Usability Evaluation of Learning Management Systems in Public Universities in Uganda: Lecturers' Perspectives

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Abstract

Recent studies in Uganda show that Learning Management Systems (LMS) were not usable, and some were complex to use, making it difficult for lecturers to use the platforms. As a result, there has been low uptake and usage of LMS in many universities. To investigate this claim, the study set out to evaluate the usability of LMS in four public universities in Uganda, namely Makerere University, Makerere University Business School, Busitema University and Gulu University. Google Docs was used to design a System Usability Scale (SUS) which was used to evaluate the usability of the LMS in the four public universities. An open-ended questionnaire was also included in the SUS to capture qualitative data. This questionnaire was sent to different staff mailing lists in the four universities. A total of 80 questionnaires were filled and analyzed. The findings showed that the average System Usability Scale score for the LMS used in the four public universities was 60, representing about 30% usability, which is poor. The study identified several usability challenges and ways to address the usability challenges. This paper, therefore, presents an IDSS usability model for improving LMS usability in learning institutions.

Keywords: *Learning Management Systems; Public universities; Usability.*

Introduction

On 11 March 2020, the World Health Organization (WHO) declared COVID-19 a global public health pandemic (Cucinotta, 2020). Since then, the virus has crossed multiple borders, which has led to a devastating impact on government institutions, businesses, and households across the globe. Due to the highly infectious nature of the virus, many countries agreed to temporarily close various sectors of the economy to control its spread. Educational institutions were among the most affected by this action. A report byUNESCO revealed that schools in over 190 countries were partially or fully closed due to the pandemic. This affected over 1.6 billion learners, which is about 60% of the world'sstudent population (UNESCO, 2020). The partial or full closure of educational institutions as a result of the coronavirus pandemic caused a massive lag in education systems worldwide.

There was, therefore, an urgent need to find solutions to the educational challenges brought about by the pandemic. Governments all over the world had to come up with a more pragmatic approach. One of the approaches that gained massive prominence was the use of ICT to aid off-campus learning. Many governments scrambled for ICT as the only solution to aid learning. This led to a surge in ICT investment (Adedoyin, 2023). The Government of Uganda, for example, considered adopting virtual learning for all its learners at different levels. The government's initial investment in virtual learning for students was worth USD 113 million. The Ugandan cabinet also approved the distribution of 10 million radio sets to an estimated 10 million households in the country worth USD 100 million (Medard, 2021). At university level, several online Learning Management Systems (LMS) were implemented to facilitate off-campus learning. Various educational institutions in sub-Saharan countries embraced online LMS.

The Use of LMS in Universities in Sub-Saharan Africa

While several universities in sub-Saharan Africa had implemented online LMS before the outbreak of the coronavirus, its uptake was largely low because of several coherent associated challenges. Maloma (2023) and Mtebe (2015) report that while the adoption of LMS was largely successful in developed countries, its uptake in sub-Saharan Africa has been very low, majorly as a result of usability challenges. Studies showed that usability challenges made up the biggest category of challenges affecting LMS in sub-Saharan Africa. For example, a study showed that 54% of interviewed Moodle users at the Open University of Tanzania indicated that the system was difficult to use, especially in uploading learning materials (Bhalalusesa, 2023; Bhalalusesa, 2013).

Another similar study conducted at Makerere University in Uganda found that 84.4% of students and 79% of faculty members indicated that the LMS was not easy to use (Mayoka, 2012). Yet another study conducted at the University of South Africa revealed that several usability problems hindered students from using the LMS (Mabila, 2014). As a result of these serious usability problems, Maloma (2023) and Mtebe (2015) observed that there was low uptake of LMS in many sub-Saharan African universities. For example, studies showed that only 20% of trained users were using LMS at the National University of Science and Technology of Zimbabwe (Dube, 2014). Similar studies also revealed that there was low uptake of LMS in universities such as Maseno University in Kenya,

Mondlane University in Mozambique, University of Zambia and four leading universities in Zimbabwe (Chitanana, 2008; Ssekakubo, 2011; Unwin, 2010).

When the world was struck by the COVID-19 pandemic, there was a widespread push by different institutions to embrace LMS. This exacerbated LMS usability challenges. A recent study conducted at Muni University, Mbarara University of Science and Technology, Makerere University, Gulu University and Busitema University, all in Uganda, discovered that some LMS were not usable and some were complex, making it difficult for lecturers to use the platforms (Bhalalusesa, 2023; Bwire, 2020). Bhalalusesa (2023) also conducted a usability study on the LMS used at the National Institute of Transport in Tanzania and found that the tutors encountered usability problems related to navigation, content, layout, interaction, feedback, help and support. Therefore, from the above studies, it can be seen that usability plays a pivotal role in the uptake of LMS. It is a very important aspect considered while evaluating an e-learning system and, therefore, an investigation of usability and its integration or contribution to the learning process is worthwhile (Maloma, 2023; Mtebe, 2015).

Usability

Several usability scholars have proffered different definitions and attributes of usability. For example, Michelle (1999) attributes usability to successfully learning and using a product to achieve a goal; while Dumas (1993) defines usability as performing tasks quickly and easily. Barnum (2020) and Rekha (1999) attribute usability to effectiveness, likeability, learnability and usefulness of a product. Nielsen (2012), on the other hand, defines usability as a quality attribute that assesses how easy user interfaces are to use in terms of five factors or components, namely learnability, efficiency, memorability, errors and satisfaction. However, for this study, we have adopted ISO9241-11:2018(en)'s definition as our working definition. According to the revised definition of usability in ISO9241-11:2018(en) , usability is the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. ISO defines effectiveness, efficiency and satisfaction thus:

- *Effectiveness* means "accuracy and completeness". It can be measured by using two usability metrics: the success rate, also called completion rate (the percentage of users who were able to complete the tasks successfully), and the error rate (number of errors made while accomplishing a goal).
- *Efficiency* means "resources expended" and how quickly a user can perform work. Efficiency is about the resources (such as time or effort) needed by users to achieve their goals. It is the time (in seconds and/or minutes) the respondent takes to complete a task.
- S*atisfaction* means the extent to which expectations are met. It is important that users are satisfied with their experience.

According to Melis (2003), e-learning usability consists of two aspects, that is, technical usability and pedagogical usability. Technical usability involves methods for ensuring a trouble-free interaction between the user and the system, while pedagogical usability aims at supporting the learning process to achieve the learning objectives. It is usability from the viewpoint of learning and teaching. Both aspects of usability are intertwined and tap

the user's cognitive resources. Usability is considered one of the most important quality attributes, being a fundamental aspect of all software products. It is even more crucial in those systems that are designed for a wide variety of users (Guerrero, 2018)

Poor usability can reduce productivity. Flawed interface design, for example, can make it difficult for users to perform tasks correctly and with confidence (Koskie, 2022). It is the reason Mbete (2015) recommends that usability assessment of LMS should be conducted regularly because it is a critical factor in determining LMS usability problems. Determining and fixing such usability problems will increase LMS usage because many users will find the systems easy to learn, easy to use and user-friendly (Mbete, 2015). It is from this point of view that the study aimed to assess the usability of LMS in four public universities in Uganda and provide a usability model for improving LMS in universities in the country. To achieve this, four objectives were formulated as follows:

Objectives of the Study

Given the research problem identified above, this research sets out to:

(i) Assess the usability of LMS in universities in Uganda.

(ii) Investigate the usability challenges affecting different LMSs.

(iii) Identify ways in which these usability challenges can be addressed to bolster the uptake of LMS in Uganda.

(iv) Develop a usability model for improving LMS usability in universities in Uganda.

Research Methodology

Objective 1: To assess the usability of LMS in universities in Uganda using the Simple Usability Scale (SUS)

To assess the usability level of LMS in public universities in Uganda, a Simple Usability Scale (SUS) was used. The System Usability Scale (SUS) is a standardized metric used to measure the usability perception of computer interfaces and a wide range of products and systems (Sauro, 2011). SUS is a simple, ten-item Likert scale type of questionnaire based on forced-choice questions, where a statement is made and the respondent then indicates the degree of agreement or disagreement with the statement on a 5- (or 7-) point scale. The ten-item Likert scale was designed on Google Form and presented to the respondents, who responded by either agreeing or disagreeing (based on a Likert scale of 5, that is, Strongly disagree, Disagree, Neutral, Agree, Strongly agree) with the following statements:

1. I think that I would like to use this LMS frequently.
2. I found the LMS unnecessarily complex.
3. I thought the LMS was easy to use.
4. I think that I would need the support of a technical person to be able to use this LMS.
5. I found the various functions in this LMS were well integrated.
6. I thought there was too much inconsistency in this LMS.
7. I would imagine that most people would learn to use this LMS very quickly.
8. I found the LMS very cumbersome to use.

9. I felt very confident using the LMS.
10. I needed to learn a lot of things before I could get going with this LMS.

Objective 2: To investigate the usability challenges affecting different LMS

To investigate usability challenges, another set of closed-ended …….. designed based on a Likert scale of 5 (Strongly agree, Agree, Neutral, Disagree, Strongly disagree). These questions were separate from the SUS scale questions but put in the same questionnaire. The questions helped to collect the different responses on the challenges affecting usability in LMS in the four universities.

Objective 3: To identify ways in which usability challenges can be addressed

To identify ways of addressing the usability challenges of LMS in the four universities, a set of open-ended questions was administered to determine ways in which the usability challenges can be addressed. Open-ended questions are, as opposed to closed-ended questions, non-directive and allow respondents to use their terms and direct their responses at their convenience.

Sample Selection

Convenience sampling was chosen as the study sampling technique because of its time and cost convenience. Four out of the seven authors of this paper are staff of the four universities that were considered for the study. It was convenient for them to collect data from the universities in which they were employed. Google Form was used to design the data collection tool, which was sent to the different staff mailing lists in the four public universities. The minimum sample for a valid usability assessment or evaluation of a product or service is five respondents/respondents (Bourke, 2020; Nielsen, 2012). According to Nielsen (2012), engaging four to five respondents in a usability study will uncover 85% of the usability problems in a test iteration. Bourke (2020) and Macefield (2009) concur and observe that between two and 20 was valid, with five to 10 being a sensible baseline for identifying substantial usability problems. Based on this evidence, the study had marked a minimum sample of 10 respondents and above for each university, giving us a total sample of 40 respondents

Data Analysis

Simple Usability Scale (SUS)

To calculate the SUS score, the total score contribution for each item was summed up. For odd (positive) questions 1, 3, 5, 7 and 9, as stated below, the points given to the scale range from 0 (for Strongly disagree) to 4 points (for Strongly agree).

Question 1: I think that I would like to use this LMS frequently.

Question 3: I thought the LMS was easy to use.

Question 5: I found the various functions in this LMS were well integrated.

Question 7: I would imagine that most people would learn to use this LMS very quickly.

Question 9: I felt very confident using the LMS.

Table 1: Points allocated for positive questions

Scale	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Points	0	1	2	3	4

Source:……..

For even (negative) questions 2, 4, 6, 8 and 10, as stated below, the points given to the scale range from 4 (for Strongly disagree) to 0 points (for Strongly agree).

Question 2: I found the LMS unnecessarily complex.

Question 4: I think I would need the support of a technical person to be able to use this LMS.

Question 6: I thought there was too much inconsistency in this LMS.

Question 8: I found the LMS very cumbersome to use.

Question 10: I needed to learn a lot of things before I could get going with this LMS.

Table 2: Points allocated for negative questions

Scale	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Points	0	1	2	3	4

Source:…….

The sum of the scores was then multiplied by 2.5 to obtain the overall value of SUS for each respondent. Brook (1996) and Lewis (2018) present an example of a SUS questionnaire filled by a respondent and how the points are calculated. According to these authors, SUS scores have a range of 0 to 100, not as a percentage. The average SUS score is 68. If the score is below 68, then it means there are probably serious problems with the system's usability. If the score is above 68, then it means it is above average but can still be improved. A score of over 80.3 means that the users like the system and mostly recommend it to their friends, as illustrated in Table 3 below.

Table 3: SUS score grading and adjective rating (Brooks, 1996)

SUS Score	Grade	Adjective Rating
>80.3	A	Excellent
68-80.3	B	Good
68	C	Okay
51-68	D	Poor
<51	E	Awful

Source:…….

Data that was collected from closed-ended questions which were used to investigate the usability challenges were analysed using Excel and SPSS. Descriptive statistics was used to generate various statistical results. Data collected from the open-ended questions that were used to determine ways in which the usability challenges can be addressed was

analysed using content analysis. This technique helped to establish the pattern of certain words or concepts within the sets of texts. The data was then formatted to follow a pattern. The themes in the data collected naturally emerge using triangulation. The most preferred result occurred when several independent sources all pointed to a matching set of events or facts.

Presentation of Results

a) Demographics of the respondents

Table 4: The respondents' demographics

	MUBS	MAKERERE	BUSITEMA	GULU	
No. of Respondents	28	24	18	10	
RESPONDENTS DISTRIBUTION					
Categories	Lecturers	Assistant Lecturers	Teaching Assistants	Senior Lecturers	Professor
Percentages	50%	26%	14%	9%	1%

The study also investigated how long each respondent had used the LMS. The study revealed that 44% of the respondents have been using the LMS between 1 and 3 years, while 32 % had been using the LMS for over 7 years, as depicted in Table 3 above.

b) Assessing the usability of the LMS

The study assessed the usability level of LMS in the four public universities in Uganda. A Simple Usability Scale (SUS) questionnaire was given out, and the results obtained in the summary are presented in Table 7. The SUS score for each respondent was calculated using the procedure discussed in the methodology. Then the average SUS score for each university was derived from the SUS score for each respondent in the particular university. Afterwards, the average SUS score for the four universities was derived from the average SUS score for each university. From the findings, the highest average SUS score was from Makerere University Business School (65.0), followed by Gulu University (60.5). The lowest average SUS score was from Busitema University (56.9), followed by Makerere University (57.5). The average SUS score for the four universities was 60.

The implication of the general SUS score

Using Table 3, the SUS score of 60 indicates that the usability of the LMS is poor because the SUS score lies between 51 and 68. Lewis and Sauro (2018) and Martins (2020) observe that when communicating SUS scores to stakeholders, especially stakeholders who may not be familiar with SUS, it is best to convert the original SUS score into a percentile. Lewis and Sauro (2018) and Martins (2020) present a simple graph that converts the SUS score into percentages. According to their graph, presented in Figure 1, a SUS score of 60 represents a percentage score of 30%.

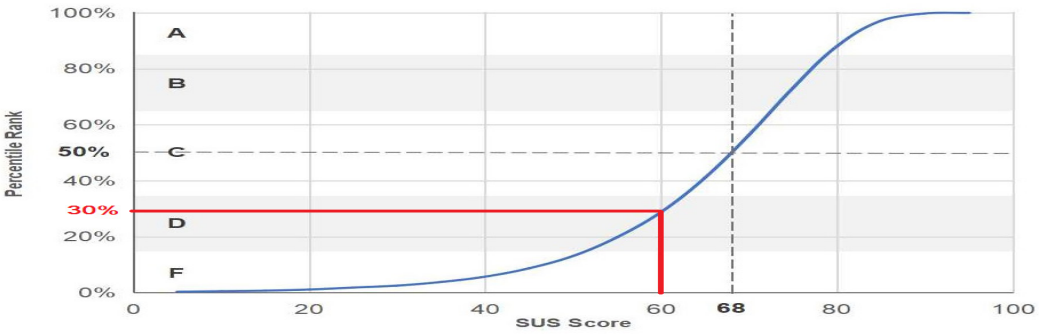

Figure 1: SUS score and its percentiles (Sauro, 2011)

Percentage-wise, the SUS score of 60 represents 30% usability, which falls below average – meaning the usability of the LMS is poor. The average score (at the 50th percentile) is 68. That means an SUS above 68, which is 50%, is above average and below 68 is below average. The usability of the LMS in Makerere University Business School, Gulu University, Makerere University and Busitema University was only 30%, which is poor. When the SUS scores for each of the four universities are converted into a percentile, the usability percentage score for each university is presented as follows: the highest usability percentage was from Makerere University Business School (40%), followed by Gulu University (31%), then Makerere University (25%), and the lowest usability percentage was Busitema University (22%).

c) Challenges of using LMS

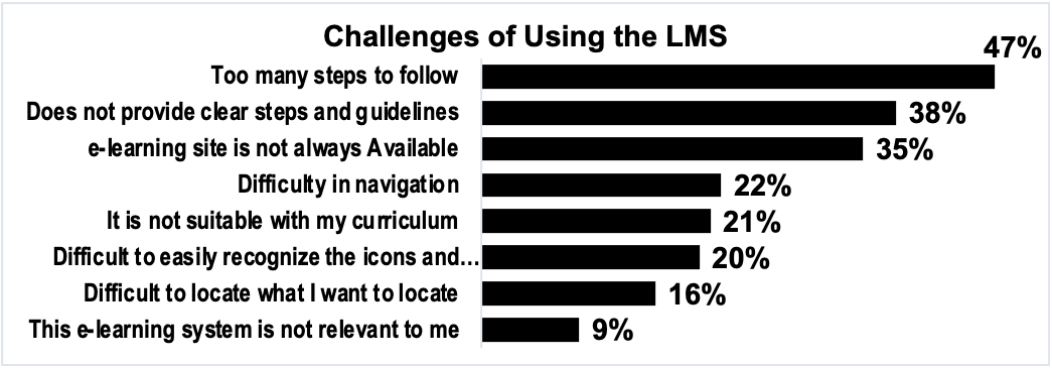

Figure 2: Challenges of using LMS

The study went ahead to investigate the usability challenges respondents faced while using the LMS. The results are summarized in Figure 2.

As shown in Figure 2 above, close to half (47%) of the respondents acknowledged that there were too many steps to follow while using the LMS. About 38% of the respondents said that there were no clear steps and guidelines, while 35% of the respondents revealed that the LMS was not always available online. About 22% of the respondents said that navigating through the LMS was difficult, while 21% said that the LMS was not suitable for their curricula. The study found that 20% of the respondents acknowledged the difficulty

of recognising icons and symbols in the LMS, while 16% and 9% of the respondents said that it was difficult to locate what they wanted and that the LMS was not relevant to them, respectively.

d) Addressing the usability challenges

The study further investigated ways of addressing LMS usability challenges and the results of the investigation are presented in Figure 3 below.

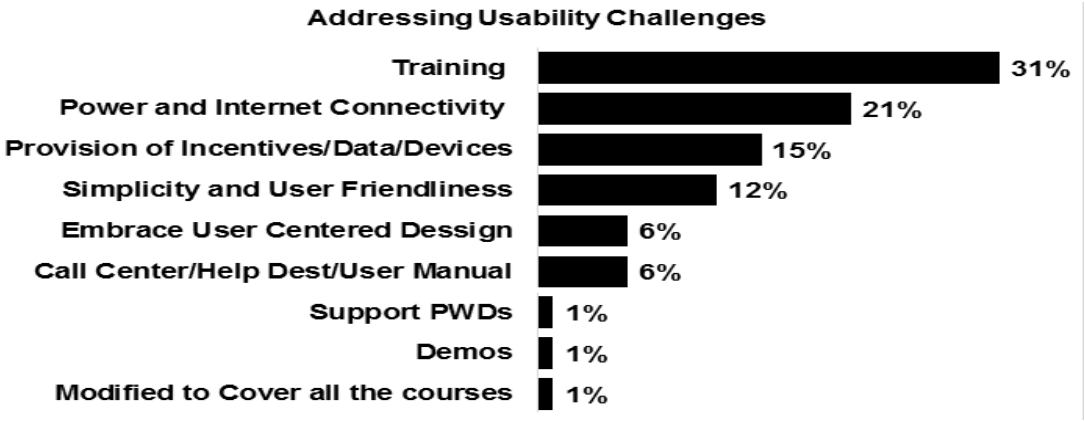

Figure 3: Addressing LMS usability challenges

The study further investigated ways of addressing LMS usability challenges. From the study, 31 % of the respondents agreed on the need for regular training. One of the respondents said: *"More training should be extended to staff members."* Twenty-one per cent said that there was a need for power and internet connectivity. One respondent wrote: *"There is a need for regular availability of the Internet connection network and power at the University for both the students and the Academic staff."* The study also revealed that 15% agreed that the provision of incentives to lecturers as motivation was of paramount importance in addressing usability challenges. A respondent wrote: *"The university should provide personal internet data, improve internet connectivity, and provide digital equipment. "* About 12 % of the respondents suggested that simplicity and user-friendliness would improve the usability of the LMS. One respondent wrote: *"Improve general user experience and make the interface simple and easy to understand. "*

The study also found that 6% of the respondents said that embracing a user-centred design approach and having a call centre/user help desk would improve the usability of the LMS. A respondent wrote: *"Involve the teachers in content development and systems customization to suit their taste would improve the usability of LMS" ; while another respondent wrote that "the usability of the LMS can be improved by employing more staff on the Help desk".* One per cent of the respondents said that it was important to provide for PWDs, provide demos, and design the LMS to suit the teaching of other courses, especially practical courses.

Discussion of the Study Findings

a) Assessing the usability of the LMS

From the usability assessment conducted, it was found that the SUS score for the LMS was 60. This indicates that the LMS usability was 30%, which reflects poor usability. Generally, poor usability has always been a challenge for many LMS in sub-Saharan universities. For example, a previous study carried out by Bhalalusesa (2013) found that 54% of interviewed Moodle users at the Open University of Tanzania indicated that the system was difficult to use, especially in uploading learning materials. A similar study conducted at Makerere University in Uganda found that 84.4% of students and 79% of faculty members indicated that the LMS was not easy to use (Mayoka, 2012). Another usability study conducted by Padayachee (2011) discovered that the LMS at the University of KwaZulu-Natal had several usability violations that made it difficult for many users to be able to use it. More recent studies, such as those by Bhalalusesa (2023) and Kaweesi (2022) also point to the same usability challenges. Whereas Bhalalusesa's study found out that the LMS used at the National Institute of Transport in Tanzania had serious problems with navigation, content, layout, interaction, feedback, help and support, Kaweesi's study discovered that some lecturers at Busitema University were not experienced in the use of the LMS.

Usability challenges may not be exclusive to sub-Saharan African universities. Kakasevski (2008), for example, found that Moodle had 75 usability problems in a study conducted to evaluate the usability of Moodle at FON University in Macedonia. The study also found that 80% of the students had significant problems with the features of online chat and discussion forums. Many sub-Sahara African universities use open-source LMS and, according to Almaiah (2019) and Mtebe (2015), the majority of open-source systems suffer from usability problems. To minimize the usability challenges associated with LMS in sub-Saharan universities, Almaiah and Mtebe recommend that universities conduct regular usability evaluations to find out any usability problems that might be hindering users from using these systems. The authors observe that fixing such usability problems will make LMS easy to use and user-friendly, and that this will increase LMS usage among both students and staff.

b) Challenges of using the LMS

Too many steps

Several usability challenges were identified during the study. The study revealed that 47% of the respondents acknowledged that there were too many steps to follow. This resonates with the study by Bwire and his colleagues, who found that some LMS in the four universities (Muni University, Mbarara University of Science and Technology, Makerere University, Gulu University and Busitema University) were not usable and that some were too complex to use, making it difficult for lecturers to use the platforms (Bwire, 2020).

No clear steps and guidelines

The study also revealed that 38% of the respondents complained that there were no clear steps and guidelines. This is similar to what Kasse (2023) states in connection with the success of LMS. He asserts that such success is based on a supportive institutional policy

that guides all forms of users, including assessors, learners and technical staff, on the general use of digital assessment systems or LMS. The lack of policies creates subjective use of systems as opposed to objective use. Such policies must also align with the institution's strategic objectives.

Not always available online

The study further found that 35% of the respondents complained that the LMS was not always available online. Mayende (2013) confirms this and observes that this particular challenge majorly affects country learning centres. For example, the LMS online library collection was not accessible to most of the Makerere University students upcountry. Bada (2020) and Kasse (2023) all posit that an institution should use a stable LMS that is available and reliable at all times so that course instructors and learners can access their course environment at their convenience.

Navigation challenges

Other usability challenges that were identified include difficulty in navigating through the LMS (22%). Navigating through many LMSs has always been a challenge. This is in line with a previous usability study conducted at Walter Sisulu University, which identified the LMS navigation challenge as one of the top three challenges affecting LMS usage (Ssemugabi, 2006). Studies by Hasan (2018) found that usability issues with the Moodle LMS at Zarqa University in Jordan included difficulties with navigation and content organization.

Not suitable for their curricula

The other challenge identified during the study was that the LMS was not suitable for the users' curricula (21%). This is corroborated by a similar study conducted at Muni University, Mbarara University of Science and Technology, Makerere University, Gulu University and Busitema University, which found that it was quite difficult to develop online content that was well aligned with the curricula and learning outcomes of the course (Bwire, 2020).

Difficulty in recognising icons and symbols/Difficulty in locating what they needed

The respondents also pointed out the difficulty of recognising icons and symbols in the LMS (20%), and 16% said it was difficult to locate what they needed. This is a common design challenge for most LMSs. This is consistent with a fairly recent study conducted among students and teachers of two leading universities using Moodle in Pakistan that found that some of the icons could not be understood just by looking at them and that there was no supporting text that helped in understanding the desired meaning of icons. This made it difficult to locate what the user wanted (Arshad, 2016).

LMS was not relevant

The study also found that 9% said that the LMS was not relevant to them. The study, however, did not find out reasons as to why the respondents said the LMS was not relevant. Komuhangi, (2022) has attempted to provide an insight into this and posited that students or lecturers, for example, who did not consider e-learning a flexible way to study were less likely to consider using LMS.

c) Addressing the usability challenges using the IDDS model

The usability assessment of the four universities indicates that the LMS usability was 30%, which reflects poor usability. This poor usability, as the investigation found out, was caused by several usability challenges already identified in Figure 4. The study, therefore, proceeded to investigate ways of addressing LMS usability challenges. As the findings in Figure 5 show, the study derived a model which provides a taxonomy for classifying the ways of addressing LMS usability challenges in three broad categories, namely ICT Infrastructure, Design and Support Services (IDSS), as illustrated in Figure 2.

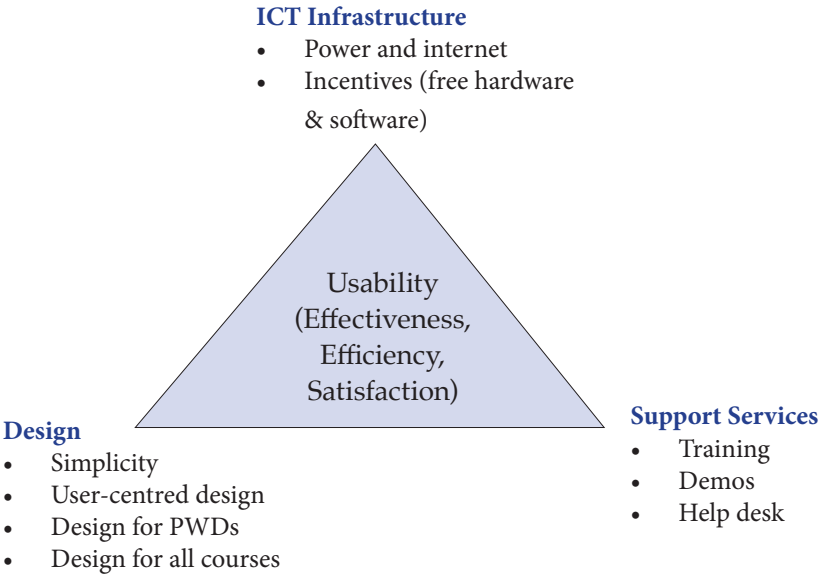

Figure 2: IDSS model for improving usability of LMS

1. ICT Infrastructure

These are all forms of information and communications technology (ICT) infrastructure and systems that are required to enable effective and efficient use of LMS. This crucial ICT infrastructure includes:

Adequate power and internet connectivity

From the study, 21% of the respondents said that there was a need for adequate power and internet connectivity. One respondent wrote: *"There is a need for regular availability of the Internet connection network and power at the University for both the students and the Academic staff"*. Scholars such as Adedoyin (2023), Amponsah (2023) and Kaweesi (2022) agree and emphasize the relevance of having a stable internet connection and power supply for the successful usage of LMS. Studies by Kumi□Yeboah (2023) point out the necessity of having an adequate internet connection, a stable power supply, and relevant hardware and software to facilitate teaching and learning.

Incentives

The study found that 15% of the respondents agreed that the provision of incentives to lecturers as motivation was of paramount importance in addressing usability challenges. Another respondent wrote: "*The university should provide personal internet data, improve internet connectivity, and provide digital equipment*." This is consistent with previous studies (Bwire, 2020) that confirmed that staff motivation and the provision of incentives enhance the use of LMS.

2. Design

Developing an LMS that is easy to use involves the provision a user-friendly interface, identifiable icons and symbols, easy navigation, clear content, consistent layout, enhanced interaction and timely feedback.

Improve simplicity and user-friendliness

From the study, 12% of the respondents pointed out that emphasis should be put on improving the usability, simplicity and use of the LMS. One respondent wrote: "*Improve general user experience and make the interface simple and easy to understand.*" Another respondent wrote that "*the usability of the LMS can be improved by employing more staff on the Help desk.*" As discussed before, usability is considered one of the most important quality attributes, being a fundamental aspect in all software products. It is even more crucial in those systems that are designed for a wide variety of users like LMS (Guerrero, 2018). High on the list of usability issues to be concerned about is that of navigation of the LMS. According to Arshad (2016), navigation of the LMS is one of the most vital factors of usability to be considered for critical evaluation. Usability evaluation is a critical factor in determining LMS usability problems. Fixing such usability problems will increase LMS usage because many users will find the systems easy to learn, easy to use and, therefore, user-friendly (Mtebe, 2015).

User-centred design (UCD) approach

In an LMS environment, a user-centred design involves designing the course with the learner and the tutor in mind, taking into account their goals, needs and preferences. From the study, 6% of the respondents said that embracing a user-centred design approach would improve the usability of the LMS. A respondent wrote: "*Involve the teachers in content development and systems customization to suit their taste would improve the usability of LMS*". This is in line with Lambropoulos' (2006) observation that UCD can be a powerful approach for designing efficient and effective LMS.

Design for PWDs

One per cent of the respondents said that it was important to design for PWDs. This is consistent with Bagumas (2021) observation that LMS should be developed in such a way that users with visual, auditory, speech, dexterity, cognitive, mobility and other disabilities can engage with content easily and effectively. Beyond the intentional design of e-learning, it may also be paired with assistive devices and technology, as necessary.

Design for all courses

The study reveals that 1% of the respondents said there was a need to redesign the LMS to cater for other courses. This is consistent with Ouma (2023) who posits that there is a need to broaden the scope of LMS to embrace a wide range of aspects, such as distance learning, flipped classroom and blended learning, practical courses, and crafts, in addition to virtual learning. He recommends that the use of recorded videos and social media, especially where virtual learning is limited, can be a good boost to achieve learning objectives.

3. Support Services

There is a need to provide technical support and assistance to LMS users.

Regular training

From the results displayed in Figure 2, 31% of the respondents recommended regular staff training. One of the respondents said: "*More training should be extended to staff members.*" Inadequate training of tutors is a great hindrance to LMS usage. A study conducted by Unwin (2010) in 25 African countries discovered that 74% of the tutors lacked adequate training and technical support. This hindered the universities from making full use of LMS features. Mtebe (2015), therefore, recommends that universities should set up functional Information Technology (IT) Units to provide support and regular training services to both students and faculty members.

Provide demos and user manuals

Another 1% of the respondents observed that there was a need for demos. According to Greenwald (2014), demos can be in the form of video tutorials, user manuals demonstrating how the system works, brochures, pictures and other tools.

Help desk

The study further found that 6% of the respondents hinted that there was a need for help desk services. One respondent wrote that "*the usability of the LMS can be improved by employing more staff on the Help desk.*" This is supported by the recommendations by Bagarukayo (2015) and Mayanja (2019) that e-learning support services (Greenwald, 2014) should be provided both online and offline. This could range from the provision of email addresses, telephone numbers, and chat rooms to hands-on services for handling tutors'/ students' complaints.

Conclusion

Usability plays a pivotal role in the uptake of LMS. It is a very important aspect considered while evaluating an e-learning system and, therefore, an investigation of usability and its integration or contribution to the learning process is worthwhile. Usability evaluation is a critical factor in determining LMS usability problems. Fixing such usability problems will increase LMS usage because many users will find the systems easy to learn, easy to use and user-friendly. This study undertook a usability study of four public universities in Uganda to measure the usability level of the different LMS, identifying challenges and determining ways of addressing the challenges. The findings of the study revealed that the SUS score for the LMS was 60. This indicates that the LMS usability was 30%, which

reflects poor usability. The poor usability, as the investigation found out, was caused by several usability challenges, namely the existence of too many steps; the lack of clear steps and guidelines; inconsistent availability online; navigation challenges; not being suitable for the users' curricula; difficulty in recognising icons and symbols; and the LMS not being relevant. The study proceeded to investigate ways of addressing the LMS usability challenges. The study, thereafter, presented the IDSS model for improving the usability of LMS in public universities.

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