A SURVEY OF RESEARCH TRENDS ON UNIVERSITY WEBSITES' USABILITY EVALUATION

By

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ABSTRACT

Research on website usability evaluation have been growing in recent times as a result of increased internet penetration rate globally. In view of this, several efforts have been made to develop usability evaluation methods for different genre of websites. Due to its uniqueness, university websites which is a class of academic websites require further attention. This paper hence provides a brief survey of various usability evaluation methods used in university websites and with special focus on Multi Criteria Decision Making (MCDM) approaches. A total of thirty five scholarly articles were retrieved from online database from year 2000 to 2018. The review was classified based on usability evaluation methods, MCDM approaches, and automated tools. Results from the trend analysis shows that automated tools, heuristic evaluation, and user testing methods are the mostly used usability evaluation methods. MCDM approach usage in usability evaluation is also found to be on the increase as well. It is therefore recommended that more attention should be given to the usage of this methodology in the usability evaluation of this important genre of websites.

Keywords: Usability, Websites, Multi Criteria Decision Making, Website Evaluation, University Websites.

INTRODUCTION

One of the most popular subjects in Human Computer Interaction (HCI) is usability. This is as a result of its focus on people (Peker, Kucukozer-Cavdar, & Cagiltay, 2016). HCI as a field is continuously evolving with the rapid changes in Technology. Consequently, universities worldwide have embraced the use of IT in its operations thus paving ways for transaction that have hitherto being done manually to be available and accomplished online.

For universities to carry out most transaction and communication, there is need for websites which should not only be functional, but usable. This is brought about as a result of the internet which has opened the flood gate of opportunities for different universities to compete favourably with one another in terms of visibility so as to improve in their search engine result position (Caglar & Mentes, 2012).

University websites is one of the specific genres. They therefore require special attention in terms of usability as they are considered as virtual gateways to students and other users from all over the world (Yerlikaya & Durdu, 2017b). The websites of various universities are meant to provide visitors the necessary information and services. Services such as news update, campus maps, research events, admission and scholarship information, departmental information, library services, and many more are usually provided. Also different website users like staff, students, alumni, researchers, and even parents are being offered different services and content as well (Caglar & Mentes, 2012; Al-Khalifa, 2014). The information available on these websites may be informational and promotional information to students, staff, and parents (El Rahman, 2016). This type of special websites thus require utmost attention as far as usability is concerned because

they serve as virtual gateways to all the stakeholders using it (Yerlikaya & Durdu, 2017a).

However, despite these special services and importance being offered, many academic and in particular university websites are still confronted with many inherent usability problems which have made them practically difficult to use (Grigera, Garrido, Rivero, & Rossi, 2017). As pointed by (Esmeria & Seva, 2017), for websites to be successful, the need for usability to be very high. According to ISO 9241-11 usability can be defined "as the extent to which product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction". The effectiveness has to do with the accuracy and completeness with which specified goals are achieved by the users. Efficiency on the other hand measures the resources expended relative to the accuracy and completeness with which users achieve goals. Satisfaction has to do with the freedom from discomfort, and exhibition of positive attitudes towards the use of the product.

According to Nelsen, a renowned usability expert, "usability rules the web and it is very essential for the success of websites". This is because if a customer cannot find a product or service he/she will not buy the product (Nielsen, 1999). In the same way, users of university websites could become frustrated with the websites if they could not find what they are looking for easily and in a timely manner. Students may lose interest in using the technology when they have difficulty in understanding the interface.

As a result of this, there is presently growing competition by universities to attract the best students, faculties, research donors among others. Many universities now spend resources to improve the look and feel of their websites. With millions undergraduates and post-graduates admission and job seekers searching the academic websites online, there is need to adequately address usability issues in this website domain.

Previous research which focus on general web usability review has shown that evaluating e-Government websites, e-Commerce websites, e-Learning websites,

and University Websites, respectively have been receiving growing interest (Esmeria & Seva, 2017). Also, there have been review on hospitality and tourism websites (Sun, Fong, Law, & He, 2017), overall website usability (Ugras et al., 2016a). A similar review on university websites usability by (Yerlikaya & Durdu, 2017) did not put MCDM approach into consideration.

While various approaches have been proposed to evaluate usability in the literature, the recent trends based on the use of MCDM is worth mentioning. This is because despite the fact there are many usability related efforts in academic websites, yet there is little or no research in providing a survey in this area about the advances for this special genre of websites. This survey therefore will enable researchers and stakeholders to know the trends in university website usability evaluation research. This survey pays more attention to usability evaluation methods for university websites usability using MCDM technique.

1. Overview Multi Criteria Decision Making

MCDM refers to making decisions in the presence of multiple, usually conflicting, criteria. The central problem is how to evaluate a set of alternatives in terms of a number of criteria. MCDM also known as Multi Criteria Decision Analysis (MCDA) is divided into two categories namely; Multi-Attribute Decision making (MADM) and Multi-Objective Decision Making (MODM). In MODM methods, there is a decision variable whose values are determined in a continuous or integer domain. This decision variable can either be an infinite or a large number of alternative choices. The intention is to satisfy the decision-makers' constraints and preference priorities. MADM methods on the other hand are used to solve problems with discrete decision spaces. They are based on a predetermined or a limited number of alternative choices (Kubler, Robert, Derigent, Voisin, & Le Traon, 2016). Selections are made among some courses of action in the presence of multiple usually conflicting finite attributes. One of the popular website performance measurement tools is through the use of MCDM according to (Sun et al., 2017).

Different categories of MCDM methods available in

literature are Analytical Hierarchy Processing (AHP), Analytical Network Processing (ANP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), Multi-Attribute Utility Theory (MAUT), Decision Making Trial and Evaluation Laboratory (DEMATEL) (ELimination Et Choix Traduisant la Réalité or Elimination and Choice Translating Reality (ELECTRE), Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE), VIse Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) meaning Multicriteria Optimization and Compromise Solution among others. Further readings on these can be found in (Ho, Xu, & Dey, 2010; Ishizaka & Labib, 2011).

In MCDM, the problem formulated is based on goals, criteria, and alternatives. The criteria may be further divided into sub-criteria. The goal may be in the form of selection of the best alternatives or ranking of the alternatives based on the criteria or prioritisation of alternatives. The common objective of various MCDM methods is to help decision makers' deal with complex problems in the form of evaluation, selection, and prioritisation by imposing a disciplined methodology. Website usability as well as website quality comes under selection or evaluation process and hence can be solved by using MCDM approach (Kubler et al., 2016).

2. Methodology

The methodology used in the paper is thorough extensive literature search and review. Relevant articles were retrieved from online databases like ACM, IEEE, Science direct, Taylors & Francis, Inderscience. Also Google Scholar is also employed to search for other relevant articles, which are not readily available in those databases. The search strategy used is by searching for the string (university website usability evaluation) OR (university website usability evaluation AND Multi Criteria Decision Making). Inclusion criteria used is that only articles related to university website usability evaluation were used in the analysis. Also, articles from peer reviewed Journals, Conference Proceedings, report as well as Workshops were included. Moreso, only articles written in English are considered. Articles from master's dissertation, PhD thesis as well questionable sources are excluded. At the end of the review, thirty five relevant articles are selected for inclusion in the survey.

3. Results and Analysis

3.1 Analysis based on Classification of Usability Evaluation Methods In University Websites

Usability Evaluation Methods (UEM) used in university websites or other genre of websites usability have been viewed from different but convergent perspectives by different authors. From extensive survey done, UEM can be classified broadly into three viz; user-based, expert-based, model based and tool based, (Yerlikaya & Durdu, 2017; Ugras et al., 2016b). According to El Rahman (2016) the methods can be classified into users, evaluator, and tools. In the same way, Agarwal and Viswanath (2002) are also of the opinion that the methods could be categorized into three-evaluators, users, or tools based. Kostaras and Mixalis (2007) classified the methods as Inspection methods, Experimental methods and Inquiry methods. Şengel and Öncü (2010) classified it as model/metric based, inquiry, inspection and testing based methods as UEM. MCDM method is added as in addition to other existing methods by (Nagpal, Mehrotra, & Bhatia, 2017). Table 1 shows an overview of the classification as viewed by different authors to give a clearer view.

In user based methods, users actively participate in the evaluation. These include user testing, interview, questionnaire, eye tracking, think aloud, card sorting, observation, remote usability testing, and focus group. User testing and questionnaire are mostly used. Other user methods include think-aloud, eye tracking, interview, card-sorting, remote usability testing, and observation.

Expert based methods involves the use of expert (usability/HCI expert) in evaluation. The interface problems are identified by the set of evaluator. The interface is compared to some standards. These include heuristic evaluation, cognitive walkthrough, and inspection review (Nagpal et al., 2017).

Tool based methods involve the use of automated tools, which are basically software tools or online services that help in evaluation. These include the use of automated tools and web analytics. Various automated tools used in

Author	User based method	Expert /evaluator based	Data driven method	Tool based method	Inquiry method	Model based	MCDM method	Data mining/Soft Computing method
(Hasan, 2014)	✓	✓						
(El Rahman, 2016)	✓	✓		✓				
(Hasan, 2014)	✓	✓		✓				
(Kostaras, & Xenos, 2007)	✓	✓			✓			
(Kaur, Kaur, & Kaur, 2016)	✓	✓		✓				
(Sengel, & Öncü, 2010)		✓			✓	✓		
(Hahn, & Kauffman, 2004)	✓	✓		✓				
(Yerlikaya, & Durdu, 2017)	✓	✓	✓					
(Nagpal, Mehrotra, & Bhatia, 2017)	✓	✓		✓		✓	✓	✓
(Ugras, et. al., 2016)	✓	✓	✓	✓		✓		✓
(Nagpal, Mehrotra, & Bhatia, 2017)	✓	✓	✓	✓		✓		

Table 1. Usability Evaluation Methods Classification

evaluating university websites are further discussed in section 3D. Though most of these tools are used to evaluate the accessibility of websites which is a subset of usability.

3.2 Analysis based on MCDM Approach

Table 2 shows work on university websites usability evaluation using some MCDM approaches. Nagpal et al. (2015) used Fuzzy AHP approach to rank four educational institutes on usability in India. Four criteria based on Response Time (RT), Ease of use (EOU), Ease of Navigation (EON), Informative (INF) were used. Further study by the same authors combined the use of Fuzzy AHP and fuzzy TOPSIS to rank four university websites. An integration of Fuzzy AHP and entropy approach was also used to determine the usability of six academic websites based on the same four criteria as previously done in (Nagpal et al., 2017).

In the work of Roy, Pattnaik and Mall (2017), AHP was used to determine the usability of three academic websites in India based on five criteria. A combination of AHP with heuristic evaluation was used to evaluate the usability of an academic website by (Delice & Güngör, 2009). Also Kabaak et al. (Kabak, Özceylan, Dağdeviren, & Genc,

2017) used combination of ANP and TOPSIS in their study. There are variations also in the number of criteria used, which is fundamental in MCDM approach. From Table 2, only few studies have adopted the use of this approach in university websites usability evaluation, with fuzzy AHP been the most used approach.

3.3 Analysis based on Number of Usability Evaluation Methods

Table 3 shows the various UEMs with the authors who have carried out research in university usability evaluation. Figure 1 gives the chart representation of the analysis of various usability evaluation methods used in university website usability. From the study, the most commonly and readily used method is tool based, which involve the use of automated tools. This is as a result of its wide acceptability and ease of use. More so, it is not costly to administer. On the hand, expert based method is the second most commonly used method. This is in agreement with (Yerlikaya & Durdu, 2017). However, this is also closely in agreement with (Nagpal et al., 2017), where expert based method was given the highest score. From Figure 1, MCDM approach usage in on the increase and has been receiving more attention as it occupies

Author(s)	MCDM method	Criteria used
(Nagpal, Mehrotra, Bhatia, & Bhatia, 2015)	FAHP	Ease of use, response time, Navigation, informative.
(Nagpal, Mehrotra, & Bhatia, 2016)	FAHP & Fuzzy TOPSIS	Ease of use, response time, Navigation, informative.
(Nagpal, Mehrotra, & Bhatia, 2016)	FAHP entropy	Ease of use, response time, Navigation, informative.
(Roy, Pattnaik, P & Mall, 2017)	AHP	Attractiveness, Controllability, Efficiency, Helpfulness and Learnability
(Delice & Güngör, 2009)	AHP	Design consideration, operation of website, website user accordance
(Kabak, Özceyla Dagdeviren, & Genc, 2017)	ANP + TOPSIS	system quality, Information quality, service quality, attractiveness

Table 2. Studies Related to MCDM Approach

| Methods	Authors
Expert Based	(González, Granollers, Pascual & Lorés, 2008) (Hasan, 2013) (Astani & Elhindi, 2008) (Noiwan & Norcio, 2000) (Kostaras & Xenos, 2007) (Du Toit & Bothma, 2009) (Pierce, 2005) (Şengel & Öncü, 2010)]
Tool Based	(El Rahman, 2016) (Mustafa & Al-Zoua'bi, 2008) (Adepoju & Shehu, 2014) (Islam & Tsuji, 2011) (Amaitik & El-Sahli, 2013) (Junaini, 2002) (Kaur, Kaur & Kaur, 2016) (Deedam, Thomas & Taylor, 2018) (Chamba-Eras et al., 2017) (Ahmi & Mohamad, 2016) (Karhu, Hilera, Fernández & Ríos, 2012) (Arasid et al., 2018) (Yerlikaya & Durdu, 2017) (Hassouna & Sahari, 2014)
User Based	(Caglar & Mentes, 2012) (Mentes & Turan, 2012) (Şengel & Öncü, 2010) (Peker, Kucukozer-Cavdar & Cagiltay, 2016) (Roy & Pattnaik, 2014)
MCDM Based	(Kabak, Özceylan, Dağdeviren, & Genc, 2017) (Nagpal, Mehrotra, Bhatia, & Sharma, 2015) (Nagpal, Mehrotra, Bhatia, & Bhatia, 2015) (Nagpal, Mehrotra, & Bhatia, 2016) (Roy, Pattnaik, & Mall, 2017) (Delice & Güngör, 2009)
SC/DM Based	(Chamba-Eras et al., 2017) (El-Halees & Abu-Zaid, 2017) (Nagpal, Mehrotra, Sharma, & Bhatia, 2013)

Table 3. Studies on Different UEM
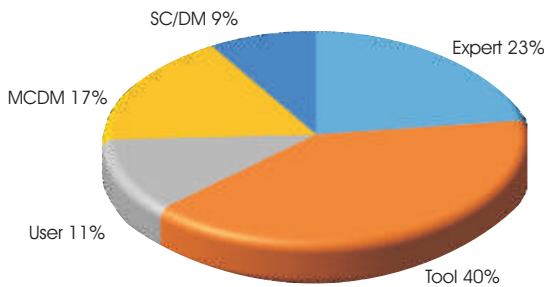
Figure 1. Analysis of UEM Methods

third place in this analysis.

3.4 Analysis based on Automated Tools

Table 4 shows the distribution of the study based on automated tools used for the evaluation. Clearly, the choice of automated tools depend on the purpose of the evaluation. However, a common trend is that some of the studies combined tool based with other UEM so as to getter a better results of the accessibility and by extension usability.

Many automated tools are available online and the choice depends largely on the purpose of the evaluation. However most tools measure websites against Web

Content Accessibility Guideline (WCGA 1.0 and 2.0). From the analysis, the most commonly used are HTML tool box, wave, Taw, and SortSite.

Automated tools analyse the websites to know the conformance level with various guidelines (WCGA) that have been set in order to make websites accessible for different types of users especially the disabled. Some of the functions that have been tested include the HTML tags, speed of the websites, availability of alt for image, number of images, correct use of colour, multimedia content, page popularity, and navigational structure (Adepoju, Shehu, & Bake, 2016). From Table 4, a lot of research have been carried out in this regards and are still going on as new technology evolves.

Conclusion

In this paper, research trends in university websites usability evaluation have been presented. The study is based on samples of thirty five selected papers from journal and conference publications that meet the inclusion criteria. From the survey, it was observed that usability evaluation of university websites is still receiving growing attention

Author	Html Tool Box	Webpage Analyser	Wave	Pingdom	GT metrix	Sort site	Achecker	Taw	Hera
(Mustafa & Al-Zoua'bi, 2008)	✓		✓						
(Adepoju & Shehu, 2014)		✓						✓	✓
(Islam & Tsuji, 2011)		✓	✓						
(Amaitik & El-Sahli, 2013)	✓								
(Junaini, 2002)									
(Kaur, Kaur, & Kaur, 2016)				✓	✓				
(Deedam, Thomas, & Taylor, 2018)				✓	✓	✓			
(Ahmi & Mohamad, 2016)		✓					✓		
(Karhu, Hilera, Fernández, & Ríos, 2012)								✓	
(Arasid et al., 2018)								✓	
(Yerlikaya & Durdu, 2017)						✓			
(Hassouna & Sahari, 2014)						✓			

Table 4. Studies on the Use of Automated Tools

from researchers. This trend and interest in the research is even increasing more in developing countries. Most studies focus on the use of automated tools while MCDM approaches are also becoming popular. The most commonly used MCDM method AHP and fuzzy integrated with AHP. The number and type of criteria used also varies. The most used criteria is ease of use and navigation. Despite the popularity of academic websites, not much attention have been devoted to it from MCDM perspective.

Integration of MCDM methods with artificial intelligent techniques like Artificial Neural network and genetic algorithms though gaining popularity in other areas is not yet applied widely in website usability. Such studies include (Ho et al., 2010; Kabir, & Hasin, 2013; Wanke, Azad, Barros, & Hadi-Vencheh, 2016; Taha & Rostam, 2011). There is therefore an urgent need to extend and apply this approach to website usability evaluation with the view of getting better evaluation results. This will in turn aid decision makers involved in educational websites development and by extension university websites.

This study has given an overview of various usability evaluation methods as it pertain to university websites. The paper therefore has contributed significance by highlighting various trends in university websites usability evaluation methods. It will further serve as a guide for researchers, academicians, and practitioners, who intend to know the trends of publication in this research area.

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