



COMPARATIVE EXPLORATORY STUDY OF USABILITY EVALUATION TECHNIQUES FOR HEIs WEBSITES

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ABSTRACT

University websites are vital for students as well as the faculty members for providing updated information. These websites can be accessed by the general public for accessing certain piece of information. Hence, the role of university websites becomes critical, therefore, usability becomes significant. Various interaction problems have been experienced by the users while accessing university websites. To minimize these interaction problems, different usability evaluation techniques have been adopted lately. This paper compares two usability evaluation techniques namely questionnaire-based (QB) and the focus group (FG) by performing three user studies for evaluating the university websites. These techniques have been applied to evaluate and compare usability factors; efficiency, learnability, memorability, satisfaction, and error. The results have been verified using the Wave accessibility tool and validated by ANOVA. The results have shown that the focus group testing technique performs better than the questionnaire-based testing technique in terms of efficiency, number of errors, learnability, and satisfaction.

Keywords: web usability; usability testing technique; questionnaire-based; focus group.

1. INTRODUCTION

People from different backgrounds and ages use the Internet for different purposes [1]. In the globalizing world, websites are emerging as an important component for an organization's survival especially for university websites [2]. There are approximately 162 universities in Pakistan, 93 are public sector universities, 64 in the private sector and 5 universities are operational under armed forces. These universities are recognized by the Higher Education Commission (HEC) of Pakistan. However, there are some universities that are not recognized by HEC. Usable university website should have [4]; easy to use, easy to learn, easy to understand, provide information to all users, good interface, good performance, accessibility, information search, up-to-date information, download time, use of color, and registration information. There are many methods for the evaluation of usability of the websites like scenario, paper prototype, email, think-aloud procedure, co-discovery learning, eye tracking, and user testing [5]. Usability testing is an essential process in the human-computer interaction for designing an interface. It is a procedure of gathering usability data of an interface and also assessing and improving the interface [3].

This paper is focused on the comparison of two usability evaluation techniques. Usability evaluation techniques are compared for the website evaluation. This comparison helps that which technique is better for evaluating website usability. To improve the website usability aspects, these techniques are evaluated. Three user studies are performed to evaluate these techniques and results are shown through tables and graphs.

A. Techniques Used for Comparison

This research focuses on two techniques. One is a questionnaire based while the other is observation-based. The questionnaire-based testing technique is used to evaluate the usability of university websites. The

questionnaire was the instrument for data collection. Questionnaires were issued to the respondents through self-introduction. Frequencies, descriptive statistics, and inferential statistics were used on the data gathered through usability studies. Microsoft Excel was also used to complement SPSS software for data analysis [6].

Focus group is a small group that normally consists of six to ten participants [7]. They discuss their ideas with each other through a skilled moderator and provide their point of view. Secondly, the focus group testing technique has been used to evaluate the usability of the same website. These techniques are discussed as follows:

B. Questionnaire Based Testing Technique

Questionnaires are useful post-data collection instruments to measure user satisfaction and to obtain user comments on system usability [8, 9]. European University of Lefke website evaluated for the usability perspectives using WAMMI questionnaire which utilizes five key factors: (1) attractiveness; (2) controllability; (3) efficiency; (4) helpfulness; and (5) learnability [10, 11]. There are different types of questionnaire (e.g., closed or open), examples of common satisfaction/usability questionnaires are: System Usability Scale (SUS) [12, 13], Questionnaire for User Interaction Satisfaction (QUIS) [13], Computer System Usability Questionnaire (CSUQ) [12, 14], Software Usability Measurement Inventory (SUMI) [15, 16], End-User Computing Satisfaction Questionnaire (EUCS) [17] and Website Analysis and Measurement Inventory (WAMMI) [18, 19, 20].

A user testing was utilized to gauge the client execution on the chose assignments and a poll to evaluate the client fulfillment on the website usage [11]. Both convenience assessment strategies were connected to the pre-decided undertakings for every college by involvement of 20 subjects. After the ease of use



assessment, the colleges were positioned as far as ease of use comes about lastly [11]. A few basic ease of use issues were attested by related past usability evaluations. They were distinguished toward the finish of convenience assessment of college sites. The ease of use comes about likewise uncovered that those Turkish university websites to experience the effects of various convenience issues. Several studies showed the importance of usability for higher education websites [21, 22, 23]. Additionally, time becomes more important day by day especially for the academic staff and students, hence university websites should be designed in such a manner that the desired information can be easily found and they should also be easy-to-use, and efficient [23].

C. Focus Group Technique

A few people even end up exchanging their contemplations and conclusions amid the gathering. "It is especially powerful in giving data concerning why individuals think or feel the way they do." [24-26]. Advantages of this technique are:

- a) Can provide speedy results
- b) Structured data can be collected
- c) Planning can enable in-depth discussion

Following are some disadvantages of focus group technique:

- a. Recruitment can be expensive, time consuming
- b. Controlled settings may affect behaviors
- c. Data can be difficult to be analyzed [26].

Software developers should design a GUI or website in such a way a user can use it easily and efficiently [27]. These users sit before a PC and solicited a few sorts of questions, contingent upon what we need to test. At that point, they are asked to discover replies of questions we give them while perusing a page. Users are, ideally individuals who could be considered as normal users, which implies no specialists in a given field. What occurs next is that the individual is requested to work with the framework normally while engineers are watching this individual. Their subject is clicking where he shouldn't and every one of those critical connections and pictures stays unnoticed. With this passage of learning, planners typically change the outline a bit and lead a similar investigation once more [28, 29, 30].

2. LITERATURE REVIEW

Websites are a popular medium for information sharing. University websites are created and maintained for students and teachers for information and news update to facilitate them. Websites must be user-friendly in order to become effective. It should be designed in such a way

that users can easily retrieve information from the websites they require [31]. If a website is not clear, users will get lost on a website, ultimately they will not use it again [32]. If a website's information is difficult to read or understand or doesn't answer users' key questions, they will not use it again and again [32].

University websites should be designed in such a manner that a user can use them easily. Usability is an important feature for the survival of the website. If a user does feel difficulty while using a website, he may leave it [32]. The usability of a website is important if it satisfies user's needs and expectations [2]. Usability is the quality attribute that measures the easiness of an interface [32].

Ease of use is generally perceived as a stand out amongst the most essential quality variables of data frameworks. Distinctive ease of use models for customary data frameworks has been proposed. The present development towards online data frameworks (WBIS) requires the requirement for uncommon ease of use models for these frameworks. The Ease of use Estimation Show (UMM) is based on the focal points and quality of convenience models; ISO-9126-1 programming quality standard, McCall demonstrate, site QEM display, and 2QCV3Q model [33]. Owoh discussed the five essential usability tips that are a must for any website such as search feature, web page organization, and layout, keeping interface consistency, web form, and help features.

Convenience has been called "the ability to be utilized by people effortlessly and successfully" [22, 34] "quality being used" [34, 35]; and "the viability, effectiveness, and fulfillment with which indicated clients can accomplish objectives specifically situations" [34, 36]. Nielsen recommends that convenience is made out of an arrangement of ideal models, standards, and traits [32]. A key research question in HCI is how to work with and enhance the convenience of intuitive frameworks. Research tending to this inquiry has prompted rules for enhancing the ease of use of frameworks [37], strategies for anticipating ease of use issues [24], methods to test the ease of use of frameworks [14], and dialogs on the most proficient method to quantify ease of use [38, 39, 34].

Another study reported that more libraries are developing websites and that several university libraries have developed their own websites [41]. Some sites are still made up of static web pages with minimum information is uploaded about the library resources, staff, and services [42].

Usability testing has proved to be a useful technique for evaluating the effectiveness of academic library websites; thus, the researcher decided to make use of this technique for exploring the usability of the CIIT library website from the user perspective [42]. "Investigating the use of web portals through qualitative research is important because of its main role for dissemination of the information resources and services" noted [43]. Regarding websites, it is believed that "evaluation is essentially a valuable judgment of web site usefulness with numerous other components that facilitate in browsing, navigation, searching and locating the desired information"; in other words, it is a means of judging the



performance against users' expectations [44]. It is guaranteed that there is no settled model for ease of use assessment [40]. He additionally meant that the accessible writing features the utilization of formal ease of use testing (through verbal process convention and center gatherings) in a considerable lot of the contextual investigations. Client overviews, client perception, and heuristic assessment techniques were additionally used to assess the ease of use of library sites. Site convenience is a fundamental component in the outline and improvement of a site. The capacity to recover data successfully is basic to any client perusing the Web, particularly youthful understudies [1]. Various appraisal techniques have been proposed to assess convenience. These incorporate master assessment, agenda, site utilization insights, center gatherings, client criticism, and heuristic assessment. The vast majority of the assessment techniques include polls for removing, recording, and gathering data to decide client fulfillment with the site [5].

A standout amongst the most mainstream methods for assessing ease of use is by directing ease of use tests, especially, client tests [9]. Where the issues have been identified with any part of the quality being used of a web application: viability, productivity, or fulfillment being used [36]. This system of ease of use testing is client particular. Center gathering procedure is utilized for current investigation instead of quantitative outline utilized by the main creator for the convenience assessment of the College of the Punjab Site in a prior examination [46].

Websites are also used as means of communication and public relations to promote organizational identities. Also, websites provide the interfaces for the interactions between humans and computer systems. The underlying web applications provide the driving force for website interactions. Websites are most times developed by non-experts, that is, people who are neither computer scientists, information technology (IT) specialists nor interaction design experts. This heterogeneous background of the people involved in the development of websites calls to question the quality of websites [47].

The primary focus of accessibility is access by people while usability focuses on the elements of learnability, memo ability, effectiveness, efficiency, and satisfaction for all website users [48, 6].

3. METHODOLOGY

The comparison between usability techniques is based on usability factors. Usability has five factors which are Efficiency, Learnability, Memorability, Error, and Satisfaction [38]. The user compares these techniques according to these factors by using a website [38]. Usability evaluation techniques are compared for making a website more usable for users. Data is collected through three user studies and usability factors are used for comparing in these user studies. This research is based on the evaluation method.

A quantitative research method [45] may not be well suited for data collection in such a scenario. Each

participant will be observed to know that whether they are succeeding or facing difficulties. In Questionnaire Testing Technique, a questionnaire can be used to take the general information of the users, having a consent form also. Then the users will be asked to perform the representative tasks on the websites. After the user testing post-test questionnaire was filled up by the user, which helped to evaluate the results. The results were evaluated through SPSS.

Qualitative method based on observation includes the focus group technique. Usability inquiry involves experts to get information about the user requirements while users are using the system. When a user communicates with system, experts observed them [46]. The Focus group technique is used for user study that opposes the quantitative design used by the principal author for the usability evaluation of the University of the Punjab Web site in an earlier study [46].

This technique is used to observe the users while performing tasks. A Focus group is a technique in which eight to ten participants are gathered and give their suggestions on the website. They also provide feedback about issues with the website. After completing the discussion, data is gathered and results are compiled. In order to gather quantitative and qualitative data from the students as regards their preferences with the tested websites, even though there are many validation usability scales that are available [20]. Usability evaluation has been performed using both methods and techniques are also evaluated. This helps to compare the techniques used in this research.

4. RESULT AND DISCUSSIONS

First user study is based on the questionnaires testing technique. To evaluate the usability technique, a website is selected. Firstly, a website is evaluated then the questionnaire usability evaluation technique is evaluated. The results after evaluation are gathered and shown in the graph. The following graph shows the standard deviation (SD) and mean of each question asked in the user study for evaluating the questionnaire testing technique. It is noticed that question four has the greatest mean and lowest standard deviation. This question is about the easiness use of the technique. The highest standard deviation is of memorability.

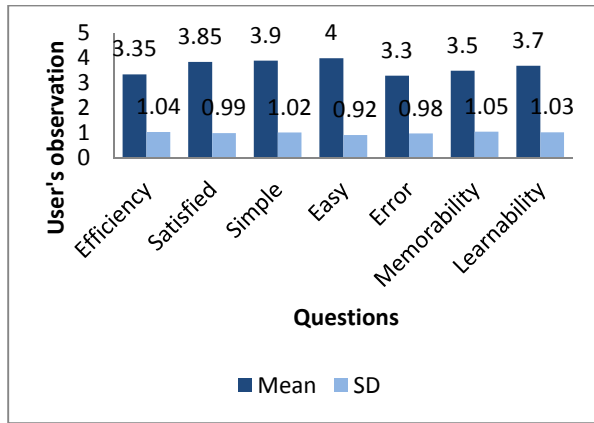


Figure-1. Questionnaire testing technique.

This graph shows how many participants of the user study strongly disagree, disagree, neutral, agree, and strongly agree with this technique. This result is against the different questions. A total of seven questions are asked from participants. The greater number of users is agreeing. Following is the graphical representation of participants' opinion. This graph shows the highest and lowest value of the questionnaire technique.

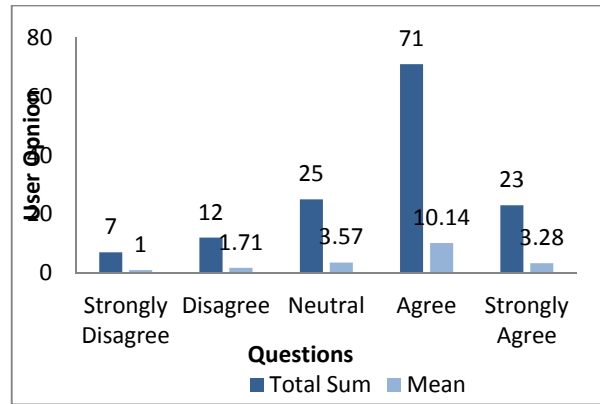


Figure-2. Participants opinion.

The graph shows the participant's rating against each question. The rating is according to the 5-Point Likert scale. This shows the participant's behavior against the questionnaire technique. Many participants agree and few disagree against some usability factors.

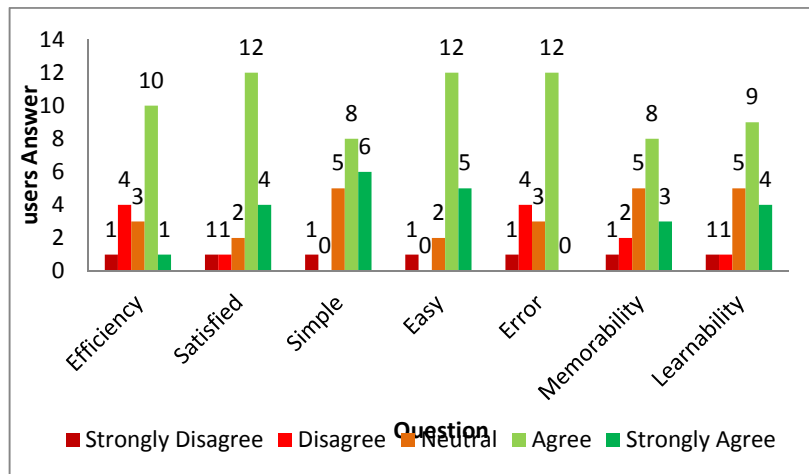


Figure-3. 5- Point Likert scale results.

Second user study is based on the focus group technique. To evaluate the usability technique, the website is selected. Firstly website is evaluated then the focus group usability evaluation technique is evaluated. The results after evaluation are gathered and shown in the graph. The graph shows the mean and standard deviation

against each question. This result shows the highest and lowest value of the focus group technique. The highest standard deviation is of error in focus group technique and the lowest value of standard deviation is of memorability. Following is the graphical representation of the result.

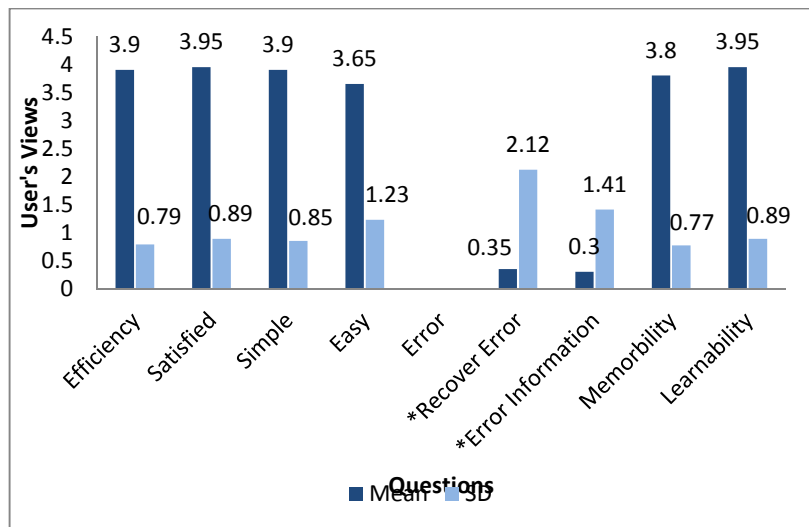


Figure-4. Focus group technique.

This graph shows how many participants of the user study strongly disagree, disagree, neutral, agree, and strongly agree with this technique. This result is against

the different questions. Total questions are seven asked from participants. The greater number of users is agreeing. The following graph also shows mean of these values.

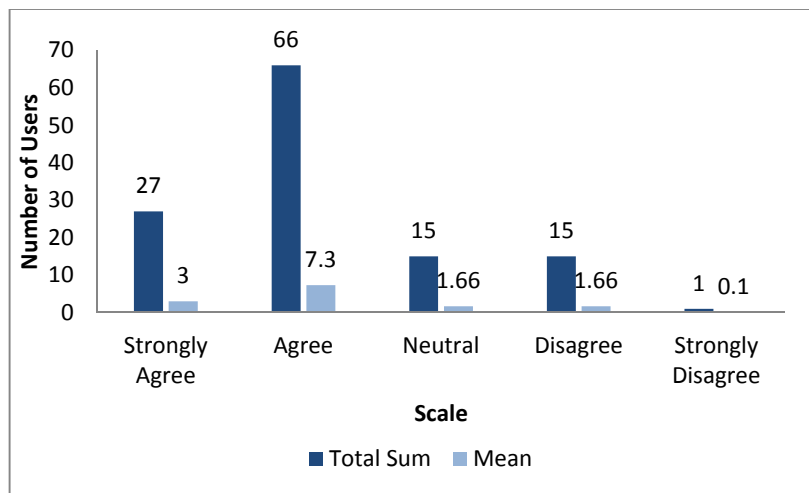


Figure-5. Participants opinion.

Following is the graph that shows the values according to the 5-Point Likert scale. The highest value is of error. Mostly, participants disagree with errors arisen during evaluating the focus group technique. The second-

highest value shows that this technique is easy to remember.

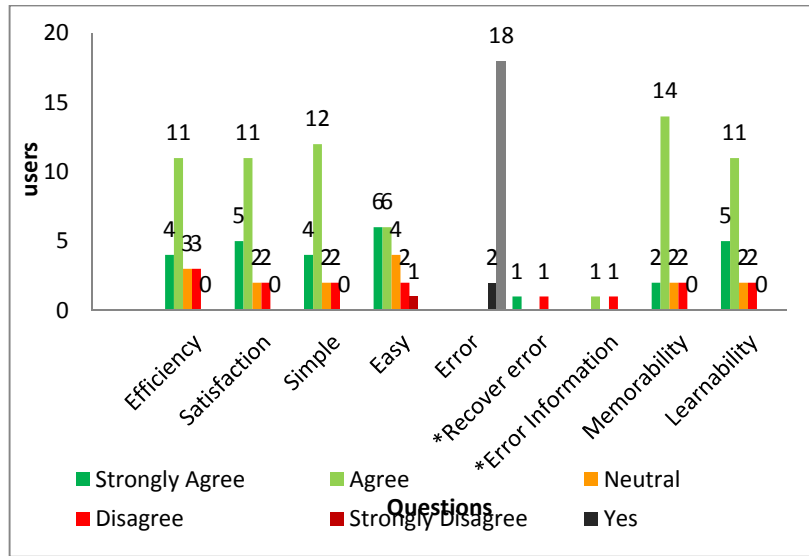


Figure-6. 5- Point Likert scale of focus group testing.

Third user study consists of both usability techniques. Both techniques, questionnaire-based and observation-based, are evaluated at the same time by the same users. These techniques are evaluated for developing better websites for users. The results are gathered and finalized. These results are shown as follows. Following is the graph that shows the values of the questionnaire testing technique against each question. Question five has the highest standard deviation and question four has lowest standard deviation. All values are shown as follows.

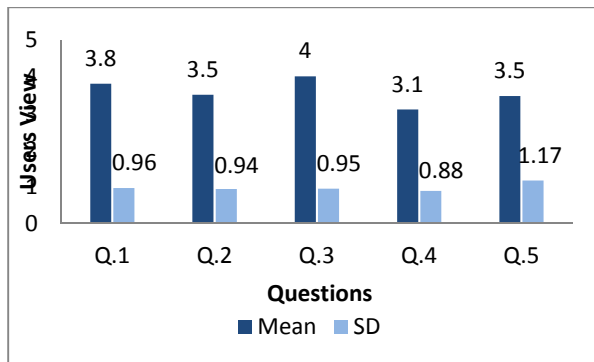


Figure-7. Questionnaire testing technique.

This graph shows how many participants of the user study strongly disagree, disagree, neutral, agree, and strongly agree with this technique. This result is against the different questions. Total questions are seven asked from participants. The greater number of users is agreeing. The question one has greater agree participants and lesser

strongly disagree participants. These values are graphically represented as follows.

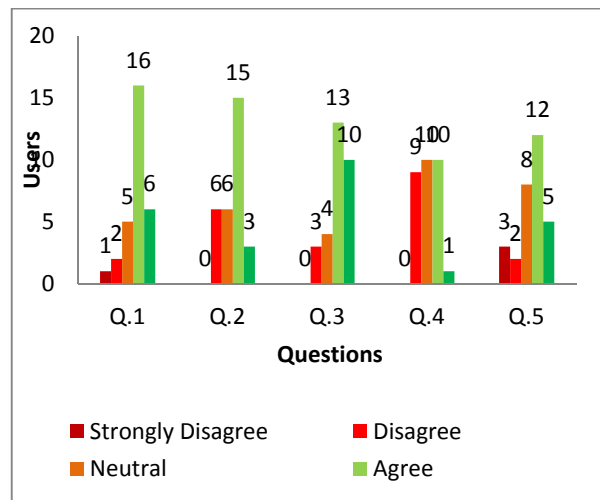


Figure-8. 5- Point Likert questionnaire testing technique.

The following graph shows the results of the focus group technique. This technique has also five same questions as the questionnaire testing technique. This graph shows the mean and standard deviation of each question. Question four has the highest standard deviation and question one has the lowest standard deviation. The graph shows the mean and standard deviation against each question.

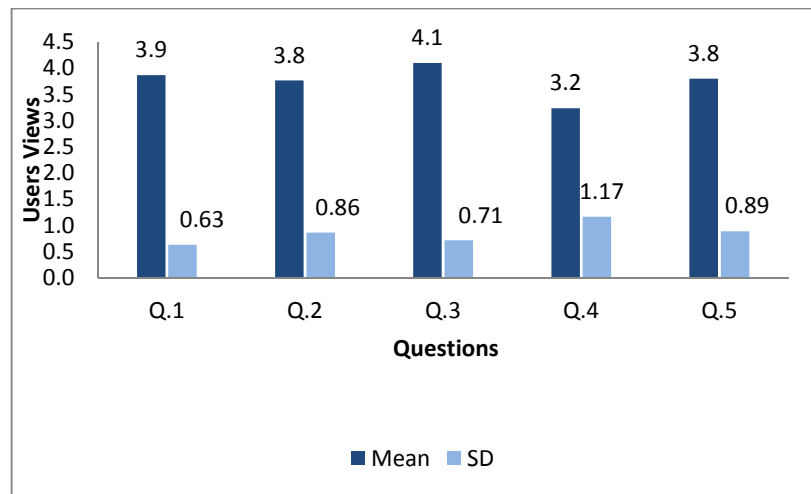


Figure-9. Focus group technique.

This graph shows how many participants of the user study strongly disagree, disagree, neutral, agree, and strongly agree with this technique. This result is against different questions. Total questions are seven asked from participants. The greater number of users is agreeing. The scale used for compiling results is 5- point Likert scale. Questions have greater users that agree with this technique. The question one has greater agree participants and only question four has strongly disagree participants. These values are graphically represented as follows.

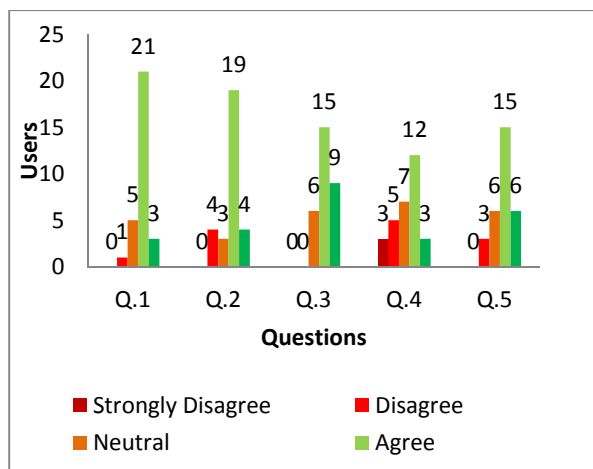


Figure-10. 5- Point Likert scale of focus group technique.

A. Comparison of both Techniques

Usability techniques are evaluated and compared. Following are the results that compare both techniques. These techniques are used for evaluating university websites. Same questions are used for evaluating both techniques. Both techniques have different values against each question. Following graph shows comparison between questionnaire based and focus group technique. These results are gathered from user study one and second user study.

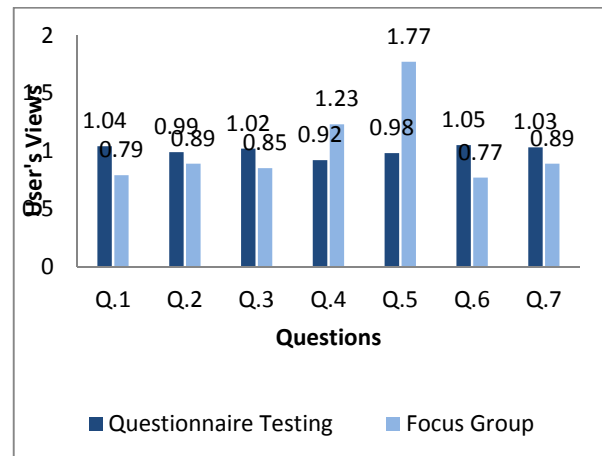


Figure-11. Comparing results of 1st and 2nd US.

Following graph shows the standard deviation of both techniques against each question. Question four has a greater standard deviation in the focus group technique and question five has greater value in the questionnaire testing technique. The question one has the lowest value in the focus group technique and question four has the lowest value in the questionnaire testing technique.

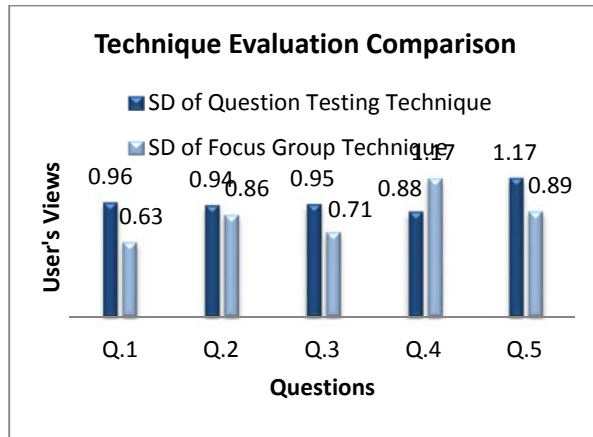


Figure-12. Comparing results of both techniques in 3rd US.

B. Website Analysis

University website has been analyzed using wave accessibility tool. This tool helps in finding the flaws in website. Wave Accessibility tool analyze issues such as error, color contrast, heading, images, style and misplaced links. Following table shows the Wave Errors in university website. While WAVE cannot replace human evaluation to determine true compliance, it can provide at least a surface analysis of a webpage's accessibility, though any automated tool runs the risk of false negatives and false positives (WebAIM, n.d.b). We used WAVE to get a general sense of accessibility compliance; WAVE and other machine-based accessibility analysis tools come with limitations. What the WAVE results suggest, however, is that many of the municipal sites have accessibility problems that need to be addressed [49]. Evaluation procedure was divided into three stages. The existing websites were evaluated against WCAG 2.0 [50].

Table-1. WAVE tool analysis of website.

Wave Error	Description
Missing Alternative Text	Image alternative text is not present
Linked Image Missing	An image without alternative text results in an empty link
Empty Links	A link contains no text
Justified Text	Fully justified text is present
A nearby image has the same alternative text	Two images near each other have the same alternative text
Missing first-level heading	A page does not have a first-level heading
Skipped heading level	A heading level is skipped
Broken same page link	A link to another location within the page is present but does not have a corresponding target
Suspicious link text	Link text contains extraneous text or may not make sense out of context
Redundant link	Adjacent links go to the same URL
Link to word document	A link to a Microsoft Word document is present
Alternative text	Image alternative text is present
Null or empty alternative link	Alternative text is null or empty (alt="")
Linked image with an alternative text	Alternative text is present for an image that is within a link
Layout table	A layout table is present
Heading level 2	A second level heading (<h2> element) is present
Heading level 3	A third level heading (<h3> element) is present
Heading level 4	A fourth level heading (<h4> element) is present
Unordered list	An unordered (bulleted) list (element) is present.
Very low contrast	Very low contrast between foreground and background colors.

There are some factors that are analyzed through Wave tool and also through usability testing technique. Usability testing technique highlights the issues of website

related to efficiency, learnability, memorability, satisfaction, simplicity, navigation, off-site links, ease of use, images, color contrast, graphics, font, open links, and



complete information. Wave tool also highlights the issues of color contrast, linked images, heading, null or empty link, broken pages, error in images, missing headings, and other issues mentioned in Table-1.

C. ANOVA Test

Results of this user study are analyzed using ANOVA. ANOVA test is applied to the results of the user study to validate the result. These results are as follows. This test validates the result of the questionnaire testing technique and focus group technique. At the end, the comparison result has been validated through ANOVA test.

Table-2. ANOVA test on questionnaire testing technique on question.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	14.23	4.00	3.56	3.67	0.01	2.43
Within Groups	140.47	145.00	0.97			
Total	154.69	149.00				

Above Table-2 shows the ANOVA test results of the questionnaire testing technique according to questions. This shows the validation of user study results.

Below Table-3 shows the ANOVA test validation of total sum, mean, and standard deviation of the questionnaire testing technique questions.

Table-3. ANOVA test on total values of questionnaire testing technique.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	36713.4	2.0	18356.7	515.5	0.0	3.9
Within Groups	427.3	12.0	35.6			
Total	37140.69	14				

Table-4 shows the validation result of the questionnaire testing technique according to the 5-point Likert scale. These values are validated using the ANOVA test.

Table-4. ANOVA test on 5- Point Likert scale values of questionnaire testing technique.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	414	4	103.5	15.22	0.00	2.87
Within Groups	136	20	6.8			
Total	550	24				

Table-5 shows the ANOVA test results of the focus group technique according to questions. User study

performed for focus group technique results has been validated through ANOVA test.

**Table-5.** ANOVA test on focus group technique questions.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	12.17	4.00	3.04	4.02	0.00	2.43
Within Groups	109.70	145.00	0.76			
Total	121.87	149.00				

Table-6 shows the valid results of Focus Group Technique question's total sum, mean and standard deviation. These are validated using ANOVA test tool.

Table-6. ANOVA test on total values of focus group technique.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	40573.4	2.0	20286.7	665.5	0.0	3.9
Within Groups	365.8	12.0	30.5			
Total	40939.2	14.0				

Table-7 shows the result of 5- point Likert scale validation result of the focus group testing technique.

Table-7. ANOVA test on 5-Point Likert scale of focus group technique.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	751.2	4	187.8	33.9	0.0	2.9
Within Groups	110.8	20	5.54			
Total	862	24				

ANOVA test has been applied to compare the results of both techniques. The test validates the standard deviation result of both techniques. Table-8 shows the

result of the ANOVA test according to the standard deviation of both techniques.

Table-8. ANOVA test on comparison of both techniques according to standard deviation.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	0.08	1	0.08	3.11	0.11	4.96
Within Groups	0.26	10	0.03			
Total	0.34	11				

Table-9 shows the result of both techniques comparison according to the 5-point Likert scale. ANOVA test is also applied for validating this result.

**Table-9.** ANOVA test on both techniques according to 5-Point Likert scale.

ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	5639	4	1409.75	37.69	0.00	5.19
Within Groups	187	5	37.4			
Total	5826	9				

D. Observations in Usability Testing Techniques

Following are some observations that occur while evaluating testing techniques:

- Questionnaire testing technique is less efficient than focus group technique.
- Questionnaire testing technique is less easy than focus group technique
- Focus group technique is time taking.
- Focus group technique has fewer errors than the questionnaire testing technique
- Focus group technique is easy to learn
- Questionnaire testing technique is easy to remember

5. CONCLUSIONS

The main purpose of this research is to determine the worth and usefulness of usability evaluation techniques. This research compares usability evaluation techniques that would be helpful in future for developing better usability evaluation techniques. Two usability evaluation techniques have been compared for evaluating website's usability. It was evaluated that focus group technique is better than questionnaire testing technique. The website result has been validated using WAVE accessibility tool. This result is also verified using ANOVA testing tool. This research could also help developers in developing better and useful websites for user. The websites should be designed in such a way that the users can easily interact without facing any problems.

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