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Performance-Based Usability maturity Assessment Framework for VLS in Universities

Kelvin K. Omieno[1], George Raburu[2], Pamela Raburu[3]

Lecturer, Department of Computer Science,

Masinde Muliro University of Science and Technology Kakamega, Kenya[1]

Senior Lecturer, School of Informatics and Innovative Systems,

Jaramogi Oginga Odinga University of Science and Technology Bondo, Kenya[2]

Senior Lecturer, Department of Education Psychology,

Jaramogi Oginga Odinga University of Science and Technology, Bondo, Kenya [3]

Abstract: Virtual learning systems are becoming an increasingly common form of education due to the need for a platform that provides ability to connect people with required sets of skills, regardless of their location in the world. However, user satisfaction has always been a major factor in the success of software, regardless of whether the software is proprietary or freeware (such as open source software). Although user-centred designs are gaining recognition among virtual learning system community, many design scenarios still do not incorporate usability as one of their primary goals. Accordingly, many individuals believe that if virtual learning system was more usable, its popularity would increase tremendously. Although there are strong usability models for information systems, there is still potential to improve the usability of virtual learning systems. The usability assessment of virtual learning systems is an area where relatively little research has been conducted, and, accordingly, the main contribution of this work is a framework that evaluates the usability maturity of a virtual learning systems. Consequently, the study presents a performance-based Virtual Learning System Usability Maturity Assessment Framework that is aimed at usability-related issues for virtual learning systems in universities.

Keywords: virtual learning systems; usability; usability assessment framework; user-centred designs

I. INTRODUCTION

The term "usability" refers to a set of multiple concepts, such as execution time, performance, user satisfaction and ease of learning ("learnability"), taken together. But usability has not been defined homogeneously, either by the researchers or by the standardization bodies. Table 1.1 illustrates how the term has been defined differently in three distinct standards.

Usability definitions in Standards

Usability Definitions
"The capability of the software product to understand, learned, used and attractive to the user, when used under specified conditions" (ISO/IEC 9126-1, 2000)
"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 9241-11, 1998)
"The ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or component" (IEEE Std. 610.12-1990)

Beside the definitions of usability offered in ISO and IEEE standards, a number of other researchers introduce their own definitions, for example, Jokela [1] define usability as a quality attribute of a product that is dependent on the extent and performance of UCD activities in a specific development project [2]. Nielsen and Phillips [3] define usability as the absence of obstacles that prevent users from completing their tasks with the system [3]. This definition implies that a high number of identified usability problems usually indicate a low degree of usability [4]. Gould and Lewis [5] declare that any system designed with the intention for people to use should be easy to remember, easy to learn, useful and pleasant to use. Preece et al. [6] points out that usability ensures optimizations of people interactions with interactive products.

This study investigates the role of virtual learning systems in support of service delivery in education particularly within the area of end-user systems usability. The study stems from the fact that, in spite of the technology being in place as a primary motivator for delivery of quality education, there still remains dissatisfactions in harnessing its potential. Within institutions of higher learning there is evidence of constant innovation and changing approaches to provision of online services; however, the wide ranging and long term issue of user usability has clearly become a secondary consideration.

However, as practitioners and researchers have found, there are challenges associated with working across time, space and cultural dimensions. Not only does technology need to be suitable to the needs of collaborating virtual team and the organization, the team must also be allowed to find its own identity and there must be a strong sense of

trust between team members to bridge the dimensional gaps ([7], [8], [9]). There has been an outpouring of popular and scholarly literature about the use of computers in the workplace and how these emerging technologies can help promote collaborative work in groups by compressing space and time ([10],[11],[12],[13]).

Other research has been ongoing in identifying approaches to improve online usability ([14], [15], [16]). Studies often focus on the download delay, success in finding a page or completing a task, or organization of the information gathered during a Web session [17], [16]. For instance, [16] suggest that there is a positive relationship between the time users spend waiting for webpages to download and the probability that they will complete their task on the website.

Other research is based on Microsoft Usability Guidelines (MUG). Five major categories are proposed as relevant while designing websites for business: content (relevance, media use, depth/breadth, current information), ease of use (goals, structure, feedback), promotion, made-for-the medium (community, personalization, refinement), and emotion (challenge, plot, character strength, pace) ([18],[19],[20]). To date, the literature has conceptualized usability as either a one-dimensional construct or a multidimensional construct composed of two dimensions. Except for Palmer[16], most research has not explored usability as a construct composed of more than two dimensions. Based on the current literature, we suggest that usability is composed of at least three dimensions: ease-of-use navigation, speed, and interactivity.

II. METHODOLOGY

A. Research Design

Ogula [21] describes a research design as a plan, structure and strategy of investigation to obtain answers to research questions and control variance. Additionally, a study design is the plan of action the researcher adopts for answering the research questions and it sets up the framework for study or is the blueprint of the researcher [22]. The methods chosen to carry out this study were a case study, a survey, use of literature (previously reviewed) and documentary evidence as appropriate. Because of the numbers of issues raised by the research questions and the need to associate them with current practice in implementation of VLS, the researcher decided not only to do a survey, discussed below, but also to do a case study of this VLS projects (see beginning of Results and Discussions. A Case Study complements and "puts flesh on the bones" of a survey ([23], p. 11), adding an important third dimension – actual practice – to theory and figures.

B. Study Area

A case study of two Kenyan universities attempted to illustrate principles by considering usability issues in virtual learning systems and strategies used to enhance usability in their information systems. It tried to describe the experience of use of VLS platform by both students and staff (content developers). It attempted to explore the field of study, as defined in the title, and gather information on it. In order to do this exploration, data was collected and assimilated from formal and informal observation, field notes, vignettes and reference to (researcher-written) profiles and interview responses. The case study therefore described in this study at one point in time 24] could therefore be assumed to produce reliable data, which could be replicated by another researcher. It attempted to provide data, which may be valid in considering these specific research questions relating to the VLS learnability, understandability and operability. All confidential data has been presented in an anonymous way, observing ethical standards. The necessary consents were given

C. Sample and Sample Techniques

The sample frame of the study included a representative sample of the individuals using virtual learning systems as their platform for the study. This involved distance learning students on the account that they are who benefit most from the increased efficiency and flexibility brought about by the e-learning systems through synchronous and asynchronous collaboration [25].

According to Zikmund [26] a number of factors need to be taken into consideration when picking the best sampling frame including: the characteristics of the target population, accessibility to the population, feasibility of the methods of data collection, and types of analysis to be conducted.

The sample size must be big enough and properly constituted, therefore, to represent all characteristics of the population. According to Bartlett et al [27], prior to sample calculations, the researcher should determine if categorical variable will play a primary role in data analysis in which case Cochran's categorical sample size formulas should be used and therefore, to get the sample size (n), Cochran [28] was used. Cochran's equation is given by: $n = Z2pq/e2$

Where n is the sample size, Z2 is the abscissa of the normal curve that cuts off an area α at the tails (1 – α equals the desired confidence level), e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p. The value for Z is found in statistical tables which contain the area under the normal curve.

The sample obtained from the students was that, at 93% (0.93) confidence level which corresponds to standard normal deviate (Z) of 1.81 p the estimated proportion is unknown hence set at maximum variability value of 0.5 (50%, worst case value). The precision e allowed for this study is 7% (0.07). Using this formula for the student sample, the sample population was found to be 167 as shown;

$n = Z2pq/e2$ Therefore

$$n = \frac{(1.81)2*(0.5)*(1-0.5)}{(0.07)2}$$

$$n = 167$$

Therefore the sample population was 167 students.

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TABLE I: UNIVERSITY STUDENTS

	Students Category	Target	Actual Number for University X	Actual Number for University Y
	Undergraduate	150	60	60
2	Postgraduate	60	23	24
	Total Number of students		167	

The usability issues are technical aspects that can't be under-estimated. The researcher therefore posed a series of questions to content developers (who are lectures) using the Virtual learning platform. There was a total of 28 staff, from both universities, that is believed to be using VLS system. Given the number was small, to obtain the desired sample, Yamane's (1967) formula was adopted given by: n = N/ (1+N (e)2)

Where N is the sample size, n is the desired sample size, N is the known population size, and e is the level of precision. In this category, this study will use 95% (0.95) confidence level and the level of precision e allowed for this study is 5% (0.05). Using this formula for the non-expert staff sample, the sample population was found to be 26 as shown;

$$n = \frac{N}{1 + N(e)2}$$

$$n = \frac{28}{1 + 28(0.05)2}$$

$$n = 26$$

D. Data Analysis

Myers and Avison [29], state that the main parts of data analysis are important to the outcomes of case research. The richness of data of the research should be presented. The reasoning of researchers should be clearly stated and defended in establishing hypotheses. The research should begin from purposes and questions, to assumptions and design choices, then to specific data discovered, and to results and conclusions. Both quantitative and qualitative approaches were used for data analysis

Quantitative data from the questionnaire were coded and entered into the computer for computation of descriptive statistics. The Statistical Package for Social Sciences (SPSS version 21) was used to run descriptive statistics such as frequency and percentages so as to present the quantitative data in form of Tables and graphs based on the major research questions

The qualitative analysis in this research followed the principles of thematic analysis [30], coded in accordance with research objectives and reported in verbation as was in Raburu [31]. According to Braun and Clarke ([30], p.79) 'it is a method for identifying, analyzing and reporting patterns (themes) within data. It minimally organizes and describes data set in (rich) details'. Interview transcripts were transcribed, coded as themes emerged as in [31]. The present study used process of analysis and interpretation (using the six phases of thematic analysis on Table 2) as shown by extracts on Table 3.8 shown next, in the next section.

TABLE 2: DATA EXTRACTS, CODED WITH THEMES

Data Extracts	Themes/Sub Themes Codes
'..I know online and e-learning platform is the way to go. Despite its benefits we are just implementing the platform without proper planning ' [P1]. 'But we have some policy on the online and distance learning' [P3]. Normally, we try to get information from lecturers on what is needed to be incorporated in the software so that customization based on their needs has to be effected [P8]	Design Strategy-UCD Methodology
For our e-learning system to be well adopted and used, we normally involve students especially those with IT skills to help in assessment of its viability before using it [P1]. Students and lectures need to be trained on use and customization of the system before its officially put in to use [P4]	Usability Methodology-User's requirements, User's Feedback, Usability Learning
We as the IT officers, we have to collate all the feedback including positive and errors so that we channel the same to developer [P7].	Assessment – Usability Bug Testing
I expect a lot of information regarding use of the environment such as electronic walk through such as CDs so that, students can easily use them to understand the platform [P2]. User manuals and help facility both online and offline are necessary [P5]	Documentation D

Table 2 is a sample of verbation quotations from interviews which were transcribed, coded and themes emerged as was in Raburu [32]. The Thematic areas included: Student learning, VLS resource / content creation, VLS system support, and organization.

III.RESEARCH FINDINGS AND DISCUSSION

A. *Study Respondents*

An online survey tool "kwiksurveys" was used to present the questionnaire and there were 125 responses from the students and 21 responses from teaching staff resulting in to 74.9 % and 80.7% response rate respectively. Table 3 provides the summary of the respondents

TABLE 3: SUMMARY OF RESPONDENTS

Category of respondent	Number of Respondents		Average Response Rate for each strata
	University X	University Y	
Student	61 (73.5%)	64 (76.2%)	74.9%
Staff	11 (84.6%)	10 (76.9%)	80.7%

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B. *Research Hypothesis and Testing*

The basis of this question is to investigate how understandability, learnability and operability affect VLS usability from the user's perspective. There are three independent and one dependent variable in this research model. The three independent variables, the usability factors, include Understandability, Learnability and Operability. On the other hand, the dependent variable of this study is VLS usability. The multiple linear regression equation of the model is as follows:

VLS Usability = γ 0+ γ 1v1+ γ 2v2+ γ 3v3 …… (1)

Where γ 0, γ 1, γ 2 and γ 3 are the coefficients and v1, v2 and v3 are the three independent variables. In order to empirically investigate the research question following study model was conceptualized

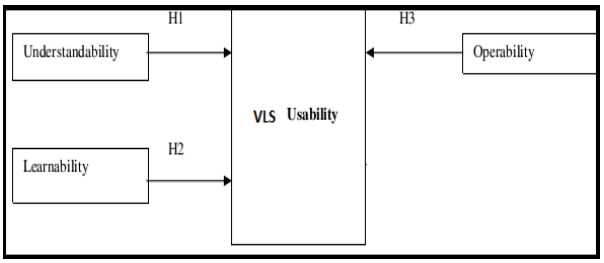

FIGURE 1: VLS USABILITY QUALITY METRICS

The three hypotheses illustrated in the study model are further described in Table 4

TABLE 4: STUDY MODEL HYPOTHESES (USER'S PERSPECTIVE)

Hypothesis #	Statement
H1	Understandability is positively related to VLS usability.
H2	Learnability is positively related to VLS usability.
H3	Operability positively affects usability in VLS

In the first phase, parametric statistics were used to determine the Pearson correlation coefficient between the individual independent variables, the usability factors, and the dependent variable, VLS usability, as displayed in Table 4.4. Specifically, with a value of 0.42 at $P < 0.05$, the Pearson correlation coefficient between understandability and VLS usability was positive, and hence, hypothesis H1 is justified. Similarly, a Pearson correlation coefficient of 0.42 at $P < 0.05$ was observed between learnability and VLS usability, and hence, this relationship was significant at $P < 0.05$. Hypothesis H3 was accepted based on the Pearson correlation coefficient of 0.51 at $P < 0.05$, which occurred between operability and VLS usability. Hence, all hypotheses were found statistically significant and were accepted.

Non-parametric statistical testing was conducted by examining the Spearman correlation coefficient between the individual independent variables, the usability factors, and the dependent variable, VLS usability, as shown in Table 5. The Spearman correlation coefficient between understandability and VLS usability was positive, with a value of 0.40 at $P < 0.05$, and hence, hypothesis H1 is justified. For hypothesis H2, the Spearman correlation coefficient of 0.41 was observed at $P < 0.05$, and thus, a significant relationship was found between learnability and VLS usability. Based on the Spearman correlation coefficient of 0.51 at $P < 0.05$, hypothesis H3, which occurred between Operability and VLS usability, was accepted. Hence, the hypotheses H1, H2 and H3 were found statistically significant and were accepted based on non-parametric analysis.

TABLE 5: HYPOTHESES TESTING USING PARAMETRIC AND NON-PARAMETRIC CORRELATION COEFFICIENTS (USER'S PERSPECTIVE)

Hypothesis	Usability factor	Pearson correlation coefficient	Spearman correlation coefficient
H1	Understandability	0.42*	0.40*
H2	Learnability	0.42*	0.41*
H3	Operability	0.51*	0.51*

*significant at p<0.05. **Insignificant at p>0.05.

On the other hand, the multiple linear regression equation of our research model is depicted in Equation 1 was conducted. For this statistical test, the testing process includes regression analysis, which yields the values of the model coefficients and their direction of association. In this case, VLS usability is considered as the response variable and the usability factors are the predicators.

As shown in Table 6, the path coefficients for all three variables are positive, whereas the t-statistics for the same variables are statistically significant at $P < 0.05$.

TABLE 6: MULTIPLE LINEAR REGRESSION ANALYSIS FROM THE USER'S PERSPECTIVE

Model coefficient name	Usability factor	Coefficient value	t-value
Understandability	γ 1	0.42	4.35*
Learnability	γ 2	0.31	1.79*
Operability	γ 3	0.27	2.51*
Constant	γ 0	4.12	0.49*

*significant at p<0.05. **Insignificant at p>0.05.

Recapping Equation 4.1 by inserting the model coefficient values, we get:-

VLS Usability = 4.12 + 0.41v1+ 0.31v2+ 0.27v3+ e . (2)

Where v1, v2 and v3 are the three independent variables while e representing an error

When the students were asked of "whether consistency of the virtual learning software system affects overall usability of the systems especially understandability", their responses were as indicated in Table 7

In total, 79% of our respondents agreed that consistency in VLS software design would increase understandability, while 16% remained neutral and only 5% disagreed.

Table 8 shows the response by students on software ease to understand and how it affects user's involvement with the information systems.

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TABLE 7: RESPONSE BY STUDENTS ON VLS SOFTWARE DESIGN ON USABILITY

Response	No. of Respondents	Percentage (%)	Cumulative% age
Strong Agree	43	34	34
Agree	56	45	79
Neutral	20	16	95
Disagree	6	5	100
Strongly Disagree	0	0	100
TOTAL	125	100	

TABLE 8: RESPONSE BY STUDENTS ON SOFTWARE EASE TO UNDERSTAND ENCOURAGES USER'S INVOLVEMENT

Response scale	No. of Respondents	Percentage (% age)	Cumulative % age
Strongly Agree	57	46	46
Agree	44	35	81
Neutral	16	13	94
Disagree	8	6	100
Strongly Disagree	0	0	100
TOTAL	125		

From Table 8, its clearly evident that, 81% of the student respondents agree with the fact that, ease of use of the software encourages understanding and hence user's involvement with the system. This is in agreement with the study done by Landry et. al. (2006) who carried out a study on measuring student perceptions of blackboard using the technology acceptance model.

On the other hand, when the students and teaching staff were asked of whether the software they are using is easy to understand and hence encourages them, the responses was as shown in Table 9

TABLE 9: RESPONSE BY STAFF ON SOFTWARE EASE TO UNDERSTAND ENCOURAGES USER'S INVOLVEMENT

Response scale	No. of Respondents	Percentage (%ge)	Cumulative % age
Strongly Agree	6	30	30
Agree	12	56	86
Neutral	2	9	95
Disagree	1	5	100
Strongly Disagree	0	0	100
TOTAL	21		

From Table 9, 86% of the staff involved in the study agree with the proposition that" software ease to understand encourages user's involvement". Understandability of any software solution including VLS cannot be ignored as supported by [33]. Understandability is thus a measure of software quality

IV. VLS-USABILITY MATURITY ASSESSMENT FRAMEWORK

A. *VLS-Framework Dimensions*

Based on the previous discussions in section III, four performance-based usability maturity dimensions were developed, which will be presented in this section. This section argues that successful integration of usable VLS and user centred design is dependent on four main dimensions: Student Learning, VLS Resource/ Content creation, VLS system support and organization. These aspects become critical while designing the performance-based usability maturity assessment framework presented in Table 11.

When selecting an appropriate usability evaluation method or combination of methods, the selector will need to take into consideration the different foci of the evaluation. Dix et al. (1998) suggest that these foci or considerations are:

The stage in the lifecycle at which the evaluation is carried out

i) The style of the evaluation
ii) The level of subjectivity or objectivity of the method
iii) The type of measures provided
iv) The information provided.
v) The immediacy of the response
vi) The level of interference implied.
vii) The resources required

Dimension 1: Student Learning

Learnability, or the ease with which the features required for achieving particular goals can be mastered. It is the capability of the VLS system to enable users to feel that they can productively use the software product right away and then quickly learn other new (for them) functionalities. Areas considered included course design, strategies to address student needs and pedagogical aspects.

Dimension 2: VLS Resource/ Content Creation

This dimension emphasizes on the e-material generation by the staff. Aspects such as student and staff being taken in to consideration while creating content for the VLS systems as this forms the main users of the platform.

Dimension 3: VLS Support

The scope, complexity, and access of support grow as e-learning gains popularity, easily straining an institution's resources. This area is concerned with the support staff offers to support all forms of e-learning. In many institutions there is segregation of most resources to address either instructor or student needs. Online training or help desk services, however, always service both instructors and students.

Dimension 4: Organization

This is concerned with the support that VLS projects get from the management of the universities. This ranges from managing training and educational records to software for distributing online or blended/hybrid college courses over the Internet with features for online collaboration. Aspects such as vision and e-strategy for VLS systems and policy on integration are examined in this dimension while creating the Usability maturity Assessment framework

B. *Levels of Usability Assessment Framework*

In order to help the identification of best practices, the following VLS- usability framework can be reframed in

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the context of e-Learning in order to identify potential outcomes rather than define key activities that lead to these outcomes. Table 5.6 defines the levels of usability maturity assessment metrics for virtual learning systems. As stated by Raza [34], usability of any software (whether proprietary or tailored) determines the overall acceptability of the system (including the VLS).

TABLE 10: LEVELS OF USABILITY MATURITY ASSESSMENT FRAMEWORK

Level	Focus
5. Optimizing	Continual improvement of VLS system
4. Managed	Ensuring quality of both the e-learning resources and student learning outcomes
3. Defined	Defined process for development
2. Planned	Clear objectives for e-learning through VLS
1. Initial	Ad-hoc processes

The researcher recognize that the value of this framework will be somewhat debatable, especially for those that advocate a more decentralised view on e-learning; however, this debate itself would seem a worthwhile outcome for considering the use of an adapted maturity model. There is need to note that, the framework does not presuppose any particular pedagogical approach, but rather recognises that individual universities need to consider and adopt pedagogies appropriate to their particular organisational context. The framework is designed to highlight the value of developing a clearly articulated approach for guiding the development of e-learning resources (through VLS) rather than require any particular approach.

At an institutional level, the emphasis of the VLS-UMAF is on guiding improvements in e-learning, through VLS facilities, which move from the realm of an ad-hoc process, based on individual initiative to an integrated process that delivers demonstrable improvements in areas like student learning and content delivery by lecturers.

In adapting the model to the domain of e-learning systems there are a number of suggestions that have been proposed. Firstly, five levels are describes as: Initial, Planned, Defined, Managed and Optimised (as discussed in this chapter). Each of the levels has also broken been broken down to reflect some of the key issues associated with virtual learning environment which provides a more coherent approach to considering complexity of outcomes that might be associated with each level. The areas that form basis of the improvement framework include: student learning, resource creation (content development), VLS project management and support and organisational management.

C. *VLS-Usability Maturity Metrics*

The research findings presented in chapter four, therefore, informed the researchers in coming up with the possible outcomes of virtual learning system usability maturity assessment framework, that is aimed at determining the level of usability characteristics in the VLS in universities. The model defines four categories of assessment metrics namely: Usability Methodology (UM), Design Strategy (DS), Usability Assessment (UA) and Documentation (D).

The visual summary of the model is summarized in the Figure 2

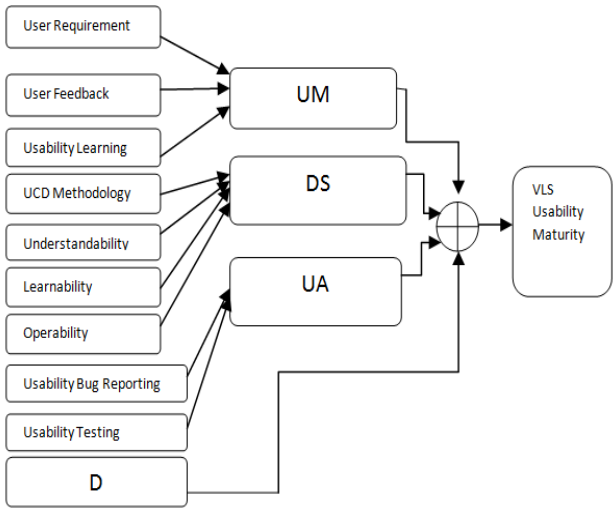

FIGURE 2: VLS USABILITY ASSESSMENT METHODOLOGY METRICS

These factors formed the basis for the usability assessment methodology which was grouped into a set of four dimensions that include: Usability Methodology, Design Strategy, Assessment and Documentation. Usability Methodology incorporates Users' Requirements, Users' Feedback and Usability Learning. On the other hand, the Design Strategy dimension covers User-Centered Design Methodology, Understandability, Learnabiliy and Operability and the Assessment Dimension comprises Usability Bug Reporting and Usability Testing.

D. *VLS-Usability Maturity Assessment Framework*

The findings for the VLS-UMAF are as presented in Table 11 However, it must be noted that does not define the key processes that would lead to the outcomes indicated.

TABLE 11: VLS-USABILITY MATURITY ASSESSMENT FRAMEWORK (VLS-UMAF)

Level 1: Initial: No formal processes
Student learning Resource creation intended to address specific teaching goals informally identified Assessment unrelated to changes in teaching and learning processes No formal preparation made to facilitate introduction of the new resources Little or no consideration of pedagogical implications as processes re run in ad-hoc **VLS Resource / content creation** Resource development undertaken by individual staff (including teaching and maintenance) No formal plans for the design and delivery of resources e.g. trainings on module development Little or no formal tracking of intellectual property of created material Technology decisions made for their own sake rather than being driven by principles and experience of educational design ie. There are no procedures to facilitate technical decisions on how virtual learning system should run

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VLS system support

Limited peer support of resource creation in VLS projects

Poor or incomplete identification of financial and other requirements ie. Poorly factored financial implications for the VLS platform

Limited planning and organization for the e-learning through VLS

Little or no use made of specialised facilities for technical and pedagogical support

Organization

Management oversight limited to financial reporting

Level 2: Recognized: Deliberate process

Student learning

Specific areas of student need identified and addressed by academics

Student learning evaluated upon delivery of the completed resources such as modules, assignments

Informal use of standard pedagogical models

VLS Resource / content creation

Student and staff needs are taken into account when determining requirements

VLS system support

Use of a consistent approach to the development of e-learning resources

Developed plans for the creation of e-learning resources with identified goals

Established educational objectives for resources

Organization

Creation of resources is supported by academic management

Course evaluations conducted to check student perceptions of success

Level 3: Defined: Structured and integrated process

Student learning

Strategies to address student needs through VLS platform is reflected in University plans

Course design practices are modified where necessary to reflect project outcomes and impact on student learning

Pedagogical models formally identified for individual courses

VLS Resource/ Content creation

Intellectual property policies well defined regarding the content developers

Specifically tagged funding available to support resource creation

VLS system Support

Policies and standards for resource creation and delivery established

A well-defined and documented process to create resources is established

Specialized technical support and educational development expertise is available through centralised unit

Peer reviews of resources (such as learning modules) are conducted

Organization

Creation of useful resources is formally recognized by the organization and included in policies and procedures for promotion and tenure

An organizational vision and strategy for e-learning is developed

Development of an organization level approach to the integration of systems

Organizational support programmes established for staff and students

Level 4: Managed: Organisational approach

Student learning

Student learning outcomes are formally evaluated

Standard pedagogical approaches identified and documented

VLS Resource / Content creation

Resources are managed as part of an organisational approach to content management

Reusable intellectual property is identified and catalogued for reuse

Student usability of the resources (using VLS platform) is regularly assessed

VLS system support

Project selection is based on detailed information about past projects

Formal procedures exist for identifying resources that have reached the end of their life

Organization

Clear educational effectiveness metrics and associated goals are established

Organizational audits of e-learning through VLS performance regularly conducted

Level 5: Optimized: Continual improvement of educational effectiveness

Student learning

Improvements in educational effectiveness are regularly evaluated

Evaluations based on a formal research programme

Pedagogical models redeveloped to reflect changing environment and student needs

VLS Resource /Content creation

New resource creation is driven by formally identified needs which are generated automatically by the strategic planning, operational monitoring and reporting processes in use

Formal process for regular re-evaluation of resources in their learning contexts is used to identify needs for incremental improvement and on-going maintenance support

VLS system support

UMAF metrics are used to evaluate and drive changes in methodology and resourcing

Learning outcomes are used as the principle drivers for new delivery approaches

Improving organizational capability associated with inter University collaboration

Regular external review of on-going e-learning and resource creation strategy

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V. CONCLUSION

This study has been primarily focused on two objectives: to identify certain usability factors that may help in improving VLS usability from the perspective of users, and to propose VLS-UMAF, a usability maturity assessment framework for VLS projects.

Some of the leading research areas and suggested future work in those areas are presented as follows:

a) Enhanced Onsite Assessment methodology
The study employed self-assessment method to perform case studies. There is need to enhance the assessment methodology by introducing on-site assessment by identifying documents to review, interview questions and mapping replies to the measuring instrument of the proposed maturity assessment model.

b) Need for Improvement Plans
Presently there is no definition of how the improvement plans was generated and implemented after the assessment. Furthermore, a guideline, regarding how to move up a ladder from one maturity level to another, is missing. We would like to work on these issues as well.

c) Further investigations for invalidated VLS factors
Regarding the factors that have not been validated in the empirical studies, further studies may be needed to establish whether these factors are relevant or not in the assessment of VLS usability maturity.

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BIOGRAPHIES

Omieno Kelvin received the degree in computer science from Masinde Muliro University of Science and Technology, in 2008 and Msc in Information Technology in 2012. He is a Phd Student in Information Systems. Currently, he is a Lecturer at Masinde Muliro University of Science and Technology.

Dr. George Raburu, is a PhD holder in information systems and MSc in Business Information System. He has a wide experience in Information systems technologies after working in industry for many years and currently is a Senior Lecturer at Jaramogi Oginga Odinga University of Science and Technology. He is a renowned researcher in the field of computing.is well received by international reader.

Dr. Pamela Raburu is a senior lecturer at Jaramogi Oginga Odinga University of Science and Technology. She is well researched in the area of education and research methods. She is currently the head of Education and Psychology Department in the School of Education.

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