Chapter 12

A Human-Centered Usability Evaluation of University Websites Using SNECAAS Model

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ABSTRACT

One of the ways universities ensure constant touch with the human populace is through their websites. Therefore, websites must be engaging, interactive, easy-to-use, and provide users with the necessary information needed. Unfortunately, most universities have found this objective quite difficult to achieve. This chapter presents an evaluation the usability of six Nigerian university websites using a model which is based on seven usability criteria of speed, ease of use, navigation, content, aesthetic, accessibility, and security. The best six university websites based on webometric ranking were selected for the study with 233 participants via an online questionnaire using Google Docs. The overall results of the evaluation indicate that the usability of Nigerian university websites performed fairly well in ease of use, navigation, and aesthetic, averagely on speed and content, while the ratings based on accessibility and security are not very satisfactory.

INTRODUCTION

Many users today depend much on web application as a result of continuous growth in internet which has transformed the world into virtual market. Hence, the need arises for a highly dependable web applications even in the midst of growing competition among organisations (Esmeria & Seva, 2017). Website of an organisation serves as an access to its information, services and products (Daher & Elkabani, 2012). Through websites, the company's reach can be extended as it gives an overview of who, what and how the organisation carries out her activities. Therefore, website development process has to be done painstakingly and carefully in order to project the organisation properly.

One of the main aims of developing software application or website is to provide its users with a noble, satisfied and fulfilling services with good and exciting user experience (Boza, Schiaffino, Teyseyre, & Godoy, 2014). Among the myriads of organisation craving for good and usable websites usability is academic institutions in which universities belong. This class of websites is very important as it provides information for a wide category of audience like students, faculty, parents and many more (Adepoju & Shehu, 2014; Hasan, 2013; Nagpal, Mehrotra, Bhatia, & Sharma, 2015). The website of any academic institution plays a vital and prominent role in shaping its image. A university's website is expected to provide adequate, correct and timely information about the university and its activities to various stakeholders. Apart from this, it is to serve as a communication medium between the institution and students, staff, alumni, and guest (Jabar, Usman, & Awal, 2013). Furthermore, websites have been found to be one of the most utilized internet resources among the various ICT facilities used in universities. This is in addition to email services and web (Egoeze, Misra, Akman, & Colomo-palacios, 2014)

So, the usability of this type of website is very important. In order to achieve this good user experience, a software application or website should then be easy to use and learn. This attribute is commonly referred to as usability (González, Lorés, & Granollers, 2008). This implies that a very satisfying and pleasing user experience is highly needed from these websites that are been developed by different higher institutions.

According to International Organization for Standardization (ISO 9241-11), usability can be defined as "the extent to which a product, service or system can be used by specified users to achieve a specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO, 2018). The user is the person who interact with the product (websites in this context), and the context of used refers to users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product. González et al.(2008) also indicated context of use to be "a picture of the actual state under which the interactive system or software application is being evaluated or is handled in normal functioning circumstances".

Generally, evaluation of websites can be done by considering it from credibility (Deedam, Thomas, & Taylor, 2018), quality (Anusha & Rama, 2016; Dominic, Jati, & Hanim, 2013), functionality (Calisir, Gumussoy, Bayraktaroglu, & Saygivar, 2011), accessibility (Al-faries, Al-khalifa, Al-razgan, & Al-duwais, 2013) and usability (Chamba-Eras, Jacome-Galarza, Guaman-Quinche, Coronel-Romero, & Jaramillo, 2017; Kaur, Kaur, & Parminder, 2016) point of view. The various evaluation aims at determining and evaluating the performance of the websites based on the metric defined in the evaluation. However, usability is seen as the most important evaluation that could be evaluated especially for academic websites.

This chapter therefore presents a comprehensive preliminary investigation into the usability of six Nigerian university websites which over the years have performed very well in webometric ranking. These are institutions with repeated good web presence over the years. This is aimed at knowing the

performance of these university websites based on usability. The study also investigates if there is any similarity between webometric ranking obtained over the years and usability ranking results obtained in the study. The study also shows the usability ratings of all the websites used in the study.

LITERATURE REVIEW

In order to evaluate usability of websites, different approaches can be used which are user testing, tool-based testing, expert-based testing, analytical method, data mining techniques and multi criteria decision making approach testing among others (Adepoju & Shehu, 2014; Das & Patil, 2014; Nagpal et al., 2017).

User testing involves engaging users to evaluate the websites in order to discover the inherent problems in the websites. Expert based method which is also known as heuristic evaluation involves the use of expert to evaluate the websites based on a ser of predefined heuristics. Analytic methods entail the use of different models to predict usability, while data mining approach uses different classification algorithms to mine usability data. Multi criteria decision making approach entails the use of decision-making model to select, rank or prioritise some alternative websites based on some usability criteria.

To use any of these methods, different usability criteria or parameters have to be considered and measured. Due to the heterogenous view of usability, different criteria are being considered based on the view of the author and context of use. However, some of the common criteria are effectiveness, efficiency, ease of use, satisfaction, speed. learnability, credibility, navigation, content, operability, aesthetic, accessibility, stickiness and security (Cheng, 2015; Manian, Yurtchi, & Shadmehri, 2014).

Usability Evaluation of University Websites

Several authors from different countries in the past few decades have conducted research aimed at evaluating academic websites usability. While some focus on academic mobile digital and repositories library (Adewumi, Omoregbe, & Misra, 2016; Alasem, 2013; Jagero, Nhendo, Sithole, Takaingenhamo, & Guvava, 2014), others focus on mobile service (Al-khalifa, 2012). However, studies with specific focus on university websites include that of (Mustafa & Al-Zoua'bi, 2008) who evaluated nine Jordan universities based on five usability criteria by using both questionnaire methods and automated toools. An acceptable level of usability was derived from the results. Hasan (2013) from the same country used heuristic evaluation to evaluate the usabilility of three Jordan universities.

Daher & Elkabani (2012) conducted usability evaluation study on the web portal of six Lebanese universities. Questionnaires were used to collect data based on Single Usability Metric (SUM) model which measures effectiveness, efficiency, satisfaction in relation to usability. The research was concluded by identifying the shortcomings of all the six-web portal and it was observed that content is the most important part of all web portals. Adepoju & Shehu (2014) study was conducted to determine the usability of Nigerian Federal universities by using three automated tools viz; Hera, A checker, and WAVE. The results of the evaluation showed that the none of the websites fully conform to the standards of accessibility as stipulated by Web Content Accessibility Guidelines (WCAG 2.0 and WCAG 1.0). Furthermore, Kiyea & Yusuf (2014) evaluated the usability of ten randomly selected Nigerian universities using

Webpage Analyser and HTML tool box. The result of the study also indicated that no website passed the evaluation from the two automated tools. A website evaluation model was developed to evaluate ten top ranking engineering universities in Asia with the results showing that the academic websites tested were partially usable (Manzoor & Hussain, 2012)

In another study, the usability of academic website of Uva Wellassa University, Sri Lanka was investigated by Jayathunga, Jayawardana, Wimaladharma, & Herath (2017). A Questionnaire which contains twenty usability criteria grouped under four categories was used. Descriptive statistical analysis and confirmatory statistical analysis were applied to analyse the data. The results showed that there exists a strong bond between usability and content and organization as well as web performance.

Boza et al. (2014) study focused on the use of a heuristic approach for usability evaluation using data mining techniques as a means to reduce cost and time consumed during usability assessment process. Apriori algorithm and J48 decision tree algorithm were used to analyse usability data obtained from thirty-five websites from diverse areas. The results indicated that the proposed method is able to mine out important patterns and show the relationship between the usability metrics under study.

Wardoyo & Wahyuningrum (2018) used the method of logarithmic fuzzy preference programming to evaluate the website quality of five university websites in Indonesia based on three usability and accessibility criteria of stickiness, backlink and web page loading time. The results obtained show that stickiness is most important factor that affect quality of the websites.

Websites Usability Models

Usability is one of the important quality factors in user interface design. This quality has attracted many researchers and hence different usability models have been proposed in literature for different products, services and systems. Some of the existing models found in literature are discussed as follows.

The ISO/IEC 9126 standard model which defined usability by five factors; understandability, learnability, operability, attractiveness and usability compliance (Botella et al., 2004). ISO 9241-11 standard model characterized usability based on efficiency, effectiveness and satisfaction of product, services and systems (Abran, Khelifi, & Suryn, 2003; Speicher, 2015). Nielsen in his model proposed that usability is to be measured based on effectiveness, efficiency, satisfaction, and learnability (Nielsen, 1994)

In the 2QCV3Q model, Mich, French, & Cilone,(2003) proposed a conceptual model that consists of seven dimensions to evaluate the quality of a website based on who-what-why-when-where- how and feasibility (with what means and devices). The model defines accessibility, navigability and understandability as usability factors.

McCall's model (also known as McCall's triangle of quality) is one of the software evaluation models which defines usability as product operation (basic functionalities), product revision (ability to change), product transition (ability to adopt new environment). Usability was defined under product operation and it comprises operability, training and communicativeness (McCall *et al.* (1977) cited in Shawgi & Noureldien, 2015)

Shawgi & Noureldien (2015) defines the high-level usability factors in the new usability measurement model (UMM) as accessibility, understandability, learnability, operability, attractiveness, and navigability, which are all defined in previous models, but not in one model.

Other usability models include Quality in use integrated (QUIM) model which defined usability in terms of efficiency, effectiveness, productivity, satisfaction, learnability, safety, trustfulness,, accessibility, universality and usefulness (Seffah, Donyaee, Kline, & Padda, 2006), Web Usability Evaluation Model

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(WUEM) proposed by Manzoor & Hussain (2012) comprises web design, page design, accessibility and Navigation as its usability attributes. The enhanced usability model (EUM) comprises effectiveness, efficiency, satisfaction, learnability and security as criteria to measure usability (Abran et al., 2003). Table 1 shows the model in a tabular form for easy representation.

In addition to these, there are still some other factors on which usability depends as viewed by other authors. For example information content and navigation have been identified as the most important parameter in measuring usability according to the study conducted by Mehrotra, Pradesh, & Pradesh (2017). This is in addition to other factors, download speed, aesthetics, visual clarity, accessibility, ease of use, learnability and user interface design. These parameters when carefully examined fits into the major models discussed above.
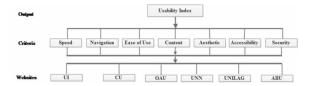
In the light of this after extensive study, data gathering, analysis and interpretation, a new usability model which comprises speed, navigation, Ease of Use, Content, Accessibility, Aesthetic, and Security (SNECAAS) is proposed as shown in Fig 1. This is based on a framework earlier proposed by Adepoju, Oyefolahan, Abdullahi, & Mohammed (2018)

Speed is the amount of time it takes for the website to render or respond after a request has been made i.e. the load time. Navigation of a website measures the ability to detect and gain possession of appropriate information, menu, reports, options, and elements. Ease of Use refers to the ease at which the user uses and understands the structure, architecture and organization of the website. Content on the

Table 1. Usability evaluation models

Usability factor	McCall	ISO 9126-11	ISO 9241-11	Nielsen	2QCV3Q	UMM	WUEM	QUIM	EUM
Understandability		✓			✓	✓			
Learnability		✓		✓		✓		✓	✓
Operability/functionality	✓	✓				✓			
Attractiveness		✓				✓			
Usability compliance		✓							
Training	✓								
Communicativeness	✓								
Accessibility / readability					✓	✓	✓	✓	
Navigability				✓	✓	✓	✓		
consistency									
comment									
Web design							✓		
Page design							✓		
Security/privacy								✓	✓
organisation									
efficiency			✓	✓				✓	✓
effectiveness			✓	✓				✓	✓
productivity								✓	
satisfaction			✓	✓				✓	✓
universality								✓	

Figure 1. SNECAAS model structure

other hand refers to the textual, aural and visual information published on the website. Accessibility is the extent to which the website is compatible for use by people with disabilities. Simply put, it is avail-ability of the websites to different categories of users without any form of discrimination. Aesthetic has to with attractiveness and look and feel of the website. This includes the design and color combination used in the website design. Lastly, based on ISO/IEC 9126 security, which is a sub-characteristic, is defined a set of software attributes which relates to its ability to prevent unauthorized access, whether accidental or deliberate to programs and data.

METHODOLOGY

The methodological steps used in carrying out the study is depicted in figure 2. The first step involved a comprehensive and detailed literature review in order to know the criteria to be used in the study. This also allow for the selection of the university websites to be used for the study. Thus it is ensured that quality and adequate data are gathered for use in the study. These steps are explained as follows.

Website Selection

The first step is the selection of the university websites to use for the study. At present Nigeria has close to 168 universities with all of them having functioning websites (NUC, 2019). More so, most of them have featured repeatedly on webometric ranking over the period of two years from 2016 to 2019 After a thorough analysis, six university websites which ranked very well over this period were selected for the study. Only six websites were selected in order to reduce the cognitive load of the human who are involved in the study (Cybermetrics, 2019) . Table 2 shows the selected websites and their URLs.

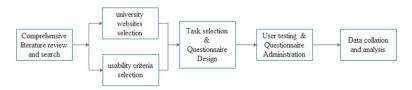*Figure 2. Methodological steps*

Table 2. University websites used for the study

	University name	URL	Acronym	2016 ranking	2017 ranking	2018 ranking	2019 ranking
1	University of Ibadan	www.ui.edu.ng	UI	1st	1st	1st	1st
2	Covenant university	www.covenant.edu.ng	CU	6th	2nd	2nd	4th
3	Obafemi Awolowo University	www.oauife.edu.ng	OAU	3rd	4th	3rd	3rd
4	University of Nsukka	www.unn.edu.ng	UNN	7th	3rd	4th	2nd
5	University of Lagos	www.unilag.edu.ng	UNILAG	2nd	6th	5th	6th
6	Ahmadu Bello University	www.abu.edu.ng	ABU	4th	7th	6th	5th

Usability Criteria Selection

The criteria used were selected based on comprehensive literature review of existing work in this area. This has been discussed in section 2. The author based the selection on criteria that have been covered in the same way as the existing model.

Task/User Testing and Questionnaire Design

To carry out the user testing, representative tasks to be performed on the websites must be selected. To do this, five representative tasks were identified for users to perform on each website. The identified tasks are:

1. View the mission and vision of the university
2. View a list of all the faculties in the school.
3. View a list of all the lecturers in the Electrical engineering department
4. Search for the university's academic calendar for the 2017/2018 session
5. Search for the latest news bulleting

To get users feedback from the test, an online questionnaire was designed using google docs. It comprises two sections. Section A is to collect data about the demography of the participants. Section B is grouped into seven items according to the numbers of criteria used. The total number of items in all is twenty-three. Users responses are rated from 1 to 5 based on five-point Likert scale of Strongly Disagree to Strongly Agree. The questionnaire was tested for both validity and reliability. Reliability with Cronbach's alpha value ($\alpha =0.876$) was obtained. A total of 233 participants who are mostly students responded to the online questionnaire.

The proposed SNECAAS model structure used for the evaluation is depicted in figure 1 earlier and explained as follows.

The goal is to calculate and generate the usability index (UI) which ranges from 1 to 5. UI from 4-5 is rated as excellent, 3.5-3.99 as good, 3.0-3.49 as average, 2.5-2.99 as below average and 0-2.49 as poor.

Each website is evaluated based on each usability criteria and the result per criteria as well as on the overall results are then obtained.

The UI index is generated by obtaining the overall score per website based on all the criteria together.

RESULTS AND DISCUSSION

The demographic data of the participants in the study is shown in Table 3. It shows the sex, internet experience and age of participants used for the study. More male participants responded to the questionnaire than their female counterpart and most of the participants are within the age bracket of 21-25 years. This is because most of the participants are undergraduates.

Figure 3 shows the performance of each university across the seven criteria. All the universities performed very low on the security and accessibility criteria as half of the websites scored below the average score. This is due to the fact most users are not sure of the security features embedded in the websites as well as its accessibility options for the disabled.

On the other hand, Ease of Use criteria take the lead in the criteria rating with UNILAG websites coming first with a score that is far above the total average score. Likewise, CU, OAU and UI performed a bit above the average score for this criterion.

Navigation of the websites shows that ABU website performed below the average while others especially UNILAG performed very well among the users. CU and UNILAG websites speed are good compared to others that performed averagely. However, none scored excellent in this criterion. The trends obtained in this result is closely similar to that obtained in (Adepoju & Shehu, 2014) where UNILAG and OAU recorded less number or errors in their websites hence depicting better usability/

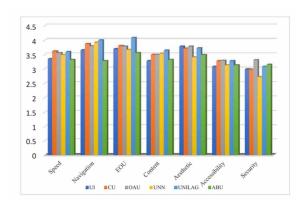*Figure 3. Performance of each university based on the criteria*

Table 3. Demographic data of the participants

Item	Option	Value
Sex	Male Female	148 85
Age	Below 16 16-20 20-25 26 and above	2 23 164 44
Internet experience	Expert Intermediate Novice	103 121 9

Further analysis of the result in Figure 4 shows that in the overall UNILAG obtained the highest usability score of 3.63, while OAU and CU followed with usability scores of 3.58 and 3.54 respectively. ABU obtained a score of 3.32 while UI and UNN are at par with scores of 3.41. However, on the average none of the websites performed excellent because none have a rating of 4.0 on all the criteria combined. This implies that only three of the six websites (UNILAG, OAU and CU) have scored good in overall usability.

Thus, the ranking obtained based on the overall usability score is in this order: UNILAG > OAU > CU > UNN >= UI > ABU. This ranking in comparison to the webometric ranking of Nigerian released from 2016 to 2018 (UI>CU>OAU>UNN>UNILAG>ABU) is a bit different. UNN and ABU retains their positions as 4th and 6th rank in both, while OAU and CU swap positions between 2nd and 3rd. UNILAG surprisingly take the lead in the overall usability rating with UI falling to 5th in the current usability rating. This implies that a good webometric ranking is not an indication of good usability in some cases.

Figure 5 shows the ranking of the criteria used in the study based on the performance by the websites. In overall, websites' Ease of Use, Navigation and Aesthetic were rated first, second and third respectively. This shows that the websites performed above average based on these criteria. However, speed and content are rated as average while accessibility and security were rated below average. This shows that while the EOU, navigation and aesthetic of the websites are to some extent designed fairly well. However, there is need for much improvement in both security and accessibility issues.

More worrisome is the fact that some websites do not have adequate and appropriate content to cater for the yawning of the users especially students. More so, the accessibility issue should be taking into
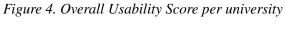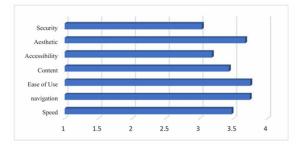
Figure 4. Overall Usability Score per university

Figure 5. Criteria ranking across the websites

consideration as well. Many disable users cannot access these websites as expected because there is no provision for them. This has been the bane of many websites developed especially in developing countries in previous studies (Junaini, 2002; Al-faries et al., 2013; Deedam et al., 2018; Yerlikaya & Durdu, 2017)

The ranking order for the criteria is as follows: Ease-of-use, Navigation Aesthetic, Speed, Content, Accessibility, Security

CONCLUSION AND RECOMMENDATION

Academic websites and especially university websites usability evaluation have been of great interest to researchers till date. Though several models and methods with varied criteria have been proposed to be used by different authors, yet the peculiarity of this genre of websites still necessitate the need to come up with new ways of carrying out its evaluation especially from the usability point of view.

While great research efforts have been channeled into this in the developed countries to ensure the development of usable and accessible websites, most developing countries are lagging behind in this aspect. Hence, the need for this type of research to know the usability status of some high performing university websites in Nigeria. By using seven criteria of Speed, Navigation, Ease-of-use, Content, Aesthetic, Accessibility and Security, a SNECAAS model was proposed and validated.

Though the results show that the selected websites performed fairly well in the overall rating, it is of utmost concern that the issues of accessibility and security are still not well taken into consideration by the developers of these websites. This is despite the observation made by researches done previously in this regard (Adepoju & Shehu, 2014; Kiyea & Yusuf, 2014). The overall usability for the websites is still not good enough.

It therefore strongly recommended that adequate attention and measure should be taken by various stakeholders and universities managers to address the concern. Now that the world is a global village, many users have access to these websites at the tip of their fingers. Hence, great efforts should be channeled towards ensuring that they are up to the standard as expected. More so, enough and adequate resources should be channeled into acquiring state of the art hardware and software necessary for developing and hosting usable websites. Furthermore, the management of various universities should also ensure that adequate usability training is provided for the staff in charge of developing university websites. This will equip them with the necessary skills to develop a user centred websites which is a core area in Human Computer Interaction.

Future work will involve the use of integrated Multi Criteria Decision Making (MCDA) approach to rank the websites performance based on their usability as well as ranking the criteria to know their order of importance to the users as well as the experts. More so, the data obtained will be subjected to further mining and statistical analysis to reveal hidden patter, trends significance and correlations.

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