Domain and Culture-Specific Heuristic Evaluation of The Websites of Universities of Pakistan

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Abstract: In this digital age, a university's website serves as a portal to its knowledge and services. These websites represent the actual university, where prospective students plan for admission, current students connect regularly, and other stakeholders can get the details they need. These users expect university websites to be professionally developed, well-organized, and have a user-friendly interface that allows them to easily search, navigate, and collect information. Users unwittingly introduce cultural norms into their lives, leading them to assume the same preferences in their daily interactions. These preferences reflect the user's cultural context as well as the domain in which the application is used. The heuristic evaluation is a widely applied method for usability evaluation. It is an inspection-based, fast, and low-cost method for detecting usability issues in a system. These heuristics are successful at identifying general usability design defects, but they fall short of detecting possible domain and culture-specific usability issues. In this regard, this research uses the domain and culture-specific heuristic evaluation to evaluate the usability of the websites of Pakistan's top ten universities. The evaluation's findings are collectively discussed, and possible usability problems in the website design of Pakistani universities are identified.

Keywords: Heuristic evaluation, usability evaluation, Pakistan, domain, culture

I. INTRODUCTION

Universities are developed, socialized, and culturally influenced over a period of time. The university's worth can also be expressed on the university's website [1]. The university website's key goal is to offer transparent and available content to target audiences while also providing the best user experience possible [2].

One of the most important aspects of the design of these university websites is usability. Usability is defined as the extent to which a product can be used by users to achieve specific goals with a high level of efficiency, performance, and satisfaction in a specific context of use [3].

Usability evaluation methods are classified into two categories: usability inspection methods and usability testing methods. Instead of considering possible users for evaluation, the findings of inspection methods are focused on expert interpretation and conclusions. These methods are fast, easy, and inexpensive, and they require less time to evaluate [4].

Usability testing methods, on the other hand, use representative users to assess the application.

Heuristic Evaluation is a quick, commonly used, and low-cost inspection method for finding usability problems in a system. Nielsen and Molich [5] were the first ones to introduce this evaluation method. During a heuristic evaluation, a small group of experts evaluates the interface against a series of proven usability parameters known as heuristics. Heuristics are a collection of few simple guidelines that can be applied to any application to determine design defects and usability issues.

For an application with a particular domain and culture, Nielsen's heuristics, which are commonly used, have been identified as failing to recognize possible usability issues. [6-9]. Heuristics have these limitations because they are incapable of taking into account the specific features of an application that are relevant to a particular domain and culture. In this regard, the use of the domain and culture-specific heuristics for evaluation may be a potential solution to this problem. These heuristics are better at finding problems that are unique to a domain or culture along with the general usability issues.

This paper evaluates the usability evaluation of the websites of the universities of Pakistan through domain and culture-specific heuristic evaluation.

The rest of the paper is organized as stated. Section II highlights the literature review. Section III presents the material and methods. Section IV presents the results of this research. Later, validations of results are discussed in Section V. Finally, Section VI concludes the research and highlights future recommendations.

II. LITERATURE REVIEW

Human-Computer Interaction (HCI) and usability studies began in Europe and America and have gained popularity in Asia in the last 15 years [10]. In terms of population, trade, and internet use, Asia is the fastest-growing country [11]. Countries in Asia, mostly China, India, and Japan, have

embraced usability testing and practices. Usability assessment analysis in Pakistan is also in its infancy.

About the fact that 29 million people had internet access in 2013, Nawaz and Clammenson [12] said there was no evidence of HCI research at the time. In Pakistan, HCI research has only been going on for a decade. In research conducted in Pakistan by Ashraf and Khan [13], they discovered that usability is only perceived in the information technology (IT) industry to a limited degree.

As usability research becomes more popular in Pakistan, it is being evaluated on a wide variety of websites i.e. banking and finance websites [24], government websites [14-16], hospital websites [17], library websites [18-23], non-profit organizations websites [24], political parties websites [25], security agency websites [26], and university websites [27-29]. The literature also indicates a usability evaluation of Pakistani websites that emphasizes regional language support for ensuring user-centered design for Pakistanis [30, 31], as well as websites for people with disabilities [22].

According to the literature review, there has been relatively limited research on evaluating the usability of Pakistani higher educational websites [27-29]. Researchers in the field of usability evaluation should pay attention to this limited literature.

Khan and Khan [29] used standard webpage evaluation criteria such as about us tab, back button, breadcrumbs, font size, logo, search, no horizontal scrolling, site map, title, typeface, and visited and unvisited links to evaluate ten Pakistani universities. The authors used direct evaluation to answer the two-point scale questions with yes or no. The authors reported the problems on the websites based on the findings.

Via a survey, Saeed and Amjad [28] evaluated the usability problems in Pakistani university websites using twelve parameters: aesthetic interface design, availability of student's information, easiness in finding information, information completeness, good user interface design, lecture material, learnability, meaningful error messages, navigation layout, quick navigation and up to date website. This study surveyed students and teachers regarding the design of the websites and gathered 12 responses in total. Despite the limited sample size, the authors were effective in representing usability issues in the websites of the universities of Pakistan. The identified issues include content issues, design issues, and a lack of frequent website updates and structure of navigation.

Lodhi [27] used Nielsen's ten heuristics to assess the usability of Pakistani university websites. A hybrid methodology study was conducted, with 50 participants from each website participating in a survey and four experts providing a heuristic evaluation. The study presented the survey findings as well as a heuristic assessment of Pakistan's four universities. The study examines a variety of usability problems on Pakistani university websites, including device visibility, consistency and standards, error prevention, flexibility, and ease of usage. These heuristics are not optimized for evaluating websites with users, despite their importance in HCI and usability analysis. These heuristics are intended to be evaluated by experts [5]. The investigator couldn't clarify whether the findings of a pair of experiments

differed, how the results were validated, or the specifics of usability problems on the target websites.

Sodhar et al. [32] used a survey to access the usability of four engineering university websites of Sindh, Pakistan using web content accessibility guidelines (WCAG 1.0) and few other parameters [33]. The authors identified certain issues with the websites from which the main issue is outdated contents in the websites and improper management of contents.

Sodhar et al. [34] further evaluate the usability of four engineering university websites using automated tools namely the WAVE tool [35] and PowerMapper tool [36]. The author further compares the results of both studies and discussed the results.

There are a few gaps in the reviewed research that are discussed here. Initially, the experiments provide generic website assessment criteria with few functionalities to review, and domain-specific features are not prioritized in evaluation. Moreover, the mentioned work is unable to generalize the issues with the problems of Pakistani university websites. It is also worth noting that in the mentioned work, the findings aren't validated. Finally, Lodhi [27] also mentions that the target group (i.e. users instead of experts) had difficulty interpreting heuristics. To overcome these gaps, an attempt is also made by researchers that evaluates the university websites of Pakistan through guideline scoring [37]. With a huge list of guidelines to evaluate, the study limits only providing the relative score of the websites on how the website adheres to the given guideline and limit in identifying usability issues.

In overall, even though multiple studies have been performed to evaluate the websites of the universities of Pakistan, none of the study considered specific domain and culture where the university websites are being used.

III. MATERIALS AND METHODS

In order to evaluate the websites of universities of Pakistan, the domain and culture-specific heuristics are used which are designed by following a methodology. Figure 1 depicts the methodology used to develop domain-specific and culture-specific heuristics [38]. The Empirical stage, the Reconnoitre stage, the Proposition stage, the Validation and refinement stage, and the Application stage are the five steps of this methodology. This methodology is proposed and validated by the researchers [38].

If no already established set of domain and culture-specific heuristics are on hand, the methodology continues from the Empirical stage to the Application stage for heuristic evaluation; alternatively, one can directly validate and refine a set of heuristics (already on hand) using the Validation and refinement stage. The validated heuristics can further be used for evaluation. Similarly, if available heuristics are not validated using the validation and refinement phase, the whole process creation of a new set of heuristics can be performed by iterating the first three stages.
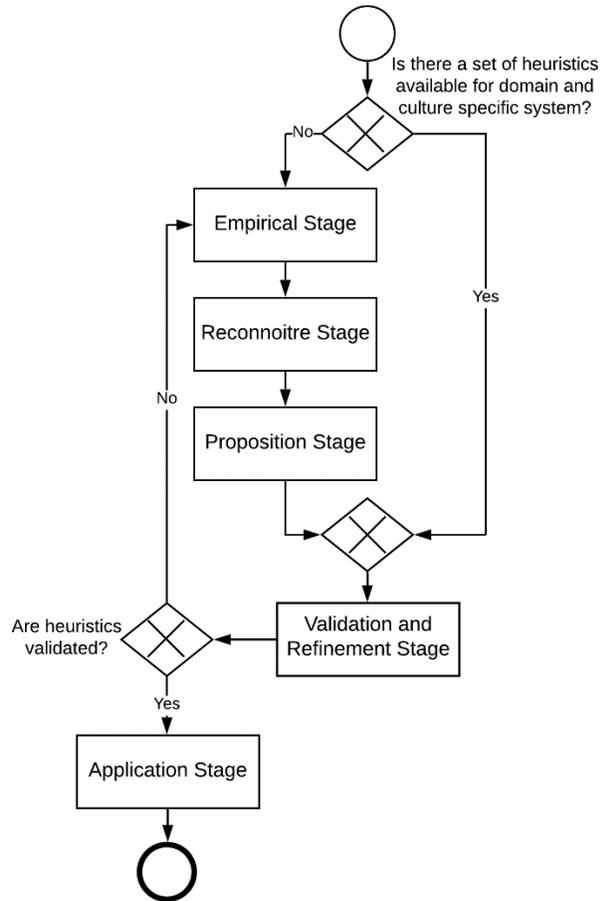
Figure 1.   Adopted methodology for heuristics creation and validation [38]

The six heuristics and associated checklist elements are reflected in Table I using the methodology portrayed in Figure 1.

Using the heuristics adopted in Table I, the websites of the top ten universities of Pakistan are evaluated. These universities are ranked by the Higher Education Commission of Pakistan (HEC) [39]. The names of the universities are mentioned in Table II.

Three experts use the domain and culture-specific heuristics to perform heuristic evaluations on mentioned university websites presented in Table II. An evaluation form with the list of heuristics is provided to each expert as a guide for evaluation for each website. Each expert spent few hours on each website. The evaluation is done in two passes, with the first pass deals with a general evaluation, and the second pass deals with a thorough analysis of the design components [40].

Each evaluator reviewed the website and acknowledged any design defects using the heuristics listed. The frequency of problems that appeared in the design is also mentioned during the assessment. The frequency scale is found in Figure 2.

TABLE I.   PROPOSED HEURISTICS [38]

Heuristics	Checklist items	Related References
Website content and the University's values	12	Engaging content in the homepage, up-to-date content, content optimized for onscreen reading, images reflecting university values, well-written mission statement, names and titles of university administrators, list of degree programs, summary of programs, fee structure, research information, basic metaphors representation using local culture, content availability directly on the website rather than on images or PDF files.
Consistency and Standards	7	Completeness, professional and academic, similar design in main and sub-pages, design consideration of all possible stakeholders, top-to-bottom page layout, high-quality clear images, and every page with an appropriate title.
User control through flexible links	10	Navigation design on common user paths, link to career, link to alumni, the main website linked with campus sites, all news/events with related links, explorable website, links of offered programs in each department pages, homepage link on every page, no broken or loop-back links and transparency in navigation information.
Help, assistance, and error tolerance	8	Inclusion of frequently asked questions (FAQ), contact us page and contact information of concerned departments, search engine optimization, admission process mentioned, reduction in chances of making mistakes, optional and required fields mentioned, visible and understandable error messages, and an indication of all possible errors occurred in page in one instance.
Recognition rather than recall	4	Well-designed and simple menus, search facility, well-designed faculty directory, and course finder if course list is huge.
Device and browser support	6	Website optimized for small screens, important functionality prioritized in mobiles, navigation optimization for smaller screens, big buttons and links, clear print-preview of webpages, and support of common browsers.

TABLE II.   THE SELECTED UNIVERSITIES [39]

| Abbreviation	University
AKU	Aga Khan University, Karachi
COMSATS	COMSATS Institute of Information Technology, Islamabad
NUST	National University of Sciences and Technology, Islamabad
PIEAS	Pakistan Institute of Engineering and Applied Sciences, Islamabad
PU	University of the Punjab, Lahore
QAU	Quaid-i-Azam University, Islamabad
UAF	University of Agriculture, Faisalabad
UoK	University of Karachi, Karachi
UHS	University of Health Sciences, Lahore
UVAS	University of Veterinary and Animal Sciences, Lahore
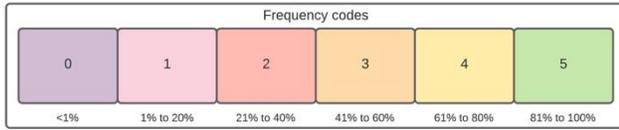
Figure 2.   The adopted frequency scale

After the evaluation, a list is generated that combines potential problems discovered by the experts individually. Separate lists are also generated that contain problems unique to each university website.

The template of evaluation is depicted in Figure 2.

Heuristic ID: Heuristic identifier
Heuristic statement: Description of heuristic
Sub-heuristic ID: Sub-heuristic identifier
Sub-heuristic statement: Sub-heuristic description
Feature(s) in application to focus in evaluation using the heuristic: Features' details
Problem ID: Problem identifier
Problem statement: Definition of problem
Problem explanation: Explanation of the problem
Snapshot (optional): Snapshot of the screen where the problem lies.
Link (optional): Link of the page where the problem lies.
Severity: Severity of the problem
Frequency: Frequency of problem

Figure 3.   Template of heuristic evaluation [38]

Experts are then asked to rate the severity of collected problems. These ratings are based on the evaluation expertise. The severity scale depicted in Figure 4 is used to rate the severity of the identified problems.
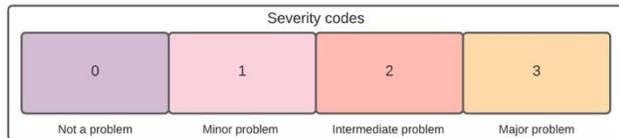

Figure 4.   The adopted severity scale

The researcher takes care of all of the individual severity ratings and combines them to build a list of final severity scores for each university's website [41]. Following that, a briefing session is held to explore potential re-design thoughts.

IV.   RESULTS

This section examines the usability issues that have been found on the websites of Pakistani universities. The number of usability problems found by experts E1, E2, and E3 during the evaluation of the university website is listed in Table III.

Individual usability issues of selected university websites are compiled and mapped to classify the most common usability issues in Pakistani university website design. The criticality of each problem found in evaluation is applied to the other relevant issues during the mapping of general issues to recognize the most central issues common to all websites. The list of common issues found on the websites of Pakistani universities is listed in Table IV.

TABLE III.   USABILITY ISSUES RECOGNIZED BY EACH EXPERT

Uni. Code	E1	E2	E3	Total Issues
AKU	5	7	7	10
COMSATS	15	13	12	17
NUST	11	9	10	12
PIEAS	49	42	41	54
PU	41	36	32	52
QAU	12	12	11	15
UAF	38	28	28	41
UHS	45	41	34	46
UoK	32	31	27	41
UVAS	8	8	6	10

TABLE IV.   TOP CRITICAL USABILITY ISSUES

ID	Topmost critical usability issues
1	The website is not sensitive to different screen sizes.
2	The text on the mobile website is too short to read without zooming in, and it is also too small to touch with fingertips.
3	There is no faculty directory available.
4	On the website, out-of-date information is available.
5	Issues with web and mobile browsers and support.
6	On internal website pages, the homepage link is not apparent.
7	Information is available in a prospectus or as an external PDF file instead of directly on the website.
8	The website does not have an internal search feature.
9	A website's navigation on popular user paths is not enabled, and all content is thrown on the site without respect for the user's chosen route for accessing information.
10	A very static list of offered degree programs is listed, with no details and related information.
11	The tool for searching degree programs is currently unavailable.
12	Difficulty in finding the necessary information from the website.
13	The research data is available, but it is not well structured.
14	Incomplete websites.
15	The website is unattractive due to the large number of links on the homepage.
16	The admission-related information is not well organized.
17	Inconsistencies in the design.
18	There are a lot of blank spaces on websites.
19	On the website, errors are not handled and informed properly.
20	It is impossible to guess where the few links on the websites would lead.
21	The fee structure isn't clarified well.
22	On the entire website, there is no link to the fee structure.
23	The images on the website do not include photographs of university students.
24	On the same page, there is overlapped text, light-colored text, mixed case, and various formatting styles.
25	On the website, there are no FAQs to be found.
26	The website is not intended for all possible stakeholders of the university.
27	On the website, there is no research menu or alternative.
28	The information about the university's study areas, centers, and publications is outdated.
29	The detail of the faculty information is missing.
30	Optional and required fields are not specified in input forms.

For a faster, more effective, and accessible design of university websites, developers and university professionals should pay attention to the issues mentioned in Table VI.

V. RELIABILITY AND VALIDITY

A. Inter-Expert Reliability

The inter-expert reliability for the three experts is measured using the "Any-two agreement (A2A)" method on selected university websites [42, 43]. It decides the possibility that a certain usability concern will be found by more than one evaluator. The equation is as follows:

$$A2A = Mean\left(\frac{Pi \cup Pj}{Pi \cap Pj}\right) for \frac{n(n-1)}{2} experts \qquad (1)$$

Where P_i and P_j are the problems sets found by expert$_i$, and expert$_j$, respectively, and n is the number of experts. The findings of the inter-expert reliability are shown in Table V.

Since the three experts come from different technical backgrounds, the overall inter-expert reliability is 0.65, which is considered satisfactory.

TABLE V.　　INTER-EXPERT RELIABILITY

	E1 and E2	E1 and E3	E2 and E3	Mean
AKU	0.500	0.600	0.400	0.500
COMSATS	0.750	0.667	0.563	0.660
NUST	0.667	0.750	0.900	0.772
PIEAS	0.717	0.714	0.680	0.704
PU	0.542	0.553	0.511	0.535
QAU	0.714	0.533	0.643	0.630
UAF	0.610	0.632	0.556	0.599
UHS	0.830	0.689	0.630	0.716
UoK	0.853	0.781	0.758	0.797
UVAS	0.778	0.625	0.556	0.653
Mean	0.696	0.654	0.620	0.657

B. Findings' Empirical Validation

The findings of this research can be empirically confirmed by former studies that evaluated the usability of Pakistani university websites [27-29].

On certain similar parameters used in both studies, a few parameters from Khan and Khan [29] can be used to equate the results of this analysis with their findings. Table VI lists the common parameters in both studies.

TABLE VI.　　COMMON PARAMETERS IN BOTH STUDIES

EVID	Parameter	Heuristic ID
1	Logo of the university website	A
2	Search option	E
3	No horizontal scrolling	B
4	Enabling of the back button	C
5	About us page that includes the information about the organization	A

Aga Khan University, COMSATS, Quaid-e-Azam University, National University of Sciences and Technology, University of the Punjab, Quaid-e-Azam University, Islamabad, University of Agriculture Faisalabad, and the University of Health Sciences are amongst the universities included in both studies. The findings of both experiments are shown in Table VII, where the problem recognition is identical in the observed parameters. The value "Yes" indicates that the topic is discussed in both studies, "No"

indicates that it is mentioned in one study but not the other, and "-" indicates that the parameter was observed but the related problem is not identified in both studies.

TABLE VII.　　EMPIRICAL VALIDATION OF PROBLEMS USING STUDY MADE BY KHAN AND KHAN [29]

ID	AKU	COMSATS	NUST	PU	QAU	UAF	UHS
1	-	-	-	-	-	-	-
2	-	No	-	Yes	Yes	Yes	Yes
3	-	-	-	-	-	-	-
4	-	No	-	-	No	No	Yes
5	-	-	-	No	No	No	No

Table VII shows that out of a total of 35 cases, only 7 times do both studies differ, whereas the other 28 times both studies agree on their decision. The analyses indicate that 80% of the results are the same in both tests. The other 20% of results vary. The possible reason is that there is a may-year gap between both studies, and websites could have been revised in that period, this is true in the case of COMSATS. Furthermore, the developers seem to address the previous problems on time.

Saeed and Amjad [28] evaluated three university websites. The university names were coded for anonymity, so validation with anonymous university names is not possible. However, the criteria where usability problems were found were navigation, completeness of information, latest and updated content, error messages that are meaningful, material findability, availability of lecture content, and availability of necessary contents for students. With the mentioned parameters, this study also identified numerous issues on the website.

Out of the four universities studied by Lodhi [27], only the Quaid-e-Azam University website is included in this study. The authors did not explicitly identify problems on the website, making comparisons between the two studies impossible. Similarly, the results of this study cannot be validated with the evaluation performed by Sodhar et al. [32, 34] as none of the universities is included in this study.

Through this study, the usability of websites is analyzed by experts using domain and culture-specific heuristics, and problems are reported. It can be observed that domain and culture-specific heuristics are shown to help in the detection of a significant variety of usability problems that were previously ignored.

VI. CONCLUSION AND FUTURE WORK

The usability of the websites of Pakistan's top ten universities is evaluated in this study [44]. This research takes into account culture as well as the application domain, which is an important consideration in design and evaluation [45-47]. This evaluation is significant because it examines and identifies design issues. Based on the frequency and criticality analysis of reported problems, it also describes the most common usability issues.

The study identifies the top critical usability issues in the websites of the universities of Pakistan. It is observed that the most important issue that needs the attention of developers is the optimal design of the website on various screen sizes. This

includes the navigation, placement of most accessed content, and buttons and links that can be touched by the finger easily. These issues are considered most critical because more number of mobile website users is increasing and this gives an important concern about the acceptance of mobile applications in various domains [48, 49].

The findings of this study will serve as a guide for academics, professionals, website developers, and usability experts in evaluating and designing more accessible and meaningful websites. The findings will also assist in understanding the issues with currently established websites for Pakistani universities. Overall, this research will benefit society because it will aid in the development of better and more accessible websites in the future, as HCI training is claimed to be lacking in Pakistan [13].

Grounded on the collective usability problems mentioned in this research, the usability specialists and web designers could recommend perfecting designs by addressing those problems, resulting in a positive impression of a university website and, as a result, of the university. The study's results add to what is already understood, not only in Pakistan but also in other developing countries with similar cultures and environments.

As future work, the issues found through the heuristic evaluation can be used to develop a more detailed and mature set of guidelines for website design and evaluation. Practitioners will use these guidelines to create more accessible university websites in the future.

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