USABILITY SCALE DEVELOPMENT FOR EVALUATING THE QUALITY OF UNIVERSITIES' WEBSITES IN PAKISTAN

By

ITRAT SULTANA

Supervised By

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Co-Supervised By

DR. HUMA HAYAT

Submitted for partial fulfilment of the requirements of the degree of MSCS to the Faculty of Engineering and Computer Science

NATIONAL UNIVERSITY OF MODERN LANGUAGES,

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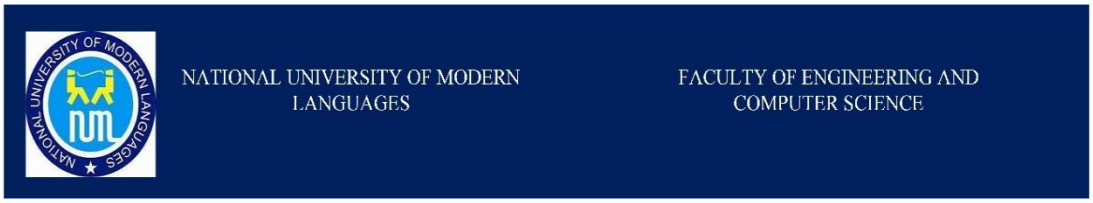

THESIS AND DEFENSE APPROVAL FORM

The undersigned certify that they have read the following thesis, examined the defense, are satisfied with overall exam performance, and recommend the thesis to the Faculty of Engineering and Computer Sciences.

THESIS TITLE: USABILITY SCALE DEVELOPMENT FOR EVALUATING THE QUALITY OF UNIVERSITIES' WEBSITES IN PAKISTAN

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2 June, 2020
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CANDIDATE DECLARATION

I declare that this thesis entitled "*Usability scale development for evaluating the quality of universities' websites in Pakistan"* is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

Emergence of the universities' websites has been revolutionised in the academic world. And they are becoming a source of benefits for their institutes. Meanwhile, the tendency of the usage of these websites is increasing among its users. However, it is observed that universities' websites are lacking the quality standards due to which usability is being compromised. It is explored by analysing the current proposed quality evaluation scales of universities' websites that, there are many important usability factors that need to be consider for development of usability scales. Thus, there is a dire need to raise the quality standards, so that user experience and satisfaction can be attained by addressing these usability issues. A systematic literature review was performed to analyze the existing website usability models and website quality evaluation models. The process was performed based on previous academic research studies, to identify basic usability factors for the quality evaluation of universities' websites. This scale comprises of 11 high-level usability factors and 31 sub-factors for universities' websites in 6 categories. Furthermore, to evaluate the developed usability scale focus group discussion was conducted. Results of evaluation process have increased the authenticity and accuracy of developed usability scale. This scale does not only act as a guideline, but it also provides a roadmap for researchers to improve websites quality by considering necessary usability factors to raise the standards of universities' websites. The identified factors help to increase the users' experience and satisfaction level that further contribute to improve the usability level of universities websites. Thus, high level of usability ultimately raises the quality of universities' websites.

DEDICATION

This thesis work is dedicated to my parents and my teachers throughout my education career who have not only loved me unconditionally but whose good examples have taught me to work hard for the things that I aspire to achieve.

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First of all, I wish to express my gratitude and deep appreciation to Almighty ALLAH and Prophet Hazrat MUHAMMAD (s.a.w.w), who made this study possible and successful. This study would not be accomplished unless the honest espousal that was extended from several sources for which I would like to express my sincere thankfulness and gratitude. Yet, there were significant contributors for my attained success and I cannot forget their input, especially my research supervisors, Dr. Muhammad Noman Malik and Dr. Huma Hayat and my teacher Dr. Fazli Subhan who did not leave any stone unturned to guide me during my research journey.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

QOS	-	Quality Of Services
HCI	-	Human Computer Interaction
ICT	-	Information and Computing Technology
HE	-	Heurist Evaluation
UIM	-	Usability Inspection Methods
ISO	-	International Standard Organization
ICT	-	Information and Computing Technology
WCAG	-	Website Consortium Accessibility Guideline
SEO	-	Search Engine Optimization
SLR	-	Systematic Literature Review
QA	-	Quality Assurance
FGD	-	Focus Group Discussion

CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter describes the background of the research, problem statement, goal, research questions and objectives along with the research scope, contributions and significance.

1.2 Background of Research

Advancement in the development and usage of internet technology, information has been made accessible to all users through websites, search engines, blogs [1]. Websites (a set of related pages located under a single domain name) are the source of spreading information in different domains. These websites are considered as an official and authenticated source of information to be available to all internet users. Furthermore, these websites are designed and developed according to different domains such as entertainment, business, health and education [1]. Specifically, in education field, in which students are more concerned about their institute's websites.

The art of designing and development of website is to provide relevant, up-to-date and authentic information to enhance user experiences. In 2000, a study by Pangannaya NB et al. reported the usage of online resources such as websites by the educational community in Mayor University, India [2]. Study discussed the

emergence of the universities' websites have revolutionized in the academic world. Everything that a student may need to know or to read is just a click away.

In 2015, a study by Ghasemifard N et al. discussed the role of appearance (look and feel), website design and services provided by universities' websites [3]. According to the authors of study, these services decide users experience regarding usage of website. A good design of interface makes it more appealing and usable for students. Study reported, "the extent to which a product can be used or the ratio of degree of its use" is known as "usability" .Furthermore, websites usability is an important measure to evaluate website quality. Study reports, universities' websites with quality services have better usability then others. In 2006, Mendes E et al. discussed the educational website's design as an important and challenging measure for websites' appearance [4]. Thus, the websites are used by academic institutes for variety of purposes. Moreover, study highlights the importance of educational website design on users' needs of information.

Along with design of a website another important feature is the development. A literature by Micali F et al. described that mostly the development is completed without the interaction with the users. Absence of users' views during the development raises issues for the usability of these websites [5]. Another literature by Bartels W et al. discussed the importance of students' interaction during development phase [6]. In 2011, Ford WG reported the importance of systematic approach for design of university website, according to user requirements [7]. This study also discussed the analyses regarding user requirements and expectations from universities websites. Furthermore, browsing can be performed through the millions of websites on a specific type of information. After analysis research concluded that, universities' websites have become necessity of life of education industry, as well as for the students.

Generally, numerous universities' websites exists today. However, there are only few universities' websites that are satisfying their users. Literature by Wu Y et

al. [8] and by Micali F et al. [5] reported some main reasons that are creating problems for universities websites usability rate and quality standard. Such as, limited experience, background of designers and developers, less time and less resources , tolerance of browsers to display incorrect code [9].

The most important extension of quality is QOS which shows the ratio of degree of the customer satisfaction about a product. Teoh, KK. Et al. discussed in their study, QOS can be measured with the help of usability [10]. Therefore, usability is taken as a basic and important measure regarding website interface. In 2017, ISO (international standard organization) 9241-11 recommendation, usability is defined as "the degrees of effectiveness, efficiency, and satisfaction to use a production in order to achieve the target determined by specific user in specific utilization situation" [11]. Definition of usability shows that increase in users will increase usability as well. The study explored, integrating both terms it is observed that number of user satisfaction increase or decrease can be predicted by number of users that will access the website that is actually usability. The term of QOS is used to evaluate the performance and effectiveness of website interfaces.

Academia evaluation is one of the challenging tasks. Study by Oztekin A et al. reported twelve high-level dimensions of usability [12]. Study shows that there have been 24 standardized questionnaires proposed for HCI evaluation [13]. And only five questionnaires are found that are dedicated to website evaluation. In 2018, literature by Rekik, Rim et al. reported, there is a need to develop usability scale regarding specific domain [14]. Particularly, in university websites, if the interface is fulfilling the needs of students properly and is providing them all the facilities and the quality of websites is according to their educational needs, then they are considered useful for them.

Studies show that many usability measures or factors may affect the quality services of universities' websites [15]. Universities' websites ought to be evaluated by the QOS that are being provided to the students. To define and measure the

educational website quality evaluation is very important. Recent studies show that the website evaluation has become more vital. Moreover, it is necessary to analyze the quality factors and the evaluation criteria that are used in the evaluation. Thus, Evaluation is a challenging task as reported in literature published during 2012 to 2014 [16]. Study by Hasan L identified some issues and weaknesses in the designs of websites such as, inconsistency of colour schemes and themes, the use of font type and sizes, lack of navigational tools, unreliable and incomplete information and websites security. However, usability models/scales to evaluate universities' websites are limited [17].

Because of limited usability scales the quality of university websites is being compromised. Such as, ignorance of needs and concerns of users regrading design, content, and QOS can lead them towards poor quality and dissatisfaction of their users. Specifically, overlooking to students' needs and involvement to gain website quality from universities' websites can lead to confusion, bad learning and ultimately dissatisfied students through which the higher education system of universities can be affected badly [18].

1.3 Problem Statement

Websites are source to provide information in a scalable, quick and cheap ways [19]. These websites have a strong impact on the image of institutes by effective profile, products and services because the largest part of student-regarding educational content is on their institutional websites [20]. Specifically, the university websites have become popular in their users for getting latest information and for the services provided by the universities. To enhance the quality, the focus should be on better design [21]. Although, studies has highlighted the usability issues of universities' websites and have proposed some usability scales. However, due to limited usability scales the quality of university websites is being compromised.

Unluckily, the design of university websites has been ignored and the usability issues such as easy access to information, fulfilment of users' needs and users' intended design, content, and QOS occur frequently [19]. These issues can lead towards poor quality of these websites and dis-satisfaction of their users. Specifically, overlooking of students' needs, it may lead to confusion, low learning and ultimately dissatisfaction of students through which the quality of education system of universities can be affected badly. Thus, it seems critical to evaluate the quality and to investigate the usability issues of university websites. Recent studies say that researchers need to develop usability scale for specific domain [22]. Because, research work related to evaluation of universities' websites performance is very limited [16]. This research is conducted for the university websites of Pakistan. Therefore, our focus is to analyze the usability measures to develop a usability scale for quality evaluation of university websites In Pakistan. The development of such scale can contribute to provide a roadmap to assess and to improve the quality of these websites.

1.4 Research Question

Research questions are as under:

Research Question 1: What are the usability factors that can improve the quality of universities' websites in Pakistan?

Research Question 2: How the quality of universities' websites in Pakistan can be evaluated?

1.5 Research Objective

Followings are the research objectives of this research:

Research Objective 1: To identify the usability factors and sub-factors for improving the quality of universities' websites in Pakistan.

Research Objective 2: To develop a usability scale for evaluation of universities' websites quality in Pakistan.

1.6 Scope of Study

The research is based upon the development of a usability scale for university websites of Pakistan from user perspective. The prime focus is on measuring the website quality by identifying the usability factors that are essentially required to improve universities' websites quality for the students.

1.7 Contribution & Significance of Study

The first contribution is done by identifying and reporting the usability factors that may improve the quality of university websites of Pakistan. Advances to the existing body of knowledge are made possible by performing the Systematic Literature Review with greater availability of published literature and with detailed searching processes. As a result, a list of 10 factors with 36 associated sub-factors under 6 categories is generated.

The second contribution of this study is a validated usability scale for university websites. As a result, a list of 11 factors with 31 associated sub-factors under 6 categories is generated Development of usability scale is based on huge variety of literature and considerable knowledge about influencing factors of university websites. This validated scale can act as a guideline for developers to develop universities' websites.

1.8 Thesis Outline

This thesis consist of 6 main chapters.

Chapter 1 comprises of introduction of the thesis by explaining the problem statements, objectives, research questions, scope, contribution & significance of the study and thesis outline.

Chapter 2 comprises of summary of literature review that explore the existing literature on the research domain and website quality evaluation. Basic usability issues and proposed websites' quality evaluation models are discussed in this chapter. A summary of existing proposed solutions is given at the end of the chapter.

Chapter 3 comprises of research methodologies used in this research. At first, detail process of systematic literature review (SLR). SLR explains the overall strategy and selection criteria of selected literature. Secondly, the overall protocol of focus group discussion (FGD) is discussed. FGD is used for solution evaluation purpose.

Chapter 4 gives the detailed process of grounded theory from open coding to axial coding. The result of this theory gives usability factors and sub-factors identifies in from selected studies of SLR, for universities' websites. Detailed description of identified factors and sub-factors is also reported.

Chapter 5 comprises of results and discussions extracted by conducting FGD. This FGD is conducted to evaluate the identified usability factors and sub-factors and to develop final and improved usability scale.

Chapter 6 comprises of conclusion and discussion of this research. The overall research summery is reported such as fulfillment of research objectives, the contributions and limitations of this research. It also reported some recommendations to enhance the experience of proposed usability scale. General recommendations for evaluating quality of universities' websites are also given at the end of the chapter.

1.9 Chapter Summary

This chapter has reported background knowledge of this research at abstract level, problem statement, research questions, research objectives and contribution

and significance of this research. The overall roadmap of the thesis is listed in terms of thesis.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

In this chapter, literature review is briefly reported. Role of universities' websites, importance of basic quality characteristics of universities' websites are discussed. Furthermore, at the end of chapter universities' websites quality evaluation scales proposed by existing studies got compared and reported.

2.2 Introduction

The role of educational technology has a great impact on student's life because of its advancements in information and communication technology (ICT). Availability of various learning applications and learning material for distance education students have made their lives easy [23]. Internet is a biggest part of technology in expanding the education along worldwide globe. Institutions and companies use websites as a weapon to convey their school of thoughts their projects/ideas to the other people of the world. Specifically, for the study career of student, benefits of educational technology has been taken into consideration from many years [24]. Nowadays websites becomes an essential part of every profession. Website makes strong impact on the image of institutes by effective profile, products /services. Recent research says that, the biggest part of educational technology regarding students is their institutional websites [20]. The institutional websites specifically higher educational university websites gives information to many people

Such as, parents, prospective, students and faculty, alumni, research groups companies and employers [25].

For students, the decision of choosing the right institute plays a vital role for their future. That decision will be effect on their earning career, professional development and personality grooming [26]. Before applying in a university most of the students' visits institute website to check the courses offered, ranking, location, fee structure and its environment. User of these websites specially those student that have not easy access to university can visit those websites and can get the information of their concern [27]. Websites of a university act like a gateway for their users through which they analyses or join that university. Furthermore these websites gives the reflection of reputation of their institute along with the facilities and activities offered by them [28].

It is important that website should have all necessary features and characteristics. Studies shows, improvement in websites has been evolving in almost all fields of life such as education, health, E-commerce, online shopping and hotel/restaurants. As the scope of this research is confined to universities' websites, thus, the focus of this research is on studies discussing issues regarding quality evaluation of universities' websites in user's lives. For example in 2017, a study by Najadat took a British university Bournemouth, to identify and analyze issues about universities websites quality evaluation. Most of the issues found regarding usability, Such as less access to information, the effect of the email system, and "landing page" with regard to Search Engine Optimization [19]. Result reported by this study highlighted the Design and appearance issues.

As from past 10 years researchers has published some studies regarding website quality characteristics. These studies somehow, show combination of some similar and different characteristics. By reading some latest research studies of past years this research summarizes their some common characteristic as follows.

2.3 Website Usability

In 2018, a study by Rekik, Rim et al. has discussed usability issues and evaluation of website. Website usability has been defined as “how well and how easily a user, without formal training, can interact with an information system or a website, How effectively a person is able to navigate and understand a website and their overall satisfaction with using the site” [15]. Usability testing allows the website capacity to engage with the target population to be optimized. Several Studies have discussed usability and websites evaluation.

In 2017, Mizuguchi T et al discussed in study that usability issues and website quality evaluation criterion is a neglected issue [12]. Evaluating the website quality is a challenging task as compare to software evaluation unless we have some evaluation criteria of framework. Because these criteria or frameworks can provide list of characteristics upon which website can be judged and evaluated. Study by M. B. Alotaibi discussed heuristic evaluation (HE) for quality evaluation. This study reported about that Saudi universities’ are developed according to high-quality usability practices. The private Saudi universities have lower usability as compared to their government universities. In the result of inspection HE method to targeted universities it was reported that some important search features are missing on websites.

According to Chambial R et al. there are five testing criterion of usability such as load time, page rank, traffic stickiness and backlink [16]. Some factors that can affect the website quality such as, usability, Number of web pages, simple web impact factor, self-link web impact factor, external link web impact factors, Aesthetics, logic and technology. A study based TELKOM university websites reported the need to improve usability, reliability and functionality. Functionality, reliability, usability, efficiency, maintainability, and portability are six quality characteristics in mentioned in ISO/IEC 9126 standard [18].

2.4 Website Quality

The term Quality is used in our daily life routine just to define the good and bad condition of product by labeling it with good or bad quality. It seems very easy to tag a product with good quality but it is really a challenging task to analyze and test it on base of quality factor. Sometime products quality is judged by their prices , high prices shows high quality and vice versa. A product that is expensive is perceived to have good quality, while a product with cheaper price is considered to have poor quality [4].The concept that quality is something that can be judges felt but cannot measured. Regardless of this general concept it is observed that to increase a product quality some controlling measure are always needed to define and maintain it. Furthermore author discussed that product can be any entity and its attributes can define its quality for example website is an entity and attributes of websites can define whether it is a good quality website of bad quality website. Furthermore, to increase the standard of website quality and to make it feasible and useable for its user, website must advise to use some quality assessment criteria or scale. And the scale should be applied from early stage up to its publication and maintenance.

2.5 Website Accessibility

In 2017, R. Ismailova et al. had identified the factors that influence on adoption. Furthermore implementation of accessibility standard was investigated [31]. By using automated assessment tool this study reported the accessibility analysis of top universities of Kyrgyzstan, Turkey, Kazakhstan and Azerbaijan,. Study identified the existence of some service problems regarding website accessibility for example, researchers in Finland, japan, Thailand, USA, Malaysia and in turkey shows that mostly websites did not match the accessibility criteria related to WCAG 1.0 checkpoint. This study compared the previous literature and to test accessibility of top 15 universities. Result shows that turkey is higher in ranking and the lowest ranking was of Kyrgyz [31].

2.6 Website Design

The good design of website appeals its users more effectively. Good design, look and feel of interface can grab more users to utilize the facilities and services provide o websites. Moreover, a websites with good design practice can enhance the quality and usability of its institute. Literature by Chambial R et al. proposed a design thinking methodic, that is basically used to know the user requirements and to find out the most possible solution to fulfill those requirements [16]. Authors discussed, design thinking methodic enhance websites services and quality with respect to usability. This study discussed, the different phases of deployment of innovative usability to the existing websites. These Phases consist of s testing hypothesis, building prototypes and gathering data from receipts. In the methodology of this literature authors discusses designing thinking methodic in terms of usability with some steps.in the first step an interdisciplinary team is formed which consist of experts, designer, psychologist . The second step was consisted of five key characteristics such as empathy, defining the problem, idea gathering, and prototype building and testing. These five key characteristic works as disciplined phase for the methodology. This study concluded, design thinking methodic can improve the websites quality and services quality that ultimately improves the usability of websites.

Another literature by J. Khlaisang described, that there is a need to design a new pedagogy based website regarding the TCU's visitor needs in 2011-2013 [32]. The methodology of study was based on four stages examining learning need, designing website structure, conducting usability test and modification of website-test ANOVA and LSD. These two tests were conducted for analysis. Furthermore, two groups as sample were used, one is TCU regular users and the other one is based on new users. Total 7147 users were participated. Data analysis and survey reviewed that female are highly respondent as compare to male. The result of this study shows that the new pedagogy designed website is appropriate for all types of users. It was integrated with all pedagogy and theoretical aspects. These results were used to

review and modified the usability analysis of website design in order to make website lifelong term and useful for all types of users.

2.7 Website Security

In 2018, a study conducted by A. Lavrenovs et al. reported the adoption rate of security policies. Security rate was tested by considering HTTP/1.1, www and HTTPS. Results show that application of HTTP response headers on website is the most easy and powerful way to improve website security. Thus, in this context very small effort is needed from website operators.

2.8 Website SEO

According to S. Kaur et al. key aspect of any website progress or failure is usability and SEO. Usability is the major factor to access the website quality [32]. Usability rate shows the quality level of websites. Authors used some automated tools for evaluation of websites. Such as site analyzer, qualidator, website grader and SEO webpage analyzer. These tools used to analyze pages content, performance, design accessibility, SEO and security. Study concluded that SEO, design, content usability of any website are the key factors that can enhance or decrease its quality performance.

2.9 Websites Development

J. Choi et al described usability testing with heuristic evaluation for development of a website. Some educational websites comprises of multimedia content such as recorded voices and visual aids. This study performed heuristic evaluation with the help of three usability experts [33]. Some design problems are identified in developmental phase. Results shows, usability errors can be removed by tackling usability problems earlier in design phase then development phase.

2.10 Website Structure

A mathematical model (MP) is proposed to reduce load of information provided on websites [34]. It was a heuristic approach that focused on improving website navigability. The main focus of was create ease for the user navigation by modifying the structure of website. in their methodology an extensive experiment is performed on the data set collected from the websites .with the help of proposed model of research, it is conclude that model not only low down the load of navigation but also produce optimal solution effectively.

2.11 Website E-service Quality

Service quality is an intangible quality which consists of heterogeneity, invisibility [35]. These four qualities are really difficult to design and measure. In methodology, three quality models (SERQUAL, QES and WPI) were used. The empirical results show that SERQUAL is better than QES and WPI. Furthermore, research structure is established with research hypothesis after deciding measurement. Such as, Navigational challenge, website design, content quality, enjoyment, System availability, ease of use, usefulness and trust a research design.

2.12 Existing Studies of Usability Scales for Quality Evaluation of Universities' Websites

The usability term is used to evaluate the effectiveness, usability of products. ISO defined usability as "The extent to which a product can be used by specified users to achieve specified goals with effectiveness" [36]. According to this study usability is concerned with some attributes such as efficiency learnability, throughput, attitude, memorability, flexibility and low error rate. An organization's important part is its website that provides information and services to its users. Specifically, universities websites plays an important role in providing learning and education services to its students. Furthermore, this study says, it is a fact that

websites should be easy to use, flexible attractive and informative. Usability can be increased by improving websites quality.

Many studies conducted that tries to focus on factors that affects the quality of websites or the ways that can enhance quality by proposing usability and quality scales. By studying and reviewing all studies related to quality evaluation scales a comparison Table 2.1 is generated reported below.

Table: 2.1 Contrast and comparison of existing studies

Paper Reference	**Domain**	**Methodology**	**Contribution**	**Limitations**
Abid Ismail et. Al , 2019 [37]	Computer sciences	Survey method	Identification of important Factors such as performance expectancy; ease expectations, computer self-efficiency	The focus of this study was all those factors that are related to just website accessibility. And this study was specific for PWD (persons with disabilities).

Rekik, Rim, et al. , 2018 [14]	Web semantics	SLR Method	Explored association rules between website criteria and category.	Although study is so informative regarding websites matrices relationships, still it was a study for general websites and not focused on just universities' websites needs and issues.
Giselle Joy Esmeria et. al , 2017 [16]	Usability study regarding Web engineering	SLR method	Explored the Relationship between usability index & metrics.	Problem identified that Still there is no standard usability index or scale to evaluate websites usability quality.
Hassan Najadat et. al. , 2017 [18]	Web engineering	Experimental research based on Data Evolvement Analysis (DEA)	The issues regarding Website Design, Website Usability and Website Performance were discussed.	Not reliable because Evaluation was performed without user interaction.
Darmawan Napitupulu , 2017 [19]	Software engineering and Information technology	Survey Method	Important website quality measures were explored such as Usability, QoI. QoS and User's satisfaction	The knowledge of participants was too low as they were under-graduate students. Study can be expanded by considering; graduates and masters level students as participants.

Renuka Nagpal et. al , 2016 [38]	Information and communication technology	Survey Methodology using Task Assignments	The main issues regarding student admission explored and discussed.	Evaluation of effectiveness of websites cannot be measure only with respect to user's capability of completing task such as finding the information on website. Not reliable.
Ana M. Santos et. al , 2016 [39]	Web semantics	Exploratory Research based on Qualitative Method	Identification of measures such as Graphic Design, Multimedia Quality, Content, Navigation and Speed of Access.	It was based on Survey of all universities' websites in Portugal. Two levels of education focused Primary School and the High school. Evaluation can be performed according to exposure of university students.
Vasilis S. Moustakis1, 2004 [40]	HCI Web engineering	Survey based study	Proposed some criteria to evaluate the quality of websites.	Too old study of 2004 as now web engineering has revolutionized. This framework was for general websites, so focus was not on universities' websites issues and needs.
Layla Hasan , 2011 [41]	Applied computing and informatics	Survey method based on criteria for accessing website quality	Proposed criteria and sub-criteria to evaluate the quality of websites.	This criterion was for general websites. Thus, it had not considered needs of universities' websites.
R. Jayakumar , 2013 [42]	Engineering and technology	A survey based research for developing E-learning framework	Website Quality evaluation performed. E-learning framework developed.	Research Publication gap. Research can be expanded by highlighting the needs and issues of university websites.

Khalid Al-Omar, 2017 [43]	Usability study of web engineering	Heuristic evaluation method.	Identified internal and external usability attributes of websites E-learning website of Saudi govt.	Followed guidelines were too old, as the websites engineering has been evolved from recent years. Thus needs and issues are regarding websites evaluation currently different from earlier.
Layla Hassan , 2014 [44]	Usability study of Web engineering	Survey method	Website design characteristics of universities' websites explored.	Research was limited to students only, not for all users of websites. And only design characteristics cannot evaluate usability thus research can be expanded.

The detail description of the articles shown in Table 2.1 is reported below. In 2019, the very recent research by Abid Ismail discussed the influential factors of online teaching. [37]. In this study Questionnaires were used and respondent were between 17-35 years old. Results reported the list of important factors such as computer self-efficiency, performance expectancy and ease expectations.

In 2018, study by author used the SLR approach to analyze all the recent studies. The collection and extraction of data were performed in this study to form out a data set. This data set was used to implements a method that can highlight the association rules between websites criteria ad categories [14]**.** This study was for general websites and did not focus on universities' websites needs and issues. There are some recent studies explored the universities' websites issues and needs such as, a study conducted by Giselle Joy Esmeria et. al discussed, there have been number of studies that discussed issues regarding design and usability of universities' websites evaluation [16]. The study focuses on the fact that, the relationship between usability metrics and its usability scale is much important to evaluate the usability of websites.

Moreover, to main the interest of users, interface design of e-learning websites must be easy to understand and use. Thus, maintaining the interest of users in interface gives too much challenge to interface designers. This article conducted systematic literature review (SLR). All the articles included in SLR are taken in the range of 2007-2017 and mostly articles that reported usability issues are in the range of 2012-2014. The results of SLR shows, some articles have design issues such as bad appearance, bad searching results and lack of clarity of data. Furthermore, there is no standard usability scale that is derived for websites quality evaluation. The usability problems identified in SLR greatly influence the effectiveness of websites that heavily relies on user interface.

Website usability, design and performance are the main issues discussed in a study by evaluating Jordanian universities websites [18]. The authors collected dataset from different Jordanian universities' websites with the help of four tools (Maxamine, GSiteCrawler, site 24x7, web page size lookup) to extract variables for performance evaluation of these universities. DEA applied for the sake of decision making to improve the websites. Resultantly, this research found some universities usable and efficient and some not. Although, this is a great work but still there is a room for improvement. Firstly, there are no proper criteria defined in this work on base of which they choose the variables for evaluation. Secondly, website design cannot be evaluated only on base of DEA because the design and appearance of websites depends on the user's choice, need and comfortable level. Moreover, the input variables (response time, page size) are not enough to judge the usability of any website. There can be others factors or elements needed to be considering such as web applications available on websites. A scale need to be developed for the usability evaluation of websites including applications.

Furthermore, a study is conducted to measure quality of educational website by using WebQual tool [19]. In this study, he discusses that for variety of teaching and learning processes such as admission registration to result cards students accesses the website. This shows that educational website needs to be in such form

they can be used and accessed by students easily. In his study he suggested that design and appearance of website have a great impact on user satisfaction. Design of websites needed to be improved to get the user satisfaction so that usability can be improved. Quantitative approach is used for primary data collection and data was based on questioners followed by Likert scale. Total 216 under-graduate students as respondent were included in research.

The overall work was done to check the user satisfaction in using the universities websites and discussed issues are usability, user satisfaction, (quality of information) QoI, (quality of services) QoS. Result shows usability and services interaction affect user satisfaction more as compare to quality information. Furthermore, the study shows that 57.5% contribution of three independent variables can explain variations in users' satisfaction. By analyzing this work it can be said, it is true that design of websites have great influence on students, such as look and feel really attracts its users. But we cannot ignore the importance of information quality of .As lot of students access their institutes websites just to take a quick glance of current information headlines such scholarship news or any upcoming events. Moreover, the knowledge level of included respondent is limited.

Effectiveness of universities' websites can be varied based on task performance. In 2016, Nagpal R et al. reported in a study that website of an institute must be helpful for performing task on admission time of students [38]. For this purpose users were given tasks to analyze the effectiveness of websites. Basic idea behind approach of task scenarios was to judge that whether the users get help from website to decide an institute for admission purpose. The design of task scenario was realistic such as how people actually access and judge an institute by just visiting its website. The basic criteria to evaluate the website were success rate and completion time of task. Information identification, designing of task based scenarios and completion time of task are the basic step to evaluate the effectiveness of website. Furthermore, their task completion time depends on the capability of user that how fast the user retrieves the information from the website. Websites having and easy

navigation and less response time will affect retrieval time. Thus, content completeness, content accuracy and easy navigation can increase the effectiveness of website. Besides the source of information websites also act as platform for different users to interact with each other while performing tasks. By analyzing this study, it can be said, that websites visitors are not only the professionals they can be fresh students entering in university life. So, task completion capability may vary from person to person based on their knowledge and self-efficiency of completing task. Thus, just on the bases of their task completion capability, effectiveness and usability of website cannot be measured.

In 2016, Santos AM et al. reported a study based on evaluation of Portugal universities' websites. The author considered primary and high school websites for analysis and evaluation. (Statistical Package for Social Sciences) SPSS tool for statistical data analysis. Accessibility, content, navigation and website design graphic design, are main focused issues in literature [39]. They use some tools like Description Sheet (FDD), Quality assessment tools and SPSS. The mixed methodology research is used in this study such as qualitative methods and quantitative methods. Evaluation of school websites was done by questionnaire survey.

Although, there are lot of usability issues need to be solved regarding universities' websites as mentioned in above paragraphs. Still there is some usability scales developed for general websites. This research also reviews those scales to get better understanding of research issues and gaps. Here is the little summarized description of those studies. For example in 2004, a study is published in which a hierarchical framework for website quality assessment was presented. In the methodology of this some criteria and sub-criteria were mentioned in the scale as a base of evaluation. Design and structure, Appearance and multimedia and Uniqueness, Content, Navigation, were main five criteria's that were further sub-divided in to 24 sub-criteria's. These all criteria together used to analyze and evaluate the website quality evaluation used to evaluate the website. It was survey

based research in which 122 users were involved in experiment of framework validation. According to these researcher results of this study confirmed framework validity [40].

Another study presented by Hasan et al. discussed a general criteria for evaluation of website quality [41]. This study includes all previous research work as a literature review. The general criteria that were purposed were based on four dimensions such as organization quality, content quality, design quality and user-friendly quality. These dimension further sub-divided into 22 dimensions. All these dimensions were used as criteria to check and judge the quality evaluation of websites. Furthermore, an e-learning framework were purposed to enhance the website design and content by evaluation [42]. The framework was based on two main processes. In first process some high-level quality metrics were used to evaluate the quality such as accuracy, feasibility, utility and propriety. It was a survey based research in which feedback was obtained from questionnaire sample (QS). Through those feedbacks a new e-learning framework were developed to enhance the quality measure of websites.

Some studies specifically worked on usability evaluation of universities' websites. But the guidelines followed by these studies through which evaluation were performed were too old. Furthermore studies focus on only student's viewpoint about websites and have not proposed any usability scale. For example, A study conducted by Khalid AL-Omar for the 12 universities of kingdom of Saudi Arabia [43]. Usability issues regarding E-Learning websites are reported. The methodology of study was based on heuristic checklist in which 12 universities were included in the evaluation process. The heuristic checklists were based on Nielsen's and Travis's checklist, squires and Peerce guidelines. Self-evaluation was employed to assess the usability evaluation.The results shows distance education websites in KS are reliable but they still some usability issues exist such as utility of their home page search engine, advance search functionality and sitemap.

Study conducted by Layla Hassan evaluate the usability of 9 Jordan's universities' websites [44]. This research was conducted specifically to check the preferences of design characteristics from only student's point of view. Results shows user satisfaction regarding usability of universities websites. Furthermore, other than content and navigation students were dis-satisfied from design of websites.

As the time passes the advancement in technology and increase in literature is always expected .By studding the existing literature of last ten years related this research it is observed, most of the studies that are published in the year range of 2012-2017. But many of them that discussed the need of developing usability scale and the need of solving usability issues are conducted in 2014-2017. Furthermore, from 2004-2018 all the scales that were developed for general websites are also reviewed as along with the universities' websites. By analyzing these existing studies it can be said that, development of usability scale is seems really necessary to overcome and reduce the usability issues of universities' websites. Because the increment of these usability issues such as bad designing, poor services, denial of user interaction, poor content quality, absence of QOS leads towards dis-satisfaction of websites users. All these usability issues along with dis-satisfaction of users degrade the websites quality. Thus, to improve the quality of universities' websites usability scales for evaluation purpose is needed to be developed. Therefore, this research focuses to analyze the usability measures to develop a usability scale to improve the quality level of the universities' websites in Pakistan.

2.13 Summary of Chapter

This chapter described the literature review by reporting current existing usability issues regarding quality evaluation scales of universities websites. The literature review covers the reporting of basic universities' websites characteristics. Furthermore, the contrast and comparison of current existing evaluation scales regarding this research is also reported.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Overview

In this chapter, Complete protocol of (systematic literature review) SLR and (focus group discussion) FGD methodologies is reported in which, the design and execution is discussed.

3.2 Research Methodology

Research methodology is a systematic way to solve the problems. Data is collected, assembled and evaluated by following some specific techniques or methods in research methodology. Furthermore, to gather concerned data regarding domain of research study is performed by using specific tools defined in research methodology such as Surveys, interviews and questionnaires.

3.3 Research Design and Procedure

The overall research methodology of this research is consisted of 7 steps as shown in above Figure 3.1. The very first step is SLR.it is already explained and reported in this chapter. The second step of research methodology is formulations of usability scale reported in chapter 4.

As shown in Figure 3.1 the first step outputs the list of factors which are further analyzed and utilized to formulate the primary usability scale in second step. After formulation of primary usability scale based on SLR in third step Focus Group Discussion (FGD) is conducted to validate the primary usability scale. Questionnaire is generated and utilized during FGD session. A complete focus group discussion is reported in chapter 5 based on the data gathered from step 4 that comprises of data collection and Analysis. Furthermore in step 5 shows updated usability scale is presented based on the results of FGD. Finally in the last step, that step 6 conclusion of results and future directions regarding this research are reported.

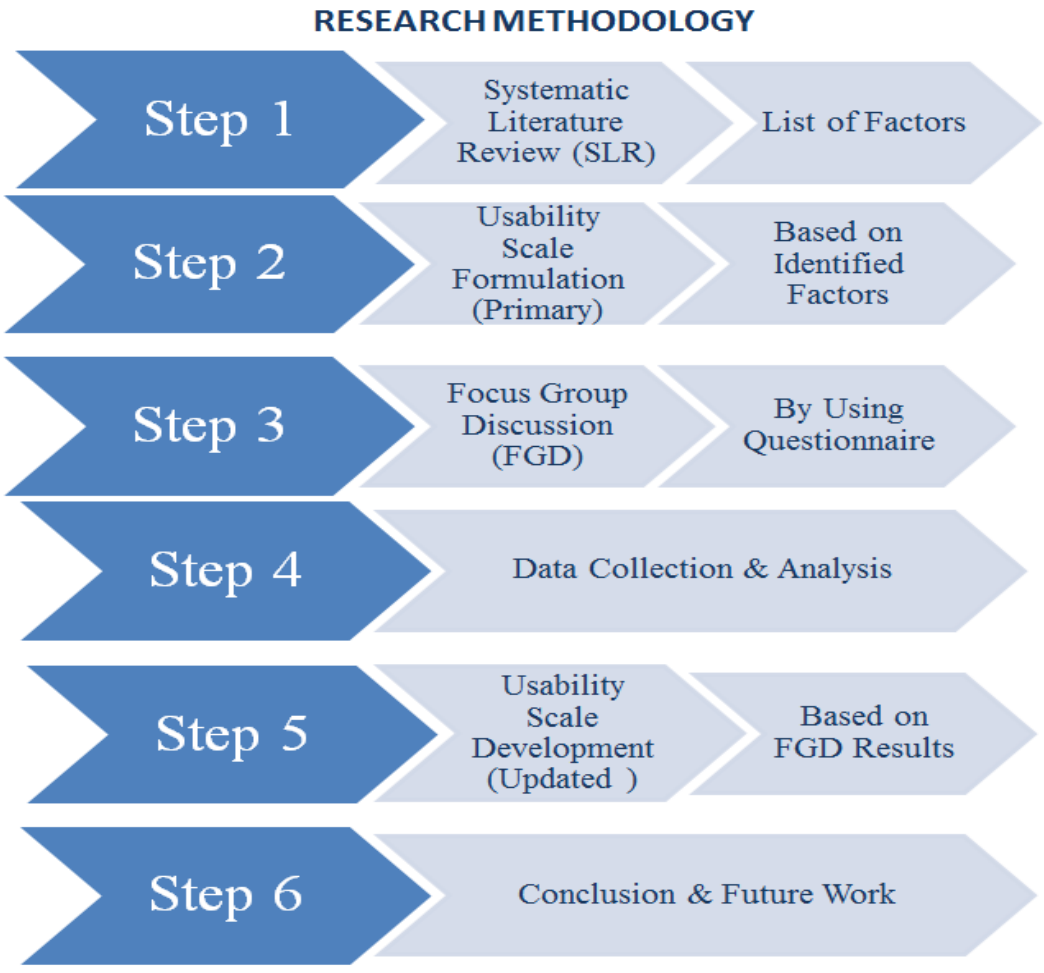

Figure: 3.1 Research Methodology Procedure

3.4 Systematic Literature Review

According to Kitchenham, “A systematic literature review (often referred to as a systematic review) is a means of Identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest" [45]. SLR has become very famous since 1990, as many of software engineering researchers used systematic review and many studies published in the context of SLR since 2004 studies used SLR [46] .

3.4.1 Reasons for Adopting SLR

There are many reasons to conduct research according to SLR methodology [45]. SLR in this research is adopted for the following reasons

- For reviewing and analysing the current study in depth such as “identifying the usability issues and factors affecting, for better quality of universities’ websites”.
- For the identification of research gap in current studies to be addressed for the future work.
- For the formulation of scale to contribute in future research activities.

3.4.2 Important Features of SLR

The most important features of SLR are reported below as according to Kitchenham.

- Development of review protocol, including research questions and overall search strategy.
- Search strategy includes identification of maximum number of literature studies relevant to research.

- Documentation of complete search strategy and its results for future studies.
- Defined Inclusion and exclusion criteria for study selection to get primary studies.
- Creations of quality assessment criteria to get desired and needed information from primary studies, through extraction from or some tool.
- Systematic literature is considered as pre-requisite for the quantitative meta-analysis.

3.4.3 The Process of SLR

There are many discrete steps that complete the SLR conduction. These steps are compounded into three phases [45] such as pplanning, conduction and Reporting. Kitchenham guidelines are followed for the conducting Systematic Literature Review (SLR). To obtain the relevant on and around study materiel keywords are used to search and explore in different journals and papers from different sources. Generally, the review process is comprises of following steps as guided by Kitchenham [45] and [46]. Figure 3.2 shows all the 9 discrete steps of SLR that are performed in their prospective phase such as planning, conduction and reporting.

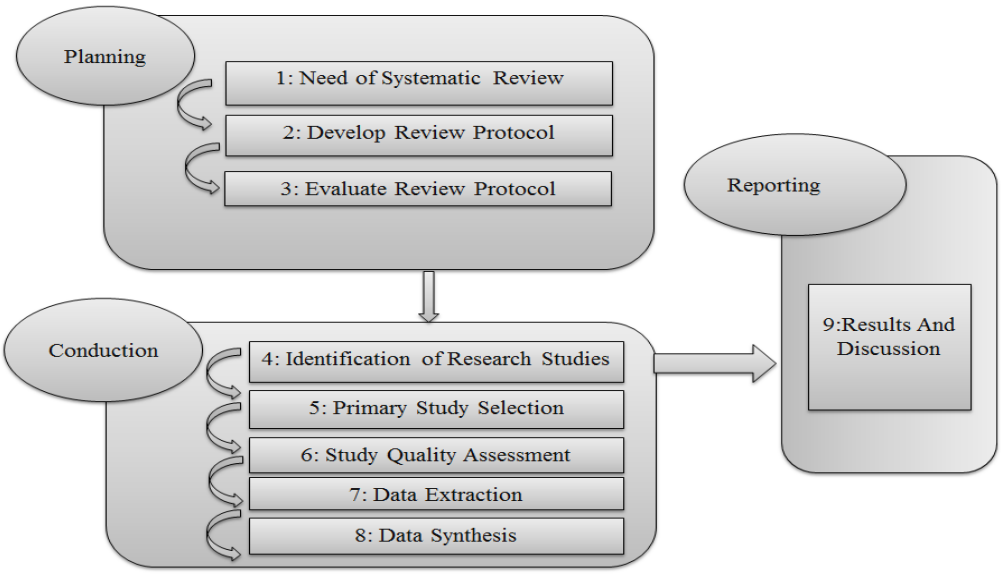

Figure: 3.2 Systematic Review Steps [45, 46]

Systematic review is based on design and execution of SLR. Systematic review is comprises of many steps. The research starts with identifying the need for the review and developing a protocol including all steps, research questions, inclusion and exclusion criteria, and analysis procedures. Systematic review that helps to identify primary studies is a vital part of review protocol development. After the development the next phase is conduction of review protocol. Actual search is performed after primary studies are identified. Overall process of review protocol is developed and conducted by following the Kitchenham guidelines.

3.4.4 Planning of SLR

Planning is the first phase of SLR. In this phase all the upcoming steps of SLR are planned. Initially the need of research conduction is identified with primary results of SLR. And then research questions are formulated and presented in the review protocol. A review protocol is developed which specifies the steps involved in the SLR. To reduce biasness of the researcher involved protocol is necessary. The protocol contains all the pre-plans for the SLR, identification of the research questions, List of the databases, details of inclusion and exclusion criteria, Checklists for the study quality assessment and data extraction techniques. Then constructed protocol is reviewed by experts.

3.4.4.1 Need for a Systematic Review

To get better understanding and valid knowledge about this research it is very important to conduct SLR. Systematic review helps to summarize and analyze the existing literature on usability scale development in the domain of universities' websites. And the need of systematic review is very important to compile the finding results without any biasness. The objectives of this systematic review are as follows:

- Summarize existing research related to development of website usability scale

- Identification of research gap

3.4.4.2 Development of a Review Protocol

Development of review protocol is necessary to keep the track of necessary steps of SLR and to most importantly to identify primary studies. After the development the next step is implementation of this review protocol in next phase of SLR. Actual search is performed after primary studies are identified. Development of review protocol, including research questions and overall search strategy, Search strategy includes identification of maximum number of literature studies relevant to research. Furthermore, documentation of complete searches strategy and its results for future studies, Inclusion and exclusion criteria for study selection to get primary studies and Creations of quality assessment criteria to get desired and needed information from primary studies, through extraction from or some tool.

3.4.4.2.1 Research Questions

Research questions are as under:
Research Question 1: What are the factors that can improve the quality of higher education universities websites in Pakistan?
Research Question 2: How the quality of higher education universities websites in Pakistan can be evaluated

3.4.4.2.2 Data Sources and Search Strategies

Search strategy is very important for the conduction of review. Search is performed electronically and manually on all possible sources of literature such as electronic databases, journals and references list obtained from primary data. To include all the positive negative and null results biasness is removed as much as possible. The process of search is reported and documented so that it can be analysed for further steps of SLR. Basic target of systematic review is to identify the primary

studies. The identification of primary studies is done by following a search strategy. In which studies related to research questions are search in electronic data bases. The process of search in databases is performed by using some keywords. The overview process of search strategy is shown in Figure 3.3.

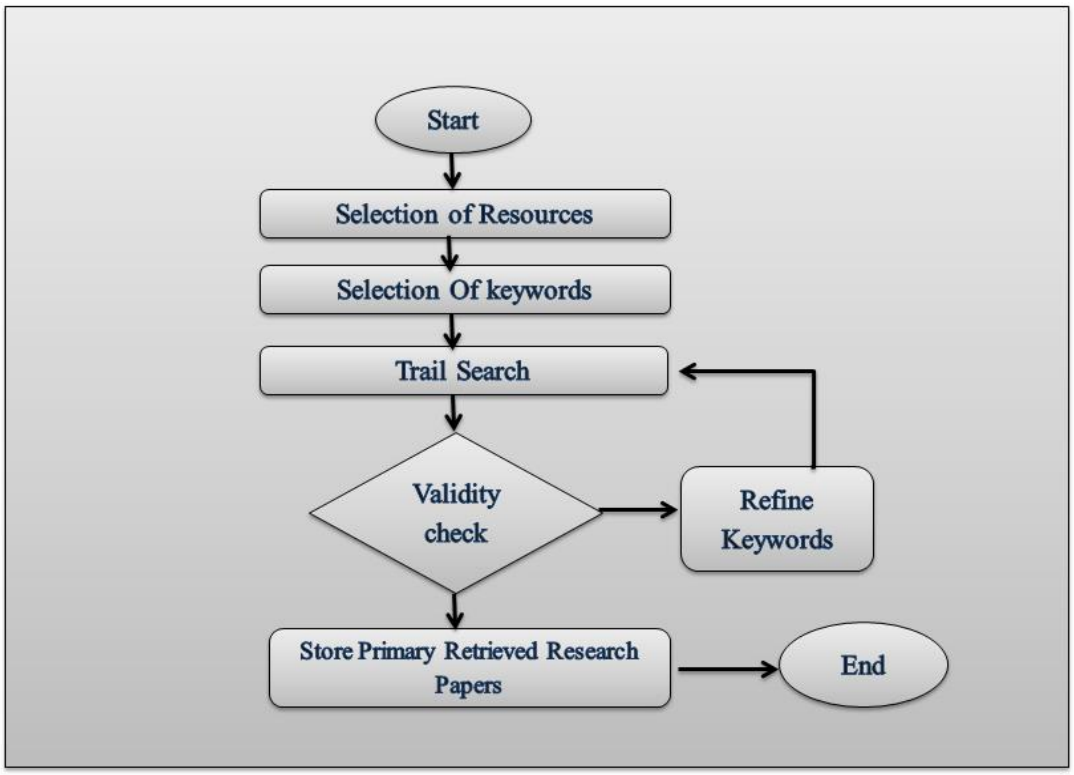

Figure: 3. 3 Search Strategy [45]

Figure 3.3 shows a search strategy in order to explore the scientific publications from related journals and conferences in relevant electronic sources such IEEE xplore, ACM Digital Library, Science Direct, Elsevier, Springer Link. Table 3.1 shows the list of selected databases to perform this SLR. It consists of two columns the list of databases and their respective URL's.

Table: 3.1 Selected databases along with their URL's

Database	**URL**
IEEE	https://ieeexplore.ieee.org/Xplore/home.jsp

ACM	https://dl.acm.org/
Science direct	https://www.sciencedirect.com/
Elsevier	https://www.elsevier.com/
Springer	https://link.springer.com/

Keyword selection in any research is always critical; this research tends to focus on the keywords, “Factor”, “Usability”, “evaluation”, “Website quality”. Combinations of terms are used for better results. The best possible synonyms could be used with the combinations of keywords so that selection process could make more effective and helpful in searching near to all possible articles related to this research. Table 3.2 has two columns representing each keyword with its corresponding synonyms.

Table: 3.2 Synonyms regarding keywords

Keyword	**Synonyms**
Factor	Constraints/measures/item/feature/characteristics
Usability	Usefulness , serviceability, usage , benefit, helpfulness , ease of access
	Website usability/ webpage usability/educational website usability/website usefulness
Website Quality	Website quality/web page quality/ E-service quality/web services quality/content quality/information quality/QOS/QOI
Evaluation	Assessment/ scaling/judgement/grading/ranking

Deriving the combination of Search string according to the research keywords is critical always. In this research composition of search strings is performed by focusing the required objective of RQ1.furthermore for the purpose of restructuring and updating search strings some Synonyms & Alternatives are also considered. Table 3.3 comprises of three columns shows, some search-terms such as Boolean OR, Boolean AND is used to incorporate alternative spellings and synonyms for more combinations in first and second column. And third column consist of string ids. Thus, this way it is assured that all possible combination of keywords with search-term are formed to be searched in electronic data bases.

Table: 3.3 Combination of search strings for each keyword

Keyword	**Search Strings**	**String ID**
Factor	(Measures OR Factors OR Features OR characteristics) AND (affecting universities' websites)	St1
Usability	(Measures OR Factors OR Features OR characteristics) AND ("affecting educational website usability")	St2
Quality	(Measures OR Factors OR Features OR characteristics) AND **(**" improving quality of educational websites")	St3
	(Measures OR Factors OR Features OR characteristics) AND **(**" affecting Quality of educational website content")	St4
Evaluation	(Evaluation OR usability Evaluation**)** AND ("educational website" OR "University websites")	St5

3.4.4.2.3 Study Selection Criteria

Inclusion of all collected papers is not possible, Thus to filter them some inclusion and exclusion criteria is introduced in order to select the most relevant ones. At first level research articles are searched in each database on the base of Keyword/Title/Abstract by using defined search strings. Then, repeated papers are considered only once. Finally, at third level each paper is read fully. Following is detail criterion that is applied.

Inclusion Criteria:
Those papers are included

- Which are discussing universities' websites quality or factors related to quality of universities' websites?
- Either the title/abstract/keywords matches our area of research.
- Papers published from 2010 to 2018 are included.
- Papers in English language are included.

Exclusion Criteria:

- Publications will be excluded if their main focus is not websites quality especially universities' websites.
- Papers and reports will be excluded where only the abstract but not the full text is available.
- Publications will be excluded if they are not written in English.
- Letters, editorials and position papers will all be excluded.
- Papers reporting the information about proceeding of conference or workshop

Level of Inclusion/Exclusion:

- Level1: At first level papers are checked on the base of keyword/title/abstract
- Level2: On the second level repeated papers are removed
- Level3: full papers are read for inclusion and exclusion.

3.4.4.2.4 Study Selection Procedure

The main purpose of study selection is to gather relevant and accurate study literature according to the research. The study selection is based on specific criterion that is inclusion and exclusion. Study selection processed through many stages to make selection biasness free. Firstly, it is assured clearly that inclusion exclusion is performed on the base of title and abstract .then in next step criterion is followed based on some distributions such as the publication year, detail of authors, language of literature etc. and to refine the selection of studies a detail quality assessment criterion is also followed at the end.

The study selection procedure is performed by following and applying the levels defined in inclusion/exclusion criterion. All the articles that are filtered through inclusion exclusion criteria on are considered to be added in research for

systematic review. But before the final selection another checksum is applied on these articles such as quality assessment. Following is the detail of quality assessment criteria.

3.4.4.3 Evaluating the Review Protocol

It is very important to validate the review protocol before its implementation. The purpose of validation is to make the research biasness free and to make it high in quality. Ketchum has proposed the method of validating review protocol. In this method firstly pilot search is performed for identifying the core potential studies by using important keywords search string in different resources. Further to ensure its validity review protocol is verified by expert supervisors of this research.

3.4.5 Conduction of SLR

After planning the SLR, The next phase is its implementation. The implementation phase started by deciding the sources from which SLR will be performed. Primary data is gathered by searching and querying of all available database sources. In this section the actual implementation of review protocol is performed by starting with search strategy. In which actual search is performed after pilot search.

3.4.5.1 Identification of research studies

The basic focus of SLR is to identify all those research studies that are related to SLR question by following and applying proper search strategies and selection criteria's. The aim of applying proper search strategy is to collect the studies without any biasness. The search strategy or section criteria's are basically distinguish the systematic review from traditional reviews. Search strategies are beneficial to search and identify the existing studies on related issues defined in SLR with preliminary searches. Then in trail searches various search terms such as keyword and search

strings are used to identify studies which basically output the primary studies of SLR. That further evaluated from experts using Quality assessment criteria's.

3.4.5.2 Selection of the Primary Study

To compile authentic and qualitative results of literature review, it is very important to find out the quality articles related the research to be reviewed. For this purpose to get the idea about quantity of literature on this research, first the articles are searched in simply google scholar by using keyword "website quality evaluation". Searched results showed 11000 hits. To get more precise results, some abstract keywords such as "Factor", "usability", "website quality", "and evaluation scale" were used to search articles in digital databases and got 5988 hits. To get more precise and to the point articles related this research, keywords were combined together to form strings. These strings further searched in digital databases with some filtrations to get the final selection of articles for literature review. This filtration is divided into two steps pilot search and actual search as reported below.

Pilot Search: Pilot search is performed to collect maximum number of studies related to the defined research domain. By using keywords article are searched in online sources such as electronic databases. There is no limitation of publication year is defined in pilot search. Furthermore there is no limit of filtering is defined and applied in pilot search. Thus all the possible on and around studies published are collected in context to this research.

Search Results: According to query strings defined in (Table 3.3) article are searched in selected databases firstly by using keywords in digital databases. As the keywords are general thus total resultant studies found are 5988 (Table 3.6). Each database has its own interface to be search article in advance way.

Table: 3.4 Results statistics of using keywords

Keywords	**IEEE**	**SPRINGER**	**ELESVIER**	**ACM**	**SCIENCE DIRECT**	**Google Scholar**	**Total**
Factor , usability , website quality, evaluation scale	637	1038	1400	146	724	44	988

Table 3.6 shows distribution of papers against each database by using search strings from St1 to St6.Column "Total" shows the total number of articles from each database. The total studies found by using strings in digital databases are 493 as shown in Table 3.7.

Table 3.5: Results statistics of using strings

Strings	**IEEE**	**SPRINGER**	**ELESVIER**	**ACM**	**SCIENCE DIRECT**	**Google Scholar**	**Total**
St1-St5	150	70	210	15	35	20	500

Table 3.7 shows the statistics of search results on the base of search strings. First column name "Strings" shows there are total 5 strings (st1 to st6) that are executed in selected database to found the related articles .From 2^{nd}-6^{th} column shows all the selected digital databases in which research articles are searched according to the defined search strings. The total numbers of research articles founded are 500 from all strings 7^{th} column "Total". Now these results will further be filtered according to actual search as discussed below.

Actual Search: In the actual search limit of publication year is defined to get the latest articles as much as possible. Such as in this research it is preferred to add the articles published after 2010 i.e. the range of articles should be 2010-2019. Some

articles are included from previous years. Just because of their most important findings regarding this research. During the actual search all the defined strings are searched in defined digital libraries with respect to publication year. The results of actual searched are compiled after applying some inclusion/exclusion criteria as filters as reported below.

Search Results: Following the above search strategy, we conducted a paper selection process by applying the first level of inclusion/exclusion criteria based on terms which appeared in article title, abstract and keywords. If any paper from first level is matched with the objective of this SLR then it is included, otherwise excluded from the dataset. At second level each remaining paper is checked for repentance, if found repeated then it excluded. Then, after applying the second level, further in third level papers are given a thorough read to be included in dataset.

Table 3.6: Search results of Exclusion/Exclusion criteria

Database	**Pre-level**	**1st level**	**2nd level**	**3rd Level**	**Post-levels selected articles**
IEEE	150	55	23	6	32
SPRINGER	70	20	11	8	
ELESVIER	210	61	45	13	
ACM	15	10	7	1	
SCIENCE DIRECT	35	14	9	1	
Google Scholar	20	7	5	3	
Total	500	176	100	32	

Table 3.8 shows the statistics of each level of inclusion/exclusion. The total number of research articles that were founded in first search, based on search strings is shown in second column regarding each database mentioned in first column. The primer number of articles reduced to lesser number when first level of inclusion/exclusion is applied. Then applying the second level, research articles are reduced up to number 176 to 100. Furthermore, when the last level of inclusion/exclusion is applied the final number of research articles is reduced up to 100 to 32. Therefore, finally 32 papers are selected for the literature review. Now, to

ensure the fair selection of these articles and to remove any kind of biasness a quality assessment criterion is composed. The quality assessment criterion and scoring levels are mentioned in Table 3.4 and Table 3.5 of this chapter.

It can be seen that mostly articles have different scoring results which shows different quality points of them to select the articles with appropriate score we defined a justified threshold value i.e. any article that will have quality points less than 4 will be given a second read just to ensure that should it be included or not. And all articles that have quality points greater than 4 are finally selected for the literature review and will be part of this research. Our results show that all the 32 papers are qualified and have quality points according to the defined threshold so; they all are selected for literature review of this research.As shown in Appendix A and C**,** data coding and listing the factors reported of 32 papers, Figure 3.4 shows the overall selection results of primary studies.

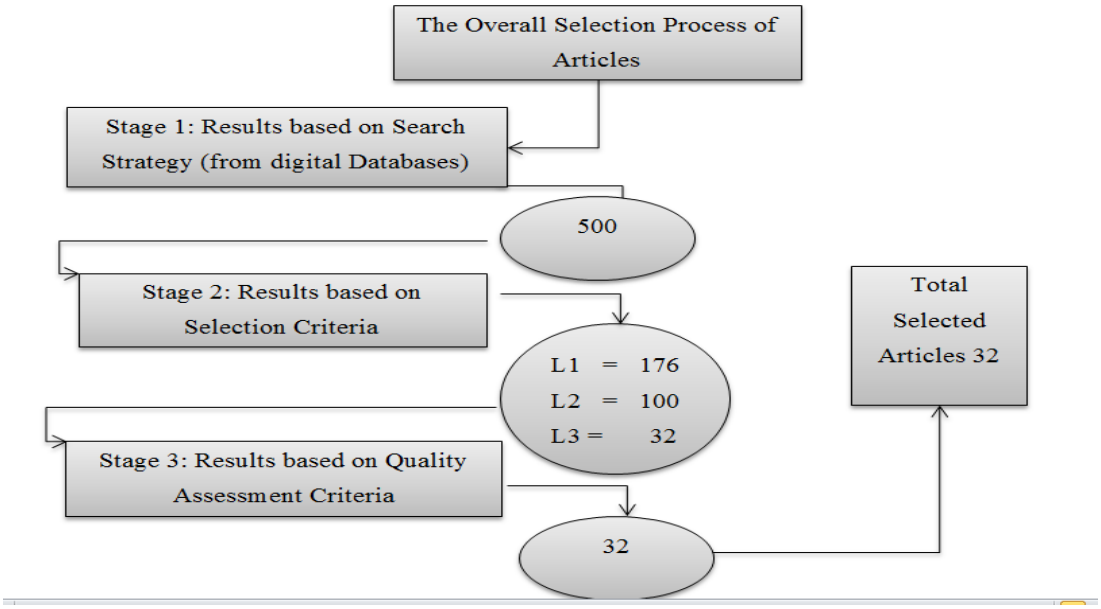

Figure 3.4: The Selection process of Primary Studies[47]

At stage 1, the total number of research articles that were founded in first search, based on search strings. At stage 2, articles are refined according to selection

criterion. At stage 3, quality assessment criteria are applied to all primary studies. Results show that all the 32 papers are qualified and have quality points according to the defined threshold; they all are selected for literature review of this research. The next step is towards arranging all the similar factors together and differentiating them from other factors. Thus for this purpose an explicit /implicit filtration is done.

3.4.5.3 Study Quality Assessment

To evaluate the validity of included studies a checklist is generated by using Kitchenham work [45] to perform quality assessment. The process of evaluation is necessary to determine the validity extent of included studies [47] to make sure that included studies meets the objective of the research or not. Table 3.4 consists of necessary question on the base of which quality assessment of articles is performed. Each question contributes in assessing the quality of articles in a right way. Every question has its possible answer with its coding scheme shown in Table 3.5.

Table: 3. 7 Quality assessment checklist

SR. #	**Question?**	**Answer!**
1	Is this a research paper?	YES/NO/partially
2	Is the description about the carried research is enough in this papers?	YES/NO/partially
3	Is its design is appropriate to describe the aim of our research?	YES/NO/partially
4	Issues that are discussed in this paper are relevant?	YES/NO/partially
5	Are the aims clearly stated?	YES/NO/partially
6	Are the findings credible and important?	YES/NO/partially
7	Data collection in this paper is fair?	YES/NO/partially
8	Is this paper defining any problem of statement?	YES/NO/partially
9	Is there any solution identifies regarding issues discussed in literature?	YES/NO/partially
10	Is this paper helps our research?	YES/NO/partially

Table: 3.8 Quality assessment coding scheme

YES	1
NO	0
Partially	0.5

Quality assessment checklist Table 3.4 is given to respondents to check and asses each article according to the defined question. Each papers is evaluated according to the questions from 1 to 10 And given a quality score to calculate the total score of each article. As in Table 3.5 scores 1, 0 and 0.5 are assigned to the answers YES, NO and partially respectively.

Resultant table of quality assessment is attached in Appendix-A. First column consist of paper ids of 32 research articles. Column 2 shows that there are total 3 respondents who evaluated the articles according to assigned scoring going through (Q1 to Q10). Articles from (P1 to P32) are given to first two respondents (R1, R2) and rest of articles to respondent R3.furthermore, average scoring is calculated and total score of each article is mentioned in last column.

3.4.5.4 Data Extraction

In the stage of data extraction strategy, a specific form is designed to keep the track of information extracted from primary studies. Data extraction form is attached in appendix B. These extraction forms are compromises of some general and some specific information such as study Title, ID number, publication type, and country of publication, year of publication, research methodology and list of factors identified.

All the data that is analysed and extracted is stored in those data extraction forms. Data redundancy and duplication is removed while this procedure to make it more clear. During data extraction from primary studies, work that is continued or in version type is also reported along with their authors' references to make extraction clear.Preliminary analysis and secondary analysis are two states of data extraction.

The first state that is preliminary analysis is performed to get the initial findings of search. The aim of preliminary analysis is to refine the initial search according to the defined research questions. And for this refinement searched articles are analyzed by reading their abstract, because abstract is a compact and concise look of the whole study. Reading of abstract clarifies the selection of appropriate data according to defined research questions of research. Furthermore, this preliminary analysis gives worked as first filtering and refinement stage in data extraction process. The second stage, secondary analysis is performed on the output of preliminary analysis. In secondary analysis the whole paper is studied and analyzed by including its all heading and subheadings. The findings or results discussed in searched papers are analyzed deeply.

3.4.5.5 Data Synthesis

Data synthesis is the process of recording or summarizing the results obtained from primary studies. These results are further documented in accordance to research questions mentioned in the review protocol. It would be possible that the results from each individual studies differs from each other thus qualitative synthesis is performed to collect the resultant data.

Data synthesis is the process of examine the results from preliminary and secondary analysis. The results of primary extracted data are reported for documentation. These extracted results give the answers to the proposed research questions. The answer of research questions are not from one source. The formation of answers could be from one then more sources. All the sources from which answers are synthesized are recorded in documentation so that they can be used as references for future needs. The sources may consist of many graph tables and other reference linked of studies. Thus the answers extracted from these sources might be highlighted in those chart graphs and tables.

3.4.6 Reporting of SLR

In this phase the results of study complied according to review protocol are reported. Data extraction forms have played vital role in extraction of relevant data. Furthermore, the collected data was synthesized using appropriate data synthesis approaches and finally report was produced.

3.5 Focus Group Discussion Protocol

Literature reported the complete description of focus group discussion [63]. In this study authors defined focus group as a form of group interviewing in which a small group – usually 10 to 12 people – is led by a moderator (interviewer) in a loosely structured discussion of various topics of interest. The course of the discussion is usually planned in advance and most moderators rely on an outline, or moderator's guide, to ensure that all topics of interest are covered. Focus group discussion (FGD) is a best strategy to conduct a session of experienced people from similar background knowledge. Moderator is the most important participant of discussion; he guides the basic agenda to other participant s of group. So that discussion can be processed in a natural and comfortable environment.

For the purpose of conducting focus group in this research, guidelines from existing studies[64-65].A flow diagram is composed as shown in Figure 3.5 by following these guidelines for step by step conduction of FGD. According to authors of these studies [64-65], the overall FGD is consist of three phases such as 'Before focus group', 'During focus group' and 'After focus group' .In the first phase that is Before focus group a complete design of focus group is generated in which focus group environment, participants and main agenda is decided .In second phase that is During focus group, expert's opinions are taken and analyzed. Whereas in the third phase 'after focus group' improvement are made to the proposed solution based on the expert's recommendation during FGD. The detail protocol of FGD is attached in appendix F.

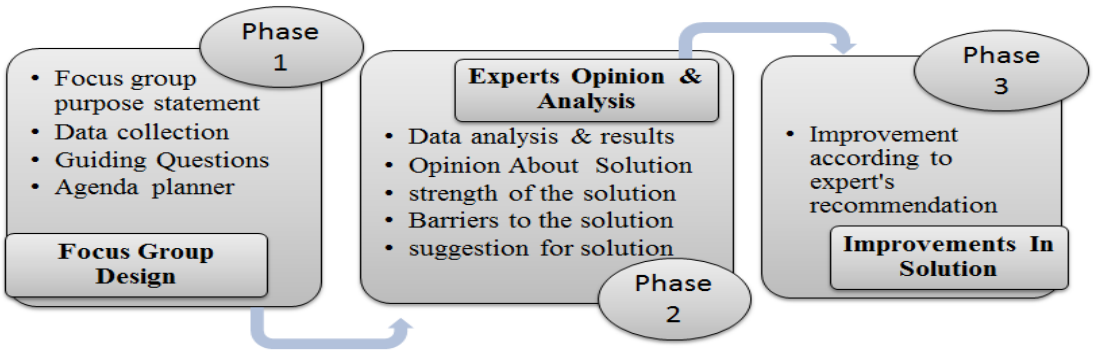

Figure: 3. 2 Focus Group Conduction phases

The detail of focus Group conduction phases is reported in following sections:

3.5.1 Phase 1 (Before the FGD)

Focus group design: It is very important to design the focus group strategy before the discussion starts. The purpose statement of focus group discussion, data collection technique, and guiding question along with agenda planner needed to be designed before the FGD. Below is the detail of these steps.

3.5.1.1 Focus group purpose statement

The basic purpose of conducting the focus group structured discussion is to obtain the in-depth quality data regarding this research. Talented and experienced group of participants is invited to get their valuable opinion and views on the proposed solution .furthermore, expert's comments were analysed to overcome the issues in proposed solution. Finally, based on comments / opinions of experts and by analysing them changing are updated to the proposed solution and finalized form of usability scale guideline is reported.

3.5.1.2 Data collection

Video session is used for recording the exact wording of participants and to observe their facial expression or movements. Notes are generated to make sure collected data is accumulated. The confidentiality of data is assured. The detail biodata of participants is attached in Appendix E (Part A). This part consist of a "Biodata form of experts", Biodata form contains complete information about the experts such as their name, company, gender, designation, email ID and age participated in FGD.

3.5.1.3 Guiding questions

Composing and planning the guiding question is the most important step for FGD conduction. Guiding questions are the combination of three types of questions such as Engagement questions, exploration questions and exit question. These questions are composed to get Opinion and suggestions of experts about solution. The opinions of experts helped in solving the main issues regarding Strengths and weaknesses of the proposed Solution. Moreover, Expert's suggestions are utilized for solution's improvements.

The details about guiding questions are reported in appendix E (Part B). This part consists of "focus group questionnaire" and table 5.2 "Evaluation of proposed USABILITY SCALE". "Focus Group Questionnaire" comprises of ten core questions regarding the proposed solution of this research. These questions are asked during the FGD to the experts. Furthermore, table 5.2 comprises of six columns. Column 1 consists of list "factors", and column 2 "sub-factors". These factors and sub-factors are the core findings of SLR and formed as usability scale in this research. Column 3 "Highly significant", column 4 "Significant", column 5 "Moderate", column 6 "Neglect-able" , and column 7 "neutral" are basically the levels that are defined to evaluate the real worth and importance of measures in our proposed solution. For example "Highly significant" in column 1 demonstrate

the importance of measure as highly significant, marked or unmarked by expert. “Highly significant”, “Significant”, “Moderate” , “Neglect-able” and “Neutral” all these that are used to judge importance of measures are assigned quality points as shown in last row of table 5.2. Such as, 30 assigned to “Highly significant”, 20 assigned to “Significant”, 10 assigned to “Moderate” and 5 assigned to “Neglect-able” and 3 assigned to “Neutral”. These quality points are further utilized to accumulate the importance of measure in proposed solution.

3.5.1.4 Agenda planner

A complete agenda for the session with time duration was planned and shared with the participants of the session. A Table in Appendix F (Part C) shows the detail execution of Focus Group such as date, location, time duration decided for focus group, actions taken by researcher and expert’s responses. The professional profile of experts participated in focus group is listed in Table 3.9. This Table comprises of three columns. Column 1 “Participants” consist of list of all those experts who evaluate the proposed solution and participated in FGD. Column 2 “Experience” shows the experience of those experts related to their field and expertise. And in the third column “Designation” their professional designations in institutes are shown.

Table: 3. 9 Professional profile of participants

Participant	Experience	Designation
Expert A	5 OR + Year	Assist. Professor
Expert B	5 OR + Year	Assist. Professor
Expert C	5 OR + Year	Assist. Professor
Expert D	5 OR + Year	Professor
Expert E	5 OR + Year	Professor

3.5.2 Phase 2 (During the FGD)

Data analysis is performed based on expert's suggestions and opinions during the phase 2 of FGD. In this phase experts' express their view points about proposed solutions. Strengths and weaknesses are highlighted. Experts' opinions about solution their comments related to strengths and barriers of proposed solution are analyzed. Moreover, experts' suggestions for improvement in solution are utilized to make proposed solution more effective and accurate.

3.5.3 Phase 3 (After the FGD)

Phase 3 is the final phase of FGD in which improvements according to expert's recommendation are performed. Once the data analysis is performed results are generated from whole FGD process. Based upon analysis and results of FGD details about phase 2 and 3 are reported in section 5.4 and 5.5 of chapter 5.

3.4 Summary of Chapter

This chapter highlighted the complete research methodology of this research.an overview of SLR is reported with all its steps along with formation and conduction of review protocol. The next chapter presents the results of the systematic review.

CHAPTER 4

FACTOR IDENTIFICATION

4.1 Overview

Chapter 3 reported the SLR technique and FGD protocol. This chapter documents the findings of SLR. Chapter 4 formulates the gathered information into a list of factors that can affect quality of universities' websites .The factors are utilized to develop a usability scale as reported in this chapter.

4.2 SLR Execution

In this study, SLR is used to identify the factors that can affect the quality of websites. In SLR, state of knowledge regarding any research area is reviewed. In this research, data coding scheme of grounded theory is used to extract factors. The protocols of SLR and data coding scheme are described in chapter 3.

4.2.1 Data Units Identification

In the process of SLR execution, quality assessment criteria are defined. Only 32 studies fulfilled that criteria and got selected to be reviewed and added in this research. Quantitative data representations of selected 32 studies are presented according to their distribution. This distribution is categorized according to their methodologies, year of publication, type of publication and with respect to their publication country.

Figure 4.1 shows the distribution of these 32 studies according to the their country .There are total 19 countries that talk about research problems related to this research such as turkey, Thailand, USA, Spain, Saudi Arabia, Indonesia, Switzerland, Netherland, UK, Jordan, Poland, Singapore, brazil, Taiwan, and Hong Kong. INDIA has maximum number of studies such as 5 among all other 18 countries. Whereas USA is on second number as it has 4 studies published on this research. Indonesia has 3 studies and Hong Kong Brazil, China, Indonesia have 2 studies related this research. And the rest of each country published one study on the same research issue as discussed in this research.

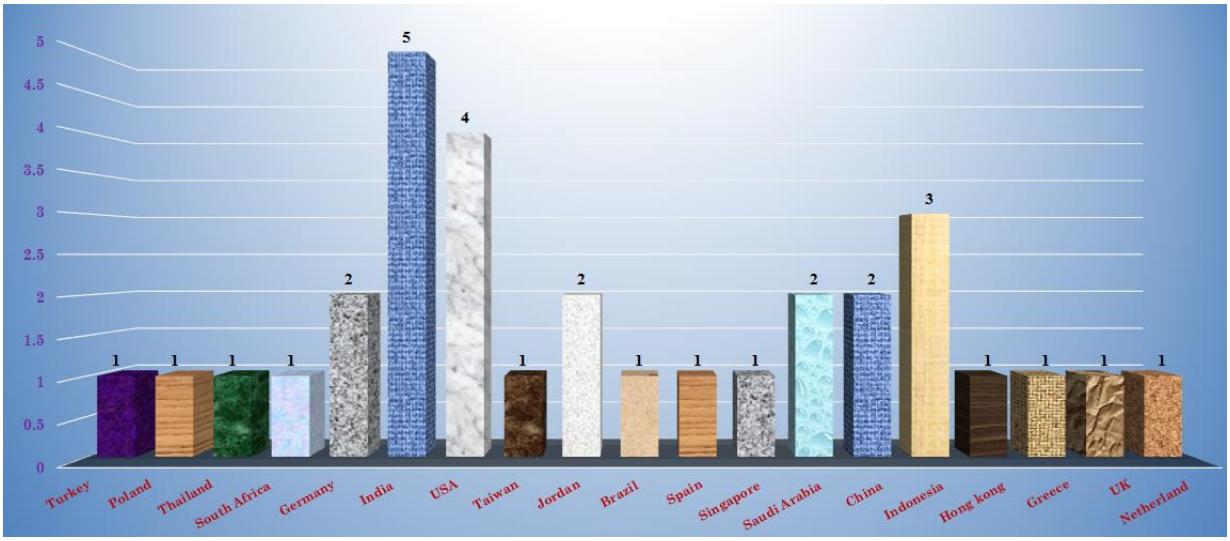

Figure: 4. 1 Number of articles with respect to country

Figure 4.2 shows a bar graph in which each bar shows a year in which study is published. The year range is from 2004 to 2019. The first quality assessment criteria of related research were published in 2004. Then from 2010 to 2018 total 31 studies were published. By analysing the bar graph it can be seen that maximum number of studies were published in 2017, 2018 and 2019 i.e. 16 studies collectively. These statistic shows that most of issues related to the research are discussed in 2018 that is most recent year. Moreover recent study from 2019 are also reviewed and reported in this research.

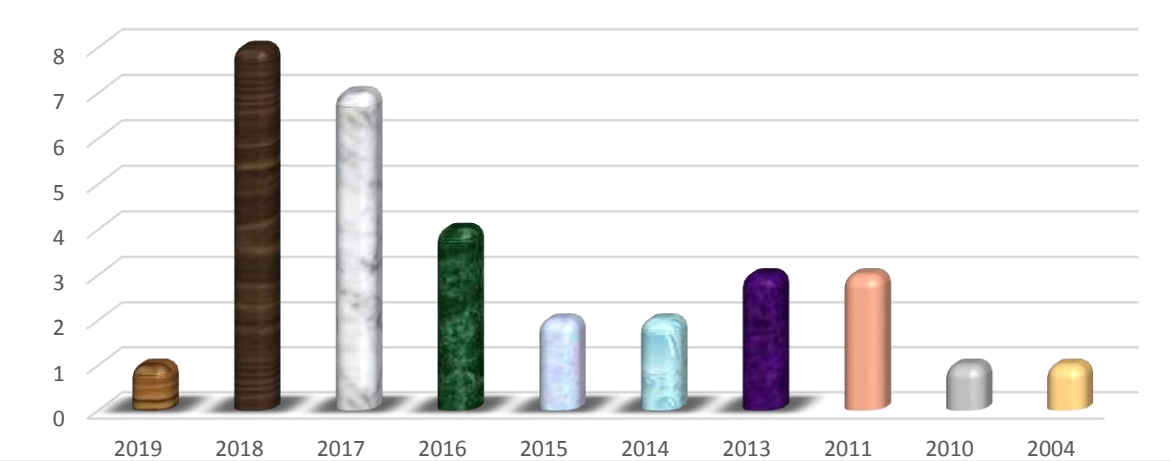

Figure: 4.2 Number of article per year from (2010-2018)

In Figure 4.3 it is shown that 32 selected studies are distributed among different types of Research Approaches (Methodology) such as surveys, case studies, SLR, content analysis and industry experiment report. By analysing the statistics shown in graph it can be seen that there are 13 studies that used the survey method to conduct the research. 8 studies used industry experiment report method, 7 studies used content analysis method whereas only two studies used the SLR method which is basically the method that is carried throughout this research.

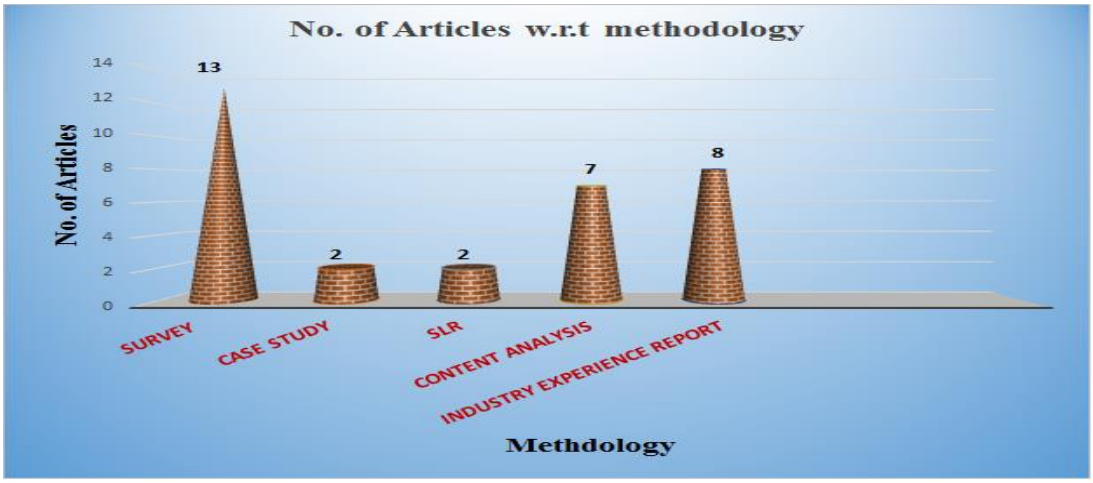

Figure: 4.3 Number of articles with respect to Methodology

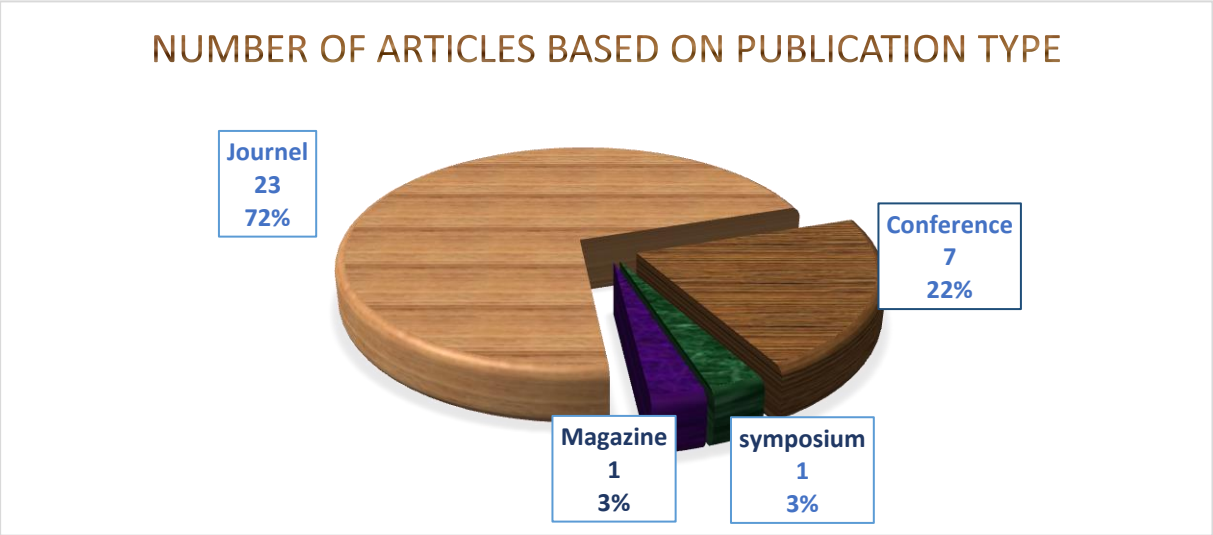

Figure: 4.4 Number of articles based on Publication Type

Figure 4.4 shows the exact percentage of 32 studies on the base of their publications. Such as 72% studies that are included are taken from journals, 22% are conference papers, 3% from Magazine and symposium. These statistics shows that majority of articles that are included are taken from known and famous journals. The further detail distributions of these 32 studies along with their publication sources name are displayed in Figure 4.5 and Figure 4.6.

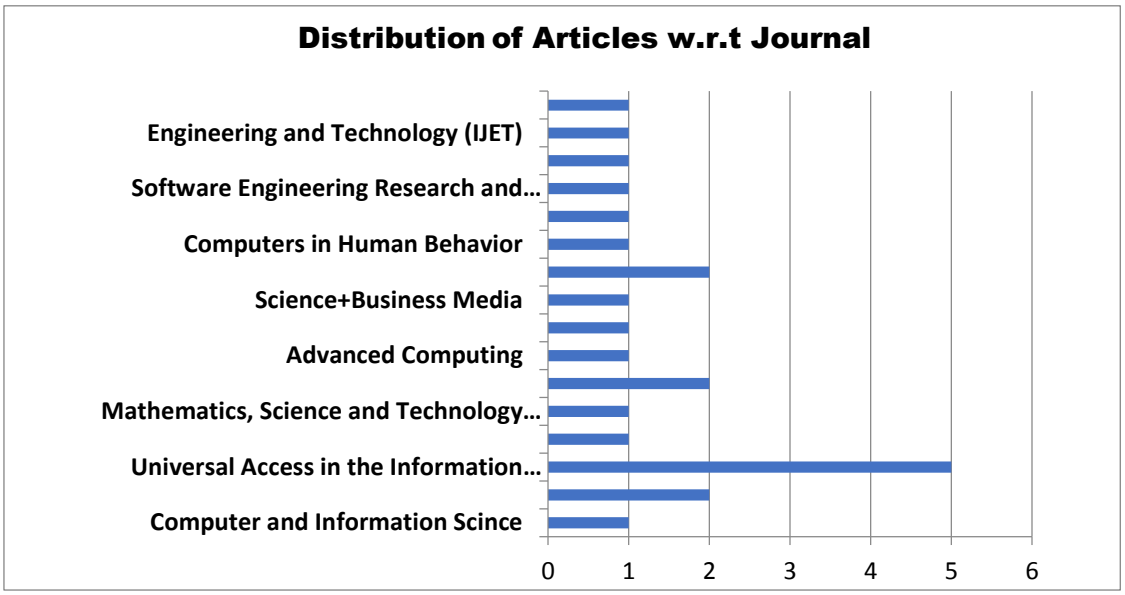

Figure: 4. 5 Number of articles with respect to Journals

It is shown in bar graph of Figure 4.5, on the left panel of graph all the names of journal are displayed whereas the right side of the graph shows number of articles selected from each journal .Maximum number of studies are from the journal "universal Access in the information society". Most of the journals are related to the information technology, advance computing, HCI and engineering domains. Whereas, bar graph of Figure 4.6 shows the list of all conferences names, that are the source of studies included in this research.

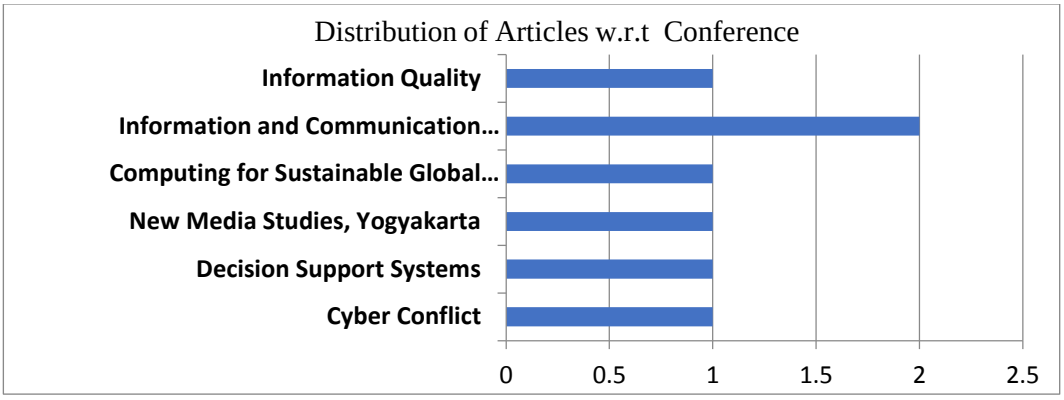

Figure: 4. 6 Number of articles w.r.t Conferences

Figure 4.7 shows the quantitative distribution of 32 selected studies with respect to the digital sources. It is shown in this figure that selected studies are taken from famous digital data bases such as IEEE, SPRINGER, ELSEVIER, Science direct and one general source that is Google scholar. Maximum number of studies that are 13 selected from ELSEIVER, 8 from SPRINGER and 6 from IEEE. Three studies are from Google scholar and the rest of two studies selected from ACM and Science Direct.

The statistics shown in Figures are used to keep track and metadata about all 32 selected studies in an organized form. Furthermore, from these studies a unique list of factors is identified that can affect the quality of universities' websites in Pakistan. This research is conducted the SLR. Conduction of SLR is based on some steps such as; at first with the help of keywords some strings are generated and browsed in online selected databases. After the collection of the relevant studies

some inclusion/exclusion criteria is applied. Furthermore the quality of selected article/studies is verified through quality assessment checklist.

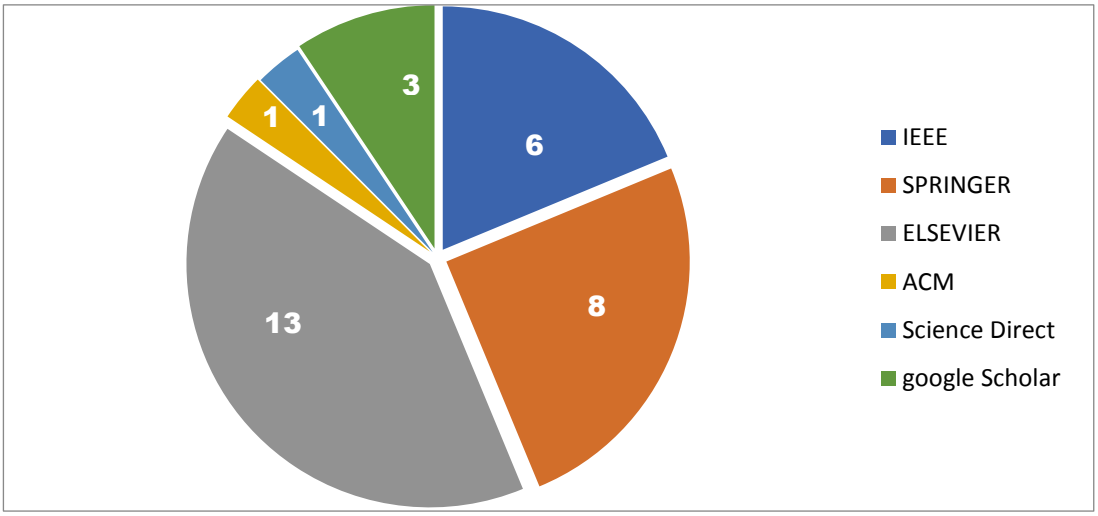

Figure: 4. 7 Number of articles w.r.t databases

The detail description of each step of SLR is presented in chapter 3. The Metadata of all 32 studies is elaborated in terms of an extraction form. Data coding scheme is done to extract the factors. Each of the 32 selected papers has its own tabular extraction form which contains its general information including type, publication methodology and factors. Each paper has discussed some factors that affect the quality of educational which is the basic focus of this SLR. The extraction form of each of the paper is attached in Appendix B.

Table 4.1 represents the distribution of data sources according to each database with respect to the levels of inclusion/exclusion. There are 7 columns in Table 4.1. The first column "Database" shows the list of those databases which are selected to search the most relevant articles related to this research. Column 2 "Pre-level Total Articles" shows the initial total studies that are selected by executing strings in data bases before applying the inclusion/exclusion strategy on them. Column 3 "1st -level" shows the number of studies from each databased on which first level of extraction is applied that is articles are selected according to

abstract/title. Column 4 "2nd level" shows the number of studies on which second level of inclusion/exclusion is applied which shows the number of total studies extracted from first level. Furthermore the total number from second level is mentioned in column 5 "3rd - level". Column 6 "post level total articles" shows the total number of studies that are extracted from inclusion/exclusion criteria's and further verified from quality assessment as shown in column 7 "total selected articles from QA". Thus total 32 studies are selected to be adding in our data set.

Table: 4. 1 Distribution of data sources for each database

Database	**Pre-level**	**1st level**	**2nd level**	**3rd Level**	**Post-levels selected articles**
IEEE	150	176	100	32	32
SPRINGER	70				
ELESVIER	210				
ACM	15				
SCIENCE DIRECT	35				
Google Scholar	20				
Total	500				

By analyzing the statistics mentioned in Table it can be seen that maximum numbers of articles such as 210 are found from the database ELESVIER that is very famous digital library for online collection of research articles. On second highest 150 articles are found from IEEE that is standard journal from research viewpoint. ACM, SPRINGER, Google Scholar and SCIENCE DIRECT are also utilized for browsing articles regarding this research. By analyzing all the facts and figures shown in table it can be seen that only 32 selected articles are finalized for SLR. These 32 articles are selected by applying a complete process of inclusion/exclusion. In this process three levels of exclusion/inclusion are applied on pre level found articles. In these three levels duplicated studies are removed on the base of title / abstract/keyword. After inclusion/exclusion a quality assessment checklist is applied on these 32 articles to finally select the right type of articles needed to be including in this study.

All 32 papers were reviewed for the purpose to generate a list of factors that can affect the quality of universities' websites in Pakistan. Factors are identified by using the data coding scheme of grounded theory. The detail of protocol of data coding scheme is mentioned in chapter 3. Whereas, the implantation of data coding scheme is as follows.

4.2.2 Example of data coding understanding

To understand the implementation of data coding scheme an example is attached in (Part A) of appendix D. The example comprises of three data sources P23, P13 and P17. Figure 1(a, b), figure 2 (c-e) and figure 3 (f-j) attached in appendix D shows the snapshots of these data sources. The highlighted statements in these snapshots are utilized for the grounded theory. The snapshots attached in the (Part A) of appendix D shows the highlighted area that is tabularized with column "paper statement".

Codification is an easy way to segment large data into summarized form. This coding then helps to define data units in compact form. Three level of grounded theory is utilized.

Open coding: Open coding is performed in first level, in which each word of statement is scanned and segmented according to its significance in concerning research. Metadata analysis is performed and initial data units are generated.

Focus coding: Focus coding is performed in second level, in which earlier identified data units are given more compact naming convention as unique identified factors which gives analytical and logical sense. Furthermore, duplicated units are removed by constant comparison and memoing.

Axial coding: Axial coding is the third level of coding in which all the unique factors are combined in different groups according to their dimensions and

properties. At axial coding level comparison and memoing takes place where data is compared among all categories and groups to form a finalize cluster.

In the implementation of data coding scheme the taxonomy used to generate the list of factors and sub-factors is highly connected with the taxonomy used in selected data sources. From all data sources factor, and sub-factor is listed along with concerning data source to be referred and utilized further.

The Table 4.2 consists of four columns. First column "paper Id" shows the id of data items taken as data sources. Second column "paper statement" shows the highlighted statement taken from the specific paragraph. Column three "open coding" shows the taxonomy of data units generated. Column four "focused coding" shows the clustering or group of initially identified data units from open coding. In table 4.2 it can be seen that line by line coding is performed.

Table: 4. 2 Examples of implementation of data coding techniques

Paper Id	**Paper Statement**	**Open coding**	**Focus coding**
P23	H0p1L7 it was determined that universities Included in the present study need to devote more effort to making their websites more *accessible for their users*.	*d1-accessible for users*	-Accessibility
	H1p3L1 It is important for the students to be able to *access information, announcements and other services provided by the websites* of their faculty or institute from the *main page of the university in an efficient, effective and satisfactory Manner*, as well as *ensuring the smooth processing of course registration* and that *course content is available to all.*	*d2-Access information,* *d3- efficient, effective and satisfactory Manner of main page* *d4- smooth processing of course registration* *d5- Course content availability.*	-Accessibility -User satisfaction -Design -Website services -Availability
	H1p3L3 In addition, academic and administrative staff should also be able to *effectively*	*d6-Effectively access services*	-Accessibility to services

	access services offered through the university website.		
	H1p4L0 Although a fundamental requirement for university websites is to have *accessibility features* that take into account the individual characteristics of the target groups and the technologies they use ,it can be argued that many university websites still have *accessibility problems , which constitute barriers particularly to those who need assistive technologies*	*d7-accessibility features* *d8-accessibility problems*	-Accessibility to features
P17	H1p3L2 A research on 71 Bangladeshi college websites reveals the important criteria of university website quality that involves the *number of web pages, simple web impact factors, self-link web impact factor and external link web impact factor.*	*d9-number of web pages,* *d10-simple web impact factors,* *d11-Self-link web impact factor* *d12- external link web impact factor.*	-Out degree-in degree pages -Web types of Impact factor
	H1p3L3 Another study on website quality shows that *website quality evaluation criteria focus on usability.*	*d13- focus on usability*	-Usability
	H1p3L5 *Usability is the determining factor* of the whole system's success.	*d14-Usability is the determining factor.*	-Usability
	H2p1L1 The quality of website can be evaluated using several factors such as *aesthetic, logics, and technology*.	*d15-aesthetic,* *d16-logics,* *d17-technology*	-Visual appeal/ -Services
	H2p1L2 Based on the perspective of *web designer and administrator*, the evaluation of website quality focuses on the *usability*.	*d18-web designer and* *d19-administrator* *d20-usability*	-Web designer -Web administrators
	H2p1L3 Usability covers the *simplicity in learning, effectiveness and pleasure for the users.*	*d21-Simplicity in learning,* *d22-effectiveness and pleasure for the users.*	-Simplicity
	H2p1L4 The factor of usability includes *page load time, page rank, traffic, stickiness and backlink.*	*d23-page load time,* *d24-Page rank,* *d26-Traffic,* *d27- Stickiness and backlink.*	-Performance
P13	H2p1L1 Many researchers have focused on *usability of a website*. Nielson's Model	*d29-usability of a website* *d30-effectiveness,*	-Usability

	is one of the most searched for in usability in engineering area. According to ISO (International Organization for Standardization) the usability is based on three main construct like *effectiveness, efficiency and satisfaction* ISO 9126-1.	*d31-efficiency and d32 -satisfaction*	
	H2p2L1 we have identified many parameters like *customer service support, easy accessing to the user, safe and successful transaction, privacy, user friendly interface, recovery of password, speed, efficiency* etc.	*d33-customer service support,* *d34-easy accessing to the user,* *d35- safe and successful* *d36 -transaction,* *d37- privacy,* *d38-user friendly interface,* *d39-recovery of password,* *d40-speed,* *d41- efficiency*	-Security -GUI -Recovery feature -Usability
	H3p1L1 The measure of how good is the service and products of a company are. Whether the website is fulfilling all the *needs of the customers* or not [13]. It is also defined *as "the number of users, or percentage of total users,* whose reported experience with a firm, its products, or its *services* exceeds specified satisfaction goals."	*d42-needs of the customers* *d43 -"the number of users,* *d44-services*	-User requirements
	H3p2L1 The *website should be accessible in a very efficient way*. It is the ability to access and benefit from some system or entity.	*d45- accessible in a very efficient way*	-accessibility
	H3p5L1 It is very important for a good website to be simple in terms of operations otherwise it can lose its *customer's interest.*	*d46-simple in terms of operations* *d47-Customer's interest.*	-Simplicity in operations/clarity
	H3p6L1 This factor is very important for web usability. If there is *ease of use* then more customers will look for it and hence it will be beneficial for it	*d48-ease of use*	-usability
	H3p7L1 This page is the key part because through *FAQ* a developer of the website can understand the *needs of customer*	*d49-FAQ* *d50-needs of customer*	-User requirement

	and their queries directly.		
	H3p8L1 Now-a-days with increasing globalization the demand for mobile application has increased. Any *user who cannot access the website* on the system because of the hectic life schedule can now easily access the e-commerce website through the *mobile website or the Application*	*d51-demand for mobile application* *d52-mobile website*	-Web services -Technology
	H3p10L1 Sometimes websites produce an error because of human or because of developer's mistakes. The helpfulness of those errors decides the usability of the website. *Error notification* should help in removing the error, should not provide more information than needed and should be *easy to understand.*	*d53-Error notification* *d56-Easy to understand.*	-Usability -Operability
	H3p11L1 Website should be *designed* in such a way that attracts more and more customers. The users are attracted to the services provided by a website. The higher the *quality of services* the more will be the *attractiveness* to the users, quality of services should also be maintained in order to balance.	*d57-Designed* *d58-quality of services* *d59-attractiveness*	-Layout/ -Graphical design/ -Image/ -Graphics.
	H3p12L1 *Website should be friendly* enough for a customer that the customer can think of using it in future not just the user look once and find it so difficult to use it in future. *Menus or links to appropriate categories in appropriate places should be present.* Additionally, each page should provide users with an *easy way to get back to the home page.*	*d60-Website should be friendly* *d61-Menus or links* *d62-easy way to get back to the home page.*	-User friendly/ -look and feel/ -attractiveness/ -links/ -navigability/ -Browsing.
	H3p16L1 The *time* that the website takes to function is very crucial. It should be *very fast and should easily* allow the user to access the website.	*d63-Time* *d64-very fast and should easily*	-Functionality/ -easiness/ -Usability.
	H3p17L1 *Loading time* of the page is an important part of any website's *user experience.* Website visitors tend to care more about speed than all the bells and whistles we want to add to the websites[18]	*d65-Loading time* *d66-user experience*	-User satisfaction
	H3p18L1 The *efficiency of the website* is a very	*d67-efficiency of the website*	-Efficiency/ -Usability

	important factor in measuring the *usability of the website*. It should be maintained because all other factors also depend on it.	*d68-usability of the website*	
	H4p1L1 *User Satisfaction* is prime parameter and most important amongst all parameters of usability.	*d69-User Satisfaction*	-User satisfaction
	H4p2L1 For attracting more and more user toward a website it is important to *design a website* in a very *attractive manner*. This parameter is less important than user satisfaction.	*d70-design a website* *d71-attractive manner*	-Graphical design/ -Attractiveness
	H4p5L1 For successful running of website and to satisfy the *user's need.* This parameter has less importance because *efficiency* may also depend on the system for processing.	*d72-User's need.* *d73-efficiency*	-User requirement
	H4p6L1 *Helps user* and save the *time of user*. It is better than other parameters as it *helps user to search easily*.	*d73-Helps user* *d74-Time of user.* *d75-Helps user to search easily.*	-User help/ -support service/ -supportability

For detail explanation and understanding of the data coding technique a paper statement from P17 data source is taken and shown below.

"Many researchers have focused on *usability of a website*. Nielson's Model is one of the most searched for in usability in engineering area. According to ISO (International Organization for Standardization) the usability is based on three main construct like *effectiveness, efficiency and satisfaction* ISO 9126-1[8]".

As shown in table 4.2 the above statement with code 'H2p1L1' is taken from P17 data source. Code is interpreted as follows "H2" shows the heading 2 of that data source, "p23" shows the paragraph 1 of that heading 2 and "L1" shows the line 1 of that paragraph. This is how the paper statements are labeled with unique codes. Latterly, data is analyzed and data units are generated with the help of open and focus coding.

With respect to above mentioned example further open coding is performed and data units “d29-usability of a website”, “d30-effectiveness”, “d31-efficiency” and “d32 –satisfaction” are generated. These four data item logically represents the same meaning and directing towards one property that is usability. Thus, we combine them together and name them into one data unit that is “Usability”. By grouping these four data units together in one unique data units focus coding is also performed.

The same procedure was performed for each data source. In the part B of appendix D Table D1 shows the constant comparison of duplicated data units between data sources P23, P13, and p17. Table D1 consist of four column .First column “similarity type” shows the duplication type between data units explicitly or implicitly. Column two “data units having similarity” pointing towards all those data units that are similar in meaning, taxonomy or analytics. Column three shows those data units that are identical or have similarity. For the purpose to remove the similarity those data units are suggested one unique name. And column 4 explains the reason under which those data units are suggested one unique name.

Similarly, data units’ d72- *“User’s need”, d42-“needs of the customers” and d50-“needs of customer”* of P13 are implicitly similar. So, thus combined into one data unit “user requirements” is called focus coding.

Implementation of data coding scheme is conducted statement by statement on each individual data source. Data units are identified from 32 data sources. To remove the duplication between all the data units identified from data sources, Constant comparison and memoing is performed among data sources. The part C of Appendix D consists of table D3 which consist of five columns. First column “paper Id” shows the ids of data sources taken as example, column two “similarity type” shows the type of duplication between the data units of ‘P23’, ‘P13’ and ‘P17’. Column three “data units having similarity” consist of all the similar data units from each data source. Column four “suggested name of data units having similarity” shows the name suggested for similar type of data units. Column five “reason of

modification" explains the reason on based of which data units are combined and assigned a single name. For example "Layout", "user interface" and "graphical design" taken from 'P23', 'P13' and 'P17' data sources are suggested into single data unit "GUI". GUI is an abstract form of these three data units thus instead of mentioning them all in specific form it is believed to combine them into more general form i.e. GUI.

Table D2 in the part B of appendix D shows the primary list of identified data units. This table contains two columns. First column "Data units" shows all the primary data units obtained from all 32 data sources by applying open coding. Column two "paper ID of data units" shows the references of data sources that having these data units. It is observed and analyzed that the primary list of data units listed in table D2 consists of many duplication and repeating. Some data units are similar in meanings and logics. Thus to remove all kind of in-consistency and redundancy, focus coding and axial coding is applied. After applying the data coding technique (open coding and focus coding) to each data source individually as well as collectively among all 32 selected data sources for this research.

The complete process of removing redundancy and inconsistency between data units and to generate a unique list of factors/sub-factors/categories explain by tables D4, D5, D6 attached in appendix E. Appendix E, Part A Table D4 in which constant memoing and comparison is performed to give primary list of data units' decent naming conventions. This table consist of three columns .in the first column list of all primary identified factors is shown. Column 2 shows the rename list of primary data units. And column 3 explains the reason of renaming primary data units. For example "access information" and "easy access to the user" are two primary data units listed in column one renamed by "easy access to information". Moreover column three explains that access to information or easy accesses to information are synonyms thus they are renamed. In the Part B of appendix shows the Table D5 for more refinement of data units another filtration is performed. In which renamed list of data units from table D4 is converted into unique list of data

units and in column three reasons is also explained. Part C of appendix E shows the Table D6 in which unique list of factors is identified. In which focus coding is performed to remove duplication and similarity in data units to generate unique list of factors and sub-factors. This table consists of four columns; in the first similarity type is mentioned that is explicit or implicit. In Column 2 data units that have similarity are listed such as “easy access to information” , “Rapid access to information” and “access to relevant data” are similar and thus they are suggest to a unique single name that is “accessibility” .

Table 4.3 consists of 5 columns. First column “category” shows the axial coding. Column two “Factors” shows a complete unique list of data units name as “factor “ paper ids of these factors is mentioned in column 3. Unique list of Sub data units name as “sub-factors” are listed in column 4. Column 5 shows the paper ids of these sub-factors.

Table: 4.3 Finalized list of uniquely identified factors and sub-factors with their categories

Category	**Factors**	**Paper id of factor**	**Sub-Factors**	**Paper id of sub-factors**
WEBSITE USABILITY	Accessibility	P23,P17, P19,P10, P24	Easy access to information	P23,P22,P6,P17
			Rapid access to information	P23,P22,P17
			Access to relevant data	P23,P22,P17
	Simplicity	P22,P17, P27	Simplicity in learning	P22,P17
			Simple in terms of operations	P22,P18,P26
	Understand ability	P22,P16	Familiar language	P16,P22,P18
USER INTERACTION	Visual interaction	P3,P4,P20,P32	Entertaining	P4,P19,P20
			User friendliness	P3,P6,P20
			Smooth course registration	P4,P20,P27

	user services	P3,P4,P13,P31,P2, P10,P21, P26	Quick recovery of user passwords	P13
			Feature of FAQ	P4,P13
			Helps user to search easily	P4,p31
			Timely error notifications	P12,P13
			Quick response to user	P2,P13,P16
			Website guide	P4,P29
WEBSITE DESIGN & STRUCTURE	Aesthetically pleasing interface/Graphical user interface	P3,P1,P6, P20,P14, P24	Displayed information is not overloaded	P1,P4,P28
			Speed of page loading	P8
			Attractive look and feel	P6,P7,P20,P1
			Well structured	P7,P3
			platform independence website	P11,P18
			Website compatibility with browsers	P12
EASY NAVIGATION	Page management	P11,P12, P14,P17, P30,P21, P24	consistent & active menu links	P8,P11,P17
			Convenience of navigation tools	P11,P14,P30
			External web Links	P11,P8,P16
			Responsive home page	P11,P14
WEBSITE UNIQUENESS	Site identity	P5,P15,p32	Organization	P32
			Security & privacy of user data	P5
			Facility of Website apps	P32

	SEO	P16	Website Popularity	P16
WEBSITE CONTENT	Information structure	P18,P20, P19,P21, P2,P11,P 24	Consistency in information	P20,P21
			Accurate information	P20,P21,P24
			Up-to-date information	P21`,P18,
			Utility of content	P18,P19,P25,P11
			Aesthetics in content	P2,P20,P21
			Completeness of information	P20,P8
			diversity of information	P20

For example in column 4 the first three sub- factors “Easy access to information”, “Rapid access to information” and “Access to relevant data” shows the easy , rapid and relevant access to information. This is basically related to accessibility of information thus assigned with the name “Accessibility”. Then for axial coding the first three similar factors “accessibility” ,”simplicity” ,and “understandability” are assigned with broad category “Website Usability”. Thus, this way all the factors, sub-factors and categories are generated. Furthermore, all these naming convention / unique terms are common in use by existing studies and have proper referencing as in selected research articles.

In this research all the common qualities/attributes (factors/sub-factors) of website quality are summarized. These qualities/attributes are necessary for the better evaluation of educational website according to the current and recent published articles. By taking into consideration these attributes this research proposed 6-dimension criteria/scale for educational website quality assessment. 6-dimension

criteria/scale includes main categories such as “website usability” ,”user interaction”, “website design & structure” ,”easy navigation” , “uniqueness” and “website content” . Main dimension are further divided into 10 main quality factors. And finally these main factors are sub-divided into 36 sub-factors.

World Wide Web has been a great source of web services since many years. These web services have been utilizing by different platform such as web service many private and government systems, technology, business and finance etc. [1]. There is need to evaluate the quality universities websites becoming necessary. So that all the possible major usability issues can be identified and tackled [21]. Most related work regarding this research is published during 2012-2014 [22]. It is very important to identify all possible quality factors that affect the usability of universities websites. Thus, with the help of those factors the usability scale can be developed [7, 8, 30, and 31].

4.3 Findings and Analysis

32 studies regarding this research domain were selected. These 32 studies are related to exact problem statement of this research. The existing proposed work comprises of different research methodologies, such as case study, survey, empirical study and industry experience report. Each study was reviewed by analyzing the context of the study, research questions, and empirical confirmation of the findings. The studies cover a range of research topics comprises of variety of unit of analysis. Initially unit of analysis were wide in range as mentioned in Appendix [C-E], then final usability constructs extracted from initial units of analysis reduced to selected factors/sub-factors as shown in Table 4.3.Below is the outline of these constructs comprises of 6 main categories that are sub-divided into 10 factors and 36 sub-factors.

Figure: 4. 8 proposed usability scale to evaluate quality of higher education university websites

Findings of research are further utilized in development of a usability scale. The proposed usability scale consists of all the basic usability constructs as shown in Fig 4.8. The usability scale is an effective approach to assess the artefact quality in the of universities website lifecycle. The proposed usability scale works to evaluate universities website quality in Pakistan regarding the user's viewpoint. This section below describes the detail constructs of proposed usability scale.

4.3.1 Website Usability

Website usability is 1st and the high-level category of proposed usability scale in this research. This category can be indirectly measured as according to the findings of this research. It represents the level of effort that requires a given set of users to operate, understand, and communicate with the website. International standard organization (ISO) defines usability as "the extent to which a product can be used by specifies users to achieve specified goals with effectiveness"[48, 49].

Websites usability can be judged by effectiveness, efficiency and satisfaction. The user experience of visiting the website can depict the website usability. If the experience is good of using navigation, quality of content, buttons and services, etc. this will show that the website have good usability and vice versa. Usability basically shows the rate of degree on which a website is visited and utilized by its users[50, 51]. When a user visits the website and his all necessary need fulfilled by website services this will increaser website usability. Usability concerns with some attributes such as easy to learn, Pleasant to use, Easy to use, with few errors, Flexibility, User satisfaction and Throughput. Accessibility, Simplicity and Understand ability are 3 main factors that are identified in SLR findings under the category of website usability.

4.3.1.1 Accessibility

Accessibility is the first main factor under website usability category. A good website makes sure that it is easily accessible by everyone. All the normal people or users that visits website must be provided with the information of their concerns[52]. This can be done by using some assistive tools to enhance the accessibility to users. To enhance the advance technology website disable people can also be served by sing text-only page in case when they can’t see images videos or other multimedia shared on website. Some websites are only accessible by specific users or tool/search engines.

This factor is related to easy access to the relevant and desired information. It captures website's explanatory profile with respect to the information contained within the site. Information should be presented in a directly usable format that does not require decoding, interpretation, or calculation. It assesses Ease, Speed and relevance to the information required, they are the actual sub-factors of accessibility[53].

4.3.1.1.1 Easy access to information

Information provided on website should be easily accessible to all kind of users. There should not any additional barriers of dialogue boxes or need of permission requirement to access the website information even for a new user [52, 54].

4.3.1.1.2 Rapid access to information

To save the time of user and for showing website efficiency it is important to provide or perform what user want in a rapid manner. This way overall efficiency of website may increases [54].

4.3.1.1.3 Access to relevant data

Website should contain a comprehensive and categorized form of data. So, that it can be make sure that right kind of audience have access to the right and relevant level of data [53].

4.3.1.2 Simplicity

The second factor under website usability category is Website simplicity.it is a quality factor through which user feel it easy to use the feature of website. Website

appearance and information decides to make it simple on not. Simplicity of the website is in two sub-factors, simplicity in learning as well as in terms of operation [50, 52].

4.3.1.2.1 Simplicity in learning

Users especially such as students visits educational website for the purpose of learning and gaining. To make their learning effective it is important to maintain the simplicity feature [54].

4.3.1.2.2 Simplicity In terms of operation

Website should be simple in terms of operation whether the operation is searching the items within website or calculating student CGPA. Simplicity in operation hides the internal complexities of operations feels user comfortable to use the website [50, 52].

4.3.1.3 Understand ability

As along with the website accessibility and simplicity, the third important main factor is website understandability regarding website usability. On broader level the text language of website must be familiar to its user and it should be free of jargons and any kind of ambiguity. The language understandability of a website also depends on the area of user from where they are accessing the website and it must be understandable. Not only in text and but also in functionality a website should be understandable for its users. Familiar language is the sub-factor of understandability factor [53, 54].

4.3.1.3.1 Familiar language

Language is a feature that acts as the best communicator between website and its user. Website text should be in the familiar language so that majority of audience or specially the targeted audience can understand what the website is about and how to use it.

4.3.2 User Interaction

User interaction is the 2nd category as mentioned in the constructs of proposed usability scale constructs. Website is the best medium to contact and communicate with many people all over the world. A building of website is based on many elements. If the website is designed in attractive manner the more users will visit and use the services of that website [30, 41]. User experience will be increased and they will find it more satisfactory appealing. To enhance the interactivity of user runtime services should be provided by the website to keep its user engaged and connected with website. Thus, to increase the website interactivity, user interaction needed to increase. Visual Interaction and User Services are two main factors of this category [55].

4.3.2.1 Visual Interaction

It includes how entertaining/boring, user-friendly and smoothly-going a website is. There are three sub-factors included in visual interaction, entertaining, user friendliness and smooth course registration [30, 41].

4.3.2.1.1 Entertaining

Use of Multimedia such as video, audio, images makes website more interesting and entertaining for the user [52].

4.3.2.1.2 User friendliness

Website should be smoothly going in operations, appearance and in providing services. Because this way a friendly environment is created, user feels it comfortable to use the website [53].

4.3.2.1.3 Smooth course registration:

From student view point to enhance the interactivity of website it should be make sure that Smooth processing of course registration is enabled and performed [56].

4.3.2.2 User Services

A user service is the second main factor under the category of user interactions. User services are the tasks that are performed by the users to facilitate its users. Availability of contents, entertainment, query's handling or error recovery are immediately served to user shows that website is good at providing user services [30, 41, 43].This sub-factor checks how user-centered the website is. It may include Recovery of forgotten passwords, FAQs, Help & Support, Error notifications and quick response to the user with a website guide/map.

4.3.2.2.1 Quick recovery of user passwords

It is possible that a user has forgotten or lost its password that always helps him to access the data. Now, to ensure the user services availability it is important to quickly recover the user Password so that he/she can get rapid access to their profile or data [42].

4.3.2.2.2 Feature of FAQ

FAQ (frequently asked question) this criterion is important in a way that mostly on each website there are some top most question related the user queries that they want to ask or know. The best way to handle those hot list queries is to provide a FAQ feature on website to ensured user services in appropriate way [57].

4.3.2.2.3 Help user to search easily

Search feature is important to be available on website to help user get access to the relevant data more quickly [58].

4.3.2.2.4 Timely error notification:

It is important to notify user that an error is occurred before he/she finishes final task such as course registration [30, 41].

4.3.2.2.5 Quick response to user

There should be Quick feedback, Quick email response or rapid Availability of user support services on website to make sure user response quick [42, 58].

4.3.2.2.6 Website guide

Sitemap availability or availability of Website catalogue must be assured on website to enhance user's experience. Because website guide can acts as breadcrumbs for user to access the services [30, 41, 43].

4.3.3 Website Design and Structure

Website design and structure is the third main category of proposed usability scale. The design and structure of website work as vital component for user from both functionality and appealing point of view. Human computer interaction (HCI) is an emerging field now-a-days. As the time passes computer technology replacing our physical world into online electronic environment [30] .User interface design (UID) is the best gateway to enter in the world of technology. So, UID need to be more easy to use and interactive for people.

The success of every UID is measured with a very vital component (i.e.) usability .it basically discusses the overall rating of use of UID in HCI that guarantee the realization of interaction [37]. A lot of research is conducted by the researchers that highlighted the issues and their proposed solution regarding UID's. And to check the usability of any software product usability tests are defined. User interface design (UID) is a subset of the HCI. It is basically a design of interface that users can use from any device such as computer and tablets. Need of structured way of UID to increase usability of web applications for users & developers to make them sustainable. Design and structure affects the quality of software [59].

Website map enhances increases the usability of website. It provide breadcrumbs for user to explore the overall structure of website [51, 53]. Graphical user interface (GUI) is the one main factor of website design and structure as mentioned below.

4.3.3.1 Graphical User Interface (GUI)

A GUI graphical user interface is an interface that uses graphics such as menu icons as compare to Command line interface. As in the earlier computers were keyboard based and commands were used and have to remember. On the arrival of GUI it becomes easier for the users to access anything in technology world by

clicking only menus. GUI makes everything easy for the user to access and interact with the website. Elements of a GUI include such things as sound, voice, motion video, and virtual reality interfaces, windows pull-down menus, buttons, scroll bars, iconic images, and wizards [37, 59]. GUI factor comprises of 6 sub-factors, such as, displayed information is not overloaded, speed of page loading, attractive look and feel, well structure, platform independent website and compatibility with the browsers.

4.3.3.1.1 Displayed information is not overloaded

Too much or poor quality information seems like it is extra or overloaded on website that leaves a very bad impact on the user. Moreover it effects the look and feel of overall website.to avoid this issue information should not be overloaded and should be managed in an attractive way to make it more effective for user [55].

4.3.3.1.2 Speed of page loading

Speed of page loading is actually the speed of a page sample to view on screen. Thus, in the website time that is taken by a page to be displayed or loaded on screen shows its speed. Page loading speed should be faster to increase the efficiency of website [34].

4.3.3.1.3 Attractive look and feel

Appearance is the first thing to be attracted in website. The color theme, style of layout enhances the look and feel of website. To make website more appealing astatically it is important to design it in attractive manners [37, 49, 59].

4.3.3.1.4 Well structured

Standardized website design/Standardized website visual design/well-designed & structured website [30, 33].

4.3.3.1.5 Platform independent website

Advancement in IOT helps the web servers decreases the OS compatibility issues. This helps website to provide access user whether they are accessing from desktop, android or IOS [50, 60].

4.3.3.1.6 Website compatibility with browsers

Sometime website looks different in different web browsers because, each web browser reads the website code differently. For example Firefox and IE can render website in their own ways. Website compatibility is important to ensure, so that it can be easily accessible from user's browsers. [49].

4.3.4 Easy Navigation

Easy Navigation is the 4th and most important category of proposed usability scale. This feature in websites works as a roadmap for the users towards all the pages. Clear navigations helps user to smoothly visit all the pages of website and it leave a good impacts on user experience[61]. Applying the appropriate breadcrumbs and sitemap keeps the user come back to visit again and again. In designing the website appropriate menus, labels links are used so that users can explore the website and get access to appropriate pages quickly without going through lot of mess of pages [49].

Proper menu labeling helps user to return towards home page with easy navigation [57, 58]. Page management is the main factor under this category.

4.3.4.1 Page management

In navigation page management is more important than page building. It is very important to align the pages in order that can be affected for the website from user viewpoint. For example the one the most important page is “about us”. Because this page always shows the introductory profile of website. Thus it should keep at first link. And all other pages such as Home Page, Contact Us Page etc. etc. are also aligned as according to the structure of website [49, 61]. This factor analyses easy navigation , proper menu labeling, links to other websites, availability and validity of search engines and responsive homepage [50, 59]. Consistent and active menu links, convenience of navigation tool, External web links and Responsive home page are the four sub-factors of page management as reported below.

4.3.4.1.1 Consistent & active menu links

Website should contain of properly labelled menu along with Active links behind their labels. It leaves a very negative impact if a page name is mentioned but by clicking on the name user found inactive link [34].

4.3.4.1.2 Convenience of navigation tools

Navigation tools like labels, buttons helps user in surfing easily around the website. These button or labels need to be placed in appropriate place in website and a back or home page link should be given to user for its easiness [57, 58].

4.3.4.1.3 External web links

External web links on website acts as outgoing door for the user and make easy for the user to interact with the related links quickly, for example the national/international scholarship opportunities for university students and teacher provided by other websites [61].

4.3.4.1.4 Responsive home page

Home page works as front page of website. And it is obvious that website can be accessed from any platform it depend on user style. Thus, it should be adjustable to maximum all types of screen. So, that home page's responsiveness shows the page management [34].

4.3.5 Website Uniqueness

Website uniqueness is the fifth category of proposed usability scale. Uniqueness refers to user's perception that the site carries something that makes it different in a world full of sites [29]. Website distinctiveness is judged according to content, aesthetics and design characteristics. The website uniqueness also includes Aesthetic sense , Uniqueness of content and design characteristics [41]. Website Identity and (Search Engine optimization) SEO are two main factors of website uniqueness as reported below.

4.3.5.1 Website Identity

Website identity Reflects uniqueness and Characteristics of website, that make it unique in a web of trillions of site [62]. It is also related to organization of the website, security and privacy of user data and facilities available in website app.

Organization, security & privacy of user data and facility of website applications are three sub-factors of site identity.

4.3.5.1.1 Organization

Each website is the representor of an organization. To maintain the unique identification of website it is really important that website must have unique monogram/LOGO, Proper indexing of webpages /URL [29].

4.3.5.1.2 Security & privacy of user data

Each educational website maintains the data of its students.it is important to hide the personal profile of students from other. Thus, to ensure this feature security and privacy of user data must be ensured in website [41, 43].

4.3.5.1.3 Facility of website apps

Along with availability of other user services availability if there are some necessary apps for user like GPA calculator are available on website .then it will increase the website efficiency [43].

4.3.5.2 SEO (Search Engine Optimization)

SEO second main factor of website uniqueness, is basically a set of rules that are applied in website to have more search and ranking in search engines. SEO is a trending strategy for a website to come in top lists of search results by search engines. This strategy makes the website more famous and popular to the users. Basically search engines uses some complex algorithm that are applied on website to check out which website have best SEIO so that it can be appeared on first top pages of search results. It refers to the popularity of the website and its ranking by search

engines like Google, Bing etc. [62]. Website popularity is the only one sub-factor of SEO.

4.3.2.2.1 Website popularity

If a website is easy to google than it will increase website page ranking and website popularity will ultimately increase [62].

4.3.6 Website Content

The last and vital category of usability scale constructs is website content. Website that has good information architecture helps there users to found what they exactly want from the website. A website that has good information architecture will surely have good content. Website content is considered good when it is authentic, understandable and easily accessed by user [].It analyses order and togetherness of information included in the website. Moreover, it checks the consistency and accuracy of the information provided.

4.3.6.1 Information structure

Information Structure [57, 60, 61] is the main factor of website content category. This factor is further divided in sub-factors such as, consistency in information, accurate information, up-to-data information, and utility of content, aesthetic in content presentation, completeness of information and diversity of information.

4.3.6.1.1 Consistency in information

The information provided on each page must be consistent through out the website [52].

4.3.6.1.2 Accurate information

The provision of information on website should be accurate and trustworthy before it conveyed to user. This will enhance the quality of information [61].

4.3.6.1.3 Up-to-date information

As according to the advancement in technology and varying events it is important to maintain and provide the update information on website. This characteristic makes the website up to date and competitive to others websites [51, 52].

4.3.6.1.4 Utility of content

On bases of grammatical errors free content, Readability and understand ability of text needed to be check [57, 60].

4.3.6.1.5 Aesthetic in content presentation

All the content whether it is text, image, voice or graphic data need a manageable look on screen that make it attractive and aesthetically pleasing [52].

4.3.6.1.6 Completeness of information

Completeness of information depicts that information should be in a form that is directly understandable to user and does not require any decoding or interpretation before read or used [57, 60, 61].

4.3.6.1.7 Diversity of information

An information hierarchy needs to be maintained to serve general and specific users according to their rank and designation or their need of data requirements [52]. The above described constructs are useful usability scale to evaluate the website quality. In addition, it could be also used in earlier stages as exploratory and development phases.

4.4 Summary of Chapter

This chapter reported the findings and results complied from SLR. In the solution usability scale is proposed to evaluate quality of universities' websites. All constructs of proposed solution explained briefly. The evaluation of proposed solution is done by conduction of Focus Group as reported in next chapter.

CHAPTER 5

VALIDATION OF WEBSITE USABILITY SCALE GUIDELINE

5.1 Overview

In chapter 4, on the basis of SLR findings a usability scale is developed. This chapter reports the validation of developed usability scale through focus group discussion. This validation is considered useful to evaluate the quality of universities websites.

5.2 Evaluation of Proposed Solution

The initial proposed usability scale regarding the user's viewpoint is reported in chapter 4, Table 4.3 along with their referenced studies. This usability scale is further analyzed and evaluated by conducting a focus group discussion. The validation process is reported below.

5.3 Focus Group Discussion Process

Focus group discussion (FGD) process comprises of group of people with same background or experience to discuss their views on some specific subject. Focus group is basically a form of qualitative research. The purpose of focus group discussion is to accumulate opinions and suggestions of field experts related to topic of research. The focus group discussion process consists of three phases. In first phase 1 focus group discussion session is designed such as, purpose statement, data collection strategies, guiding questions and agenda planner. Phase 2 comprises of

analysis and results of collected data such as, all the opinions, strengths, barriers and suggestions commented by experts. In phase 3 improvements according to expert's suggestions are reported. The detail of phase 1 is reported in chapter 3 under section 3.4. However, the details about results and conclusions extracted from phase 2 and 3 are reported below.

5.4 Data analysis and results

FGD data analysis is performed based on expert's suggestions and opinions. Analysis of Metadata gathered from questionnaire form of focus group session and represented in graph below. Figure 5.1 shows the distribution of factors with respect to their influence in usability scale. Scale comprises of 11 uniquely identified factors that are evaluated. The x-axis shows the ids of all 11 factors denoted as F-1 up to F-11. The y-axis shows the average evaluated values of each factor.

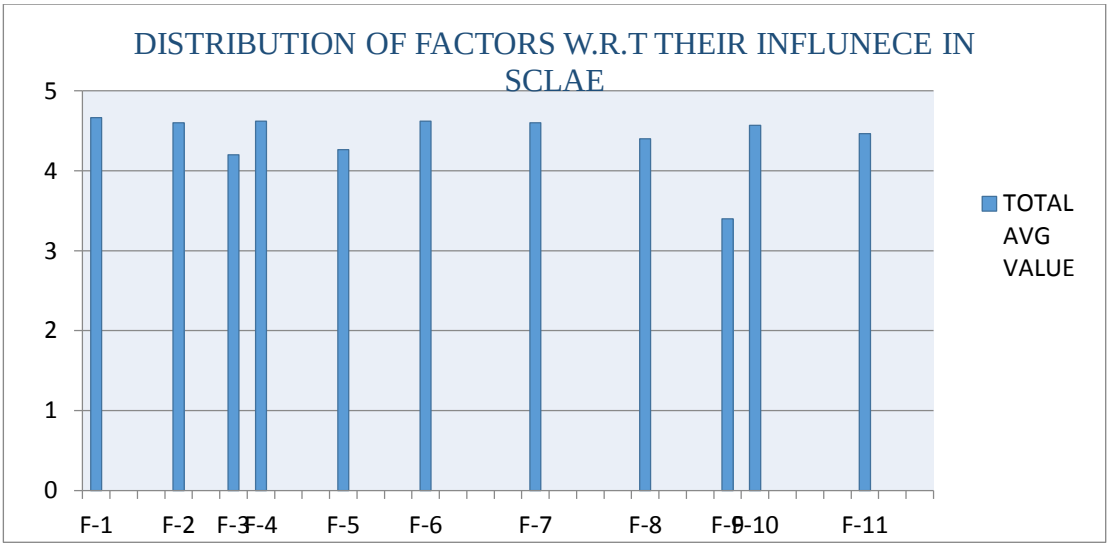

Figure: 5.1 Distribution of Factors w.r.t influence

Graph in Figure 5.1 shows the influence level of each factor regarding their average merit-values. The statistics represented in Table 5.1 shows each factor along with its id and merit value. Table 5.1 comprises of four columns. The very first column consists of ID's (F-1 to F-12) of eleven most influential factors. Second

column “Factors” consist of all the finalized naming conventions of influential factors such as “Accessibility”, “Simplicity”, “Interactivity”, “Responsiveness”, “Effectiveness”, “Aesthetically Pleasing Interface”, “Navigation Flow”, “Website Identity”, Search Engine Optimization (SEO), “Content Structure” and “Content Integrity”. Furthermore, Third column “Merit-values” shows all the average calculated values (1 to 5) according to each individual factor. And fourth column “Quality Level” shows the level of quality such as “Highly-Significant”, “Significant”, “Moderate”, “Neglect able” or “Neutral”.

Table: 5. 1 List of Factors Based on their Influence

ID’s	**Factor**	**Merit-values**	**Quality Level**
F-1	Accessibility	5	Highly-Significant
F-2	Simplicity	5	Highly-Significant
F-3	Interactivity	4.2	Significance
F-4	Responsiveness	5	Highly-Significant
F-5	Effectiveness	4.3	Significance
F-6	Aesthetically Pleasing Interface	5	Highly-Significant
F-7	Navigation Flow	5	Highly-Significant
F-8	Website Identity	4.4	Significance
F-9	Search Engine Optimization (SEO)	3	Moderate
F-10	Content Structure	5	Highly-Significant
F-11	Content Integrity	4.5	Significance

By analysing the Merit-values shown in Table 5.1 it is observed “Accessibility”, “Simplicity”, “Responsiveness”, “Aesthetically Pleasing Interface”, “Navigation flow”, “Content Structure” are Highly-Significant Factors. As, all these seven factors have highest merit value. Secondly, three factors such as “Interactivity”, “Effectiveness”, “Website Identity”, and “Content Integrity” are Significant as according to their quality level and merit values. The single factor “Search Engine Optimization (SEO)” found moderate. is Moderate as according to its Merit-value and Quality Level. Statistics shows that none of the factor is Neglect-able or Neutral. During the focus group session experts commented their view points about proposed usability scale. In comments strengths and weaknesses are

highlighted. Below is the detail description about experts' opinion and suggestion regarding usability scale.

5.4.1 Expert Opinion about Usability Scale

Expert's opinions are analysed and reported as follows. According to expert 'A' this usability scale can significantly raise the website standard. He reports, "If solution adopted completely, it can significantly raise the standards of higher education websites". By analyzing the opinion of expert 'A', it can be said that, the websites of educational institutes, specifically universities, are designed and created to help current as well as future students of the institute. These websites are supposed to provide answers to all the questions that may occur in the minds of students. A website should provide all the information needed by a student. Moreover, all the information provided in the website should be handy, easy to access and searchable. Having all these features, it should not be messy and the data provided should not be at sevens and sixes. If the website does not possess these attributes, it is not fulfilling its requirements and is not as much useful as it should be. To check its usefulness and compatibility, the proposed usability scale should be adopted. This usability scale, if adopted completely, will help to know if the website is providing all the information needed properly, with the ease of access and search, or not. The adoption of the suggested usability scale completely will lead to significant raise in the standards of the websites.

Likewise, Expert 'B' shared his opinion about relationship of construct of usability scale. He reports, "Perfect and no problem are found during studying it". "Content integrity is needed to add by splitting the content factor". "Factors and sub-factor need to be analyzed and grouped based on their meaningfulness". According to expert 'B', the usability scale fulfils the level of satisfaction as according to current needs of users. The current era of IOT is advancing so fast to establish and develop new technologies and techniques. Universities' websites are the main source of information for the students. Users assessing universities' websites from distance

want all the necessary factors that can fulfill their requirement and needs. The proposed usability scale seems have all the essential and influential factors. However, there is just a need to modify them as according to their meanings. Content integrity can be improved by splitting some factors and sub-factors regarding their meanings and re-adjusting them in appropriate groups. The re-adjustment can improve mapping of association rules between Factors and sub-factors. This appropriate mapping will also help developers to develop universities' websites at expert level.

Similarly expert 'C' share his opinion about usability scale by reporting, "It can be tried for an institutional level first to have a feedback and can be then implemented at large scale". "The scale should be expanded by considering the industry experience". "Expert level web developer need to be hired by university". "Content quality can be improved". "Standardization can be established for quality of service". According to expert 'C', though the need of the usability scale for the websites of educational institutes is obvious, it must be tried in an individual institute's website at first. Under the observation and monitoring of expert level developer, feedback, comments and opinions should be collected from the visitors and it should be modified accordingly. The use of the scale at experimental level will help in improving the scale and its effectiveness. The observations and opinions of expert-level web developer and feedback from the visitors would lead to a perfect, universal and effective usability scale that will ultimately improve the quality of the websites. After that experimental use, the scale can be adopted at large scale by the educational institutes. This will help in finalizing the model of the scale. Moreover, it can improve the quality of content available on websites. The process of experiencing scale at industry level and reviewing by many experts' level developers can lead to a better standardization state. And this state would be more acceptable for further future use. And it can play a vital role in development of universities websites according to needed standard.

According to expert ‘D’ constructs need to be rearranged. He reports, “Some sub-factors can be readjusted”. “Few constructs are duplicated in meanings”. “Scale can contribute to improve the experience; however some sub-factors can be adjusted into other categories”, “It’s better to have some e-guidance for industry practice”. By analyzing the opinion of expert ‘D’, it is observed that opinion by expert ‘C’ and ‘D’ almost have same agenda. Expert ‘D’ also recommends re-adjustment of factors in the usability scale. There are some actions needed to perform such as, add removal and merging of some factors and sub-factors. All the redundant and duplicated factors needed to remove to map them within relevant groups. Usability scale with appropriate mapping and association rules is more standardized. Furthermore, the effectiveness of usability scale can be enhanced by experiencing it at industry level. With the help of expert level developer usability scale can be presented as e-guidance for future use.

Expert ‘E’ also shared his opinion about usability scale. He reports, “Need extra effort to create scale”. “An electronic version of the scale can be good help for practice”. Furthermore, “The scale should be extended by industry responses”, “The scale should be transformed to atomized level”. As according to the scope of this research proposed usability scale is specific for universities websites. All the constructs are basically identified by taking into consideration the needs of universities websites users. Generally the scale is very comprehensive and designed well. However, there is need to expand the scale by adding the industry experience. An electronic version of usability scale can be helpful. Opinion by expert E shows the need of electronic guideline of the proposed usability scale. This guideline could be utilized at industry level. This opinion can be utilized as future work of proposed usability scale.

By analyzing the experts’ comments regarding usability scale. It can be said the proposed usability scale seems quite helpful for quality assurance due to its comprehensiveness. And if these scales are added to universities websites they will really help to raise the websites standard. This is because of its variations in factors

and sub-factors. And it's a great effort to improve the usability of the higher universities' websites and can be adopted for a useful deployment of such websites.

5.4.2 Strengths of the usability Scale

Experts' shared their viewpoints about strengths of usability scale. According to expert 'A' the usability scale is very helpful for universities' websites. He reports, "The usability scale is helpful for quality assessment of the universities' websites as it covers majority of the academic requirements for their users". It shows the importance of usability scale for an educational website that has all the quality content and features to facilitate its users. If a website fulfills the basic requirements of its users then it is more accessible and its usability is higher than others universities websites. According to expert 'A', the strong thing about the proposed usability scale is, it provides help in quality assessment of universities' websites. All the possible academic requirements that must be present in a website are covered by the usability scale. Moreover, it is obvious that the proposed scale can act as a roadmap or tool for the quality assurance of universities' websites. And this quality assurance can lead to develop these websites with better quality. Thus the quality standard of university websites will surely rise.

Similarly expert 'B' reports, "Comprehensive, well organized due to Majority of terms due to commonly used and understandable". According to him ,usability scale must be understandable and organized. The second strength of usability scale that it is very comprehensive as it covers all the major terms. The majority of these terms have been used among experts to develop scales and to evaluate the universities' websites. Thus it is very easy to understand the proposed usability scale. Moreover, the scale is well organized. Constructs are aligned as according to their appropriate categories that makes it easy to adopt it as a proper guideline to be followed step by step. According to expert B, having a comprehensive and organized form of scale is a great strength itself.

Diversity of usability scale is another strength that is highlighted by expert 'C'. He reports, "Diversified". According to him each individual constructs in scale is unique. And there is a range of aspects regarding website usability that are presented in scale. Weather it is about design, structure, content or navigation of universities' websites. The strong point of scale is all the diversified constructs are encapsulate according to their appropriate categories. That makes the usability scale more consistent and concrete in the matter of term used.

Likewise expert 'D' reports, "Cover aesthetic and emotion sense for QOS and no problem found in the scale". He specifically highlights the aesthetic and emotion sense of terms that are used to evaluate the quality of services of universities' websites. Constructs of usability scale are not only rich in meanings but also rich in using artful terms. Thus, the usability scale is aesthetically designed and no problem found in it.

According to expert 'E' usability scale is very understandable and useful. He reports, "Scale is understandable and scale is useful to enhance the quality of websites". The strength highlighted by expert 'E' is same as expert 'B', the scale is understandable. Most of the terms that are used in scale are common naming conventions used by existing studies. Labeling of each construct is very clear and rich in meaning. Furthermore, Scale is very comprehensive as all the constructs shows their own meaning and dimensions by their common naming conventions. Users or experts developers can utilize scale without any further interpretation or translation. Moreover, scale is very useful for evaluation of universities websites. As the scale have all rich variables need to follow for enhancing the usability of these websites. The quality of universities' websites can be evaluated with the help of proposed usability scale. Thus, usability scale seems very useful to enhance the quality of universities' websites.

Summary of Comments of experts expressing the strength of developed usability scale. Such as the scale is really useful for the quality assessment and it can

act as a real guideline to evaluate the universities websites. As the scale covers factors addressed in all the possible recent studies. Thus it gives a complete comprehensive form that act as roadmap towards the betterment of universities websites standard.

5.4.3 Barriers to solution adoption

The process of focus group discussion is performed to enhance the authenticity and reliability of usability scale. The opinions and strength highlighted by all experts are worthy to ensure the credibility of developed usability scale. However, there are also some barriers in usability scale highlighted by experts that may cause obstacle for its adoption. Expert 'A' share his view regarding barrier exist in usability scale. He reports, "Relationship between constructs of usability scale is missing". According to him, the relationship between the constructs is missing. It means that there are some factors or sub-factors that are in appropriate placed under categories. And they must be in relevant groupings according to their meanings and dimensions. Thus, there is need to re-arrange the groupings. Some factors may be needed to merged or split as according to their accurate association rules regarding categories.

(Web Content Accessibility Guidelines) WCAG 2.0 guidelines provide verity of suggestions and recommendations to make a website more accessible from content point of view. The main focus of these guidelines is to provide content that is more accessible for the people with disabilities. Such as, there may be users that are deaf, doom, blind and have mental illness or low vision. In such cases if the website is not providing the easy and appropriate content for these users, it will leads to the less usability of website. Expert 'B' reports, "Accessibility must relate to WCAG 2.0 guidelines". According to him the "Accessibility" factor used in scale must be related to WCAG 2.0. So, those users with disabilities can also have easy access to the relevant data. Thus, in case "Accessibility" factor is not related WCAG it may cause barrier in its adoption.

As according to the domain of developed usability scale, it is developed for the quality evaluation of universities websites in Pakistan. There are many universities in Pakistan associated with different organizations such as Government, private or semi- government. Each university institute has their own unique website providing services to their users. Barrier highlighted by expert 'C', "Different universities have the varied policies that can have an impact on the adoption of proposed usability scale". According to him, terms and conditions regarding policies of each university may be varied. The adoption of usability scale may not be feasible for every university due to variation in their policies. Thus, varied policies of universities might cause barriers for scale adoption at national level.

Furthermore, expert 'D' reports, "The knowledge level of organization employees may act as barriers for its adoption". Expert 'D' focus attention on a barrier regarding the knowledge level of universities employees. As the universities have different levels of employees starting from lower scale to higher scale. Thus it may cause trouble for the lower scale staff to understand the usability scale. As their knowledge level and exploration is comparatively less then higher educated staff.

Moreover, Expert E spotlight on privacy concerns regarding users. He reports, "Privacy of the users is not discussed and can be considered if possible" according to him, the developed usability scale does not have user privacy feature. To enhance the application of usability scale it is suggested to add privacy feature in it. So that usability scale could be more efficient.

By analyzing the opinions and barriers commented by experts the usability scale is updated. However, there are few points regarding the barriers that need to explain here before making improves to usability scale. Such as, the barriers highlighted by expert B, D and E. firstly, in developed usability scale the sub-factor "Access to Relevant Data" under factor "Accessibility" is basically depicts access to data as according to user relevancy. The scale is developed by focusing the general user of specific domain i.e. universities. Now, in case if the user is a disable person

then the “Access to Relevant Data” is still applied. Because, this sub-factors shows that relevant data is accessible as according to its user needs and type either it is normal user or with special disabilities. However, scale could be expanded as by targeting specific disable persons such as adding features for deaf, dull or blind users. Secondly, the usability scale is developed to evaluate the quality of university websites by experts. And it provides road map for developed to develop universities websites as according to the developed scale. The employees of organizations are also the users of websites but they are not evaluators. Thus, the knowledge level of employee will not affect the adoption of usability scale. Thirdly, sub-factor “Security and privacy of User Data” under factor “website identity” is basically a privacy feature from user point of view. However, the comment of expert C regarding opinion about solution could be adopted as contribution to future work. Such as, the developed scale could be tried at any individual level of universities websites under the observation of industry experts and feedbacks. Thus, it will be more effective and rapidly adaptive.

5.4.4 Expert suggestions for improvement

Experts suggested some improvements in relationship of factors and sub-factors .Table 5.2 consists of detail list of suggested improvements and opinions by experts that are considered to modify the primary usability scale.

Table 5.2 consist of all the rename suggestions guided by experts collectively. Table consist of 3 column names as “Original Name”, “Suggested Name”, and “Reason”. In the first column “Original Name” indicates the names of factors, sub-factors or category that were used in primary usability scale. Column two “Suggested Name” shows all the possible suggested names by experts that needed to be modify or change. And column three “Reason” shows the main reason behind each rename suggestion of category/factors/sub-factors.

Table: 5. 2 Factor Rename suggestions

Original Name	**Suggested Name**	**Reason**
Category : website usability	Usefulness/understand-ability	Because, usability is a broader term and this is the basic evaluation criterion on which the whole scale is developed. All factors and sub-factor directly or indirectly lies under term usability.
Factor: visual interaction	Interactivity	Because, the term "visual" seems more specific towards the appearance and coming under GUI. Whereas, "interactivity" shows the interaction connection of user with website.
Sub-Factor: user friendliness	Friendliness	It suits better
Factor: user services	Responsiveness	Because, this term "Responsiveness" can be defined on broader term under category of user interaction. And sub-factor of "responsiveness" is now aligned accordingly.
Factor: GUI	Aesthetically appealing interface	Because, GUI can't be a Factor to analyse, yeah but when we say "aesthetically appealing interface". Now it makes sense that we are analysing that how good an interface is.
Factor : Page Management	Navigation flow	"Navigation flow" is more appropriate term to be used under category "easy navigation".
Factor : information structure	Content structure	Because, the term "content" directly links with "content" category instead of "information".
Sub-factor: Consistency in information	Consistency in content	Because, the term "content" directly links with "content" category instead of "information".
Sub-factor : Accurate information	Accurate content	Because, the term "content" directly links with "content" category instead of "information".
Sub-factor : Up-to-date	Up-to-date content	Because, the term "content"

information		directly links with “content” category instead of “information”.
Sub-factor : Completeness of information	Completeness of content	Because, the term “content” directly links with “content” category instead of “information”.
Sub-factor : diversity of information	diversity of content	Because, the term “content” directly links with “content” category instead of “information”.

For example in the first row , Category “website usability ” is suggested to be renamed as “usefulness/understand-ability” .Because, usability is a broader term and this is the basic evaluation criterion on which the whole scale is developed. All factors and sub-factor directly or indirectly lies under term usability. Rest of the rows in table are also representing other changings. Those are suggested by experts regarding renaming the factors, sub-factors and categories.

Table: 5. 3 Modifications suggestions by all Experts

Sr. #	**Modifications suggestions/opinion**
1	Remove term “website” from whole scale. Use only in name of scale.
2	Website usability is renamed as “understand ability” thus remove it from Factor list of website usability category.
3	“Familiar language” is not related to “understand-ability” Category, shift or merge it in “content” Category. Because it relates with the language of content available on website.
4	Remove sub-factor “entertainment” from factor “Visual interaction”. Because it is basically representing multimedia content. So thus, merge it under “content” category.
5	Remove “quick response to user” because this term is already defined while using factor “responsiveness”.
6	“Smooth course registration”, “help user to search easily” and “page loading speed” are co-related and must be under one factor. Thus suggested name as “effectiveness”.
7	Remove sub-factor “website guide” from user interaction category and add it under “easy navigation” category. Because it relates to navigation.
8	Remove sub-factor “well structure” from “GUI” Category. Because “well structure” actually relates to organizing something in a meaningful way such as “content”. Thus it ca be merged in “content” category.
9	Remove “responsive home page” sub-factor, because this is already

	being defined under “responsiveness” Factor.
10	Merge “external links” in “consistent and active menu links”. Because they both have same agenda.
11	Split “consistent active meu links” into “menu labelling”.
12	Add sub-factor “ethical content ” under “content integrity”
13	Split “content structure” into another factor with name “content integrity”
14	Group “consistency in content, diversity of content, utility of content and completeness of content” together under factor “content structure”.
15	Group “accurate content, up-to-date content, ethical content” under Factor “content integrity”.
16	Remove “Aesthetic in content” because this is already covered by “look and feel” factor.

Table 5.3 shows all the possible modifications that are suggested by experts to associate the direct connection between factors and sub-factors. This table actually modify the mapping of suggested factors with respect to their sub-factors such as by adding, removing, replacing and splitting actions. For example row 10 says “Merge “external links” in “consistent and active menu links”. Because, they both have same agenda.” this statement shows that sub-factor “external links” and “consistent and active menu links” are creating redundancy and duplicated in terms of meaning. And they both can be merged together to refine the unique identification more clearly.

5.5 Improved Usability Scale

Improvements in solution: After conduction of the successful meeting with experts, improvements are made in the proposed solution. These improvements are made on the basis of findings from expert’s opinion and suggestion. Table 5.4 shows the finalized constructs of improved usability scale.

Table: 5. 4 Improved Usability Scale

Category	**Factors**	**Sub-Factors**
UNDERSTANDABILITY	Accessibility	Easy access to information
		Rapid access to information

		Access to relevant data
	Simplicity	Simplicity in learning
		Simple in terms of operations
USER INTERACTION	Interactivity	Friendliness
	Responsiveness	Quick recovery of user passwords
		Feature of (Frequently Ask Questions) FAQ
		Timely error notifications
	Effectiveness	Smooth course registration
		Helps user to search easily
		Speed of page loading
DESIGN & STRUCTURE	Aesthetically appealing interface	Displayed information is not overloaded
		Attractive look and feel
		Platform independent
		Compatibility with browsers
EASY NAVIGATION	Navigation Flow	Consistent & active menu links
		Convenience of navigation tools
		Menu Labelling
		Website guide
UNIQUENESS	Website identity	Organization
		Security & privacy of user data
		Facility of Website applications

	Search Engine Optimization (SEO)	Website Popularity
CONTENT	Content Structure	Consistent in content
		Utility of content
		Completeness of content
		Diversity of content
	Content integrity	Ethical content
		Accurate content
		Up-to-date content

By comparing the primary usability scale with improved usability scale following are the improvements that are made according to Focus group Result.

Improvement 1: Modification in the name of categories is performed such as first category that was labelled as “website usability” in primary usability scale is renamed as “understand-ability/usefulness”. Secondly, the keyword “website” is removed from each category label. For example in primary usability scale the name of categories were labelled as “website design & structure”, “website uniqueness” and “website content”. Whereas in improved usability scale the names of categories are ladled as “Design and Structure” and “Content”.

Improvement 2: Second improvement is at performed at Factor level as follows. Such as “understand-ability” factor is removed from category 1 “Understand-Ability”. “Visual interaction” and “user services” are replaced with “Responsiveness’”, “effectiveness”, and “interactivity” under category 2 “User Interaction”. Factor “Graphical user interface (GUI)” replaced as “Aesthetically Pleasing Interface” under category 3 “Design and Structure”. Factor “Page

Management" replaced as "Navigation Flow" under category 4 "Easy Navigation". Factor "Information Structure" is replaced into two factors "Content Structure" and "Content Integration" under category 6 "Content". Thus, there were total 10 factors in primary usability factors are now upgraded Into 11 factors.

Improvement 3: The third improvement was performed at sub-factor level. Sub-factor "Familiar Language" is removed and Friendliness "is added under factor "Interactivity". Sub-factors "Quick Response to user", "feature of FAQ" and "Timely error notification" is grouped together under factor "Responsiveness". Sub-factors "Smooth course registration", "help user to search easily", "Speed of page loading" are grouped together under factor "Effectiveness". Sub-factor "Well structured" is removed from "Aesthetically Pleasing Interface" factor. Sub-factor "external web links" and "responsive Home page" removed. "Menu labelling" and "website guide" added under factor "Easy Navigation". Sub-factor "Consistent content", "completeness of Content", "utility of content" and "Diversity of Content" is grouped together under factor "". Sub-factor "Ethical Content", "Accurate content", "Up-to-Date content" is grouped together under factor "". There were total 36 sub-factors mentioned in primary usability scale, whereas 31 sub-factors are upgraded in improved usability scale. The number of sub-factors that is reduced is just because to removed redundancy and duplication in meaning.

Fig 5.4 shows the improved usability scale for evaluating the quality of university websites in Pakistan. Figure shows the hierarchal order of scale formulation. The very first level is consisting of all the possible 6 categories. The second level shows the 11 usability factors. And the third level shows 31 Sub-factors.

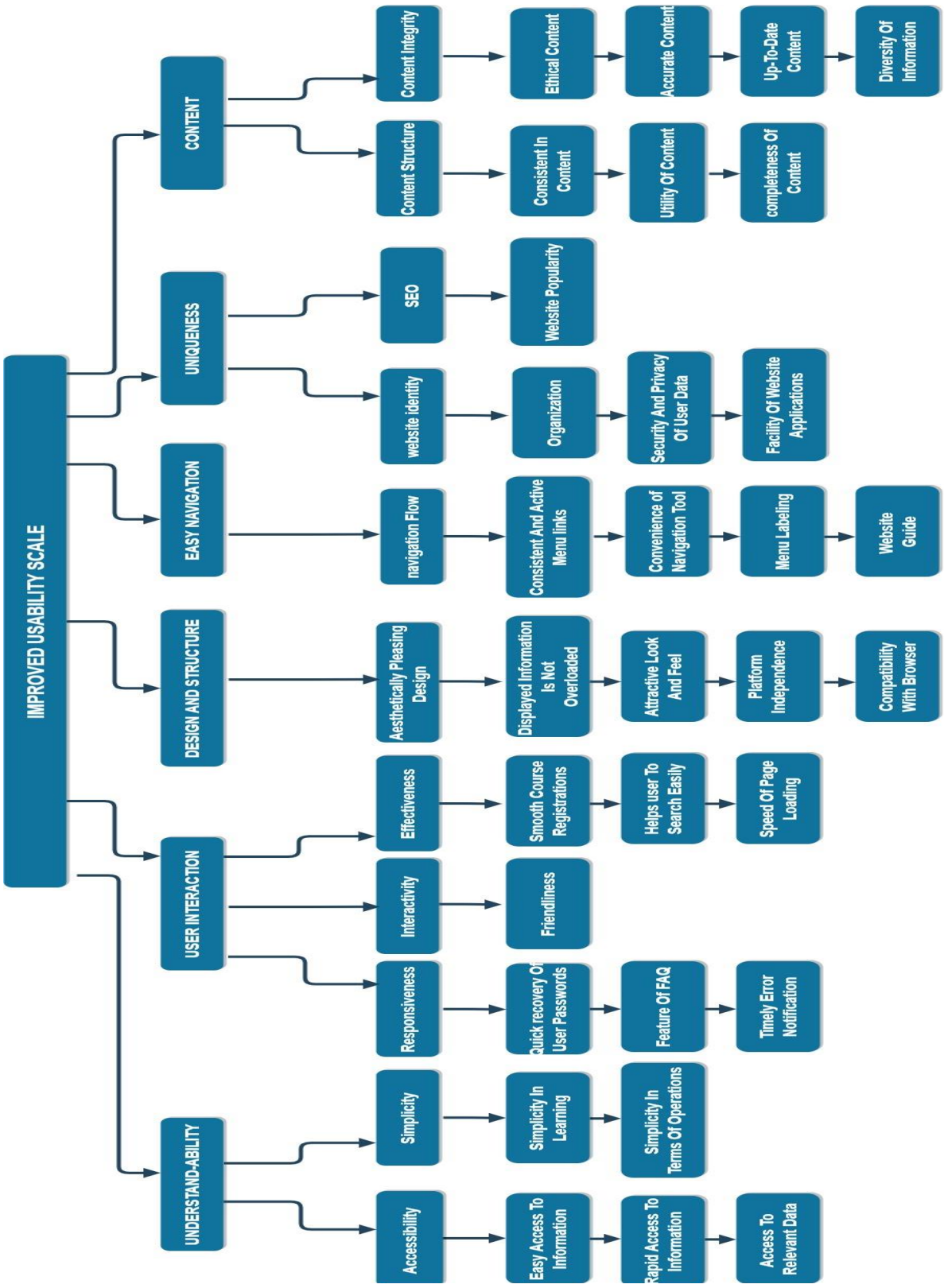

Figure: 5. 2 Improved Usability Scale

5.6 Chapter Summary

The proposed website usability Scale is evaluated in this chapter through Focus Group discussion. Data Analysis is performed on the metadata assembled from Experts feedback. Furthermore, with the help the results of Focus group discussion a list of most influencing usability factors is generated. And this list further utilized in upgrading the primary usability scale into improved website usability scale.

CHAPTER 6

DISCUSSION AND CONCLUSION

6.1 Research Summary

This study was conducted to explore the impact of usability factors for quality evaluation of universities' websites. For this purpose, we identified the unique and most influential usability factors and sub-factors affecting the quality of universities' websites. A usability scale was developed for universities' websites that can act as a guideline to evaluate or rank the universities based upon the quality of their websites and also can increase and influence the educational standard. This research sought to answer two research questions.

1. What are the usability factors that can improve the quality of universities' websites in Pakistan?
2. How the quality of universities' websites in Pakistan can be evaluated?

The first research question was answered by identifying the usability factors affecting the quality of universities' websites. SLR was conducted to review the existing literature for identifying the usability factors. In order to generate a unique list of usability factors, data coding techniques of grounded theory were used. As a result, a list of 11 usability factors, 31 sub-factors and 6 categories was generated.

The second research question was answered by development of a usability scale. Initially, the usability scale was developed on the base of SLR findings. Scale was designed by mapping all the identified factors and sub-factors under their appropriate categories. Furthermore, to evaluate the practicality and importance of the usability factors with industry, the focus group discussion is conducted. Based on the feedback of experts improved usability scale was developed after evaluation. The primary usability scale was merged with new identified Usability factor hence, an improved and evaluated list of factors is generated based on their influence.

The new and improved usability scale guides the university website developers to identify the usability factors that could affect the quality of universities' websites. Moreover, our evaluation of usability scale gave a generalized view of success of our research results in the real-world practices as it enhanced the user's competency to identify the more accurate and more adequate set of usability factors.

6.2 Fulfillment of Research Objectives

The two research objectives of this research have been achieved. This study provided an evaluated set of usability factors that a, website quality assurance team should aware of while designing and development of universities' websites. The study identified 11 usability factors, 31 sub-factors and 6 categories that served as a basis for further studies (Objective 1). The results are reported in Chapter 4 (Section 4.1; Table 4.3). The initial ranking list of the usability factors was based on their level of influence on the quality of universities' websites. As an outcome, the most influential usability factors were identified.

The second objective achieved by evaluating the usability scale with Focus group discussion. The results are reported in Chapter 5 (Section 5.4.1). The final list of usability factors and their ranking as most influential usability factors were integrated into a primary usability scale. We managed to develop an improved usability scale that acted as a reference guideline which not only could help the

website quality assurance team, to understand the usability factors, but also allowed them to identify the usability factors that could affect the quality of universities' website. The result showed that the usability scale has high level of usability and it enhanced the website quality assurance to identify the more accurate and adequate set of usability factors in educational field.

6.3 Contributions and Significance of the Study

This section presents various unique contributions of this research. The contributions of this study are more towards the QA of universities websites. The contributions are presented in terms of academic and practical perspectives.

6.4 Academic and Practical Contribution

The first contribution was done by identifying and reporting the usability factors that can influence quality of universities' websites. Advances to the existing body of knowledge were made possible by performing the SLR with greater availability of published literature and with detailed searching processes. As a result, a list of 11 situational factors with 31 associated sub-factors and 6 categories was generated. By identifying the usability factors, we managed to overcome the gap of lack of existing studies that reports usability factors, influencing university website quality in Pakistan.

The second contribution of this study was the investigation of most influential usability factors by conducting the focus group discussion. Contribution was done by identifying the ranking of most influential usability factors. By ranking the most influential usability factors, were presented them as being "Highly-Significant", "Significant", "Moderate", "Neglect-able" and "Neutral" .The evaluation process performed by FGD session would not only help to develop reference guideline but would also allow the user to identify the usability factors that could affect the quality of universities' websites.

The third contribution was done by development of usability scale after. This improved usability scale was based upon an extensive field of knowledge and a wide range of literature about usability scale affecting universities' websites. Usability scale is a guideline that would help to overcome the competency issues of the users in order to identify the accurate and adequate set of website usability factors.

6.5 Limitations of the Research

In this section study limitations are reported. All the selected studies of this research processed through the quality assessment phase. The phase of quality assessment was performed by allocation of data sources to researchers and was asked to evaluate the quality of each data source by assigning them quality score (attached in Appendix A). Some data sources were crossed check to ensure the biasness free process. But still it might happen that some of the significant studies in the field of are missed as regarding usability factors in the domain of universities websites.

For expert evaluation, we contacted seven professionals of HCI field who had several published research work on Web Engineering/Website site QA. After many reminders, we managed to get the response from 5 experts (the list of experts is shown in Chapter 3; table 3.9). Although, all of the 5 experts were mature researchers it would be more assured if we would have managed to get responses from more experts.

6.6 Conclusion

The university Websites QA is the subject of Usability factors. Website QA faced challenges in identification of those usability factors positing difficulties for computer science. While research on Website Engineering is rapidly growing, only few studies focused on importance and identification of Usability factors but none of

them targeted website QA in educational field, in specific. Lack of such studies restrained the competence of website engineers in identifying the usability factors affecting their QA process. Thus, we identified the usability factors that can affect QA, the most influential usability factors for each website QA activity, and formulated them into a website usability scale for universities' websites. This scale not only acted as a reference guideline for the practitioners and academicians but also allowed user to identify the usability factors that could affect their Website QA process in universities websites. Website usability scale helped users to enhance their competence towards more accurate and adequate usability factors identification.

QA of universities websites can be performed by utilizing this research work as a foundation. In future this research can be more strengthen to repeat the survey to other countries also. The addition of other countries might take in new insights to the research. The major purpose of this research has been successfully achieved. The methodological and theoretical of this research makes an invaluable contribution to the existing literature and industry of website QA in universities websites. This study not only overcomes the knowledge gap but also opens new opportunities for further studies. Finally, it is hoped that this research is beneficial for HCI environment as it provide QA of universities websites by following the guideline of usability scale. This research work is for understanding and identifying the usability factors that can influence the quality of universities' websites.

References

[1]. M. A. Tate, (1999) How to Evaluate and Create Information Quality on the Web. *Laurence Erlbaum Associates, London*, 2-17.

[2]. N. Pangannaya & S. Kumar, (2000). Use of Internet by the Academic Community: a case study, in DRTC. *Annual Seminar on Electronic Sources of Information*. 1(3), 77-86.

[3]. N. Ghasemifard, M. Shamsi, A. R. R. Kenari, & V. Ahmadi, (2015). A new view at usability test methods of interfaces for human computer interaction. *Global Journal of Computer Science and Technology*. 15(1), 1-9.

[4]. E. Mendes, N. Mosley, & S. Counsell, (2006). The need for web engineering: an introduction. *Web Engineering, ed: Springer*. 1-27.

[5]. S. Cimino & F. Micali, (2008). Web Q-Model: a new approach to the quality. *proceedings of the The 26th Annual CHI Conference on Human Factors in Computing Systems, Florence, Italy*. 115-121.

[6]. W. Bartels, M. Breeze, & N. Peterson, (2003). Evaluating Web sites through the use of Focus Group. *University of Florida Institute of Food and Agricultural Sciences, Florida*. 1-12.

[7]. W. G. Ford, (2011). Evaluating the Effectiveness of College Web Sites for Prospective Students. *Journal of College Admission*. 212, 26-31.

[8]. Y. Wu & J. Offutt, (2002). Modeling and testing web-based applications. *GMU ISE Technical ISE-T*. 02-08

[9]. S. H. Mustafa & L. F. Al-Zoua'bi, (2008). Usability of the academic websites of Jordan's universities an evaluation study. *Proceedings of the 9th International Arab Conference for Information Technology*. 31-40.

[10]. K. Teoh, T. Ong, P. Lim, R. P. Liong, & C. Yap, (2009). Explorations on web usability. *American Journal of Applied Sciences*. 6, 424.

[11]. T. Mizoguchi, Y. Ito, & R. Koyashiki, (2017). Effect of Communication Quality Degradation on Web Usability over 6to4 Networks. *Electronics and Communications in Japan*, 100, 3-14.

[12]. A. Oztekin, Z. J. Kong, & O. Uysal, (2010). UseLearn: A novel checklist and usability evaluation method for eLearning systems by criticality metric analysis. *International Journal of Industrial Ergonomics*. 40, 455-469.

[13] A. Assila & H. Ezzedine, (2016). Standardized usability questionnaires: Features and quality focus. *Electronic Journal of Computer Science and Information Technology: eJCIST*. 6(1), 1-17.

[14] R. Rekik, I. Kallel, J. Casillas, & A. M. Alimi, (2018). Assessing web sites quality: A systematic literature review by text and association rules mining. *International Journal of Information Management*.. 38, 201-216.

[15]. R. Chambial & S. Sharma, (2011). An Imperial Investigation of Validation Problem of Top Indian Websites. *People*. 1, 36-40.

[16]. S. R. Esmeria GJ, (2017). Web Usability: A Literature Review. *DLSU Reasecrh Congress*. 1-7.

[17]. L. Hasan, (2012). Evaluating the usability of nine Jordanian university websites. *International Conference on Communications and Information Technology (ICCIT)*. 91-96.

[18]. H. Najadat, A. Al-Badarneh, R. Al-Huthaifi, A. Abo-Zaitoon, & Y. Al-Omary, (2017) Evaluating Jordanian universities' websites based on data envelopment analysis. *8th International Conference on Information and Communication Systems (ICICS)*. 159-164.

[19]. D. Napitupulu, (2017). Analysis of Factors Affecting The Website Quality (Study Case: XYZ University. *International Journal on Advanced Science, Engineering and Information Technology*. 7, 792-798.

[20]. G. Losonczi, (2012). Competitive website evaluation in higher education. *FIKUSZ annual conference organized by obuda university*. 1-17.

[21]. C. N. Faisal, M. Gonzalez-Rodriguez, D. Fernandez-Lanvin, & J. de Andres-Suarez, (2016). Web design attributes in building user trust, satisfaction, and loyalty for a high uncertainty avoidance culture. *IEEE Transactions on Human-Machine Systems*. 47, 847-859.

[22]. S. Hermawati and G. Lawson, (2016). Establishing usability heuristics for heuristics evaluation in a specific domain: Is there a consensus. *Applied ergonomics*. 56, 34-51.

[23]. S. Lazar, (2015). The importance of educational technology in teaching. *International Journal of Cognitive Research in Science, Engineering and Educatio.,* 3(1), 1-4.

[24]. S. M. Ross, G. R. Morrison, & D. L. Lowther, (2010). Educational technology research past and present: Balancing rigor and relevance to impact school learning. *Contemporary Educational Technology*. 1, 17-35.

[25]. L. Hasan, (2013). Using university ranking systems to predict usability of university websites. *JISTEM-Journal of Information Systems and Technology Management*. 10, 235-250.

[26]. K. M. Tucciarone, (2009). Speaking the same language: Information college seekers look for on a college web site. *College and University*. 84, 22.

[27]. B. Benjamin & J. Lee, (2005). Enhancing Your Web Site as a Recruitment Tool by Implementing Chat Technology. *Association of Small Computer Users in Education (ASCUE)*. 1-9.

[28]. K. Schimmel, D. Motley, S. Racic, G. Marco, & M. Eschenfelder, (2010). The importance of university web pages in selecting a higher education institution. *Research in Higher Education Journal*. 9, 1.

[29]. M. B. Alotaibi, (2013). Assessing the usability of university websites in Saudi Arabia: a heuristic evaluation approach. *10th International Conference on Information Technology: New Generations*. 138-142.

[30]. J. Khlaisang, (2017). Proposing a new pedagogy-based website design: A usability test with lifelong learners. *Education and Information Technologies*. l. 22, 1713-1735.

[31]. A. L. a. F. J. R. Melón, (2018). HTTP security headers analysis of top one million websters. *1st International Conference on Cyber Conflict (Cyclone)*. 345-370.

[32]. K. K. S. Kaur & P. Kaur, (2016). Analysis of website usability evaluation methods. Computing for Sustainable Global Development (INDIACom). *3rd International Conference*. 1043-1046.

[33]. J. C. a. S. Bakken, (2010). Web-based education for low-literate parents in Neonatal Intensive Care Unit: Development of a website and heuristic

evaluation and usability testing. 79(8), 565-575.
[34]. M. Chen, (2018). Improving website structure through reducing information overload. *Decision Support Systems.* 110, 84-94.
[35]. Y.-S. C. H.-M. Chuang, C.-Y. Lin, & P.-C. Yu, (2016). Featuring the e-service quality of online website from a varied perspective. *Human-Centric computation and information sciences.* 6(1), 6.
[36]. S. M. Ghasemifard N, Kenari AR, Ahmadi V, (2015). A new view at usability test methods of interfaces for human computer interaction. *Global journal of computer sciences and techology.* 15(1), 1-9.
[37]. K. S. K. Abid Ismail, (2019). Web Accessibility Investigation and Identification of Major Issues of Higher Education Websites with Statistical Measures: A case study of college websites. *Journal of king saud university computer and information scineces.* 1-17.
[38]. M. D. Nagpal R, Bhatia PK, (2016). Task based effectiveness evaluation of educational institute websites. In *2016 International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT).* 315-319.
[39]. G. J. Santos AM, Díaz RG, (2016). Websites of learning support in primary and high school in Portugal: a performance and usability study. *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality*. 1121-1125.
[40]. V. Moustakis, et al. , (2004). Website Quality Assessment Criteria. *ICIQ*. 59-79.
[41]. L. Hasan, & Emad Abuelrub, (2011). Assessing the quality of web sites. *Applied Computing and Informatics*. *9*(1), 11-29.
[42]. R. Jayakumar, & Banbehari Mukhopadhyay, (2013). Website quality assessment model (WQAM) for developing efficient e-learning framework-A novel approach. *International Journal of Engineering and Technology (IJET)*. *5*(5), 3770-80.
[43]. K. a. omar, (2017). Evaluating the internal and external usability attributes of e-learning websites in Saudi Arabia. *Advanced Computing: An International Journal (ACIJ). 8*(3/4), 1-12.
[44]. L. Hassan, (2017). Evaluating the Usability of Universities' websites Based on Students' Preferences of Design Characteristics. *International Arab Journal of e-Technology. 3*(3), 179-193.
[45]. B. K. a. S. Charters, (2007). Guidelines for performing Systematic Literature Re- views in Software Engineering.
[46]. B. M. Z. He, (2009). Systematic Literature Review in Software Engineering: Preliminary Results from Interviewers with Researches.
[47]. S. M. N. M, (2009). Experiences using systematic review guidelines. *Evaluation and Assesmnet in software enginerring.* 1-10.
[48]. N. A. a. I. Karaim, Y. (2019). Usability and accessibility evaluation of Libyan government websites. *Universal Access in the Information Society.* 18(1), 207-216.
[49]. R. a. I. Ismailova, Y. (2018). Accessibility evaluation of top university websites: a comparative study of Kyrgyzstan, Azerbaijan, Kazakhstan and Turkey. *Universal Access in the Information Society.* 1-9.

[50]. T. Wahyuningrum, Rokhman, N. & Musdholifah, A. (2019). November. Algorithm comparison performance in assessing the quality of university websites. *In 2017 4th International Conference on New Media Studies (CONMEDIA).* 19-24.

[51]. L. Hasan, (2014). Evaluating the usability of universities' websites based on students' preferences of design characteristics. *International Arab Journal of e-Technolog.* 3(3), 179-193.

[52]. P. Wetzler, Bethard, S., Leary, H., Butcher, K., Bahreini, S.D., Zhao, J., Martin, J.H. & Sumner, T. (2013). Characterizing and predicting the multifaceted nature of quality in educational web resources. *ACM Transactions on Interactive Intelligent Systems (TiiS).* 3(3), 15.

[53]. S. Kaur, Kaur, K. & Kaur, P. (2016). March. Analysis of website usability evaluation methods. *In 2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom).* 1043-1046.

[54]. M. Nowakowski, (2016). Website usability in the design thinking methodic. *Studia Informatica Pomerania.* 123-133.

[55]. D. W. L. Verkijika SF, (2018). A usability assessment of e-government websites in Sub-Saharan Africa. *International Journal of Information Management.* 1(39), 20-9.

[56]. J. Pande, Opportunities and challenges in the adoption of open educational resources for course development: a case study of Uttarakhand Open University. *International Journal of Information Technology*. 10(3), 339-347.

[57]. T. Ramakrishnan, Prybutok, V. & Peak, D.A. (2014). The moderating effect of gender on academic website impression. *Computers in Human Behavior*. 35, 315-319.

[58] J. F. a. H. Chen, H.F. (2018). Empirical Study on the Factors Influencing the Web-based Teaching Effect. *EURASIA Journal of Mathematics, Science and Technology Education.* 14(5), 1635-1643.

[59]. H. L. a. R. Nir, A. (2018). Evaluation of Web content accessibility in an Israeli institution of higher education. *Universal Access in the Information Societ.* 17(3), 663-673.

[60]. D. D. J. Suwawi, Darwiyanto, E. & Rochmani, M. (2015). May. Evaluation of academic website using ISO/IEC 9126. *In 2015 3rd International Conference on Information and Communication Technology (ICoICT).* 222-227.

[61]. L. a. C. Rivero, T. (2013). Using an empirical study to evaluate the feasibility of a new usability inspection technique for paper based prototypes of web applications. *Journal of Software Engineering Research and Development.* 1(1), 2.

[62]. A. a. G. Xu, S. (2012). October. Discussion on usability and optimization issues in overseas university websites: A British university as an example. *2012 11th International Symposium on Distributed Computing and Applications to Business, Engineering & Science*. 482-485.

[63] Lokanath Mishra. (2016). June. Focus Group Discussion in Qualitative Research , *Techno LEARN* 6(1),1-5.

[64] Krueger. Richard A, and Mary Anne Casey. (2014). Focus groups: A practical

guide for applied research. *Sage publications*.
[65] M. D, C. W, (2018). Understanding the Soft Skills that Industry Wants from Requirements Engineers: a Focus Group Study

APPENDICES

Appendix A

Table A1: Results from Quality Assessment of Each Article

Paper id	Respond-ents ids	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Score	Total score
P1	R1	1	0.5	0.5	1	1	1	1	0.5	1	0.5	8	8+9/2 = 8.5
	R2	1	0.5	1	1	1	1	1	0.5	1	1	9	
P2	R1	1	1	1	1	1	1	1	1	1	1	10	10+10/2 = 10
	R2	1	1	1	1	1	1	1	1	1	1	10	
P3	R1	1	0.5	0.5	1	1	1	1	0.5	1	0.5	8	8+9/2 =8.5
	R2	1	0.5	1	1	1	1	1	0.5	1	1	9	
P4	R1	1	1	1	1	1	0.5	1	1	1	1	9.5	9.5+9.5/ =9.5
	R2	1	1	1	1	1	0.5	1	1	1	1	9.5	
P5	R1	0.5	0.5	0.5	0	1	0	0	1	1	0.5	5	5+6.5/2 =5.75
	R2	0.5	0.5	0.5	1	0	1	1	0.5	0	0.5	6.5	
P6	R1	1	1	1	1	1	0.5	1	1	1	1	9.5	9.5+8/2 =8.75
	R2	1	0.5	0.5	1	1	1	1	0.5	1	0.5	8	
P7	R1	1	1	1	1	1	0.5	1	1	1	1	9.5	9.5+8.5/2 = 9
	R2	1	1	1	0	1	1	1	1	1	0.5	8.5	
P8	R1	1	1	0.5	1	0	0.5	0.5	0.5	1	1	7	7+8.5/ = 7.75
	R2	1	1	0.5	1	0	1	1	1	1	1	8.5	
P9	R1	1	1	0.5	1	1	1	1	1	1	1	8.5	8.5+9.5/ = 9
	R2	1	1	1	1	1	0.5	1	1	1	1	9.5	
P10	R1	1	1	1	0	1	1	1	1	1	0.5	8.5	8.5+8.5/2 = 8.5
	R2	1	1	1	0	1	1	1	1	1	0.5	8.5	
P11	R1	1	1	0.5	1	0	0.5	0.5	0.5	1	1	7	7+9/2 = 8
	R2	1	0.5	1	1	1	1	1	0.5	1	1	9	
P12	R1	1	1	1	1	1	0.5	1	1	1	1	9.5	9.5+9.5/ = 9.5
	R2	1	1	1	1	1	0.5	1	1	1	1	9.5	
P13	R1	1	1	1	0	1	1	1	1	1	0.5	8.5	8.5+9/ = 8.75
	R2	1	0.5	1	1	1	1	1	0.5	1	1	9	
P14	R1	1	1	0.5	1	0	1	1	1	1	1	8.5	8.5+8.5/ = 8.5
	R2	1	1	0.5	1	1	1	1	1	1	1	8.5	

P15	R1	1	1	1	1	1	1	1	1	1	1	10	10+9/2 =9.5
	R2	1	0.5	1	1	1	1	1	0.5	1	1	9	
P16	R1	1	0.5	0.5	1	1	1	1	0.5	1	0.5	8	8+9/2 = 8.5
	R2	1	0.5	1	1	1	1	1	0.5	1	1	9	
P17	R1	1	1	1	1	1	0.5	1	1	1	1	9.5	9.5+9.5/2 = 9.5
	R2	1	1	1	1	1	0.5	1	1	1	1	9.5	
P18	R1	1	1	1	0	1	1	1	1	1	0.5	8.5	8.5+7/2 = 7.75
	R2	1	1	0.5	1	0	0.5	0.5	0.5	1	1	7	
P19	R1	1	1	0.5	1	0	1	1	1	1	1	8.5	8.5+8.5/2 = 8.5
	R2	1	1	0.5	1	1	1	1	1	1	1	8.5	
P20	R1	1	1	1	1	1	1	1	1	1	1	10	10+7.5/2 = 8.75
	R2	1	1	1	0	1	1	0	1	1	0.5	7.5	
P21	R3	1	1	0.5	1	0	0.5	0.5	0.5	1	1	7	7
P22	R3	1	1	0.5	1	0	1	1	1	1	1	8.5	8.5
P23	R3	1	1	0.5	1	1	1	1	1	1	1	8.5	8.5
P24	R3	1	1	1	1	1	1	1	1	1	1	10	10
P25	R3	1	1	1	0	1	1	0	1	1	0.5	7.5	7.5
P26	R3	1	0.5	0.5	1	1	1	1	0.5	1	0.5	8	8
P27	R3	1	0.5	1	1	1	1	1	0.5	1	1	9	9
P28	R3	1	1	1	1	1	0.5	1	1	1	1	9.5	9.5
P29	R3	1	1	1	1	1	0.5	1	1	1	1	9.5	9.5
P30	R3	1	1	1	1	1	1	1	1	1	1	10	10
P31	R3	1	1	0.5	1	1	1	1	1	1	1	8.5	8.5
P32	R3	1	0.5	0.5	1	1	1	1	0.5	1	0.5	8	8

Appendix B

Data Extraction Form

Paper Title:	Web Accessibility investigation and identification of major issues of higher education websites with statistical measures: A case study of college website	
Paper ID:	P1	
Type:	Journal	
Methodology:	This research is based on case study	
Country:	INDIA	
Year:	2019	
Factors Identified:	**F.code**	**Factor**
	P1H5.p1L2	*Color contrast* *Alternative texts* *Link visibility* *Label caption*

Paper Title:	Analysis of Factors Affecting the Website Quality Based on Web quall Approach (Study Case: XYZ University)	
Paper ID:	P2	
Type:	Journal	
Methodology:	Survey Method Quantitative Approach. Sampling by Questionnaires. Analysis by Multiple Linear Regressions.	
Country:	Indonesia	
Year:	2017	
Factors Identified:	**F.code**	**Factor**
	P2.T1	*Usability* *QOI* *QOS* *User satisfaction*

Paper Title:	Proposing a new pedagogy-based website design: A usability test with lifelong learners	
Paper ID:	P3	
Type:	Journal Springer	
Methodology:	Industry experience report that conducts usability test with four stages.	
Country:	Thailand	
Year:	2016	
Factors Identified:	**F.code**	**Factor**
	P3H2.p4L5	Pedagogy-based design (responsive & universal design)

Paper Title:	A usability assessment of e-government websites in Sub-Saharan Africa	
Paper ID:	P4	
Type:	Journal Elsevier	
Methodology:	Heuristic evaluation with six dimension usability framework	
Country:	South Africa	
Year:	2018	
Factors Identified:	**F.code**	**Factor**
	P4H2.p3L3	Interactivity search tools, sitemap, help or FAQ pages, Legal policies.
	P4H2.p4L2	Poor Website design (broken links, poor use of fonts and poor text to background contrast, poor navigation.)

Paper Title:	Evaluating the internal and external Usability attributes of e-learning websites In Saudi Arabia	
Paper ID:	P5	
Type:	Journal	
Methodology:	Heuristic evaluation technique to identify internal and external usability attributes.	
Country:	SAUDI ARABIA	
Year:	2017	
Factors Identified:	**F.code**	**Factor**
	P13H7L2	Performance Accessibility Mobile Friendly SEO Usability Security

Paper Title:	Analysis of Website Usability Evaluation Methods	
Paper ID:	P6	
Type:	Journal	
Methodology:	Industry experience report that uses tow tools to analyse website usability.	
Country:	India	
Year:	2016	
Factors	**F.code**	**Factor**

Identified:	P6H4.p1L1	Usability , Accessibility , SEO , Content , design , performance, page analysis score

Paper Title:	Web-based education for low-literate parents in Neonatal Intensive Care Unit: Development of a website and heuristic evaluation and usability testing	
Paper ID:	P7	
Type:	Journal	
Methodology:	Heuristic evaluation with end-users performance in completing tasks.	
Country:	USA	
Year:	2010	
Factors Identified:	**F.code**	**Factor**
	P7p3L2	User cantered design and development to facilitate presentation.

Paper Title:	Improving website structure through reducing information overload	
Paper ID:	P8	
Type:	Journal	
Methodology:	Industry experience report presenting mathematical model to reduce info overload.	
Country:	US	
Year:	2018	
Factors Identified:	**F.code**	**Factor**
	P8H1.p1L5	Page's out degree (number of links to page) Visual complexity

Paper Title:	Featuring the e‑service quality of online website from a varied perspective	
Paper ID:	P9	
Type:	Journal	
Methodology:	Survey based research that differentiate three models with the help of evaluation from consumers	
Country:	Taiwan	
Year:	2016	
Factors Identified:	**F.code**	**Factor**
	-----	WPI Service quality

Paper Title:	Usability and accessibility evaluation of Libyan government websites	
Paper ID:	P10	
Type:	Journal	
Methodology:	Heuristic evaluation technique to identify usability problems	
Country:	Germany	
Year:	2017	
Factors Identified:	**F.code**	**Factor**
	P10H4.p1L3 P10H4.p1L2	Website usability Website accessibility Less user control Error prevention.

Paper Title:	Using an empirical study to evaluate the feasibility of a new usability inspection technique for paper based prototypes of web applications	
Paper ID:	P11	
Type:	journal	
Methodology:	In order to verify the feasibility of these technologies, in this study performed two empirical studies. Web DUE, WDP tools used.	
Country:	Brazil	
Year:	2013	
Factors Identified:	**F.code**	**Factor**
	P11.T1	Content and usability of webpages (navigation, system state, information services , user interface) Web applications

Paper Title:	Assessing web sites quality: A systematic literature review by text and association rules mining	
Paper ID:	P12	
Type:	Journal	
Methodology:	SLR based research consist of tree phase from problem formulation to data extraction and submersing facts.	
Country:	Tunisia , Spain	
Year:	2018	
Factors Identified:	**F.code**	**Factor**
	P12 .F18	All factors up till now

Paper Title:	E-commerce website quality assessment based on usability
Paper ID:	P13
Type:	Journal

Methodology:	Survey based research with user feedback & two techniques.	
Country:	India	
Year:	2016	
Factors Identified:	**F.code**	**Factor**
	P13p3	User satisfaction Customer support system Simplicity Ease of use FAQ Password recovery Error notification Attractiveness User friendly Appearance

Paper Title:	Evaluation of Web content accessibility in an Israeli institution of higher education	
Paper ID:	P14	
Type:	Journal	
Methodology:	Industry experience report, an automated evaluation tool WAVE was used.	
Country:	Germany	
Year:	2018	
Factors Identified:	**F.code**	**Factor**
	P14. T5	Empty link Empty buttons Image button missing alternative text Empty form label Empty headings

Paper Title:	Assessing the Usability of University Websites in Saudi Arabia: A Heuristic Evaluation Approach	
Paper ID:	P15	
Type:	Conference	
Methodology:	Heuristic evaluation with comparative research of existing literature	
Country:	Saudi Arabia	
Year:	2013	
Factors Identified:	**F.code**	**Factor**
	P15.T1	Visual design and consistency Links and navigation Data entry forms Information, truth and precision Privacy and security Search functionality Help, feedback and error tolerance

		(HE Components)

Paper Title:	Discussion on Usability and Optimization Issues in Overseas University Websites: A British University as an Example	
Paper ID:	P16	
Type:	Symposium	
Methodology:	Detailed analysis of existing literature related problem. And identification of solution.	
Country:	China	
Year:	2012	
Factors Identified:	**F.code**	**Factor**
	P16.H4 P16.H5 P16.H6	Language ,Email Responses, SEO and landing page

Paper Title:	Algorithm comparison performance in assessing the quality of university websites.	
Paper ID:	P17	
Type:	Conference	
Methodology:	Industry experience report using two methods to identify the best one by using five tests test criteria's.	
Country:	Indonesia	
Year:	2017	
Factors Identified:	**F.code**	**Factor**
	P17H1.p3L2	Number of web pages, simple web impact factor, self-link web impact factor, External link web impact factors.
	P17H1.p3L8	Usability
	P17H2.p1L1	Aesthetics , logic , technology, usability

Paper Title:	Evaluation of Academic Website Using ISO/IEC 9126	
Paper ID:	P18	
Type:	Conference	
Methodology:	Survey based research in which data collection and analysed with the help of student's respondents.	
Country:	Indonesia	
Year:	2015	
Factors Identified:	**F.code**	**Factor**
	P18H1.p3L1	Functionality , reliability ,

		understand ability
	P18H5.p2L1	efficiency, maintainability, portability
	P18H2.p4L1	Information quality

Paper Title:	Characterizing and Predicting the Multifaceted Nature of Quality in Educational Web Resources	
Paper ID:	P19	
Type:	Journal	
Methodology:	Industry experience report that Develop computational models of quality that can assist users with the help of four stages step by step.	
Country:	Singapore	
Year:	2013	
Factors Identified:	**F.code**	**Factor**
	P19.T2	Inclusion of graphs, readability of text, Access to relevant data

Paper Title:	Evaluation of hotel websites: Progress and future developments	
Paper ID:	P20	
Type:	Journal	
Methodology:	Evaluation performed on the base of analysis from dataset collected from SLR.	
Country:	Hong Kong	
Year:	2018	
Factors Identified:	**F.code**	**Factor**
	P20H4.1.p2L5	Website features/website characteristics (visual appearance, information quality and variety).
	P20H4.2.p1L2	website usability, Customer satisfaction.
	P20H4.3.p1L5	Screen appearance, interactivity with consumers, Use of media (measure website usability).
	P20H4.4.p1L3	information quality Functionality and security, customer relationships.
	P20H4.5.p1L2	Information quality.

Paper Title:	The moderating effect of gender on academic website impression	
Paper ID:	P21	
Type:	Journal	
Methodology:	This research used a survey methodology to collect data for testing the stated hypotheses.	
Country:	US	
Year:	2014	
Factors Identified:	**F.code**	**Factor**
	P21.T2	Website quality Website navigation

Paper Title:	Website usability in the design thinking Methodic	
Paper ID:	P22	
Type:	Presented in Magazine	
Methodology:	Industry experience report which consist of four phases to conduct results.	
Country:	Poland	
Year:	2016	
Factors Identified:	**F.code**	**Factor**
	P22H5.p1	User Requirements, Design , usability , services quality

Paper Title:	Accessibility evaluation of top university websites: a comparative study of Kyrgyzstan, Azerbaijan, Kazakhstan and Turkey	
Paper ID:	P23	
Type:	Journal springer-Verlag	
Methodology:	Survey based research in which 60 universities of different states evaluated with the help of two tools. Similiarweb tool was used to check ranking characteristics and Achecker was used to check the accessibility test.	
Country:	Kyrgyzstan, Turkey	
Year:	2017	
Factors Identified:	**F.code**	**Factor**
	P23H0.p1L7 P23H1.p3L1 P23H1.p3L3 P23H1.p4L0	*-accessible for users* *-Access information,* *-efficient, effective and satisfactory Manner of main page* *-smooth processing of course registration* *-Course content availability.* *-Effectively access services*

		-accessibility features *-accessibility problems*

Paper Title:	Evaluating the Usability of Educational Websites Based on Students' Preferences of Design Characteristics	
Paper ID:	P24	
Type:	Journal	
Methodology:	Survey Based research, in which detail review is conducted to find out design characteristic of website	
Country:	Jordon	
Year:	2014	
Factors Identified:	**F.CODE**	**FACTORS**
	P24.T3	Navigation Organization/architecture Design Content Ease of use and communication

Paper Title:	The Assessment of Quality, Accuracy, and Readability of Online Educational Resources for Platelet-Rich Plasma (PRP)	
Paper ID:	P25	
Type:	Journal	
Methodology:	Evaluation was performed by using 25-point criteria based on guidelines published by the American Academy of Orthopedic Surgeons, and accuracy was assessed by 3 reviewers independently. Readability was evaluated using the Flesch-Kincaid (FK) grade score.	
Country:	USA	
Year:	2017	
Factors Identified:	**F.code**	**Factor**
	P25H1p3L3	Assessment of quality Readability accuracy

Paper Title:	Empirical Study on the Factors Influencing the Web-based Teaching Effect	
Paper ID:	P26	
Type:	Journal	
Methodology:	Survey based research conducted via questionnaire investigation	
Country:	China	
Year:	2018	
Factors	**F.code**	**Factor**

Identified:	P26.T1	Performance expectancy Ease Expectations Computer self-efficiency

Paper Title:	Evaluation of an educational website for parents of children with ADHD	
Paper ID:	P27	
Type:	Journal	
Methodology:	A single pre-test, post-test survey designed to explore the perceptions, experience, knowledge improvement and usage patterns for 'ADHD & You 'educational website.	
Country:	UK	
Year:	2015	
Factors Identified:	**F.code**	**Factor**
	P27H3.5.p1L1	Content analysis (appearance: design, text, color, content, functionality, perceptions, target audience, usability, usage pattern and miscellanea).
	P27H3.1.p1L1	Participant characteristics (age , relationship to child , ethnicity , diagnostic status , qualification level)

Paper Title:	Factors explaining adoption and implementation processes for web accessibility standards within E-Government systems	
Paper ID:	P28	
Type:	Journal	
Methodology:	Factors identified and interviewed by experts in the field of organizational) accessibility. The new formed extended model was then validated by interviews with key stakeholders. Finally, the outcome is in existing adoption models in a new context.	
Country:	Netherland	
Year:	2017	
Factors Identified:	**F.code**	**Factor**
	P28H2.p1L3	Assessment standard Design Budget and knowledge Structure

Paper Title:	Opportunities and challenges in the adoption of open educational resources for course development: a case study of Uttara hand

Paper ID:	P29	
Type:	Journal	
Methodology:	Survey based research in which an offline form was developed and the data was captured on the basis of an interview. Furthermore, Basic mathematical operations like addition, subtraction, multiplication, percentage, mean average were used for the analysis of data.	
Country:	India	
Year:	2018	
Factors Identified:	**F.code**	**Factor**
	P29H1.p1L5	Lack of quality assurance for contact available Information overload

Paper Title:	Website Quality Assessment Criteria	
Paper ID:	P30	
Type:	Conference	
Methodology:	Survey based methodology	
Country:	Greece	
Year:	2004	
Factors Identified:	**F.code**	**Factor**
	P30H2p1 P30.T1 P30.T2 P30.T3 P30.T4 P30.T5	Utility of content Completeness of information Convenience of navigation tools Links to other sites Ease of use of navigation tools Search engines Loading speed Site map Graphic representation Readability of content Multimedia Design characteristics Aesthetics in content presentation

Paper Title:	Website Quality Assessment Model (WQAM) for Developing Efficient E-Learning Framework- A Novel Approach	
Paper ID:	P31	
Type:	Journal	
Methodology:	Survey based research	
Country:	India	
Year:	2013	
Factors Identified:	**F.code**	**Factor**
	P31H3.p1	Accuracy Relevant Grammatical errors

		Up-to-date Information source Compatibility Ease of learning Interaction Downloading Usability Error recovery

Paper Title:	Assessing the quality of web sites Layla Hasan	
Paper ID:	P32	
Type:	Journal	
Methodology:	Survey based methodology	
Country:	Jordan	
Year:	2011	
Factors Identified:	**F.code**	**Factor**
	P31H4.p1	Attractive Appropriateness Color Image/Sound/Video Text Index Mapping Consistency Links Logo domain Usability Reliability Interactivity features Security/Priv. Customization

Appendix C

Table D1: Data coding of identified factors

Paper ID	Variable coding	List of Factors
P1	P1H5.p1L2	*Color contrast* *Alternative texts* *Link visibility* *Label caption*
P2	P2.T1	*Usability* *QOI* *QOS* *User satisfaction*
P3	P3H2.p4L5	Pedagogy-based design (responsive & universal design)
P4	P4H2.3p3L3 P4H2.3p4L2	Interactivity search tools, sitemap, help or FAQ pages, Legal policies. Poor Website design (broken links, poor use of fonts and poor text to background contrast, poor navigation.)
P5	P5H1.p2L5	HTTP Response header website Security
P6	P6. T1	Usability Accessibility SEO Content Design Performance Page analysis score
P7	P7H1.p3L2	User centered design and development to facilitate presentation.
P8	P8H1.p2L1	Page's out degree (number of links to page) Visual complexity
P9	P9H2.p0L0	WPI Service quality
P10	P10H4.p1L3 P10H4.2.p1L2	Website usability Website accessibility Less user control Error prevention.
P11	P11.T1	Content and usability of webpages (navigation, system state, information services , user interface) Web applications
P12	P12.T12	All factors up till now

P13	P13p3	User satisfaction Customer support system Simplicity Ease of use FAQ Password recovery Error notification Attractiveness User friendly Appearance
P14	P14. T5	Empty link Empty buttons Image button missing alternative text Empty form label Empty headings
P15	P15.T1	Visual design and consistency Links and navigation Data entry forms Information, truth and precision Privacy and security Search functionality Help Feedback and error tolerance (HE Components)
P16	P16H4. p1L1 P16H5. p1L1 P16H6.p1L1	Language Email Responses SEO Landing page
P17	P17H1.p3L2 P17H1.p3L3 P17H1.p3L5 P17H2.p3L1 P17H2.p1L2 P17H1.p3L3 P17H1.p3L4	Out degree-in degree pages Web types of Impact factor Usability Usability Visual appeal/ Services Web designer Web administrators Simplicity Performance Usability
P18	P18H1.p3L1 P18H1.p2L1 P18H2.p4L1	Functionality Reliability Understand ability Efficiency Maintainability Portability Information quality
P19	P19.T2	Inclusion of graphs Readability of text Access to relevant data

P20	P20H4.1p2L5 P20H4.3p1L2 P20H4.3p1L5 P20H4.4p1L3 P20H4.5p1L2	Website features/website characteristics (visual appearance, information quality and variety). website usability Customer satisfaction. Screen appearance Interactivity with consumers Use of media (measure website usability). Information quality Functionality and security Customer relationships. Information quality.
P21	P21.T2	Website quality Website navigation
P22	P22H1.p1L1	Information accuracy
P23	P23H1.p1L3	Quality information
P24	P24.T3	Navigation Organization/architecture Design Content Ease of use and communication
P25	P25H1.p3L3	Assessment of quality Readability accuracy
P26	P26.T1	Performance expectancy Ease Expectations Computer self-efficiency
P27	P27H3.1p1L1 P27H3.5p1L1	Content analysis (appearance: design, text, color, content, functionality, perceptions, target audience, usability, usage pattern and miscellanea). Participant characteristics (age , relationship to child , ethnicity , diagnostic status , qualification level)
P28	P28H2.p1L3	Assessment standard Design Budget and knowledge Structure
P29	P29H1.p1L5	Lack of quality assurance for contact available Information overload
P30	P30H2.p1 P30p0T1 P30p0T2 P30p0T3 P30p0T4 P30p0T5	Utility of content Completeness of information Convenience of navigation tools Links to other sites Ease of use of navigation tools Search engines Loading speed Site map Graphic representation Readability of content

		Multimedia Design characteristics Aesthetics in content presentation
P31	P28H2.p1L3	Accuracy Relevant Grammatical errors Up-to-date Information source Compatibility Ease of learning Interaction Downloading Usability Error recovery
P32	P31H4.p1	Attractive Appropriateness Color Image/Sound/Video Text Index Mapping Consistency Links Logo domain Usability Reliability Interactivity features Security/Priv. Customization

APPENDIX D

Part A

Figure 1a: Snap shot of the statements taken from page 1 of the paper 'P23'

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COMMUNICATION

Accessibility evaluation of top university websites: a comparative study of Kyrgyzstan, Azerbaijan, Kazakhstan and Turkey

Rita Ismailova[1] · Yavuz Inal[2]

Abstract It is important that university websites and services offered through their sites are used effectively, efficiently and satisfactorily by the whole target group of the university, including disabled users. However, universities in many countries are still unable to meet the criteria for web accessibility. This study aimed to test the websites of the top universities in Kyrgyzstan, Kazakhstan, Azerbaijan and Turkey using automated assessment tools. The results showed that university websites are more popular in Turkey, and in Turkish universities developers pay more attention to the performance of websites, followed by websites of Azerbaijani, Kyrgyz and Kazakh universities. The majority of the university websites in the study did not meet the WCAG 2.0 accessibility criteria. Only two Kyrgyz and two Kazakh university websites attained conformance level A, and only three, one Kyrgyz and two Kazakh, achieved accessibility conformance level AAA. Based on the results, it was determined that universities included in the present study need to devote mo[illegible]ffort to making their websites more accessible for thei[illegible]rs.

Keywords Web accessibility · Online evaluation tools · Web performance · Quality · University websites

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1 Introduction

It is important that components of a web page such as text, audio, images and video have features that are accessible to all users. Web accessibility consists of a number of practices that need to be undertaken to meet the specific needs of people, for whom ordinary web browsers used by non-disabled people are not sufficient to access web content [7]. According to the Web Accessibility Initiative (WAI), "Web accessibility means that people with disabilities can use the web. More specifically, web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the web, and that they can contribute to the web" [42]. In this context, the main focus of web accessibility is on disabled users who need assistive technologies such as screen readers, Braille embossers and touch screens to smoothly use the developed websites [30].

As in all areas of daily life, web accessibility is extremely important for higher education. It is critical that university websites and the services offered on these websites can be easily used by the target group of students including disabled users. Studies have shown that in recent years, there has been an increase in the number of higher education students with disabilities [28] and universities use assistive technologies to help these students throughout their university education [11]. University websites that have accessibility features allow these students to more effectively undertake activities with the use of assistive technologies, and this is one of the factors affecting their academic success.

It is important for the students to be able to access information, announcements and other services provided by the websites of their faculty or institute from the main page of the university in an efficient, effective and satisfactory manner, as well as e[illegible]ing the smooth processing

Figure 1b: Snap shot of the statements taken from page 2 of the paper 'P23'

of course registration and that course content is available to all. It should also be noted that websites are the first doors to universities and introduce universities to enrollees as well as prospective students, including those with disabilities [10]. In addition, academic and administrative staff should also be able to effectively access services offered through the university website.

Although a fundamental requirement for university websites is to have accessibility features that take into account the individual characteristics of the target groups and the technologies they use [2], it can be argued that many university websites still have accessibility problems [27, 36], which constitute barriers particularly to those who need assistive technologies [30]. The Web Content Accessibility Guidelines (WCAG) criteria set by the World Wide Web Consortium (W3C) provide specific standards for the features of an accessible website [41]. Automated evaluation tools are frequently used to assess the compliance of websites to these criteria, and the reports, generated by these tools, help determine which criteria have not been met.

Despite the availability of research in the literature regarding the testing of the accessibility of university websites in different countries using automated assessment tools, there are only a limited number of studies that have undertaken a comparative evaluation. Therefore, in this study, we aimed to test and compare the accessibility of websites of the top universities in Kyrgyzstan, Kazakhstan, Azerbaijan and Turkey, using automatic evaluation tools.

2 Related literature

Several researchers that have used automated assessment tools to evaluate the accessibility of university websites have shown that, in general, university websites still have serious problems in terms of accessibility and there is a need to undertake more work in this area. For example, Hashemian [19] analyzed web accessibility in higher education in Finland using automated assessment tools to test the accessibility of all university websites including the University Admissions Finland. The researcher found that at least one of every three university websites was at the WCAG conformance level A (priority 1); however, none of the websites conformed to the WCAG level AA (priority 2). In Japan, a similar study was conducted on the websites of 90 randomly selected universities, high schools, junior high schools and elementary schools, which were evaluated in terms of their accessibility according to the Japanese Industrial Standard (JIS), developed for web accessibility [34]. It was reported that the university websites had more accessibility problems than the websites of other educational institutions in other categories.

Another study evaluating the accessibility of 60 randomly selected university websites in the USA using the WebXACT service [12] revealed that the majority of the websites did not meet the Section 508 standards of the United States Rehabilitation Act and the WCAG criteria. The basis of the study was the hypothesis that universities with a high number of students were more compatible with the accessibility criteria of their websites; however, the results showed that there was no significant relationship between the web accessibility of websites and number of students. Solovieva and Bock [38] analyzed the subpages of the website of a large public university in the USA in terms of their conformance to WCAG 1.0 and 2.0 using the automated evaluation tools of Cynthia and WAVE. Of the total 509 web pages that were tested, approximately half (51%) successfully passed the WCAG 1.0 accessibility test, whereas only 35% achieved the WCAG 2.0 conformance level A.

Ismailova and Kimsanova [23] tested the accessibility and usability of 42 university websites in Kyrgyzstan using the EvalAccess 2.0 automatic evaluation tool, and they found that the conformance of these websites to WCAG 1.0 was poor. Maisak and Brown [31] used the WAVE and SortSite tools to analyze the accessibility of higher education websites in Thailand according to the WCAG 2.0 criteria and reported that these websites had a high number of accessibility flaws, particularly with respect to the perceivability and operability components of the guidelines. The authors stated that although the Thai government had already signed the Convention on the Rights of Persons with Disabilities, there was a need for stricter policies to be implemented in the area of web accessibility. In another study that tested 302 university websites in India for their WCAG 2.0 compliance using the AChecker, Webpage Analyzer and WAVE automated assessment tools [21], a significant number of problems were observed that could obstruct the use of assistive technologies by disabled people, including the unavailability of alternative text in non-text web elements, page numbering and options to change color contrast and browse the websites using a keyboard.

Aziz et al. [6] assessed the accessibility and usability of the websites of 120 higher education institutions in Malaysia, including the Ministry of Higher Education of Malaysia (MOE) portal, according to WCAG 1.0. Using EvalAccess 2.0, the authors determined that all the websites required more work to ensure that disabled people could easily use them. Similarly, Ahmi and Mohamad [2] evaluated 20 public university websites in Malaysia based on the WCAG 2.0 criteria and Section 508 standards using AChecker and WAVE. The authors reported that despite recent improvements in accessibility, the university websites needed to have more accessibility features irrespective

Figure 2c: Snap shot of the statements taken from page 1 of the paper ‘P17’

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Algorithm Comparison Performance in Assessing the Quality of University Websites

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***Abstract*— The rapid use of the internet in education field encourages website developers to make improvements in university website quality. University websites are also part of the criteria of a higher education institution performance appraisal. Thus, a good university is considered to have a good website. The website reflects the popularity and prestige of a college. There are at least three university ranking agencies of the world with different ratings on the quality of the website. Due to several elaborated and numerous criteria, the quality rating of the website is often associated with Multi-Criteria Decision-Making issues. Linear Weightage Model (LWM) and Simple Additive Weighting (SAW) are the simplest algorithm for data rank. This paper aims to compare LWM and SAW algorithm performance to determine the best method on ranking University websites. This research uses five testing of usability criteria: load time, page rank, traffic, stickiness, and backlink. The results of LWM algorithm of the experiment using the language of C++ have more rapid execution time in comparison to SAW. Based on the results of Pair sample t test, both algorithms have significant different effects on ranking results because of the different of normalization process.**

Keywords—Linear Weightage Model, Simple Additive Weighting, website quality.

I. INTRODUCTION

Quality assurance of higher education institutions adopt World Class University (WCU) terminologies, which include academic and teaching excellence, research quality, knowledge development and dissemination, and activities that contribute to culture, science, and society [1]. These criteria encourage universities to make the best efforts at the world level [2], [3]. However, there are some obstacles in achieving WCU that are considered less objective, due to the many different assessment criteria [4]. The quality of university websites is one of the criteria to measure universities performance [5]. The criterion in line with the rapid use of the internet to access educational information. At least, there are millions of people visiting the university web to access information every year [6]. Good university generally have high qualified websites regarding the appearance and the performance. The high qualified website show the credibility and popularity of higher education institutions.

Webometrics, uniRank and eduroute are the most popular academic rankings for the higher institutions [7]–[9]. In fact, each ranking method comes with weaknes. The disadvantage of the webometrics method is the influence of bad practice in the university web name, having two or more domains or changing the URL that would reduce the rating. UniRank has a weakness in its methodology that emphasizes only on the popularity of the website. Mean while, eduroute has no clarity in ranking methods, as well as tools used for data retrieval.

Based on the weakness of ranking mentioned above, it is necessary to do further assessment about the criterion and the method of university website quality rating. A research on 71 Bangladeshi college websites reveals the important criteria of university website quality that involves the number of web pages, simple web impact factor, self-link web impact factor and external link web impact factor [10]. Another study on website quality shows that website quality evaluation criteria focus on usability [11]. Usability is considered as an assessment that represents the convenience and satisfaction of the users, thus forces the website enterprise to build a better web [12]. Therefore, developers do not only concentrate on the design of the user interface but also pay attention to the fulfillment of the users needs with certainty. If the website is difficult to use or it fails to state clearly what would be offered, then the user would leave it [13]. Therefore, it is important to assess usability. In other words, usability is the determining factor of the whole system's success [14]. In this case, usability is a relevant factor in business success. Hence, this paper propose five testing of usability criteria: load time, page rank, traffic, stickiness and backlink.

The experiments performed by Dominic and Hanim (2013) conducted by combining Linear Weigtage Model (LWM) and Fuzzy AHP methods called New Hybrid Model (NHM) on the quality of university websites in Malaysia based on usability criteria. In these experiments, NHM is applied using a combination of LWM and FAHP to produce better and preferred criterion weight [11]. The excellence of LWM methods are related to their simplicity in measurement by searching the summation of weight from the subsection of

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Figure 2d: Snap shot of the statements taken from page 2 of the paper 'P17'

performance in each alternative in all criteria. The result of the highest summation is the best alternative chosen [15]. The other simple method on weighting and ranking is Simple Additive Weighting (SAW). This paper aims to compare LWM and SAW algorithms to determine the best method in ranking university website. The comparison of both algorithms is conducted based on the execution time required, and the difference of generated mean. This research is conducted to find out whether the two algorithms give the same or different effect in ranking.

Based on the test result, the most efficient algorithm could be used as the reference for further researches. The paper is organized as follows. Section 2 discusses the literature study; Section 3 describes the research method; Section 4 explains the result and discussion, and Section 5 presents the conclusions and suggests some areas for further investigation.

II. Literature Study

A. Website Quality

The quality of website can be evaluated using several factors such as aesthetic, logics, and technology [11], [16]–[20]. Based on the perspective of web designer and administrator, the evaluation of website quality focuses on the usability [11]. Usability covers the simplicity in learning, effectiveness and pleasure for the users [21]. The factor of usability includes page load time, page rank, traffic, stickiness and backlink.

Loading time is the real median time required to load a webpage on the website on the browser of the users. The standard of websites performance shows that webpage loading time must be less than 30 second. The maximum average server response time is 0.5 second [22]. The page rank meanwhile is taken from the data of the site ranking based on the traffic of the visitors in a month. Stickiness is a capability to ensure that each user has been stuck on a page of website in certain time period. A pleasurable website would attract the users to revisit later emerging a positive impact called traffic impact. Backlink is measured based on the numbers of links referring to the main page. The backlink represented the credibility of a website for being correlated to the prestige and popularity of a website [11], [19].

B. University web rank

Webometrics, eduroute, and uniRank are university ranks based on activities on the internet. Webometrics uses four assessment criteria including Visibility (50%), Presence (5%), Openness (10%), Excellence (35%). The visibility obtained from the number of external backlinks to the web pages represents the credibility, quality, and popularity of university websites. The Webometrics rank used the analytic tools and scholar database such as google, ahrefs, majesticseo, google scholar, and scimago to reach the data [7], [8], [23], [24].

UniRank assesses the provided websites by considering the popularity of the website with Moz Domain authority, Alexa Global Rank, SimilarWeb Global Rank, Majestic Referring Domains and Majestic Trust Flow [5], [25]. Alexa is an intelligent personal assistant developed by Amazon that provides data with the criteria mentioned above. Alexa estimates web traffic based on data from millions of internet users from the different browser.

Eduroute focuses on the study and evaluation of university websites, not on the university performance. Eduroute's volunteers study new ways based on the information provided by educational institutions, the internet, and the outsiders. The route review indicator is the volume of information published on the website, online university scientific publications, website link quantity, and link quality and website content[26].

One of the shortcomings of the webometrics method is the influence of bad practice in the university web domain name, such as having two or more domains and changing the university web URL. Webometrics is closely related to the university's open-source policy, an institutional commitment is needed. Unirank has a weakness in the methodology that emphasizes only on the popularity of the website[5]. Eduroute release the first ranking in 2011, but it did not continue until now. Table 1 shows the methodology comparison between webometrics, eduroute, and uniRank University ranking.

TABLE I. METHODOLOGY

Webometrics	uniRank™	eduroute
Visibility (50%) Size (20%) Rich Files (15%) Scholar (15%)	Google Page Rank Total Number of inbound links Alexa Traffic Rank * Not mentioned percentage of each criterion	Volume (20%) Links quantity (30%) Quality of links and content (40%) Online Scientific Information (10%)

C. Linear Weightage Model

LWM is the simplest model that commonly depend on the assessment of decision maker. The weight of the criteria is fixed based on the interest of each criterion in comparison to other criteria [11], [19], [27].

The steps of LWM algorithm are presented as follows :

Step 1 : Determine the criteria and alternative.

Step 2 : Assign the weights of each criterion, W=[W_1, W_2, W_3, …W_j]

Step 3 : Determine a threshold for each criterion.

Step 4 : Transform the measures to make them all positively related to scores and normalized into a 0–1 scale.

$$r_{ij} = \begin{cases} \frac{max_{(x_{ij})} - x_{ij}}{max_{(x_{ij})} - min_{(x_{ij})}}, if\ the\ threshold\ is\ maximum \\ \frac{x_{ij} - min_{(x_{ij})}}{max_{(x_{ij})} - min_{(x_{ij})}}, if\ the\ threshold\ is\ minimum \end{cases} \quad (1)$$

where

X_{ij} = a specific website considered at the time.

Figure 2e: Snap shot of the statements taken from page 3 of the paper 'P17'

t_6 = m+(m-1)+(m-1)+(m-1)+(m*(m-1))+(m*(m-1))+(m-1)
= m+4(m-1)+2(m*(m-1))
= m+4m-4+2(m^2-m)
= m+4m-4+2m^2-2m
= 2m^2+3m-4

For *n* criteria, *m* alternatives, and t_i time complexity each step, following is the analysis of LWM and SAW algorithm below=
t = t_1+t_2+t_3+t_4+t_5+t_6+t_7
= (3+nm+n)+1+6+(4n+10nm)+(m+2nm) + (2m^2+3m-4) +2m
= 2m^2+13nm+5n+6m+6
If n = m, then
= 15n^2+11n+6
= an^2+bn+c
From the calculation above, the time complexity of both algorithm is O(n^2).

To measure the execution time, experiments using C++ language are conducted to evaluate the algorithm performance. The experiment is conducted 10 times with the alternative website number of 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 units. The result measurement is presented in Table 1.

TABLE II. EXECUTION TIME COMPARISON OF LWM AND SAW

∑ University Websites	Execution Time	
	LWM (second)	*SAW (second)*
5	0.45	0.51
10	0.50	0.84
15	0.74	1.04
20	0.91	1.26
25	1.06	1.45
30	1.13	1.65
35	1.26	1.81
40	1.36	1.99
45	1.48	2.19
50	1.68	2.38
χ (mean)	1.057	1.512

Table 2 shows that the time required to execute the SAW algorithm is larger in comparison to the one in LWM algorithm at approximately 4.5 seconds. Thus, it can be conducted that the LWM algorithm works faster than SAW.

B. Website quality rank comparison of LWM and SAW

Measurement units for the criterion of load time and stickiness are second. Meanwhile the criterion of page rank, traffic and backlink was number. This research use 50 official websites of universities in Indonesia. Data that have been collected and normalized by the formula (1) and (3) are displayed in Table 3.

TABLE III. ORIGINAL DATA

Criteria	Load time	Page rank	Traffic	Stickiness	Back link
UGM	1.74	8837	3.25	256	8653
ITB	1.45	23552	3.81	268	4758
UI	1.50	11618	3.96	346	6830
UB	1.53	12718	3.07	272	4415
IPB	1.78	14205	4.34	268	4954
UNPAD	1.44	30791	3.67	266	3770
UNDIP	1.44	15216	2.91	220	4520
UNRIAU	1.11	79537	2.46	368	633
UNUD	1.41	31023	2.99	289	1829
UNAIR	2.21	22208	2.48	248	3679
UNS	2.08	15906	2.55	219	4997
UNSYA	1.65	48743	4.07	340	1105
UNHAS	2.60	29096	3.65	306	1558
UNILA	1.51	26271	2.36	271	1993
ITS	1.18	26545	3.88	352	2813
UNSOED	1.84	58489	2.91	286	971
UAD	1.82	48683	5.81	496	1635
UNTAD	1.68	86829	3.03	507	1885
PETRA	0.56	62542	2.77	253	1389
BINUS	1.74	33286	3.43	282	1202
UPI	1.51	16441	2.28	175	4209
UMY	2.61	45586	3.88	274	3011
UDINUS	1.87	54757	2.37	230	705
UBAYA	1.94	103686	3.23	319	496
ATMA	1.10	142302	3.20	392	660
UNNES	1.61	18707	2.52	254	2890
NARO	2.60	64124	1.34	103	2645
UNY	2.13	10077	2.68	243	3078
GUNA	0.77	37640	3.67	236	23163
UINJKT	1.17	36081	2.59	219	1015
UNESA	2.77	52872	2.43	163	2222
TEL U	2.88	34585	3.82	401	962
UM	2.78	24924	2.72	275	2727
UNAND	1.56	36302	3.18	252	1708
UNSRI	1.39	53563	3.70	319	1930
UINSBY	1.07	46107	2.62	210	1164
UINMLG	1.70	48433	3.16	296	1977
UMM	1.38	44910	3.38	454	2498
UMS	1.83	20946	2.26	179	1509
UNPAR	2.27	128150	3.55	607	546
UNTAN	1.02	79004	3.26	310	660
UNEJ	2.13	26249	3.43	413	1381
UNSRAT	2.56	49856	1.54	299	757
UKSW	2.27	79441	2.30	177	465
UT	2.03	19155	9.91	872	1397
WIDYA	1.55	57954	2.93	206	412
UNJA	3.04	998570	6.07	729	488
UINP	1.48	180007	4.50	352	1069
USU	0.76	11530	2.81	159	9237
UNISU	3.52	123642	4.15	297	505

Table 3 shows the multiplication of values by weights generating the total scores and rank of the LWM and SAW algorithm for 50 alternative websites in universities. The weight of the five criteria defined are set as follows : load time (0.3); page rank (0.25); traffic (0.2); stickiness (0.15); backlink (0.1).

The highest rank of LWM is found in UT followed by Gunadarma, USU, Petra and ITS. The results are different from the measurement using SAW algorithm. The results show that there are five universities with the highest web quality; UMM, UT, Gunadarma, USU, and Petra. The difference is caused by the difference in measurement in data normalization process. LWM calculates the division with the difference of maximum and minimum value. Meanwhile, SAW calculates the division directly using the maximum

Figure 2f: Snap shot of the statements taken from page 1 of the paper ‘P13’

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E-Commerce Website Quality Assessment based on Usability

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***Abstract*— Today website is considered as an image of an organization. For designing an effective website it is required to identify the need of the visitors of the website. In current scenario the objective of e-commerce websites is to provide the users or customers a platform where they can retrieve any information and also can perform other tasks like adding to cart, save for later, checkout, payment, tracking records and may more. In this paper, techniques like Adaptive Neuro Fuzzy Inference System Approach (ANFIS) and Analytical Hierarchy Process (AHP) were used to assess the usability of e commerce website and propose a model to successfully assess and compare websites on the basis of usability. First of all, the important factors related to usability from the literature or educational materials were identified. A survey using these factors as base was conducted which served as a valuable input from user for identifying the parameters affecting usability, which was further used in assessing the usability parameters of the e-commerce websites (such as Flipkart, Amazon, Snapdeal, Myntra). A Fuzzy inference system (FIS) file was generated using the parameters identified in the survey, member functions and other rules. Training data was generated using the survey conducted. ANFIS system used this training data and FIS file to create an optimal model for assessing the usability of the websites. This model can also be used to identify the important parameters to improve usability of the website using the valuable review of daily website users via the conduct of survey.**

Keywords*— *Usability, Fuzzy inference system (FIS); Analytical Hierarchy Process (AHP); Adaptive Neuro Fuzzy Inference System (ANFIS);

I. INTRODUCTION

The coming of privatization has led to a cut throat rivalry among the different e commerce foundations; in a way planning a viable site is extremely imperative. Sites are developing as a key part of an e-commerce firm's survival in our constantly globalizing aggressive world. For planning a viable site web developers are obliged to recognize the need of the guests of the site. In present situation the target of sites of an e commerce establishment is to give the understudy and other clients a stage where they can easily buy any products and search for them as efficiently as possible and can perform undertaking such as online payment, saving last items, product recommendation etc, in other words give them a user friendly stage. The main concern of the users towards an e commerce websites is the easy to use interface, simple login process and trustworthy online payment portal.

Nielson (1994) [3] defined usability as “Usability is a quality attribute that assesses how easy user interfaces are to use”. ISO 9241-11[4] defines usability as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”. IEEE [5] defines usability as “ease with which a user can learn to operate, prepare inputs for and interpret outputs of a system or component” ISO 9126-1,2001 [6] defines usability as “the capability of the software product to be understood, learned, used and attractive to the user when used under specified conditions”. Usability is the most critical parameter thus the designer should identify the users need at the early stage and generate the rules for the usability. These can be used to compare the usability of various prototypes of the websites.

This paper is divided into five sections. In section I we define usability as a critical parameter for designing an ecommerce website. Section II describes different types of methodologies adopted for assessing the usability. In section III different factors affecting the usability of a website are described. Section IV compares different influencing parameters. Section V concludes that user satisfaction is the most prominent factor in assessment of ecommerce website.

II. METHODOLOGY FOR DESIGN AND IMPLEMENTATION

Many researchers have focussed on usability of a website. Nielson’s Model is one of the most searched for in usability in engineering area. According to ISO(International Organization for Standardization) the usability is based on three main construct like effectiveness, efficiency and satisfaction ISO 9126-1[8]. The objective of this model is to provide the visitor services like making safe online payments, adding items to the cart, saving the items for later review, storing the tracking details of the product, storing personal details of the customer.

In this paper we have identified many parameters like customer service support, easy accessing to the user, safe and successful transaction, privacy, user friendly interface, recovery of password, speed, efficiency etc. Usability can be measured by ANFIS along with questionnaires. From these

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Figure 3g: Snap shot of the statements taken from page 2 of the paper 'P13'

surveys the result can be drawn by using the techniques AHP and ANFIS.

A. AHP (Analyical Hierarchy Process)

This process is a kind of decision making process. In this process the large and complex problem is broken down in sub problems. This process includes the breaking down of unstructured and unmanageable tasks into its variable parts which are easy to mange and can handle by human easily [9]. This process is very efficient as various structure to decompose, bind, breaking and also control the complexity of the problem by using various techniques. It uses knowledgeable judgement to integrate the characteristics and give an appropriate answer. AHP is much better than many other techniques which use perceptible and non-perceptible techniques. This process leads to a quality assured decisions and their management.

There are five steps to find the solution for a decision problem through AHP, which are as follows:

- Breaking down the complex problem in small sub problems.
- Collecting inputs through the decision elements.
- Check if there is consistency in the decision element comparisons.
- Calculate the relative weight of the decision elements.
- By aggregating the obtain relative weights of decision elements give ranks to decision elements alternatively.

This method can handle discrepancies by measuring the assessment inconsistency. This measurement is an important element in prioritizing the pair wise comparisons. Higher the consistency ratio, more inconsistent is the assessment result.

B. ANFIS(Adaptive Neuro Fuzzy Inference System)

This approach uses adaptive neural network to find the optimal solution with very less involvement of humans. . Fuzzy inference system is an inference system which uses fuzzy logic to represent knowledge in terms of constraints to minimize the search space. It approximates the input to a class which is further used as an input for inference system[11]. Fuzzy system manages thinking on a more elevated amount, utilizing etymological data. Adaptive neural network provides a framework which adapts according to the environment, learning and changing itself. In ANFIS, integrated neuro-fuzzy frameworks can join the parallel processing and learning capacities of neural systems with the human-like information representation and clarification capacities of fuzzy frameworks [12].

III. FACTORS AFFECTING USABILITY

A. User Satisfaction:

It is defined as the measure of how good is the service and products of a company is. Whether the website is fulfilling all the needs of the customers or not[13]. It is also defined as "the number of users, or percentage of total users, whose reported experience with a firm, its products, or its services exceeds specified satisfaction goals."

It has following sub parameters:

- *Accessibility:*

The website should be accessible in a very efficient way. It is the ability to access and benefit from some system or entity.

- *Customer support services*

This is a very integral part for making a good image in customer's eyes and also to stand with the growing competition. It is obvious that customers might have queries or problems related to products, features or shipping. To handle these kind of issues, one must have good customer support team who knows how to tackle the real time customer.

- *Successful Transaction*

It is very important to have a trust worthy and successful transaction for gaining customer's trust. In order to purchase a product it would be beneficial to both the supplier and the customer if the checkout process could be contained to the minimum number of page. The whole transaction process should be very smooth and should consume less time so that the customer does not lose their interest.

B. Simplicity

It is very important for a good website to be simple in terms of operations otherwise it can lose its customer's interest. Following are the sub parameters:

- *Ease of Use*

This factor is very important for web usability. If there is ease of use then more customers will look for it and hence it will be beneficial for it [16].

- *FAQ*

This page is the key part because through FAQ a developer of the website can understand the needs of customer and their queries directly.

- *Mobile Application*:

Now-a-days with increasing globalization the demand for mobile application has increased. Any user who can not access the website on the system because of the hectic life schedule can now easily access the e-commerce website through the mobile website or the application.

- *Password Recovery:*

In advance e-commerce websites they are built with privacy feature with a login id and its password which is unique for every new and old customer. But sometimes it can happen that a user can forget his/her password or even his/her login id name. So to overcome this problem which can cause huge issue of worry for the user it is required to have the password recovery feature.

- *Error Notification:*

Figure 2h: Snap shot of the statements taken from page 3 of the paper ‘P13’

Sometimes websites produce an error because of human or because of developer’s mistakes. The helpfulness of those errors decide the usability of the website. Error notification should help in removing the error, should not provide more information than needed and should be easy to understand.

C. Attractiveness :

Website should be designed in a such a way that attracts more and more customers. The users are attracted to the services provided by a website. The higher the quality of services the more will be the attractiveness to the users, quality of services should also be maintained in order to balance. The sub-parameters of attractiveness are the following[17]:

- *User Friendly:*

Website should be friendly enough for a customer that the customer can think of using it in future not just the user look once and find it so difficult to use it in future. Menus or links to appropriate categories in appropriate places should be present. Additionally, each page should provide users with an easy way to get back to the home page. Services like shopping cart will help and it should also contain other features which customer may require, such as the ability to select a payment option, select shipping options, change quantities, promo codes, or continue shopping, etc.

- *Appearance:*

Appearance should be attractive and beautifully designed.

D. Speed:

It is one of the most important factors to measure the usability of a website. Web loading times for e-commerce sites should manageable enough for the customer. apparently a delay of microseconds can potentially cause a significant loss of users. The sub-parameters of speed are the following:

- *Response Time:*

The time that the website takes to function is very crucial. It should be very fast and should easily allow the user to access the website.

- *Loading Time:*

Loading time of the page is an important part of any website’s user experience. Website visitors tend to care more about speed than all the bells and whistles we want to add to the websites[18].

E. Efficiency:

The efficiency of the website is a very important factor in measuring the usability of the website. It should be maintained because all other factors also depend on it.

- *Recommended Products:*

Effective product recommendations are very necessary. When done correctly they can heavily contribute to the success of a website, both by increasing the quantity and the size of orders being placed.

- *Product Categorization:*

One must keep things as simple as possible by opting for product category display on pages, organizing your product in a hierarchy.

F. Searching:

Product search result should be efficient and easily accessible,. Developers should ensure that site uses competent, reliable and efficient search engine tool, and allow filtering for more advanced search queries.

G. Product Information:

Every thing in the website depends upon the product and its detail and if even the minute detail of the product missed or goes wrong then the trust of the customer is lost and also it can effect the economy of the e-commerce website.

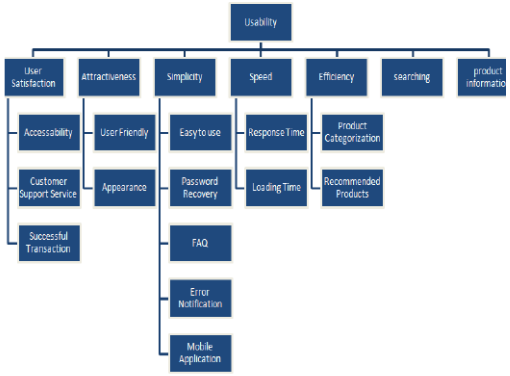

Fig 1: Hierarchical chart of usability parameters and sub parameters.

IV. COMPARATIVE STUDY

A. User Satisfaction

It is necessary for a website to satisfy the customer’s need. For a better e-commerce website. User Satisfaction is prime parameter and most important amongst all parameters of usability.

B. Attractiveness:

For attracting more and more user toward a website it is important to design a website in a very attractive manner. This parameter is less important than user satisfaction.

Headings

C. Simplicity:

Considering that the customer can be of any age and maturity level the website should be as simple to use as it can be so that anybody can use without any complexity. This

Figure 2i: Snap shot of the statements taken from page 4 of the paper 'P13'

parameter is equally important as user satisfaction and also the most important parameter.

TABLE I. DIFFERENT PARAMETERS OF USABILITY

Approach	Parameters	Sub Parameters	Advantage and limitations
AHP & ANFIS	User Satisfaction	Accessibility	ADV.: User can easily interact with website. LIM: But knowledgeable user required.
		Customer Support Service	ADV: Provides benefit for website as well as user. LIM: A well mannered and sophisticated team is required.
		Trust	ADV: beneficial for over all development of the e-commerce website. LIM: to maintain it for a long time.
		Successful Transaction	ADV: privacy of user account and payment is maintained. LIM: Skilled website with safety is required.
	Attractiveness	User Friendliness	ADV: provides user with the ease to use the website without any problem. LIM: Skilled web designer required.
		Appearance	
	Simplicity	Easy to use	ADV: provides user with easy access and security with password, direct resolving of customer's doubts, easily access to mobile application which can be used any time and any where, LIM: Highly maintained and developed frame for website is required.
		Password Recovery	
		FAQ	
		Error Notification	
		Mobile Application	
	Speed	Response Time	ADV: save the time of customer and reduce load on website. LIM: Sometime due to overloading these features fail.
		Loading Time	
	Efficiency	Product Categorization	ADV: For successful running of website and to satisfy the user's need. LIM: Sometime due to unavoidable factors and crashes it fails.
		Recommended Products	
	Searching		ADV: Helps user and save the time of user. LIM: Unwanted searches also come.
	Product Information		ADV: Helps the user to know about the product and also maintain the website integrity. LIM: The whole reputation stands on the ground of product detail i.e quality etc.

D. Speed :

For competing with other websites it is important for a website to have an optimal speed. This parameter has less importance than other important parameters because speed may differ from system to system.

E. Efficiency :

For successful running of website and to satisfy the user's need. This parameter has less importance because efficiency may also depend on the system for processing.

F. Searching:

Helps user and save the time of user. It is better than other parameters as it helps user to search easily.

G. Product Information:

Helps the user to know about the product and also maintain the website integrity.

Among these all above stated parameters are the important parameters for assessing a website usability.

V. CONCLUSION

It is very important for developing an e-commerce website to identify the factors which affect it. The main purpose of the website is to satisfy user's need and to provide the with full knowledge of product. Identifying the critical factors and developing a rule base system for evaluating usability of the website is need of today. In the current study we have assessed the usability of an e- commerce website. According to the survey conducted the five key parameters identified are: user satisfaction, attractiveness, simplicity, speed and efficiency that affects the usability of e-commerce websites. These parameters are divided into a number of sub-parameters namely, accessibility, customer support service, successful transaction, trust, user friendliness, appearance, easy to use, password recovery, FAQ, error notification, mobile application, response time, loading time, product categorization, product searching, product information and recommended products. Based on the result of this survey, further implementation of this model is done using AHP and ANFIS.

REFERENCES

[1] Ruchika Malhotra and Anjali Sharma: "A Neuro-Fuzzy Classifier for Website Quality Prediction". IEEE, 978-1-4673-6217-7/13, 2013

[2] Mehrbakhsh Nilashi, Karamollah Bagherifard, Othman Ibrahim, Nasim Janahmadi, Mousa Barisami: "An Application Expert System for Evaluating Effective Factors on Trust in B2C Websites". 10.4236/eng.2011.311132 Published Online November 2011

[3] Senay Oguztimur: "Why fuzzy analytic hierarachy process approach for transport problems?"

[4] Avadhesh Kumar, P.S. Grover, Rajesh Kumar: "A Quantitative Evaluation of Aspect-Oriented Software Quality Model (AOSQUAMO)". ACM SIGSOFT Software Engineering Notes, Volume 34 Number 5: September 2009.

Part B

Table D1: Constant Comparison and Memoing within data source (P23 and P13 and P17)

Similarity type	**Data units having similarity**	**Suggested names of data units having similarity**	**Reason of modifications**
Explicit	*d1-accessible for users* *d2-Access information,* *d8-accessibility problems* *d34-easy accessing to the user,*	Accessibility to information	Data items (d1, d2, d8, d34) are directly demonstrating and linked with each other. And familiar in textual form also. We together them and tagged them with the term **"Accessibility to information"**
Explicit	*d6-Effectively access services* *d7-accessibility features* *d45- accessible in a very efficient way*	Accessibility to services	Data items (d6, d7, d45) These three data items are focusing towards one thing that is actually the access towards all the services provided on websites. We group them together and name "**Accessibility to Services**"
Implicit	*d9-number of web pages,* *d15-aesthetic,* *d16-logics,* *d17-technology* *d61-Menus or links*	Layout	Data units (d9, d15, d16, d17, d61) are linked with each other in meanings and showing one direction. We assemble them into one name "**Layout**"
Explicit	*d38-user friendly interface* *d60-Website should be friendly* *d3- efficient, effective and satisfactory*	User interface	Data units (d38, d60, d3) directly showing the relationship between each other and are same in meanings. We tagged them into single data unit name **"User interface "**
Implicit	*d18-web designer* *d21-Simplicity in learning,*	Graphical Design	Data items (d18, d21, d57, d59, d70, d71)

	d57-Designed *d59-attractiveness* *d70-design a website* *d71-attractive manner*		These data item are similar in meanings. Each data item of them direction towards graphical design of website so Thus, we name it **"graphical design"**
Explicit	*D14-Usability is the determining factor.* *d29-usability of a website* *d68-usability of the website*	Usability	Data item (d14, d29, d68) directly focusing towards one way. And are synonyms of each other. We together them into one name "**Usability**"
Implicit	*d32 –satisfaction* *d48-ease of use* *d56- Easy to understand.* *d46-simple in terms of operations*	Easiness & Understand ability	Data item (d32, d48, d56, d46) are same in meanings and have relationship between them that is pointing "**Easiness & understand ability**"
Explicit	*d3- efficient, effective and satisfactory Manner of main page* *d22- effectiveness and pleasure for the users.* *d30-effectiveness,* *d31-efficiency and* *d41- efficiency* *d64-very fast and should easily* *d73-efficiency*	Efficiency & Effectiveness	Data item (d3, d22, d30, d31, d41, d64, d73) are synonyms of each other and exactly same in meanings. We combined them into single data unit and named it as **"Efficiency & Effectiveness"**
Explicit	*d33-customer service support,* *d43 -"the number of users,* *d66-user experience* *d69-User Satisfaction*	User satisfaction	These four data items (d33, d43, d66, d69,) show relationship among each other. They are identical in their meanings. We combine them all and suggest them with one name **"User satisfaction"**
Explicit	*d72- User's need.* *d42-needs of the customers* *d50-needs of customer*	User needs	Data items (d72, d42, and d50) these three data units Shows a similar meaning of user needs and are synonyms of each other. We tagged

			them as single name "**user needs**"
Implicit	*d65-Loading time* *d27- Stickiness and backlink.* *d23-page load time,* *d26-Traffic,* *d40-speed,* *d65-Loading time*	Speed	These data units (d65, d27, d23, d26, d40, d65) represent the link between times of utilizing services provided on website. We tagged them together as "**Speed**"
Explicit	*d44-services* *d58-quality of services* *d51-demand for mobile application* *d52-mobile website*	Web apps & Quality of services	Data units (d44, d58, d51, d52) are pointing towards one direction of website services. They are synonyms in meanings Thus, we combine them together and a lot them a name "**Web apps & Quality of services**"
Implicit	*d4- smooth processing of course registration* *d24-Page rank,* *d36 –transaction* *d49-FAQ* *d39-recovery of password,* *d53-Error notification* *d75-Helps user to search easily.*	Feedback & recovery Services	Data items (d4, d24, d36, d49, d39, d53, d75) all are focusing towards the different services and facilities that should be provided on website. Thus, we combine them all together into one name **"Feedback & recovery Services"**
Explicit	*d35- safe and successful* *d37- privacy,*	Security	(d35, d37) these two data items are directing towards same point. Same in meaning and have relationship that leading towards the website security feature .hence we name it as **"Security"**

Table D2: Primary list of identified data units

Data units	Paper ID's Data units
Access information, Easy accessing to the user Effectively access services Accessible in efficient way	[P1] [P13] [P25]
Layout website design User-centred design Simplicity in learning, aesthetic, logics, technology Website should be friendly Pedagogy based design Responsive design Universal design Visual design Menus or links number of web pages, Attractive Appropriateness Colour Image/Sound/Video Text Index Mapping Consistency Links Logo domain Usability Reliability Interactivity features Security/Priv. Customization	[P10] [P12,P13,P14] [P7][P15,P19] [P20,P21] [P3,P27] [P4,P6,P9] [32]

customer service support, number of users, user experience User Satisfaction needs of customer User satisfaction Customer-support-system Simplicity Ease of use User's need.	[P27,P29] [P2 ,P13]
services quality of services Information quality Content Quality Legal policies Access to relevant data Feedback Email responsive demand for mobile application mobile website smooth processing of course registration Page rank, transaction FAQ recovery of password, Error notification Helps user to search easily. Accuracy Relevant Grammatical errors Up-to-date Information source Compatibility Ease of learning Interaction Downloading Usability Error recovery	[P2] [P4] [P9] [P13] [P24.P25] [P14,P15] [P16] [P17] [P19,P20] [31]
Accessibility Performance User satisfaction Attractiveness Usability Consistency Functionality	[p10] [P2] [P6,P11,P17]

Readability Understand ability Efficiency Maintainability Portability Information accuracy Usability is the determining factor. usability of the website satisfaction ease of use *Easy to understand.* simple in terms of operations efficient, effective and satisfactory Manner of main page Effectiveness and pleasure for the users. effectiveness, efficiency and efficiency very fast and should easily efficiency Loading time Stickiness and backlink. page load time, Traffic, speed, Loading time	[P15,P18] [P19] [P20] [P21,P22]
Interactivity Visual appearance Content Search tools Sitemap Search functions Text Colour Font Utility of content Colour contrast Link visibility Label caption Completeness of information Convenience of navigation tools Links to other sites Ease of use of navigation	[P2] [P4,P6,P8] [P15] [P20] [P21] [P30] [P1]

tools Search engines Loading speed Site map Graphic representation Readability of content Multimedia Design characteristics Aesthetics in content presentation	
Privacy & security safe and successful privacy	[P5,P15,P20]
SEO	[P6,P16]
Content Visual complexity Page out degree Layout User interface User friendly Visual attraction Navigation Links Language Attractive Appropriateness Colour Image/Sound/Video Text Landing pages Number of web pages Information quality Readability of text Visual appearance Information variety Screen appearance Text Colour Font Style	[P6,P8] [P10] [P11] [P13] [P14,P15] [P16] [P32] [P17,P18] [P19] [P20] [21]

PART C

Table D3: Constant Comparison and Memoing among (P23 and P13 and P17)

Paper id	Similarity type	Data units having similarity	Suggested names of data units having similarity	Reason of modifications
P23	Explicit	Accessibility to information	Website Accessibility	Data units "accessibility to information" & "accessibility to services" are more specific which can be covered by single data unit "website accessibility". And both data units shows the same point of interest .Thus, we moved both into single unit "website accessibility"
P13		Accessibility to services		
P23	Implicit	Layout	GUI	"GUI" is an abstract form which can represent data units "Layout", "mobile friendly" and "Graphical design". These data units are basically identical in meaning and direction. Thus to represent the compact form of them we combine them into one name "GUI".
P13		Mobile friendly		
P17		Graphical design		
P23	Implicit	Usability	Website Usability	"usability" , "performance" and "Efficient & Effectiveness" these all data items pointing towards the property of usability of website as logically they are similar to each other. We grouped
P13		performance		
P17		Efficient & Effectiveness		

				them into abstract data unit "website usability"
P23 P17	Explicit	User satisfaction User needs	User requirements	"User satisfaction" & "user needs" these data items are same in meanings thus Instead of using these general data units we combine them into more specific category "user requirements"
P23 P13 P17	Explicit	Speed SEO Feedback & recovery services	Website services	"Speed", "SEO" and "Feedback & recovery services" are more specific data units that are pointing towards the services of different type such as application services, recovery services. We combine them all in an abstract data unit name "website services"
P13 P17	Explicit	Security	Website security	It will remain as web security

APPENDIX E

PART A

Table D4: constant comparison and memoing for assigning accurate naming conventions to primary identified factors

List of primary Data units	Renamed List of data units	Reason for renaming
1. Access information, 2. Easy accessing to the user	Easy access to information	" Access information" and " Easy accessing to the user" are synonyms thus renamed into one data unit " Easy access to information "
3. Effectively access services 4. Accessible in efficient way	Rapid access to information	" Effectively access services " and " Accessible in efficient way" similar in meaning thus renamed as "Rapid access to information"
5. Simplicity in learning,	Simplicity in learning	Remain same
6. Technology 7. Image/Sound/Video	Multimedia (video, audio, images) used.	" Technology and Image/Sound/Video" has same direction which shows use of multimedia in website thus renamed into one data unit "Multimedia (video, audio, images) used."
8. Website should be friendly	Website should be friendly/user friendliness	Remain same
9. Layout website design 10. User-centred design 11. Pedagogy based design 12. Responsive design 13. Universal design 14. Visual design	well-designed & structured website	" Layout website design ,User-centred design, Pedagogy based design, responsive design, and Universal design and Visual design" these data units are not similar nor synonyms of each other but as they are very deep in knowledge and hard to understand for a naïve user thus renamed into a simpler term "well-designed & structured website"
15. Menus 16. or links 17. number of web pages,	Menu are properly labelled/consistent menu orders	"menus" , "links" and "number of web pages" data units are incomplete in their expression thus

	Active links behind labels Sufficient numbers of web pages.	defining them into complete name renamed them as " Menu are properly labelled/consistent menu orders , Active links behind labels and Sufficient numbers of web pages."
18. Logo 19. domain 20. Index	Unique identification of website /unique monogram Proper indexing of webpages /URL	"logo" , "domain" and "index" data units seems incomplete in their terms of expression thus renamed as " unique identification of website /unique monogram Proper indexing of webpages /URL"
~~21. attractive~~ ~~22. Appropriateness~~ ~~23. Mapping~~ 24. Consistency 25. Reliability ~~26. Links~~ ~~27. Usability~~ ~~28. Interactivity features~~ ~~29. Customization~~	Consistency in information Reliability of information	Data units "consistency" and "reliability" seems incomplete in expression thus for more clear understanding renamed as " Consistency in information " And "Reliability of information".
30. Security/Priv.	Personal bio data of user is secured in website./User privacy is assured/Website is secured	Data unit "Security/Priv." is more clearly renamed as "Personal bio data of user is secured in website. User privacy is assured/Website is secured".
31. customer service support, 32. User Satisfaction 33. needs of customer 34. User satisfaction ~~35. user experience~~ ~~36. Customer support system~~ ~~37. Simplicity~~ ~~38. Ease of use~~ ~~39. User's need.~~	Availability of user support services	Data units "customer service support, User Satisfaction, needs of customer and user satisfaction" have same direction and almost similar in meaning thus for more convenient rename as "Availability of user support services".
40. demand for mobile application 41. mobile website	Availability of necessary apps for user like GPA calculator Mobile Website is available /machine independence/OS portability	To give data units " demand for mobile application" and " mobile website" more clear and understanding meaning renamed "Availability of necessary apps for user like GPA calculator Mobile Website is available /machine independence/OS portability"
42. Feedback 43. Email responsive	Quick feedback	"feedback" and "email response" are similar in meaning thus

		renamed as “Quick feedback”
44. Access to relevant data	Access to relevant data	Remain same
45. Compatibility 46. Downloading ~~47. services~~ ~~48. Legal policies~~ 49. ~~transaction~~ ~~50. Relevant~~ ~~51. Ease of learning~~ ~~52. Interaction~~ ~~53. Usability~~ ~~54. Error recovery~~	Website compatibility with browsers Information downloading speed	Data unit “compatibility” and “downloading” seems incomplete in terms of expressions thus renamed into “ Website compatibility with browsers ” and “ Information downloading speed” to make them more clear in naming conventions.
55. Grammatical errors 56. Up-to-date 57. Information source 58. Accuracy	grammatical errors free content Up-to-date information Information sources are authentic Information accuracy	Data units “Grammatical errors, Up-to-date, Information source and Accuracy “ needed to be assigned explanatory naming conventions to make them more clear to user thus renamed as “grammatical errors free content, Up-to-date information And Information sources are authentic Information accuracy”
59. Page rank,	Website page ranking	Remain same
60. Error notification 61. Helps user to search easily. 62. FAQ 63. recovery of password,	Timely error notifications Helps user to search easily Feature of FAQ Quick recovery of user passwords	Data units “ Error notification, Helps user to search easily, FAQ and recovery of password, ” are renamed just make their wording more clear to user such as “ Timely error notifications , Helps user to search easily, Feature of FAQ and Quick recovery of user passwords”.
64. Consistency 65. Readability 66. Understand ability	Information consistency Readability of text Understand ability of text	Data unit “ Consistency, Readability and Understand ability” are more general in meaning to make them specific according to user point of view renamed as “Information consistency, Readability of text and Understand ability of text ” .
67. Maintainability	Displayed information is not overloaded	Data unit “Maintainability” is more general in meaning which may be un easy to understand for user .thus renamed as” Displayed information is not overloaded” to make it clearer.

68. Stickiness and backlink. 69. page load time,	Page stickiness in display	"Stickiness and backlink. " And "page load time" similar in meaning thus renamed as "Page stickiness in display".
70. simple in terms of operations	simple in terms of operations	Remain same
71. Interactivity 72. Visual appearance 73. Content 74. sitemap 75. Text 76. Colour 77. Font	Visual interaction Website content Sitemap availability /website guide/website catalogue Attractive look and feel	Data units " Interactivity, Visual appearance, Content , sitemap, Text, Colour and Font" are general in terms of expression to make them more customized for the users renamed as " Visual interaction , Website content ,Sitemap availability /website guide/website catalogue And Attractive look and feel "
78. usability of the website	Usability of the website	Remain same
79. Smooth processing of course registration	Smooth processing of course registration/smooth data processing	Remain same just a slight change
80. Convenience of navigation tools 81. Links to other sites	Convenience of navigation tools External Links	Remain same just a slight change
82. Utility of content 83. Completeness of information 84. Aesthetics in content presentation 85. Graphic representation 86. efficient, effective and satisfactory Manner of main page 87. Effectiveness and pleasure for the users. ~~88. Accessibility~~ ~~89. Performance~~ ~~90. User satisfaction~~ ~~91. Attractiveness~~ ~~92. Usability~~ ~~93. Functionality~~ ~~94. Efficiency~~ ~~95. Portability~~ ~~96. Information accuracy~~ ~~97. Usability is the~~	Utility of content Aesthetics in content presentation Completeness of information Good graphic presentation	Remain same just a slight change

~~determining factor.~~ ~~98. satisfaction~~ ~~99. ease of use~~ ~~100. Easy to understand.~~ ~~101. effectiveness,~~ ~~102. efficiency and~~ ~~103. efficiency~~ ~~104. very fast and should easily~~ ~~105. efficiency~~ ~~106. Loading time~~ ~~107. Traffic,~~ ~~108. speed,~~ ~~109. Loading time~~ ~~110. Ease of use of navigation tools~~ ~~111. Search tools~~ ~~112. Sitemap~~ ~~113. Search functions~~ ~~114. Loading speed~~ ~~115. Site map~~ ~~116. Readability of content~~ ~~117. Multimedia~~ ~~118. Design characteristics~~		
119. Privacy & security 120. safe and successful 121. privacy	Secure website Safe and successful data entry	Remain same just a slight change
122. Language	Familiar Website language.	To make Data unit "language" more clear in understanding renamed as "familiar website language"
123. SEO	Easy to google	Data unit "SEO" is more general to make it specific and easy for user renamed as "easy to google"
124. Layout 125. User interface 126. Navigation 127. Information 128. variety ~~129. User friendly~~ ~~130. Content~~ ~~131. Visual complexity~~ ~~132. Page out degree~~ ~~133. Visual~~	Attractive Layout of website Attractive user interface Proper Navigations/easy navigation Availability of variety of information/diversity of information	Data units " Layout, User interface, Navigation and Information variety" are renamed into "Attractive Layout of website, Attractive user interface ,Proper Navigations/easy navigation And Availability of variety of information/diversity of information " because these terms are more clear in meaning and understanding for the users.

~~attraction~~ ~~134. Links~~ ~~135. Landing pages~~ ~~136. Number of web pages~~ ~~137. Information quality~~ ~~138. Readability of text~~ ~~139. Visual appearance~~ ~~140. Screen appearance~~ ~~141. Text~~ ~~142. Colour~~ ~~143. Font~~ 144. ~~Style~~		
All the data units which are strikethrough are similar, repeated or not related to research. Thus removed from primary factor list.		

PART B

Table D5: Constant comparison and memoing between data units to generate list of unique data units

Renamed List of data units	Unique Data units	Reason for modification
1. Easy access to information	1. Easy access to information	Remain same
2. Rapid access to information	2. Rapid access to information	Remain same
3. Simplicity in learning	3. Simplicity in learning	Remain same
4. Access to relevant data	4. Access to relevant data	Remain same
5. simple in terms of operations	5. simple in terms of operations	Remain same
6. Website language is understandable	6. Familiar language	"Website language is understandable" data unit seems a very explanatory sentence to make it in appropriate point , replaced as "familiar language"
7. Website should be friendly/user friendliness	7. User friendliness	Data unit "website should be friendly" is seems like an explanatory sentence, renamed as "user friendliness" to make it more compact and to the point.
8. Multimedia (video, audio, images) used.	8. Entertaining	Data units "Multimedia (video, audio, images) used" shows the videos/photo gallery of the website. This data unit is replaced with the more common term "Entertainment" to make it more clear
9. Standardized website design/Standardized website visual design/well-designed & structured website	9. Well structured	To avoid any knowledge complexity from naïve user the word "standardized" is replaced with "well" to make it simpler. So this way "well structured" data unit is formed.
10. Menu are properly labelled 11. Active links behind labels	10. Consistent and active menus links	Data units " Menu are properly labelled " and " Active links behind labels " both shows the same direction towards proper functioning and labelling of menus so merged into one data unit " Consistent and active menus links" to make it more Concise.

12. Unique identification of website /unique monogram 13. Proper indexing of webpages /URL	11. Organization	" Unique identification of website /unique monogram " And "Proper indexing of webpages /URL" talks about monogram and URL of website. And these two terms lies under the identity of organization, thus replaced as "organization".
14. Smooth processing of course registration/smooth data processing	12. smooth course registration	Almost same just a slight change by removing word processing to avoid any complexity for a naïve user.
15. Consistency in information 16. Displayed information is not overloaded	13. Consistent Information	"Consistency in information" and "Displayed information is not overloaded" are merged together as the term consistent also shows that information is manageable and arranged in display.so thus renamed into one data units "consistence Information"
17. Quick recovery of user passwords	14. Quick recovery of user passwords	Remain same
18. Reliability of information	15. Reliable Information	Remain same
19. Personal bio data of user is secured in website./User privacy is assured/Website is secured	16. privacy & security of User data	To make data unit "Personal bio data of user is secured in website. /User privacy is assured/Website is secured" more to the point renamed as "User data privacy & security".
20. Feature of FAQ	17. Feature of FAQ	Remain same
21. Timely error notifications	18. Timely error notifications	Remain same
22. Availability of necessary apps for user like GPA calculator	19. Facility of Website apps	Almost same just a slight change in naming convention
23. Mobile Website is available /OS portability	20. platform independent website	Almost same just a slight change in naming convention
24. Quick feedback 25. Quick email response 26. Availability of user support services	21. Quick response to user	Data units " Quick feedback" , " Availability of user support services" and " Quick email response" merged together into one data unit "" because both are similar in meaning
27. Up-to-date information	22. Up-to-date information	Remain same
28. Information sources are authentic	23. Accurate information	"Information sources are authentic "and "Information accuracy" merged

29. Information accuracy		together in one data unit "Accurate information" as both are similar in meanings.
30. Website compatibility with browsers	24. Website compatibility with browsers	Remain same
31. grammatical errors free content 32. Information consistency 33. Readability of text 34. Understand ability of text	25. Utility of content	Data units "Grammatical errors free content", "Information consistency ", "Readability of text" and "Understand ability of text" seems to be various directions of term utility. thus all are merged together under one abstract data unit "utility of content"
35. Attractive Layout of website 36. Attractive look and feel 37. Displayed information is not overloaded 38. Responsive screen	26. Attractive look and feel	" Attractive Layout of website , Attractive look and feel , Displayed information is not overloaded, AND Responsive screen" all have same direction and similar in meaning as they are related to look and feel of a website thus merged together and renamed as "attractive look and feel"
39. Helps user to search easily	27. Helps user to search easily	Remain same
40. Website page ranking 41. Website popularity 42. Easy to google	28. Website Popularity	" Website page ranking and Website popularity and Easy to google" showing the same direction and concerned. And they are similar in logic and meaning .thus merged together and renamed as "Website Popularity" which shown more concise and Compaq point.
43. Sitemap availability 44. website catalogue	29. website guide	" Sitemap availability And website catalogue" are similar in meaning and helping user to get website guide thus renamed as " website guide"
45. Convenience of navigation tools	30. Convenience of navigation tools	Remain same
46. External Links	31. External web Links	Remain same
47. Aesthetics in content presentation	32. Aesthetics in content presentation	Remain same
48. Secure website 49. Safe and successful data entry	33. Security & privacy of user data	"Secure website and Safe and successful data entry " Data units merged into one "Security & privacy of user data" which shows more

		appropriate naming convention.
i. 50. Consistency in information	34. Consistency in information	Remain same
51. Up-to-date information	35. Up-to-date information	Remain same
52. Completeness of information	36. Completeness of information	Remain same
53. Availability of variety of information	37. diversity of information	Remain same

PART C

Table D6: Constant Comparison and Memoing among All selected articles

Similarity type	**Data units having similarity**	**Suggested names of data units having similarity**	**Reason of modifications**
Implicit	Easy access to information Rapid access to information Access to relevant data	Accessibility	"Easy access to information", "Rapid access to information" AND "Access to relevant data" expressing the attributes of easy, rapid and relevant access to information. They are basically directing towards the accessibility. Thus assigned a broad name as "Accessibility"
Explicit	Simplicity in learning Simple in terms of operations	Simplicity	"Simplicity in learning" AND "Simple in terms of operations" both data units show the simplicity quality of learning and operation. Thus assigned name as "Simplicity"
Explicit	Familiar language	Understand ability	"Familiar language" data unit is assigned a generic name "understand ability"
Implicit	Entertaining (Multimedia (video, audio, images) used.) User friendliness Smooth course registration	Visual interaction	Data units "Entertaining (Multimedia (video, audio, images) used.)" , "User friendliness" AND "Smooth course registration" are similar in logic as they are sub-points of visual appearance thus assigned with a broad name "visual interactions"
Implicit	Quick recovery of user passwords Feature of FAQ Helps user to search easily Timely error notifications Quick response to user Website guide	User services	"Quick recovery of user passwords" , "Feature of FAQ" , "Helps user to search easily" , "Timely error notifications", "Quick response to user" AND "Website guide" data units concerned with the need and facilities provided to user thus have the direction towards services of users. Thus, suggested a name "user services" at a broader level.

Implicit	Displayed information is not overloaded Speed of page loading Attractive look and feel Well structured platform independence website Website compatibility with browsers	Aesthetically pleasing interface/Graphical user interface	Data units "Displayed information is not overloaded" , "Speed of page loading" , "Attractive look and feel" , "Well structured" , "platform independence website" and "Website compatibility with browsers" all pointing towards the physical appearance of interface, the front look and feel and structure.as these all attributes are related to GUI thus tagged into one name as "Aesthetically pleasing interface/Graphical user interface "
Explicit	consistent & active menu links website user guide Convenience of navigation tools External web Links Responsive home page	Page management	Data units "consistent & active menu links", "website user guide", "Convenience of navigation tools", "External web Links" AND "Responsive home page" expresses the interconnection of website links on website pages & similar in logic and direction. Thus these all data units tagged into one name "page management"
Implicit	Organization Security & privacy of user data Facility of Website apps	Website identity	"Organization" , "Security & privacy of user data" AND "Facility of Website apps" data units basically discuss about the unique qualities of site thus tagged into one name "Site identity"
Explicit	Website Popularity	SEO	"Website Popularity" is similar in meaning with search engine optimization ,thus suggested a name with "SEO"
Explicit	Consistency in information	Information structure	"Consistency in information" , "Accurate information" , "Up-to-

	Accurate information		date information" , "Utility of content" , "Aesthetics in content presentation" , "Completeness of information" AND "diversity of information" are similar in logic and direction.as all these data units expresses the attribute of information provided on website thus suggested a name as broader term "information structure"
	Up-to-date information		
	Utility of content		
	Aesthetics in content presentation		
	Completeness of information		
	diversity of information		

APPENDIX F

PART A

Biodata form of Experts

NAME	
COMPANY NAME	
DESIGNATION	
WORK EXPERIENCE	
EMAIL ID	
GENDER	
AGE	

PART B:

Focus Group Questionnaire

1. In your opinion does proposed scale is helpful for quality assessment of educational website? (how)

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2. In your opinion, to which extent the proposed scale can contribute in raising the standard of higher education websites?

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_____

3. What are the strengths and weaknesses of proposed scale to evaluate the quality of higher education websites?

Strength	**weaknesses**

4. Do you see any problem in scale comprehension?

_____
_____
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5. In your opinion what could be the organizational barriers to the proposed scale adoption?

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_____

6. Do you think there is any important quality factor that is not added in proposed scale? If yes kindly briefly describe.

_____
_____
_____

7. In your view point how the proposed scale can be deployed in practice?

8. What aspects of scale can be improved and how?

9. Is the proposed scale is understandable? If not, kindly highlight the barrier.

10. Is there anything else you would like to say about our research?

Table 5.2: Evolution of proposed Usability Scale

Factors	**Sub-Factors**	**Highly-significant**	**Significant**	**Moderate**	**Neglect-able**	**Neutral**
Accessibility	Easy access to information					
	Rapid access to information					
	Access to relevant data					
Simplicity	Simplicity in learning					
	Simple in terms of operations					
Understand ability	Familiar language					
Visual interaction	Entertaining					
	User friendliness					
	Smooth course registration					
User services	Quick recovery of user passwords					
	Feature of FAQ					
	Helps user to search easily					
	Timely error notifications					
	Quick response to user					
	Website guide					
	Displayed information is not overloaded					

Aesthetically pleasing interface/Graphical user interface	Speed of page loading					
	Attractive look and feel					
	Well structured					
	platform independence website					
	Website compatibility with browsers					
Page management	consistent & active menu links					
	Convenience of navigation tools					
	External web Links					
	Responsive home page					
Website identity	Organization					
	Security & privacy of user data					
	Facility of Website apps					
SEO	Website Popularity					

Information structure	Consistency in information					
	Accurate information					
	Up-to-date information					
	Utility of content					
	Aesthetics in content					
	Completeness of information					
	Diversity of information					
"Highly Significant" = 5, "Significant" = 4, "Moderate" = 3, "Neglect-able" = 2, "Neutral" = 1.						

PART C

Table 5.3: FGD agenda planner Execution

TIME DURATION	**Researcher**	**Experts**
10-15 mints	Greetings. Self-introduction. Clarify Purpose of FGD.	Greetings. Experts May ask question about research and focus group.
15 mints	Presentation of Topic	Experts May ask question about research Topic
30 mints	Answer –question session.	Experts express opinions and comment on usability scale guidelines
15 mints	Interpreting and analyzing the expert's opinion. Summarizing Discussion	Experts may share their experiences regarding this research and adding concluding remarks.