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A USER-CENTERED APPROACH TO WEBSITES USABILITY EVALUATION

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ABSTRACT

Usability evaluation of interactive systems has been a topical issue in human-computer interaction. People at different times and places have attempted to evaluate software, websites, and other tools to ascertain their levels of usability. The essence is to indicate the extent to which such interactive systems are easy to learn, easy to use, easy to remember as well as to determine their effectiveness, efficiency, error tolerance, aesthetics and user satisfaction. The evaluation methods applied so far have not yielded desired results in the perspective of users. This work adopts a user-centered approach to usability evaluation of two Nigerian universities' websites (www.unical.edu.ng and www.uniport.edu.ng) by applying a systematic methodology of involving users in performing set tasks (user testing) and using the tasks completion time as metric. Data collected from the tasks completion time were statistically analyzed for usability criteria of learnability, efficiency, and satisfaction. Feedbacks were obtained from users through questionnaires on areas where improvements are desired from the sites, and the design-evaluate-redesign cycle recommended to the Universities' Web Teams to amend poorly developed interfaces and contents. It is inferred in the paper that www.unical.edu.ng received more preference from the perspective of users due to its ability to allow quick tasks performance, fast downloads, effective navigation, error tolerance, consistency, and minimal background coloring.

Keywords and Phrases: Usability evaluation, interactive systems, human-computer interaction, user-centered approach, metric

I. INTRODUCTION

The academic sector increasingly uses the Internet as a communication medium for internal and external purpose. Apart from the publication of general information, universities' websites may allow students and staff to apply online, answer surveys, register for e-learning sessions, get lecture notes, browse the library catalogs, send and receive e-mails, check academic results, print documents etc. Designing of usable interactive systems require considering such factors as who is going to use them, where they are going to be used, the kind of activities users are doing when interacting with the systems, the appropriateness of different kinds of interfaces, the arrangement of input and output facilities etc. A key design problem and challenge is to design the interface for users' interaction in such a way that the system is simple to use, does not involve much training, and is robust and reliable. The desired usability goals and user experience goals need not be compromised if users' interactions with the systems must be optimized. For a website, navigation through the system needs to be straightforward and well supported. Recent researches by Nielson [6], Donahue [3], Dumas [4], Preece *et al* [11] and Siegel [15] have shown that users often get frustrated and may not visit the site any longer, if the interface for interaction with the system lacks the above characteristics or a combination of them. A user interface (or human-computer interface) simply refers to the parts of a hardware and/or software system that allow a person to communicate with it. Usability testing provides a systematic approach to the evaluation of human-computer interfaces.

Although more institutions are grasping the importance of user experience, many are slow to actively improve it. If the interface for an institution's web-based procurement system, staff/student online application, or e-learning session registration is difficult to understand, incorrect orders and entries will be placed at a potentially substantial cost to the employer. These and other pitfalls contribute to poor user experiences and lead to a negative impact on business.

Generally, usability of a website simply refers to the degree of ease (or difficulty) which its users experience. There are five basic criteria for evaluating usability. These are [10] navigation, response time, content, interactivity and responsiveness. Websites usability can be tested using three cost effective methods [9]. In the first method, a panel of potential users work with the site and report on their experience via a carefully prepared questionnaire by the designer. This method is regarded to be the best. In the second method, third-party sources are used by the designers to capture basic user feedback and provide comparative metrics for similar websites. Such third-party sources include BizRate [19] and Alexa Internet [20]. The third method is the use of software agents which count words/content, monitor response times, and record interactions or keystrokes during site navigation.

In [10], a survey was conducted on 750 corporate websites for usability. It was found out that businesses whose homepages address usability and incorporate other essential design criteria report higher traffic, more repeat visitors, and greater customer satisfaction. Websites, like other interactive systems, may have a perfect hardware and software blend, follow every engineering standards and measurements, but may not be usable especially if they were designed without having the users in mind. Thus, a good user interface design is imperative for a positive human-computer interaction.

In an earlier paper [1], a comparative analysis of the websites of three Nigerian Federal Universities of Technology, namely Federal University of Technology, Owerri [21], Federal University of Technology, Akure [22], and Federal University of Technology,Yola [23], was conducted to ascertain their levels of user interface usability and whether the sites' contents are obtainable and functional. In the paper, selected users were made to carry out set tasks to help obtain quantitative and statistically validated data. Users' opinion on the websites' usability goals and user experience goals were collected by administering questionnaires and these were used as feedback into the design by reporting

performance measures or errors while findings provide a benchmark for future versions through a redesign. It was discovered that [22] was preferred by users due to the efficiency, effectiveness and satisfaction obtained by users in accomplishing tasks.

The present paper uses a similar methodology as above but instead, evaluates the websites of the University of Calabar, Nigeria (UNICAL) [24] and the University of Port Harcourt, Nigeria (UNIPORT) [25]. These sites provide access to web-based information to prospective and potential students and staff. By using a user-centered approach in evaluation, the paper's goal is to enhance improved communication to enable users have easy, quick, and effective access to the facilities offered by the interactive systems and obtain satisfaction from their use. The findings in the paper indicate that the website of UNICAL (i.e www.unical.edu.ng) received more preference from the perspective of users due to its ability to allow quick tasks performance, fast downloads, effective navigation, error tolerance, consistency, and minimal background coloring.

II. USABILITY EVALUATION

From its beginning, the World Wide Web (WWW) "was conceived and implemented as platform-neutral, device-independent means of accessing information" [16]. Despite this intention, a large percentage of websites today are inaccessible to users, even though accessibility guidelines have been freely and widely available for over three years. The percentages of websites that are accessible are not increasing and may even decrease with the proliferation of graphics and animation rich content over recent years. According to the World Wide Web Consortium (W3C) [17], the web has become a key resource for news, information, commerce, entertainment, classroom education, distance learning, job searching, workplace interaction, community participation, and government services. It has replaced the traditional sources of information and interaction like the schools, libraries, print materials, and discourse of the workplace. In order to help organizations make their website accessible and usable, a number of methods and tools have been developed by researchers, practitioners, and Information Technology companies.

Usability evaluation methods have been of great interest to human-computer interaction (HCI) researchers and practitioners since the 1990s, and numerous studies have been conducted comparing the effectiveness of these methods [18]. These methods include cognitive walkthrough, focus groups, GOMS (Goals, Operators, Methods, and Selection Rules), prototyping, task analysis, usability inspection, and user testing. The quality of the user experience is measured by the usability of the sites. Usability is the degree of the effectiveness, efficiency, learnability, and satisfaction users achieve when interacting with the sites. When users are able to do what they need to do quickly, they are less likely to make errors, more likely to be satisfied with the services and more likely to return to the site. The key to improving site usability and promoting positive user experiences lies in systematically identifying and correcting problems users have or may potentially have in interacting with a site.

As researchers and practitioners call for increased accountability from designers in terms of meeting the needs of all users [14], it is critical that individuals from every discipline become aware of the value of user testing for improving the usability of information interfaces. There is no doubt that user testing demonstrations can be an extremely powerful way of illustrating the potential benefits of usability analysis to a wide variety of audience. Fogg [5] opined that apart from conveying trust, reputation, credibility, and professionalism, ensuring that a website is usable can results to improved consistency in navigation flows, improved download times, decreased cost of user supports, reduced site maintenance costs, increased productivity, guaranteed repeated visits and increased revenue. The complete user testing process requires usability evaluators to study an interface, access its strengths and weaknesses, develop representative scenarios of

use, administer these scenarios to representative users, analyze and evaluate the results, and generate relevant and useful recommendations for design improvements [6, 13]. The end result of the application of a systematic user-centered approach culminating in empirical usability testing is a greatly enhanced user experience. The user-centered approach to evaluation focuses on the mindset of target users and can include the following:

- Users' prerequisite knowledge and skills
- Users' goals and objectives (which are often different from, and in some cases in opposition to, that of authors, designers, and/or programmers of the site).
- Users' reactions to getting lost or frustrated or being unable to accomplish their goals.

It is a fact that usability depends on a number of factors including how well the functionality fits user needs, how well the flow through the application fits user tasks, and how well the response of the application fits user expectations. User testing is the mainstay method when it comes to usability evaluation. The past ten years have witnessed great advances in the willingness of most organizations to concede the value of usability engineering for improving their products [4]. The most fundamental usability method to acquire direct information on how people use technology and challenges faced is usability testing. The overall usability of websites, for example, continues to improve as a direct result of more attention being paid to user testing by design companies [7].

To test the usability of a website, a developer can adopt two kinds of methods namely, usability inspection method (e.g. heuristic evaluation [8]) or user testing method [7]. In performing usability testing, a representative of the target user population must be selected [12], and a usability laboratory can be used for a controlled environment.

III. METHODOLOGY

The user-centered approach to the usability evaluation of the websites of the University of Calabar and the University of Port-Harcourt involves performance test. A formal summative evaluation was conducted to document the usability characteristics of the websites against usability criteria of learnability, efficiency and satisfaction. The evaluation involved seven users each from the class of end-users, which were undergraduate students, postgraduate students, teaching staff, and non-teaching staff of the two universities.

The volunteered user testers each received a scripted, verbal introduction, which explained the purpose and goals of the test and were asked to fill out a pre-survey questionnaire, which the evaluator used to gather their demographic information. The twenty-eight (28) users who volunteered for the test include 18 males (64.29%) and 10 females (35.71%), as represented in Table 3.1 below.

Table 3.1: Sex Distribution of the Participants

Sex	Frequency	Percent	Valid percent	Cumulative percent
Male	18	64.29	64.29	64.29
Female	10	35.71	35.71	100.00
Total	**28**	**100.00**	**100.00**	

From Table 3.2 below, 71.43% of the participants were within 16-25 years range and 50% of them were male while 21.43 were female. Out of the 5 participants within the age range of 26-35, 3.57% were male while 14.29% were female. Again only 7.14% male participants and 3.57% female participants were within the age ranges of 36-45 and 45-above respectively.

Table 3.2: Age Distribution by Sex of the Participants

Age range (years)	Frequency	Percent	Valid percent	Cumulative percent	Male	Female
16-25	20	71.43	71.43	71.43	14 (50.00%)	6 (21.43%)
26-35	5	17.86	17.86	89.29	1 (3.57%)	4 (14.29%)
36-45	2	7.14	7.14	96.43	2 (7.14%)	-
≥ 45	1	3.57	3.57	100.00	1 (3.57%)	-
Total	**28**	**100.00**	**100.00**		**18**	**10**

The status distribution of the participants from Table 3.3 indicates that 53.57% of the participants used for the user testing were male undergraduate students while 25% were female undergraduate students. 10.71% were male postgraduate students while 25% were female undergraduate students. Finally, 7.14% of the staff were female, with no male staff.

Table 3.3: Status Distribution of the Participants by Sex

Status	Frequency	Percent	Valid percent	Cumulative percent	Male	Female
Undergraduate	22	78.57	78.57	78.57	15 (53.57%)	7 (25.00%)
Postgraduate	4	14.29	14.29	92.86	3 (10.71%)	1 (3.57%)
Staff	2	7.14	7.14	100.00	-	2 (7.14%)
Total	**28**	**100.00**	**100.00**		**18**	**10**

The performance test consisted of series of tasks that the volunteered user testers carried out while the evaluator noted time (in seconds (s)) to complete each task by each user with a stopwatch. Errors encountered where tasks are not accomplished were also noted. The set of tasks completed on each of the sites were:

* Task 1: Locate the university historical perspective
* Task 2: Locate the university postgraduate school
* Task 3: Locate the university fees schedule for undergraduate students
* Task 4: Locate faculty of science
* Task 5: Locate the university Alumni

The usability test was conducted in a computer laboratory under a controlled environment fully air-conditioned. Accessibility to the sites was granted to the participants through a full multimedia digital computer with 100Mbps Internet connection speed and Windows Xp unlimited operating systems using Windows Explorer as the web browser. After concluding the test, the users completed a post-survey questionnaire to gauge their responses to the

tasks. This enables information on users' preference to be gathered as well as comments and recommendations on areas of improvements on the sites. The questionnaire was based on a 5-point likert scale of strongly agreed, agreed, disagreed, strongly disagreed, and neutral.

IV. RESULTS

Table 4.1 and Table 4.2 below indicate the time taken by each user tester to complete each set task on the websites.

Table 4.1: Time to complete tasks on www.unical.edu.ng

User testers	Task1 (s)	Task 2(s)	Task3(s)	Task 4(s)	Task 5(s)
User tester1	8.56	-	16.62	7.91	-
User tester2	7.45	-	17.89	9.74	-
User tester3	7.41	-	16.45	5.78	-
User tester4	7.78	-	17.08	13.67	-
User tester5	9.17	-	11.28	10.18	-
User tester6	10.41	-	12.87	9.70	-
User tester7	8.18	-	13.78	8.19	-
User tester8	8.11	-	12.01	6.99	-
User tester9	9.04	-	15.42	7.88	-
User tester10	10.17	-	12.56	10.92	-
User tester11	8.45	-	14.71	9.56	-
User tester12	8.19	-	19.45	11.33	-
User tester 13	12.11	-	14.12	9.18	-
User tester14	8.95	-	13.17	8.89	-
User tester15	7.85	-	15.06	7.23	-
User tester16	9.12	-	14.23	8.52	-
User tester17	9.59	-	16.16	8.39	-
User testrer18	8.27	-	16.27	9.40	-
User tester19	8.98	-	13.53	8.67	-
User tester20	7.85	-	12.45	9.67	-
User tester21	8.14	-	14.23	7.87	-
User tester22	8.89	-	14.56	9.34	-
User tester23	7.23	-	11.42	8.29	-
User tester24	8.48	-	13.38	8.34	-
User tester25	9.23	-	13.11	9.04	-
User tester26	9.86	-	11.12	7.83	-
User tester27	8.45	-	16.34	7.83	-
User tester28	8.38	-	15.31	8.46	-

Table 4.2: Time to complete task on www.uniport.edu.ng

User testers	Task1 (s)	Task2 (s)	Task 3 (S)	Task 4 (s)	Task 5 (s)
User tester1	13.56	9.35	30.51	7.83	-
User tester2	10.79	7.91	21.35	14.03	-
User tester3	21.15	18.69	26.60	21.23	-
User tester4	11.58	10.17	22.57	17.01	-
User tester5	9.62	8.87	19.15	10.11	-
User tester6	12.67	10.12	20.04	11.07	-
User tester7	11.05	21.65	18.55	8.34	-
User tester9	12.45	12.11	26.56	9.01	-
User tester10	10.14	8.91	19.56	11.08	-
User tester11	16.18	19.87	24.98	15.95	-
User	11.34	7.78	16.6	12.6	-

tester12			5	0	
User tester 13	10.17	9.45	21.78	11.85	-
User tester14	19.67	17.72	20.13	19.55	-
User tester15	9.16	11.56	19.53	15.11	-
User tester16	10.45	6.87	18.67	19.21	-
User tester17	14.01	8.66	16.45	20.03	-
User testrer18	16.56	14.23	24.54	18.05	-
User tester19	9.13	8.38	17.63	13.55	-
User tester20	14.67	17.34	22.76	12.44	-
User tester21	12.14	11.60	17.16	18.23	-
User tester22	10.12	8.16	16.88	22.31	-
User tester23	12.56	9.25	27.51	8.83	-
User tester24	12.09	7.98	14.55	23.61	-
User tester25	11.67	9.16	15.59	21.42	-
User tester26	10.72	8.83	14.27	20.23	-
User tester27	9.45	12.04	16.54	17.83	-
User tester28	12.13	16.34	20.23	12.65	-

The blank columns indicate participants' non-performance of tasks due to site contents unavailability and absence of links to navigate. For instance, www.unical.edu.ng has Postgraduate School and Alumni as orphan pages since they are yet to be developed.

V. DISCUSSION OF RESULTS

Table 5.1 below indicates that most of the participants have more than 3 years experience with using the computer and up to 3 years experience with using the Internet. Similarly, Table 5.2 indicates that 50% of the participants surf the Internet for up to 3 hours.

Table 5.1: Participants Experience in using the Computer and the Internet

Usage	Never	<1 year	1-3 years	>3years	**Total**
Computer	0	2	8	18	**28**
Internet	0	2	14	12	**28**

Table 5.2: Number of hours participants spend weekly on the Internet

Number of hours used	Frequency	Percent	Valid percent	Cumulative percent
<1 hour	4	14.29	14.29	14.29
1-3 hours	14	50.00	50.00	64.29
>3 hours	10	35.71	35.71	100.00
Total	**28**	**100.00**	**100.00**	

The average time to complete tasks on each site is shown below in Table 5.3, indicating that the same tasks were performed faster on www.unical.edu.ng than on www.uniport.edu.ng. Figure 5.1 indicates a graphical representation of the average task completion time on each site, where the tasks are on the horizontal axis while the average time is on the vertical axis. This also indicates that usability goals of learnability and efficiency were highly obtained from www.unical.edu.ng, thereby leading to greater user satisfaction.

Table 5.3: Average time to complete tasks on each site

Institution	Task 1 Average (s)	Task 2 Average (s)	Task 3 Average (s)	Task 4 Average (s)	Task 5 Average (s)	Total Average (s)
UNICAL	8.74	-	14.45	8.98	-	10.72
UNIPORT	12.30	11.64	20.39	15.33	-	14.92

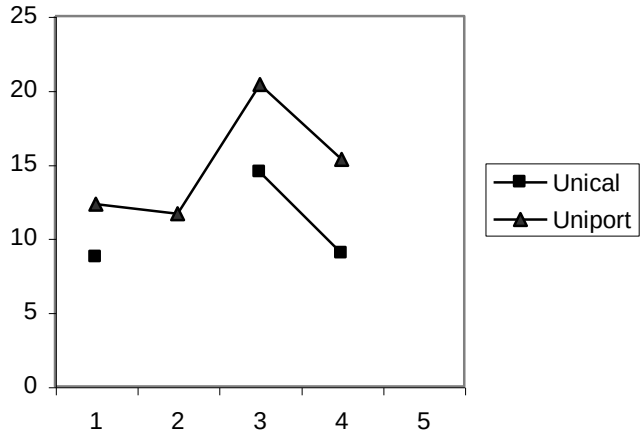

Figure 5.1: A line graph showing tasks completion time on each site

VI. CONCLUSION AND RECOMMENDATIONS

This research was carried out to perform a user-centered approach to the usability evaluation of two Nigerian university websites, namely University of Calabar website and University of Port-Harcourt website. For the purpose of efficient redesign of these websites, the following recommendations would be useful to the web team of the universities:

- The web site design, including page layout, use of colors, and placement of page elements, should be consistent to give users a standard look and feel of the website.
- The web site should not contain elements that are distracting or irritating to users, such as scrolling text, marquees, and constant running animations.
- The web site should contain no orphan page. Every page should contain at least a link up to the home page and some indication of current page location, such as site map or menu.
- The placement of site map or menu should be consistent so that users can easily recognize them and identify the targeted link.
- Standard link colors should be used so that user can easily differentiate links that have been visited and those that have not.
- Information should be up-to-date and outdated pages should be replaced.
- The web site should respond according to users' expectation. This includes standard use of graphical user interface widgets such as radio buttons for selecting one among many options.
- Meaningful words should be used to describe the destination of a hyperlink. This will save the users' time by not going to unnecessary pages.

Postscript

This paper is mainly part of the M.Sc (Computer Science) project work of the first author written under the supervision of the second author.

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