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Functionality of Web-Based E-Learning Systems in Kenyan Universities

Harriet Wangui Ndirangu[1], Kelvin Omieno [2], Raphael Angulu [3]

[1]School of Computing and Informatics, Masinde Muliro University of Science and Technology, Kenya

[2]School of Computing and Information Technology, Kaimosi Friends University, Kenya

[3]School of Computing and Informatics, Masinde Muliro University of Science and Technology, Kenya

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ABSTRACT

In Kenya, Universities are increasingly using e-learning systems to enhance content delivery and user interaction in a cost-effective manner. Against the backdrop of increasing acceptance of the systems in the universities, there was need of assessing the functionality of e-learning systems adopted by the universities. The paper focused on evaluating the functionality of web-based e-learning systems implemented in Kenyan Universities; drawing from ISO/IEC 9126 model that focuses on systems suitability, accurateness, interoperability, compliance and security. The study was conducted in two Kenyan universities; a public university, Masinde Muliro University of Science and Technology (MMUST), and a private university, Mount Kenya University (MKU). The study used a descriptive survey design utilizing quantitative data. Collection of data was done using questionnaires and analyzed using descriptive and inferential statistics. Respondents were sampled using Simple random sampling. 269 respondents were recruited from a target population of 900 drawn from both universities. Evaluation of E-learning systems indicated that existing systems had certain limitations that negatively affect system functionality elements. The functionality was also influenced by poor ICT infrastructure in the learning institution as well as type and organization of the content published in the systems. The study concludes that functionality of e-learning systems is influenced by interactivity between students and instructors, system security, content delivery and assessment and perceived usefulness of the system. Adoption of an appropriate System Functionality Evaluation Model to identify system weaknesses and improvement of ICT infrastructure in learning institutions will help to improve functionality of the e-learning systems in Kenyan universities.

Keywords: e-learning, functionality, universities, infrastructure

I. INTRODUCTION

E-Learning refers to using Information and Communication Technologies (ICT's) while delivering content in the education sector [1]. In spite of the initiative taken by universities to provide flexible learning in institutions of higher education, the acceptance and implementation is limited due to inadequately functioning systems which pose a challenge to user interactivity. This is supported by previous studies on the content and technology in online learning systems which highlight the need to continuously evaluate the effectiveness of content delivery in e-learning systems [2],[3].

Analyzing the effect of e-learning systems on learners is central to the development of suitable and effective e-learning systems [4]. [5] indicates that Africa lags behind developed economies in the application of e-learning despite of the fact that it is an emerging market. Internet access, professional and training development, availability of content that has been developed locally are amongst the key challenges. Indeed, e-learning is affordable; According [6] it can be accessed from anywhere at any time thus making it feasible for worldwide audience. According to [7], 58% of learners learn from the office while 29% learn at home. The implication of this finding is that online learning can be done more effectively by improving the interaction between learners and online instructors as this helps to address challenges in the delivery methods.

A system can be well designed but it can only function efficiently when users are considered without which a system cannot function efficiently. [8] suggested that e-learning should be open, flexible and distributed so as to be suitable for diverse learners. Most e-learning system users utilize mobile devices and prefer to access the systems at their convenience which may jeopardize the learning process. However, the architecture of the current systems has limitations with regard to allowing flexibility, openness and accessibility for diverse learners. Each institution designs courses with its own unique limitations and purposes according to [9]. These systems are not developed for particular learner or institution making them hard to meet the needs of the users. Therefore, a careful assessment of whether these systems are functional and effective in the Kenyan learning environment is required.

There has been a significant increase in enrolment of students in institutions of higher learning in the past few years [10]. Consequently, most institutions have resulted to adoption of e-learning mode of study to enhance access of courses by students. Despite these developments, there is little attention on assessment of the existing e-learning environments [11]. This situation is further worsened by insufficient empirical research on e-Learning systems [12]. Therefore, there is need to evaluate different aspects of the e-learning environment such as learners' characteristics, user interactivity, security features and system accessibility, in order to enhance the learners' experience with the system and overall performance.
An appropriate Content Management System (CMS) is required for effective content delivery in e-learning. A CMS is used to manage content so as to improve the education process. According to [13] learning is done in networked environments where content is accessed through a centred server. The needs of education require a courseware that can be used for creation and updating of the online content.

In this study, the researchers [13] emphasize on the importance of assessment and feedback in the learning experience. If a software does not deliver these functionalities, it sets a ground for complains from users. The internet based and CMS based system illustrated below in figure 1 has been proposed.

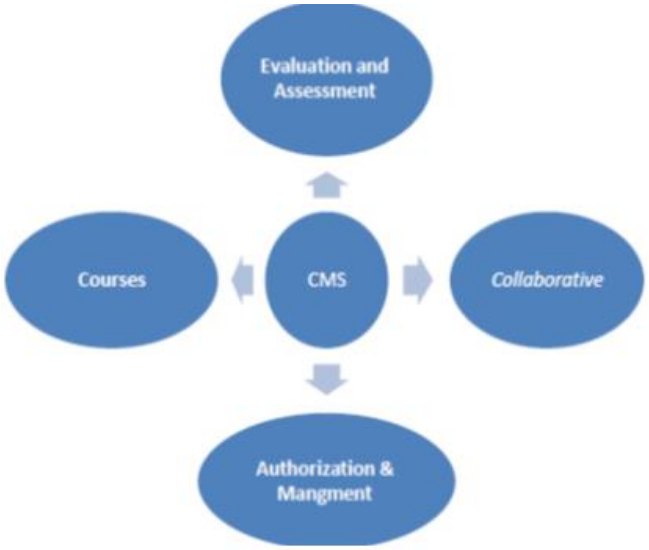

Figure 1- Feedback and Assessment

For a learning experience to be complete, learners need to be continuously evaluated and accessed. Though this system provides a mechanism to examine the assessment and feedback within the e-learning environment, it falls short of evaluating all the functionality components of e-learning systems. This paper seeks to address the existing knowledge gap by examining the functionality of the systems by specifically, focusing on structure and architecture of the systems, user interactivity of the existing platforms and compatibility of the systems with other existing systems. The study drew from ISO/IEC 9126 model that looks at systems suitability, accurateness, interoperability, compliance and security in order to measure functionality.

II. METHODOLOGY

The study was conducted in two Kenyan universities; a public university, Masinde Muliro University of Science and Technology (MMUST), and a private university, Mount Kenya University (MKU). The study focused on SAKAI platform used by MKU and MOODLE used by MMUST. Mount Kenya University is said to be the largest private university with the largest number of e-learning students both local and international. The University has also implemented the use of SAKAI as their platform for e-learning. MMUST is one of the seven largest public universities in Kenya. The University has implemented MOODLE as their platform for e-learning.

A descriptive survey design utilizing quantitative data was used. This study used percentages, correlation and Analysis of variance (ANOVA) to undertake data analysis within the quantitative research paradigm, research approaches and research deductively within controlled parameters.

III. DATA COLLECTION & ANALYSIS

Data was collected using researcher-administered questionnaires. From the 269 questionnaires distributed, 260 were dully filled and returned. This represents response rate of 96.7%.

Data was analyzed using descriptive and inferential statistics. Respondents were sampled using Simple random sampling. Krecjie and Morgan table was used to recruit a sample of 269 respondents from a target population of 900 drawn from both universities. A pilot study was undertaken to determine the reliability and validity of the research tools. Permission for data collection was sought and obtained from the Directorate of Postgraduate studies, MMUST and the National Commission for Science Technology and Innovation (NACOSTI). All the necessary ethical issues were considered in this study; respondents' confidentiality was highly maintained.

IV. RESULTS AND DISCUSSION

DEMOGRAPHIC CHARACTERISTICS

Table 1 presents the results of demographic characteristics including Age, Gender, Level and Year of study of the respondents. As shown in the table below, majority of the respondents (56%) were Male above 30years of age (47%) and were at bachelors' level of study (77%). Further, majority were in the first (35%) and second (30%) year of study.

Table 1. Demographic characteristics of the respondents

Variable	Frequency(N)	Percentage (%)
Age (years) Below 20	15	6
20-25	52	20
25-30	70	27
Above 30	123	47
Gender Male	145	56
Female	115	44
Level of study Postgraduate	47	18
Bachelors	199	77
Diploma	14	5
Year of Study Year 1	92	35
Year 2	79	30
Year 3	71	27
Year 4	18	8

Content Management System used

Table 2 below shows that (57%) of the respondents were using MOODLE e-learning platform while the rest (43%) were on the SAKAI platform.

Table 2. E-learning platform used

E-learning Platform used	Frequency (N)	Percent (%)
SAKAI	112	43
MOODLE	148	57
Total	260	100

Architecture of E-Learning System

Architecture refers to the structure and organization of the web-based e-learning system. Table 3 shows results on level of agreement on different aspects of the system architecture. Most respondents reported that the architecture of the e-learning systems needs improvement. On the aspect of accessibility of the e-learning system, a majority of the respondents indicated that the system could be accessed from anywhere and anytime.

Table 3. Architecture of E-Learning System

E-learning system architecture variable	SD	D	N	A	SA
Accessibility of e-learning system (can be accessed from anywhere, anytime)	9 (4%)	32 (13%)	30 (11%)	108 (42%)	81 (30%)
Structure and organization of e-learning system needs improvement	3 (1%)	11 (4%)	43 (17%)	105 (40%)	98 (38%)
Consistency of content (remains the same)	7 (3%)	22 (9%)	69 (26%)	96 (37%)	66 (25%)
Different modules can be accessed within the system	14 (5%)	35 (14%)	39 (15%)	109 (42%)	63 (24%)

Key

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

1) User Interactivity

It refers to the interaction between users and the software used for the e-learning system. As shown in table 4 below, (55 %) of the respondents were satisfied with the system interactivity while (45%) were not satisfied. A significant number of learners indicated that the interaction between the students'

and the instructor (36%) and student-coordinator (44%) as well as student-student interaction (38%) needed to be improved.

Table 4. Level of agreement on user interactivity

E-learning user interactivity variable	**SD**	**D**	**N**	**A**	**SA**
System allows student-instructor interaction	11 (4%)	31 (12%)	51 (20%)	120 (46%)	47 (18%)
System allows student-coordinator interaction	20 (8%)	43 (16%)	51 (20%)	105 (40%)	41 (16%)
System allows student-student interaction	16 (6%)	34 (13%)	49 (19%)	109 (42%)	52 (20%)
Satisfaction with the system interactivity	18 (7%)	46 (18%)	53 (20%)	108 (42%)	35 (13%)

2) Suitability in content delivery and assessment

As per tab 5 below, majority (55%) expressed dissatisfaction with the ability of the e-learning system to sharing of content with other systems

Table 5. level of agreement on suitability in content delivery and assessment

Suitability in content delivery and assessment component	**SD**	**D**	**N**	**A**	**SA**
System allows content import from other systems					
System allows submission of assignments	8 (3%)	19 (7%)	40 (15%)	116 (45%)	77 (30%)
System allows access to content and assignments	12 (%)	20 (8%)	39 (15%)	109 (42%)	80 (31%)
System allows student assessment	14 (5%)	33 (13%)	73 (28%)	103 (40%)	37 (14%)

3) System accurateness

This refers to the extent to which online web-based systems delivers the expected results and objectives for the users. As per the results in table 6, majority (57%) reported that the E-learning system provides mechanism for notices. Further, majority (54%) suggested that the system provides for online testing.

Table 6. Level of agreement on system accurateness

System accurateness component	**SD**	**D**	**N**	**A**	**SA**
System provides mechanism for notices	13 (5%)	24 (9%)	75 (29%)	118 (45%)	30 (12%)
System provides for online testing	7 (3%)	38 (15%)	75 (29%)	102 (39%)	38 (15%)

4) System inter-operability

This is the capability of the system to interact with other systems or platforms. As shown in table 7,

majority of the respondents (52%) reported that the system allowed data import from other web-based systems while few (45%) reported that the system allowed data export to other systems. (51%) of the respondents were dissatisfied with the inter-operability component of the system.

Table 7. Level of agreement on system inter-operability

System inter-operability component	SD	D	N	A	SA
System allows data import from other web-based systems	13 (5%)	42 (16%)	79 (31%)	89 (34%)	37 (14%)
System allows data export to other systems	11 (4%)	38 (15%)	95 (37%)	93 (36%)	23 (9%)
User satisfaction with system inter-operability	16 (6%)	37 (14%)	75 (29%)	109 (42%)	23 (9%)

5) System security

6) System security is the mechanism of a system to maintain the privacy of important information about learners. As indicated in table 8, majority (80%) of the system users were satisfied with the system security.

Table 8. Level of agreement on system security

System security component	SD	D	N	A	SA
System allows user restrictions for staff and students	3 (1%)	9 (4%)	34 (13%)	153 (59%)	61 (24%)
System allows password security for resources	5 (2%)	5 (2%)	42 (16%)	130 (50%)	78 (30%)
System provides content restriction	6 (2%)	7 (3%)	60 (23%)	126 (48%)	61 (24%)
Satisfaction with system security	6 (2%)	9 (4%)	37 (14%)	143 (55%)	65 (25%)

7) Perceived usefulness

According to the results shown in the table below 9, a majority of the users who filled the questionnaires were satisfied with the systems usefulness. Most of the respondents (76%) reported that the system allows speed delivery of tasks. Similarly, majority (80%) reported that the system improved learning performance, was useful for learning (83%) and enabled the learner to control the learning process (80%).

Perceived usefulness component	SD	D	N	A	SA
System allows speed delivery of tasks	4 (2%)	13 (5%)	44 (17%)	141 (54%)	58 (22%)
System improves learning performance	3 (1%)	5 (2%)	44 (17%)	154 (59%)	54 (21%)
System is useful in learning	7 (3%)	8 (3%)	29 (11%)	150 (58%)	66 (25%)
System enables the learner to	3 (1%)	11 (4%)	38 (15%)	145 (56%)	63 (24%)

control the learning process					

Table 9. Level of agreement on perceived usefulness of E-learning system

Analysis of variance using ANOVA

Analysis of Variance (ANOVA) was done to ascertain the level of association between the system functionality components and different variables ($p<0.05$, 95%CI). As indicated in Table 10, the findings indicate that student-instructor interactivity was significantly associated with system access (t=3.139, p=0.002) and module access (t=2.994, p=0.003). A significant association was found between system's content delivery and assessment and the platform used (t=-2.603, p=0.010), system access (t=-2.245, p=0.026), system structure and organization (t=-1.989, p=0.068) and module access (t=3.062, p=0.002). System security was significantly associated with system structure and organization (t=2.231, p=0.027) and module access (t=2.856, p=0.005). Perceived system usefulness was significantly associated with system user's age (t=2.344, p=0.020) and module access (t=3.157, p=0.002).

Table 10. ANOVA analysis for system functionality

Functio-nality Variable	Age (t, p value)	Gender	Level of Study	Year of study	Major Equipment used	Platform Used	Architecture Accessibility	Architecture structure and Organization	Architecture Content Consistency	Architecture Module Access
Student Instructor Interactivity	-0.489 .625	0.865 0.388	0.108 0.914	0.690 0.491	-0.137 0.891	1.669 0.016	3.139 0.002	-0.761 0.447	-1.166 0.245	2.994 0.003
Student Coordinator Communication	1.460 0.146	-.572 0.568	-.1634 0.104	0.620 0.536	2.056 0.41	-3.707 0.000	0.329 0.742	-0.432 0.666	-1.467 0.144	4.842 0.000
Student Student Interactivity	-.700 0.485	-0.688 0.492	0.835 0.404	-0.582 0.561	1.067 0.287	-1.851 0.065	-0.576 0.565	-1.021 0.308	-.990 0.323	7.070 0.000
Am Satisfied with System Interactivity	1.189 0.236	1.209 0.228	0.389 0.697	-1.268 0.206	.609 .543	-3.256 0.000	.344 .731	-2.340 .020	.777 .438	8.525 0.000
Content Import	-1.548 0.123	-1.700 0.090	.510 .610	-.311 .756	1.012 0.312	2.677 0.008	1.363 0.174	.795 .427	-.385 .701	2.677 0.008
Assignment Submission	.813 .417	.158 .874	1.051 .294	-.506 .613	-.339 .735	.584 .560	4.579 0.000	-1.098 .273	-.378 .706	7.442 0.00
Content Assignment Accessibility	.871 .385	-.079 .937	-1.923 0.56	-1.873 0.62	.152 .880	.152 .049	4.786 0.000	.679 .498	.842 .400	4.734 0.000
Am satisfied with Assessment	.456 .648	1.184 .238	-1.103 .271	.948 .344	-.108 .914	-2.603 .010	2.245 0.026	-1.989 0.068	1.227 .221	3.062 0.002
Accurate Notices	-.004 .997	.748 .455	-.890 .374	1.870 .063	.306 .760	-.251 .802	.403 .688	2.975 0.003	2.100 .037	4.588 0.000
Accuracy in Online Testing	-.388 .698	1.652 .100	-.220 .826	1.255 .211	-.336 .737	1.569 .118	3.060 0.002	-2.153 .032	.298 .766	4.119 0.000
Allows Data Import	-1.301 .194	-2.299 0.022	-1.349 .179	1.156 .249	2.581 0.010	.282 .778	1.914 .057	-.346 .729	-.723 .470	3.908 0.000
Allows Data Export	-1.336 .183	-1.889 0.060	-1.435 .153	-.025 .980	.627 .531	-1.043 .298	2.350 .020	1.493 .137	-.877 .381	4.743 0.000
Am satisfied with system interoperability	.206 .837	-.916 .361	-.539 .591	-1.709 .089	.812 .418	-1.601 .111	1.733 .084	-2.383 .018	-.469 .639	6.053 0.000
User Restrictions	.262 .794	-.287 .775	1.383 .168	-.068 .946	1.384 .168	1.459 .146	.616 .539	.107 .915	.565 .573	3.166 0.002
Resources Security	-.693 .489	-1.470 .143	.886 .376	.446 .656	.263 .793	3.580 0.000	.762 .447	3.604 0.000	-1.219 .224	3.639 0.000
Content Restriction	-.425 .671	-.123 .902	.283 .777	-1.990 .048	.514 .607	1.656 .099	1.921 .056	1.320 .188	-.147 .883	2.911 .004
Am satisfied with system security	.740 .460	.397 .692	.524 .601	-.932 .352	.117 .907	.134 .894	.643 .521	2.231 .027	.677 .499	2.856 0.005
Useful in Speed Task Delivery	1.738 .084	-1.440 .151	.583 .560	.992 .322	.915 .361	1.612 .108	2.589 .010	.044 .965	.774 .440	2.743 .007

Useful in Performance Improvement	1.500 .135	.609 .543	-.294 .769	.849 .397	-.122 .903	.796 .427	1.342 .181	.291 .771	-.671 .503	5.784 .000
Useful in Learning	3.051 .003	-1.207 .229	-.210 .834	1.004 .316	.329 .743	.061 .951	.970 .333	.776 .439	2.669 .008	5.065 .000
Useful ContrLearning	2.344 .020	.103 .918	-.749 .455	-.305 .761	-1.438 .152	-1.438 .346	1.829 .069	.460 .646	1.390 0.166	3.157 0.002

V. DISCUSSION

In the current study, different functionality components of the e-learning systems were evaluated to establish their strengths and limitations. For user interactivity with the systems, the findings indicated that a significant number of learners reported that the interactivity of the existing systems needed to be improved, particularly on student-instructor and student-student interactions. These findings are supported by [14] who asserted that institutions of higher learning should improve students and staff knowledge and abilities to interact with the system through training. Training improves perceived ease of use, which leads to improved functionality.

The study found a significant association between system's content delivery and assessment and the platform used and system access, module access as well as system structure and organization. These findings are supported by [15] who suggested the need for instructors to develop quality course modules that meet intended educational goals and are aligned with the learners' knowledge, abilities and skills. This helps to among other benefits enhance the learners' learning experience. Other studies that used a descriptive survey approach [16], [17] stressed the necessity to update learning materials and manuals in order to improve system usability.

Online assessment is an important aspect which should be included in the evaluation of e-learning systems. Assessments are important for measuring learning objectives, particularly in the e-learning mode. Assessment should be practicable, appropriate, precise, and consistent with the content [18]. According to [17], there are delays in the release of assignment and examination results in most e-learning systems. Further, instructors do not integrate online quizzes and examinations in the courses that they offered in a similar study [19].

In the current study, perceived system usefulness was significantly associated with system user's age and module access. Studies by [20], [21] indicate that higher learning institutions should review their teaching processes to ensure that institutional goals and purposes of the course have been met to suit learner's characteristics. The evaluations should examine the e-learning systems to user satisfaction, provides information and service quality that results to academic success [22] [15]. System security is an important aspect in ensuring data integrity in the e-learning environment. In the study, there was a significant association between system security and system structure and organization as well as module access.

VI.CONCLUSION

The study concludes that the functionality of the e-learning system is influenced by interactivity between learners and instructors, system security, content delivery, assessment and perceived usefulness of the system. The study recommends adoption of an appropriate System Functionality Evaluation Model to identify system weaknesses and improve functionality of the e-learning systems. Content and assessment was identified to be amongst the important aspects in evaluating functionality therefore, the type and organization

of the content published in the systems should be looked into so as to ensure that each organization publishes content that suites its organizational needs. The study also recommends improvement of ICT infrastructure in learning institutions as this will ensure that communication is made smooth thus helping in reduction of delays and system downtimes.

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