Asian Journal of Information Technology 7 (3): 109-116, 2008
ISSN: 1682-3915

Critical Factors Affecting the Usability of Igbinedion University Online Portal System

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Abstract: Usability is an important aspect of software products. However, in practice not much attention is given to this issue during software evaluation. Software evaluators often do not have the knowledge, instruments and /or time available to hand le usability issues. Nevertheless, evaluating usability of any software product most especially from the end users view gives an in-depth analysis of the product which could be used to either enhance the product or develop it entirely. This study introduces a Software Usability Evaluation Technique that can be used to evaluate the critical factors affecting the usability of a portal system, using Igbinedion University Online Portal System as a case study. The technique consists of a web-based questionnaire that is supported by an extensive database and embedded in an effective analysis and reporting tool called SPSS (Statistical Packages for Social Sciences). This approach consists only of methods to measure software usability from the users' perspective. Using this approach, software product can be evaluated in a consistent and objective manner.

Key words: Critical factors, usability, online portal system, Igbinedion university, Nigeria

INTRODUCTION

Usability refers to the ease-of-use of a system. Usability testing is performed to ensure that systems meet the criteria established to determine ease of use. Usability assessment involves both the measurement of user performance and user satisfaction. Usability testing was pioneered by IBM in the 1960's. IBM tested computer systems and human interaction to obtain user feedback about products before release. Usability studies became a procedure for product and systems assurance and IBM has optimized usability testing to set the industrial stand ard. The usability of a product can be tested from mainly 2 different approaches, ease-of-use and quality-in-use. Most times, the scope is limited to the first perspective. The ease or comfort during usage is mainly determined by characteristics of the software product itself, such as the user-interface. Within this type of scope, usability is part of product quality characteristics.

The usability definition of ISO 9126 is thus giving in this perspective as the capability of the software to be understood, learned, used and liked by the user, when used under specified conditions. In a broader scope usability is being determined by using the product in its (operational) environment. The type of users, the tasks to be carried out, physical and social aspects that can be related to the usage of the software products are taken into account. Usability is being defined as quality-in-use. The usability definition of ISO 9241 (1996) is thus giving as the extent to which a product can be used by specified users to achieve goals with effectiveness, efficiency and satisfaction in a specified context of use. Achieving quality-in-use is dependent on meeting criteria for product quality. Nevertheless, to determine the usability of a software product, the product quality and quality in use are determinant factors to be considered. The interrelationship is shown in the Fig. 1.

Organizations and educational institutions have been investing in information technologies to improve education and training at an increasing rate during the last 2 decades. Especially in universities where the need to convert the manual rigorous university exercises such as registration process, admission process, result checking, staff recruitment etc to a more hitch free process. This hitch free process can only be achieved by taking a step ahead of mere computerization of these processes, but developing an online portal system that could be used globally through the internet. Igbinedion University,

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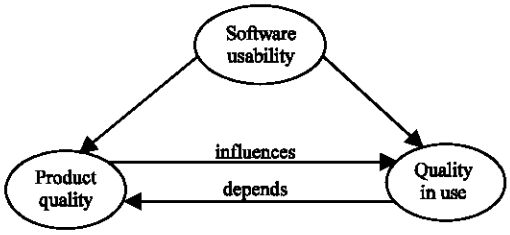

Fig. 1: Relationship between different types of usability

Okada with the aim of joining the trend developed its Online Portal System in 2004 by socket works Ltd. Although, Igbinedion University Okada (IUO) Online Portal System is emerging as 1 of the fastest institutional uses of the Internet, it still suffers some lapses such as relevancy of content, comfort level with technology, availability of technical support etc, but 1 major contributor is the poor usability level of the online portal system which is the focal point of this study. This research aims at developing a web-based questionnaire that can be used to evaluate the critical factors affecting the usability of IUO Online Portal system.

To this end, the following specific objectives shall be pursued:

- Design a web-based questionnaire and software that will be used to evaluate the critical factors affecting the usability of Igbinedion University online portal system.
- Analyse the data collected from the online questionnaire using SPSS 14 to generate report about the usability of Igbinedion University online portal system.
- To perform a usability evaluation technique that can be tested by the end users whose responses can be analyzed using SPSS 14.

Literature review: There have been attempts to derive a single measure for the construct of usability. Babiker *et al.* (1991) derived a single metric for usability in hypertext systems using objective performance measures only. They found their metric correlated to subjective assessment measures but could not generalize their model to other systems. Various Questionnaires for subjective assessment are available. For example, such usability questionnaires are Software Usability Measurement Inventory (SUMI) (Kirakowski, 1996) Post-Study System Usability Questionnaire (PSSUQ) (Lewis, 1992), Development of an instrument measuring User Satisfaction of the Human-Computer Interface (QUIS) (Chin *et al.*, 1988) and A quick and dirty usability scale (SUS) (Brooke, 1996). These questionnaires allow subjective assessment of recently completed tasks or specific product issues and claim to derive a reliable and low-cost stand ardized measure of the overall usability or quality of use of a system. Specifically, McGee (2004) uses a geometric averaging procedure to stand ardize ratios of participants' subjective assessment ratings on tasks to derive a single score for task usability. His research identifies the potential for a stand ardized measure of usability, to support comparisons across products over time, at lower levels of detail and of tasks common to multiple products. Lewis (1991) used a rank-based system when assessing competing products. This approach creates a rank score comprised of both users' objective performance measures and subjective assessment, but the resulting metric only represents a relative comparison between like-products with similar tasks. It does not result in an absolute measure of usability that can be compared across products or different task-sets. These methods provide helpful information to the analyst in making decisions about usability; however, one must question the ability of methods relying solely on objective or subjective measures to effectively describe the entire construct of usability in light of the guidance set by ISO 9241 and ANSI 354-2001 (a point also made by Dumas (2003). Additionally, the reliance on relative ranking falls short of an absolute measure that can be freely compared as a stand ardized measure. Yet, the existence and usage of all these methods demonstrates the need to represent the complex construct of usability into a succinct and manageable form. Sauro and Erika (2005) proposed a process (6 Sigma) that supports more effective analysis of usability data by stand ardizing traditional usability metrics on a uniform scale. Six Sigma is a methodology that promotes product or system quality. At its heart are statistical techniques used to quantitatively measure process defects that are defined by customers or users.

MATERIALS AND METHODS

Software Usability Measurement Inventory (SUMI) questionnaire designed in 1990 by HRFG (Human Factor Resource Group) within the MUSiC project to develop questionnaire methods of accessing data was adopted as a guide to the development of the online questionnaire used in this study. SUMI is a solution to the recurring problem of measuring users' perception of the usability of software. It provides a valid and reliable method for the comparison of (competing) products and differing versions of the same product, as well as providing diagnostic information for future developments. It consists of a 50-item questionnaire devised in accordance

with psychometric practice. SUMI was adopted for the design of this web-based questionnaire because it enables researchers to evaluate software systems based on an absolute benchmark and not comparatively as other applications such as Software Usability Scale (SUS), Computer User Satisfaction Inventory (CUSI) and Questionnaire for User Interaction Satisfaction (QUIS). Also, the SUMI subscales are being referenced in international ISO stand ards on usability and software product quality. Product evaluation with SUMI provides a clear and objective measurement of user's view of the suitability of software for their tasks. This provides basis for specialized versions of SUMI. However, the analysis of responses from users was not done with SUMI, instead Statistical and descriptive analysis using SPSS 14 was used in this research work. This approach tends to be simple with a broad potential of carrying out more statistical analysis on software usability test. The Hypertext Markup Language (HTML) is the language used to create the web document. It defines the syntax and placement of special instructions (tags) that are not displayed, but tell the browser how to display the document's contents. MACROMEDIA DREAMWEAVER MX 2004 is a professional HTML editor for designing, coding and developing web pages and web applications. This was also used to facilitate easy creation of the web pages. The website has been designed and developed as a full site and can run in any browser that has Microsoft Internet Explorer or Netscape Navigator. The system is a prototype online system and it is not hosted due to cost. But in order to ascertain the viability of the online system, it is then necessary for the user to first publish it to the system's local server named the Internet Information Service using any package like the Dreamweaver or Microsoft FrontPage. After publishing it, launch the Internet Explorer and on the address Bar, type in this information http://localhost/index.htm. Click the Go button or press enter key. This will take some few minutes and then the homepage will be displaced. Clicking on any of the links takes you to their appropriate web page. The online system has just one database file named database and a table name Record. The database file stores the information entered by the respondents to the questionnaire.

The major instrument that was used was an Online Questionnaire designed for the software users. This enables the target users to fill in and submit their responses within a period of 6 months (January 2007-June 2007) after wish the site was closed for data analysis. The online questionnaire includes fifty different questions all with the aim of testing student's perception in software usability, ease of task, time on task, efficiency of the software, correctness of the software and the overall task satisfaction. Clicking on the submit button transfers the information on the form to the database record. In the process, the program converts all the Agree to 1, Undecided to 2 and Disagree to 3. This is necessary to simplify the data for the purpose of analysis (Fig. 2).

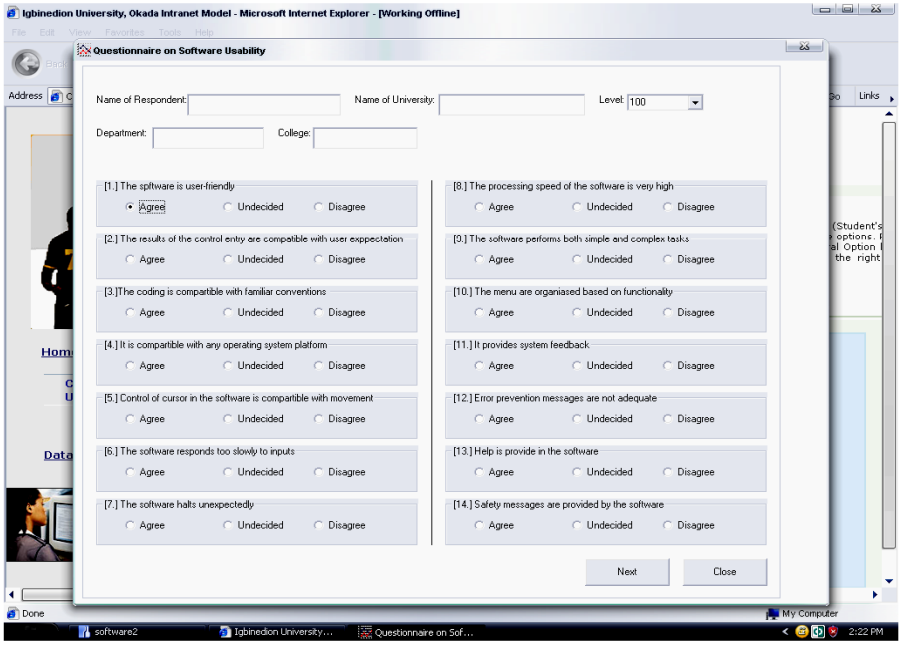

Fig. 2: Screen design for the first 14 questions

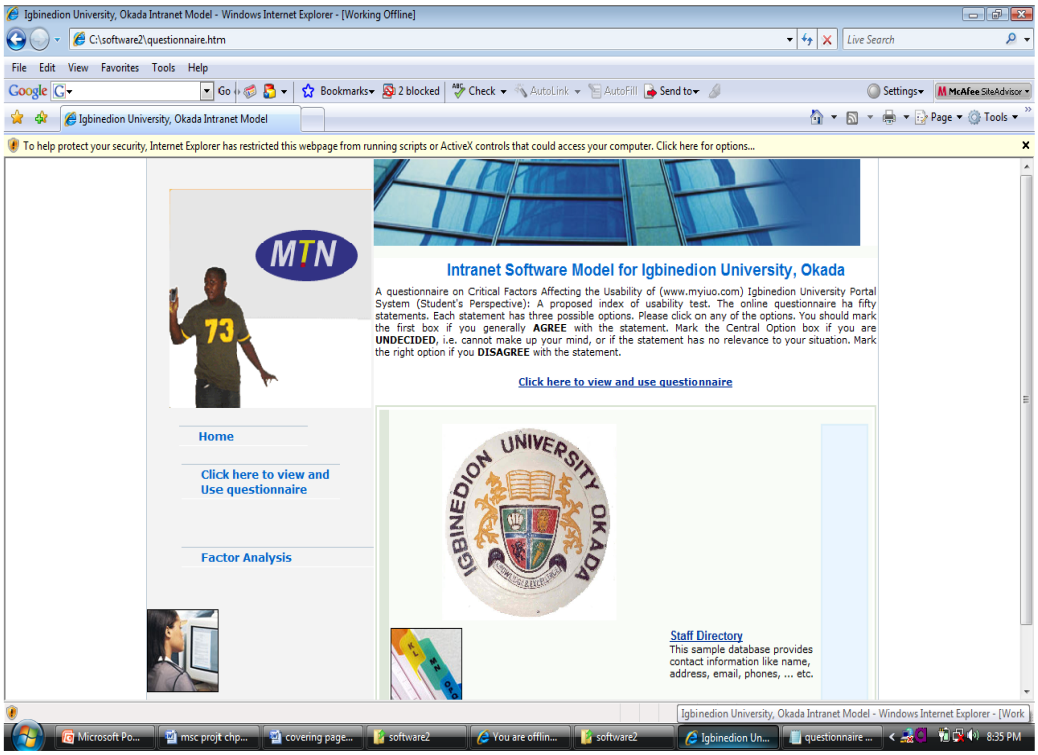

Fig. 2: Homepage screen of the web-based questionnaire

However, to analyse the data, there is a link from the homepage called data analysis. Click on the link as shown in Fig. 3 and subsequently it will transfer the database file at Microsoft Access during data gathering to SPSS 14 environment for analysis. Also, an assessment research method was applied which analyzed and evaluated the critical factors affecting the usability of Igbinedion University Online Portal System. Thus, the main data used in this research comprises mainly of responses that were provided by respondents in the sample, which are the students of Igbinedion University, Okada.

RESULTS AND DISCUSSION

Users' responses from the fifty items of the online questionnaire to evaluate the critical factors affecting the usability of Igbinedion University Online Portal System were subjected to Principal Components Analysis (PCA) using SPSS 14. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser-Meyer-Oklin value was 0.66, slightly exceeding the recommended value of 0.6 (Kaiser, 1974) and the Barlett's Test of Sphericity reached statistical significance, supporting the factorability of the correlation matrix.

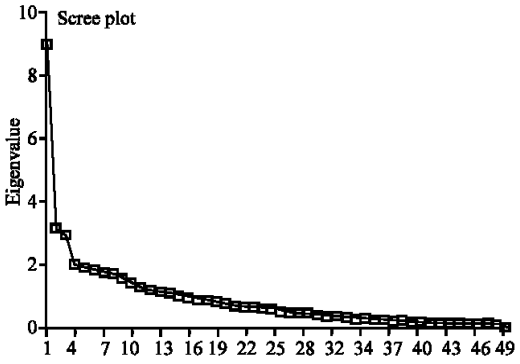

Fig. 4: Screeplot graph

Principal Components Analysis revealed the presence of 16 components with eigenvalues exceeding 1, explaining a total of 69.4% with variance of the specific component from17.98% down to 2.09% as shown in Table 1. The remaining 30.6% unexplained could be as a result of other extraneous factors such as inability of the University to provide internet access 24 h due to power problems, students' level of computer literacy etc.

In other to further determine suitable factors to be considered, a Screeplot graph was plotted as shown in Fig. 4. An inspection of the Screeplot revealed a clear break after the 3rd and 5th component. Factor extraction

Table 1: Total variance explained

	Initial eigenvalues			Extraction Sums of squared loadings		
Factors	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)
1	8.989	17.977	17.977	8.989	17.977	17.977
2	3.161	6.321	24.299	3.161	6.321	24.299
3	2.960	5.921	30.219	2.960	5.921	30.219
4	2.062	4.125	34.344	2.062	4.125	34.344
5	1.962	3.924	38.268	1.962	3.924	38.268
6	1.860	3.720	41.988	1.860	3.720	41.988
7	1.801	3.601	45.589	1.801	3.601	45.589
8	1.751	3.502	49.091	1.751	3.502	49.091
9	1.591	3.182	52.273	1.591	3.182	52.273
10	1.462	2.923	55.196	1.462	2.923	55.196
11	1.357	2.714	57.910	1.357	2.714	57.910
12	1.259	2.518	60.428	1.259	2.518	60.428
13	1.215	2.430	62.858	1.215	2.430	62.858
14	1.167	2.333	65.192	1.167	2.333	65.192
15	1.076	2.151	67.343	1.076	2.151	67.343
16	1.043	2.085	69.428	1.043	2.085	69.428
17	0.966	1.932	71.360			
18	0.953	1.906	73.266			
19	0.915	1.830	75.096			
20	0.843	1.685	76.781			
21	0.775	1.549	78.331			
22	0.748	1.496	79.827			
23	0.724	1.449	81.276			
24	0.704	1.407	82.683			
25	0.672	1.345	84.028			
26	0.599	1.197	85.225			
27	0.565	1.129	86.354			
28	0.552	1.104	87.459			
29	0.537	1.073	88.532			
30	0.476	0.952	89.484			
31	0.456	0.912	90.395			
32	0.447	0.895	91.290			
33	0.414	0.828	92.118			
34	0.381	0.762	92.880			
35	0.371	0.743	93.623			
36	0.338	0.677	94.300			
37	0.313	0.627	94.927			
38	0.307	0.613	95.540			
39	0.289	0.578	96.118			
40	0.258	0.516	96.634			
41	0.248	0.496	97.131			
42	0.232	0.464	97.595			
43	0.229	0.457	98.052			
44	0.194	0.389	98.441			
45	0.168	0.336	98.777			
46	0.152	0.305	99.082			
47	0.146	0.292	99.374			
48	0.130	0.260	99.634			
49	0.108	0.216	99.850			
50	7.512E-02	0.150	100.000			

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization

for 3, 4 and 5 components where carried out using Varimax with Kaiser Normalization Rotation Method. However, factor extraction of 4 components showed a more even distribution of the items. It was decided to retain the 4 components for further investigation. These 4 component or factors after proper study where regrouped as follows: Factor 1: Test for Compatibility and Helpfulness, Factor 2: Test for Subjective Satisfaction, Factor 3: Test for Efficiency and Factor 4: Test for Learnability (Table 2).

A vivid look at Table 3 shows that students in College of Engineering disagree more to subjective satisfaction (208.33) as against all other factors under review. This implies that most students do not really derive subjective satisfaction while using the online portal system. However, the students' level of disagreement for the 4 factors is in the following descending order: Subjective Satisfaction (208.33), Efficiency and Accuracy (192.86), Compatibility and Helpfulness (177.50),

Table 2: Regrouping of questions by varimax method of factor extraction and Principal Component Analysis (PCA)

	Factors			
Items	1	2	3	4
Q30. Provides the user with consistent feedback.	0.605			
Q19. It provides flexible user guidance.	0.602			
Q31. The software is case-sensitive.	0.592			
Q34. Requires one simple key to return to general menu.	0.572			
Q18. The software is interactive.	0.571		-0.318	
Q9. The software performs both simple and complex task.	0.533			
Q37. Input screen design is appropriate and adequate for input data with respect to their size.	0.506			0.328
Q14. Safety messages are provided by the software.	0.484			0.312
Q20. The software provides flexible sequence control.	0.465			
Q35. Provides the user shortcut control keystrokes.	0.462			
Q5. Control of cursor in the software is compatible with movement.	0.459	0.327		
Q32. It provides the user default values.	0.458			
Q15. The software provides explicit entry of corrections.	0.458			
Q13. Help is provided in the software.	0.454			
Q33. Requires one simple step to return to higher menu levels.	0.451			
Q29. Colours are assigned using the conventional approach.	0.436	0.324		
Q11. It provides system feedback.	0.415			
Q27. The display orientation of the software is consistent.	0.401			
Q28. The coding is compatible with familiar conventions.	0.375			
Q2. The results of the control entry are compatible with users' expectation.	0.374			0.324
Q50. Working with the software is mentally stimulating.		0.685		
Q48. I like using the software everyday.		0.634		
Q47. I will recommend his software to my colleagues.	0.307	0.63	-0.324	
Q44. Jobs produced with the software are usually large in size.		0.629		
Q46. Working with is software is satisfying.		0.573	-0.362	
Q23. The software commands are meaningful.		0.453		0.369
Q45. Provides full installation option.		0.436		
Q16. It provides user-friendly input design screens.		0.422		
Q41. The software requires large memory space for installation.		0.411		
Q43. Provides compact installation option.		0.386		
Q49. The softest meets my requirements, goals and objectives.		0.37		
Q1. The software is user-friendly.	0.338	0.351		0.308
Q7. The software halts unexpectedly.			0.678	
Q6. The software responds too slowly to inputs.			0.645	
Q42. The software is very slow to loading.			0.588	
Q8. The processing speed of the software is very high.			0.533	
Q26. The software does not re-start easily when it stops.			0.497	
Q39. The software meets standards.			0.398	
Q38. Outputs from the software meet user's expectation.			0.335	
Q12. Error prevention messages are not adequate.			0.331	
Q17. I do not understand the software.				0.693
Q25. Menu options are logically ordered.	0.328			0.56
Q24. Menu options are logically grouped.				0.528
Q21. The software commands are complex to learn.				0.524
Q3. The coding us compatible with familiar conventions.				0.489
Q36. Outputs from software are quite factual.				0.458
Q10. The menu is organized based on functionality.			0.344	0.453
Q22. Learning to operate this software initially is full of problems.			0.351	0.395
Q4: It is compatible with any operating system platforms.				0.329

Factor 1: Test for Compatibility and Helpfulness, Factor 2: Test for Subjective Satisfaction, Factor 3: Test for efficiency and Accuracy, Factor 4: Test for Learnability

Learnability (179.63). For students in college of natural and applied science, the level of disagreement is in the following descending order subjective satisfaction (211.04), compatibility and efficiency and accuracy (191.22), compatibility and helpfulness (190.00) and learnability (188.89). For students in health science the level of disagreement is in the following order; compatibility and helpfulness (203.09), subjective satisfaction (222.34), efficiency and accuracy (185.14) and learnability (179.97). For students in college of arts and law, the level of disagreement is in the following order; subjective satisfaction (235.71), efficiency and accuracy (203.57), learnability (185.71), compatibility and helpfulness (177.86). For students in social science and business management science, the level of disagreement is in the following descending order; compatibility and helpfulness (190.98), subjective satisfaction (190.65), learnability (185.56) and efficiency and accuracy (183.82).

Table 3: Summary reports of the various means of the 4 factors

Aarea of study		Test for compatibility and helpfulness	Subjective satisfaction	Test for efficeincy and accuracy	Test for learnnability
Engineering	Mean	177.50	208.33	192.86	179.63
	N	6	6	7	6
	Std. Deviation	49.168	25.820	29.631	20.387
Natural/applied science	Mean	190.00	211.04	191.22	188.89
	N	33	37	37	37
	Std. Deviation	41.740	43.747	28.545	32.500
Health science	Mean	203.09	222.34	185.14	179.97
	N	68	72	74	71
	Std. Deviation	39.588	40.677	29.600	30.145
Art and law	Mean	177.86	235.71	203.57	185.71
	N	7	7	7	7
	Std. Deviation	46.355	103.829	42.521	61.769
Social sc,bus/manngt sc	Mean	190.98	190.65	183.82	185.56
	N	51	49	51	50
	Std. Deviation	41.268	46.387	27.872	21.793
Total	Mean	194.73	210.87	187.07	183.76
	N	165	171	176	171
	Std. Deviation	41.383	47.991	29.456	29.918

It should also be noted that the level of agreement for all the above named students for the 4 factors is in the reverse order. However, it is obvious that almost all the students have the same usability perception to all the 4 factors except for the college of social science and business management science whose level of disagreement is more to compatibility and helpfulness than to subjective satisfaction. However, the difference in perception is negligible (0.33).

Generally from Table 3, the usability perception of the online system is in the following descending order; subjective satisfaction (210.87), compatibility and helpfulness (194.73), efficiency and accuracy (187.07) and learnability (183.76).

CONCLUSION

Motivated by the need to address the critical factors affecting the usability of Igbinedion University Online Portal System, a usability evaluation method was developed. The developed questionnaire-based usability evaluation method was used to analyse the critical factors that affects the usability of the online portal system. The data collected from the users responses on the fifty items web-based questionnaire were subjected to Principal Component Analysis (PCA) using SPSS 14. Principal Component Analysis revealed the presence of 16 components with eigenvalues exceeding 1, explaining a total of 69.4% with variance of the specific component ranging from 17.98% down to 2.09%. The other unexplained percentage could be as a result of some other extraneous factors such as poor administrative management of the online portal system, unavailability of consistent power supply, computer literacy level of individual students etc. These (16) components were subjected to Factor extraction using Varimax with Kaiser Normalization Rotation method. However, after performing 2, 3 and 4 component extractions, 4 component extractions gave a more even distribution of the items, hence it was adopted for further analysis. These components where renamed as Compatibility and Helpfulness, Subjective Satisfaction, Efficiency and Accuracy and Learnability. A detailed descriptive statistics was carried out and it revealed that considering the 4 critical factors/ components, the usability perception of students tend to be highest with Subjective Satisfaction as indicated in Table 3, the total mean score of 210.87 followed by Compatibility and Helpfulness with total mean score of 194.73, Efficiency and Accuracy (187.07) and lastly Learnability with a total mean score of 183.76.

RECOMMENDATIONS

The findings of the research work make the following to be imperative for University Management, the Students and the software developers:

Igbinedion university management: An adequate and fully functional Internet Access should be provided within the university environs to make usability and adaptability of the online portal system effective. Also, the university should ensure adequate electricity power supply especially in the Internet centers currently in use by the staffs and students of the university.

Students of igbinedion university: The students should endeavour to always use the online portal system at all time. The idea of allowing computer operators to access

the portal system should be discouraged. The students should always read error prevention and dialogue box messages before keying okay to such messages. It should be noted that the developers of the Online Portal System incorporated security checks in the design of the system. This makes it very difficult or near impossible when you either submit a data on the system or accept an error prevention message

Software developers (socketworks Ltd): The software developer should ensure periodic maintenance of the Online Portal System. Students complain as feedback should be used to improve the quality of the Online Portal System.

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