Zambia. These results were obtained by administering a questionnaire to 490 students but only 454 students responded to the questions giving a response rate of 93%.

A. Socio-demographic

The socio-demographic data of this study included gender, age, marital status, employment status and place of residence as presented in Table 1. Out of a total of 263 respondents, 28 % were males and 72% were females. The data revealed that 41% of the respondents belonged to the 15-19 age group, 56% belonged to 20-24 age group and 3% were above the age of 25. Data on other information such as marital status, employment status and place of residence were shown in the Table 1.

Table 1: Socio-demographic characteristics of the students (n=263)

Variables	Category	Percentage
Gender	Male	28
	Female	72
Age	15 – 19	41
	20 – 24	56
	25 – 29	2
	30 and above	1
Marital status	Single	99
	Married	1
Employment status	Full time	1
	Part – time	2
	Unemployed	97
Place of Residence	Lusaka	46
	Outside Lusaka	54

B. Level of Knowledge Students have on E-learning

The information regarding the level of knowledge, the training obtained from the institution, access of internet, devices used and their general usage on the internet were collected and tabulated in Table 2.

Table 2:- Level of knowledge students have on E-learning (n = 263)

S No.	Variables	Category	Frequencies	Percentages
1	Have you ever used E- learning platform before COVID – 19 pandemic?	Yes	30	11
		No	233	89
	If your answer is ‘no’, then how did you come to know about E- leaning?	Internet	14	6
		Learning Institution	162	70
		Friends	50	21
		Others	7	3
	If your answer ‘yes’, how do you rate your knowledge about E-learning based on the key?	High	7	23
Medium		12	40	
Low		11	37	
2	Have you been trained by your institution on how to use E-learning for lectures?	Yes	73	28
		No	190	72
3	Do you have access to internet for online classes?	Yes	171	65
		No	92	35
4	How effective is your internet provider?	Very bad	42	16
		Bad	126	48
		Good	85	32
		Very Good	10	4

5	Which device do you use for online lectures?	Smartphone	223	85
		Computer	23	9
		Tablet	5	2
		Others	12	4
6	How often do you use internet?	At least once/day	175	67
		At least once/week	82	31
		At least once/month	6	2

The results shown in Table 2 were extracted and are presented in bar graphs (Figure 1 and Figure 2) as well as on pie-charts (Figure 3 and Figure 4).

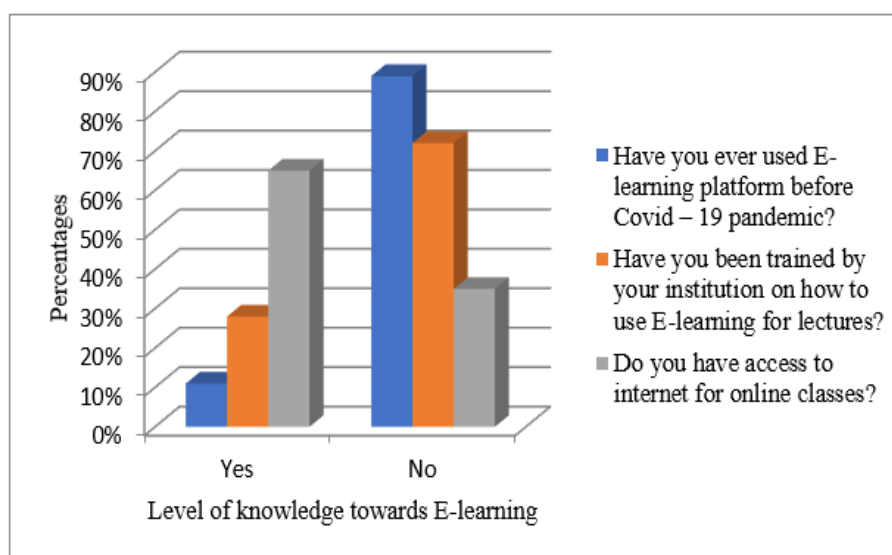


Fig 1:- The Level of knowledge students have on E-learning.

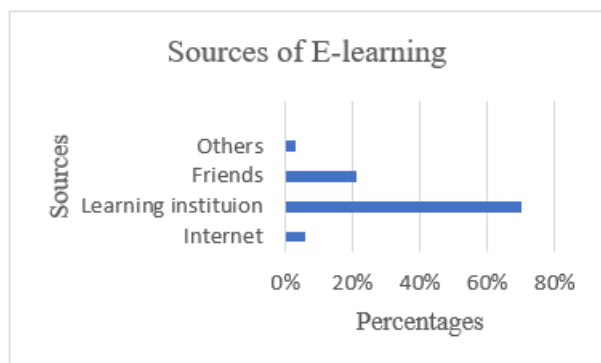


Fig 2:- Sources of E-learning for students

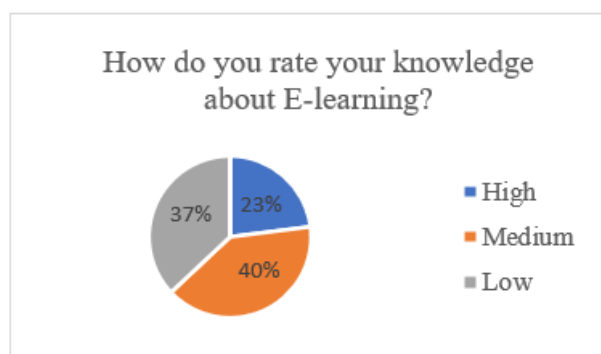


Fig 3:- Previous knowledge towards E-learning

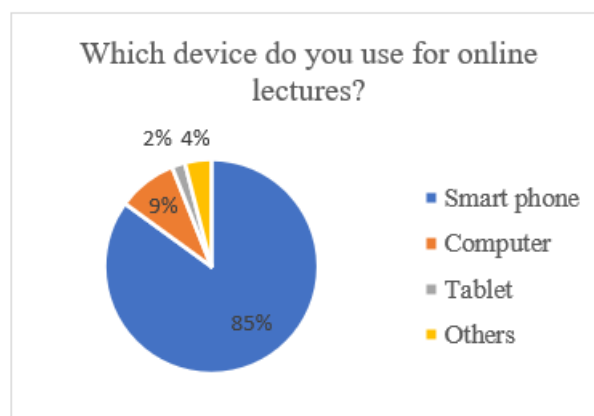


Fig 4:- Devices used for E-learning

C. Students Perceptions about the usage of Moodle Platform for Online Lectures

Table 3 gives a detailed summary of student's perception on ten variables for evaluating the usage of Moodle platform that were important in the study. In particular, the participants provided information related to the ease of use, purpose and the commonly used components of the Moodle platform.

Table 3: Students perceptions about the usage of Moodle platform for online lectures ($n = 263$)

S No.	Variables	Category	Frequencies	Percentages
1	What is the reason behind accessing online lectures in Physics during the lock down period?	For completing the regular program which basically has face to face teaching	97	37
		For completing the online assignments/quizzes only which is an important evaluation component	154	59
		For upgrading the skills in technology	12	4
2	Which communication platform is used for online lectures?	Zoom	7	3
		Skype	0	0
		You-tube	0	0
		Moodle	247	94
		Google classroom others	1 8	0 3
3	What is the main purpose of using Moodle platform for E-learning?	Download materials	200	81
		See announcements	4	1
		Deliver assignments	31	13
		Communicate with lecturers	12	5
		Ask questions	0	0
4	How user friendly is Moodle platform?	Very user friendly	41	17
		Somewhat user friendly	162	65
		Not user friendly	44	18
5	How is E-learning conducted at your institution?	Watching pre-recorded videos of the lectures	2	0.76
			6	2.26
		Having live lectures via the internet	1	0.38
		Listening to pre-recorded audios of the lectures	254	96.6
		Reading posted lecture materials		
7	Is it easy to download learning materials using Moodle platform?.	Yes	177	67
		No	62	24
		No response	24	9
8	Is it easy to write and submit an online quiz for assessment purposes using Moodle	Yes	93	35
		No	134	51
		No response	36	14
9	Are workloads heavier during online lectures?	Yes	207	79
		No	56	21
10	Has E-learning reduced the amount of interaction with your instructors (consultation times/ clearing doubts etc)?	Yes	240	91
		No	23	9

Figure 5 gives a summary in bar chart form of the responses given by the students for the purpose of using Moodle in learning Introductory Physics. Figure 6 represents a pie-chart showing the ease of use of Moodle platform by the students.

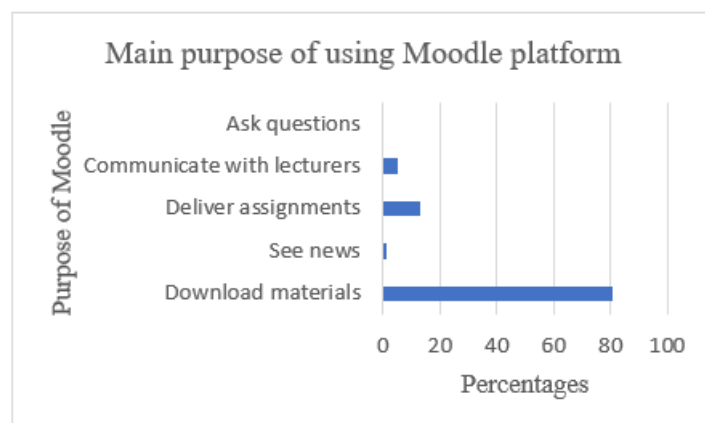


Fig 5:-Percentage of Introductory Physics students using Moodle for different purposes

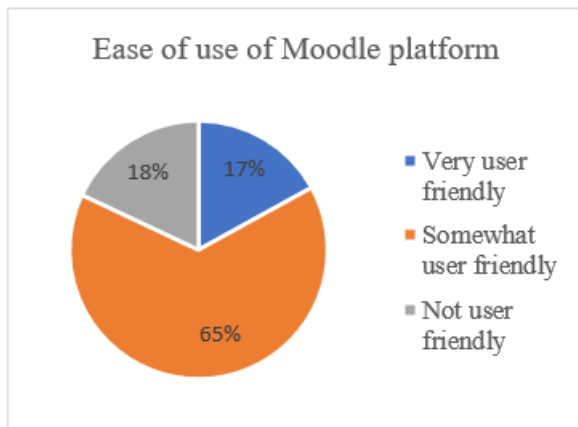


Fig 6:- How friendly Introductory Physics students found Moodle to be

V. DISCUSSION

The study assessed students' perceptions towards E-learning and the use and effectiveness of Moodle platform for Physics online lectures amidst COVID-19 pandemic.

A. Level of Knowledge Students have on E-learning and their Access and Usage of Internet for Online Lectures

The results revealed that most of the participants (89%) have not used E-learning platforms before COVID-19 pandemic and only 11% had used it earlier. Out of 89% of students who have not used E-learning platforms before the lockdown period, 70% came to know about E-learning through the learning institution after Covid-19 lockdown had started. This was followed by 21% who knew about E-learning through friends, 6% knew about it through internet and 3% knew about it by other means.

A good number of students (72%) reported that they were not trained by the institution on how to use the E-learning platform while 28% received training from the institution. The onset of COVID-19 compelled the university to quickly adopt online delivery of lectures without offering proper training to students. The university was able to provide training to instructors through workshops and face-to-face lectures on the features of Moodle. However, many students in developing countries, especially the younger and minority groups were not used to online learning platforms as this mode of education started after the onset of the pandemic and lockdown [12]. Studies have shown that hindrances such as student's level and lack of skills in computer can affect their attitudes towards E-learning [13].

Table 1 revealed that 65% of the students have access to internet for online lectures while 35% have no internet for online lectures. 64% of the students were not happy with the internet provider and only 36% were happy with the services. This shows that lack of sufficient internet connectivity in remote areas of Zambia is one of the most serious challenge impeding the adoption any E-learning platform.

The most used electronic devices by the students were smartphones (85%), followed by computers (9%), tablets (2%) and others (4%). Further, 67% of the students used the

internet at least once a day, 31% at least once per week and 2% at least once per month. The common use of smartphones by the students can be attributed to the fact that they are affordable and provide fast access to knowledge to meet their information needs via online platforms. As smart phones have all the advanced functions, students may not necessarily need a computer which is more expensive, to access electronic learning materials. Studies [14, 15] show that students use smartphones as learning aids due to many reasons such as convenience to access online learning platforms, millions of downloadable applications, and digital interaction.

B. Student's Perceptions about the usage of Moodle Platform for Online Lectures

In this sub-section the usage of the Moodle platform by the Introductory Physics students at the University of Zambia were analysed to find out the ease of use and purpose of the accessing the lectures.

The students were asked about the general reason for accessing online lectures in Physics during the lock down period and 59% of the students responded that they accessed the lecture materials for completing the online assignments and quizzes only which is an important evaluation component of their course. This was followed by 37% who said they accessed the lectures to complete the regular program which basically has face to face teaching and 4% accessed the lectures to upgrade their skills in the technology. Most education systems in developing countries were grossly underfinanced even before the corona virus crisis and in Zambia education financing depends heavily on households. The corona virus induced recession which led to loss of jobs and income for parents and poor families have to make extraordinary efforts to support their children in education. Relying on online lectures is challenging as many students do not have essential internet availability and affordability, making E-learning a distant prospect for most students.

As shown in Table 3, the response of the students indicate that the common communication platform used for online lectures was Moodle (94%), followed by Zoom (3%) and others (3%). The onset of COVID-19 compelled the students to use Moodle which was the primary E-learning platform adopted by University of Zambia. Some lecturers used other platforms like Zoom and others for solving problems on tutorial sheets.

The students used the Moodle platform mainly to download materials (81%), followed by delivery of assignments (13%), while 5% used Moodle to communicate with lecturers and only 1% used the platform to receive announcements from the lecturers. The study also revealed that 96.6% of E-learning Physics lectures were conducted by posting lecture materials, followed by live lectures (2.26%), pre-recorded videos of the lectures (0.76%) and 0.38% by pre-recorded audios of the lectures. Posting materials on Moodle platform was the most common method of lecture delivery at University of Zambia because of the difficulty to prepare audios and videos amidst COVID-19 pandemic. Conducting live lectures using internet was not possible during this unprecedented time as many students have no

access to internet and devices to work with. These results can be interpreted that Moodle was being mainly used as a repository of materials and information. Similar results were reported by [16] where a study was conducted on forty-six engineering students to evaluate the effectiveness of the Moodle-based E-learning system at the German Jordanian University, Jordan.

The Moodle platform provides a series of communication facilities such as forum, chat and feedback and so on. The forums allow the instructors and students to communicate in an asynchronous manner and the chat system provides the opportunity of synchronized communication. The message system allows private communication between users. The study clearly shows that even though this platform has such great potential, the students were completely unaware of such practical applications this platform provides.

65% of the students said that Moodle is somewhat user friendly and 18% reported that it is not user friendly. 17% of the students believed that Moodle is very user friendly. These passive and mixed responses can be attributed to the fact that the use of Moodle as an E-learning tool for learning Physics is an unconventional method and students were used to face-to-face learning which is a more conventional mode of studying the subject.

67% of the students admitted that it is easy to download learning materials using Moodle platform and 24% had problems in downloading materials. 9% did not respond to this question. These figures correlated well with the results from the previous section where only 65% of the students had internet access for online lectures and 35% lacked internet access. Studies have shown that slow and meagre internet facilities often make students develop a negative attitude regarding online learning [17].

Just more than half of the students (51%) had a negative perception while 35% had a positive perception towards online tests/assessments using Moodle platform and 14% did not respond. Students living outside of Lusaka (54%) may have experienced poor access to internet and interruptions in power supply. This in effect could have made it difficult to submit their online assessments on time and hence created a negative perception towards online tests/assessments on the Moodle platform.

Interactions play a vital role in the effectiveness and success in the administration of any E-learning platform. Three types of interactions namely learner-instructor interaction, learner-content interaction and learner-interface interaction were examined in this study. The learner-instructor interaction can take the form of face-to-face exchange between instructor and learner during live lectures as well as both synchronous and asynchronous digital communication online. This type of interaction is intended to help reinforce student's understanding of the subject. A vast majority (91%) of the students reported that E-learning using Moodle platform has reduced the amount of interaction with their instructors in terms of consultation times and clearing

doubts with only 9% of the students being contented with electronic communication during online lectures.

The actual live lectures using Moodle platform for Introductory Physics was only 2.26%. There was practically no learner-instructor interaction in terms of asking and answering questions. Additionally, unstable internet connection for students could have restricted them from asking questions. In comparison to the investigation by [18] the use of an online discussion forum in an introductory Biology course resulted in students asking questions. They gave an extra credit to those students who used the online discussion forum to pose at least 4 or 5 meaningful questions during each semester. Our results show that more live lectures should have been given for a better learner-instructor interaction because of large number of students.

Another point to take into consideration is that students want answers from the instructors as soon as possible [19] and hence timely feedback is paramount in E-learning. As most of the academic staff have other responsibilities to attend to a daily basis, instructors are unlikely to be able to pay attention to the online forum all the time and this results in a delay in response from instructors. This could have created a negative perception of students regarding learner-instructor interaction. This problem can be overcome to a certain extent if there was at least one instructor permanently online to answer student's questions as fast as possible. Obviously, this would result in an increasing demand of instructor's dedication time for each course which is not easy to accomplish at University of Zambia as many instructors have more than two courses to teach. Studies [20] show that the instructor must monitor the discussion forum from time to time to maintain the quality of the discussion.

The student-content interaction refers to student engagement with course resources or subject of study. [21] defined it as the process of intellectually interacting with the content with impacts in learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind. The 'external tool activity module' on the Moodle platform enables the students to interact with learning resources and activities on other web sites. Accessing and downloading the course materials from home was reported as satisfactory for most students (67%) while some students encountered a few serious barriers such as limited internet access and intermittent power supply. The study [22] found that three general factors—clarity of design, interaction with instructors, and active discussion among course participants—significantly influenced students' satisfaction and perceived learning.

The learner-interface interaction refers to the interaction between student and the E-learning platform in learning process. Some factors that affect the learner-interface interactions include design of the E-learning platform, computer literacy and experience of students, perceptions on technology, and access to technology [23]. Also, the complexity in interacting with the technology in E-learning platforms may lead students to view technology negatively, and so affecting their learning process. The study revealed

that the student-interface interaction was extremely limited, and the primary interactive features of Moodle platform were underutilized by the students.

The study [24] showed that “perceived use, perceived convenience, and perceived usefulness had significant positive impacts on attitude towards using Moodle and that continuance intention to use Moodle was directly influenced by the users’ attitude towards the act of using Moodle”.

VI. CONCLUSIONS AND RECOMMENDATIONS

In this paper, a questionnaire-based study was conducted with two hundred and sixty three first year Introductory Physics students at the University of Zambia to evaluate the level of knowledge students have towards E-learning and their access and usage of internet for online lectures. The study also identified the main functionalities and tools of Moodle platform used by the students at the University of Zambia.

The successful use of E-learning platforms critically depends on the students having knowledge about the tools, being aware of how they should be used and being capable of accessing the platform from anywhere. The UNZA MOODLE contains some of the main tools of the standard Moodle platform like Assignments, Chats, Forums, News and Quiz/Survey. But the analysis of the students’ answers revealed that the most mentioned purpose of the use of the UNZA MOODLE by students were ‘Download materials’. The other interactive learning tools of Moodle were not effectively utilized.

To elicit more student’s involvement in Moodle, our study recommends that the students should be trained on how to use the platform at the beginning of the first year. The University management has an excessively big role to play in sensitizing both the academic staff and students on the use of Moodle platform. The University management should organize seminars and workshops for giving practical training to enrich students’ skills regarding the use of Moodle platform and E-learning platforms in general. Such training would increase student’s confidence with the computer and introduce them to skills and opportunities they do not have for E-learning.

The instructors also have to play a major role of creating interactive activities that facilitate the students’ learning to motivate them in using the platform more beneficially. As this study was undertaken during the COVID-19 pandemic, the question of developing the content becomes even harder for the academic staff because they have to set aside time to develop the electronic learning content and upload it in the Moodle when they were away from campus. In future, the academic staff will be motivated to use E-learning platform if management provide incentives such as promotion and recognition for creating and participating in various E-learning activities.

The paper also discloses the extent of poor online course design and lack of virtual interactivity among instructors, students, contents and interfaces of the platform. The communication was limited as Moodle was used just for repository of all the learning materials. The study deduced that unreliable internet connectivity is one of the major challenges facing the usage of Moodle by students and instructors. To bridge the interactivity gaps, the University should increase the resources reserved by providing good internet infrastructure to both instructors and students. The lecturers are encouraged to find out how the students feel and to identify gaps to bridge and take full advantage of E-learning opportunities.

While it is important to conduct a comprehensive research, this study is limited to a target population of first year Physics students and focused on making accurate conclusions. One of the major limitations in this study was that it addressed a single subject. Failure to conduct face to face interviews with students amidst the COVID-19 pandemic is another limitation of the study. Even though it is not justifiable to compare different subjects/courses as each subject/course has its own type of content and level of difficulty, still it is recommended to extend this study to other subjects/courses in the School. One other limitation of the study was that few variables such as the ease of use, purpose and usability of Moodle platform were used in the study to evaluate the effectiveness of the platform. Despite limitations listed above, it is believed that this study offers firm indications about the student’s perceptions and current state of E-learning using Moodle platform at the University of Zambia in handling Introductory Physics. It is hoped that the work will contribute significantly to the growing literature on E-learning in Zambia. It is suggested that a follow up study be conducted in other courses in the Department of Physics to investigate on the underlying reasons for the negative views presented by the students regarding problems and challenges of Moodle platform.

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