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USABILITY EVALUATION AND TRAFFIC ANALYSIS OF UNIVERSITY WEBSITES

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Abstract

In World especially in our society educational websites are not been fascinating and haven't paid any attention to the website to load time, website design and user experience to be friendly. In Today's world of emerging technologies education is focused on distance learning and providing online education. For education to be online its focus must be upon the website for users because the website point of attraction is their websites friendly and useful designs, and their overall load time. In this research "tool-based approach" is used to measure the performance and traffic analysis of Educational websites in Pakistan and limit the research focus is given to top universities of Pakistan.

INTRODUCTION

In today's digital era, online education has become an essential mode of learning all over the world. As technology advances, most educational institutions have shifted to digital platforms for distance learning, online courses, and virtual academic resources. However, in Pakistan, the performance and usability of educational websites have not received adequate attention. Many universities fail to pay attention to critical aspects such as website load time, responsiveness, user-friendly design, and overall accessibility. These shortcomings create challenges for students, educators, and researchers in accessing essential academic resources, course materials, and other online services efficiently.

A university's website is the first digital gateway for students, faculty, and prospective learners. It serves as a portal for learning activities, which include course registration, virtual classes, access to research, and administrative procedures. However, when a website is not optimized well, it will result in slow loading times, poor navigation, and poor responsiveness, which ultimately affects the user experience. A slow or difficult website may make students avoid using online learning sites, hence a decrease in participation and satisfaction. On the contrary, a good structured, quick, and friendly website can add a lot of value to the learning experience in which students easily interact with digital resources and other academic services.

Another important element that determines how effective an education website is how it handles its web traffic. University websites attract huge volumes of traffic, particularly during admission seasons, exam time tables, and online class registrations. When a website is not optimized, it may suddenly crash or stop responding when many are logged in, affecting academic work and creating problems for students and faculty alike. The process of establishing a digital learning framework aimed at optimizing large quantities of users without compromising performance is thus critical.

This research approach is tool based for the determination of performance with traffic analysis based on educational web sites in Pakistan, focusing

its research on universities ranked at number one in this country. Other tools for evaluation of web pages will be key performance metrics as page load speeds, responsiveness user experience, overall accessibility, the performance of educational websites under certain conditions of high traffic, as well as determination of whether their standards meet a modern web benchmark.

This paper identifies major areas of improvement in optimizing educational websites and provides insight into best practices for doing so. The aim is to identify challenges that are already present and to offer some possible solutions in the hope of motivating universities to invest in enhancing their websites and thereby improving accessibility, engagement, and overall user satisfaction.

"The website's delay can increase the user's stress level. For example, a two-second delay in the loading YouTube video can increase stress by 3% compared to 0- second delay [1]."

The findings of this study will be of great value to educational institutions in Pakistan, with the recommendation of optimizing websites for a smooth and efficient online learning experience. With the world transforming towards digital transformation in education, it is high time that universities recognize the importance of high-performance websites in shaping the future of learning. By addressing key technical and design-related issues, institutions can enhance their digital presence, facilitate seamless access to educational resources, and contribute to the overall growth of online education in Pakistan.

Literature Review:

S. No	REFERENCE	TARGET WEBSITES	METHOD USED	RESULTS
1.	[2]	Website Performance Evaluation	Tool-based and Questionnaire-based Methods. Tool based and Questionnaire based methods.	Tool-based Method: Quantitative data on page load time, responsiveness, uptime, and interactivity. Questionnaire-based Method: Qualitative feedback on user experience and satisfaction.
2.	[3]	Websites Needing Performance Optimization	Tool-Based Evaluation Method	Identifies performance issues (e.g., slow load times, poor interactivity) using metrics.
Provides data for optimization to improve speed and user experience.				
3.	[4]	Websites Evaluated for Engagement and Traffic Analysis	Traffic Analysis	Provides insights into user behavior and site performance. Enables optimization to enhance user engagement and meet demand.
4.	[5]	General Website Performance •	Tool-Based Evaluation	Tracks metrics like page load time and uptime.
Identifies areas for improvement to optimize performance and enhance user experience.				
5.				
[6]				
		Nine Jordanian universities		
		Tool based Method is used in this paper and tools used are:		
•		HTML Toolbox		
Webpage analyzer.		It results in overall Satisfactory performance of websites and		
the usability of Jordan's university websites is acceptable, based on the measures of evaluation used.				
6.	[7]			
		Educational websites of Punjab India;		
		Tool based Method is used in this paper and tools used are:		
•		Pingdom		
•		GT Metrix		
•		Website Grader		

• Site speed checker This paper evaluated the comparative results of various factors and maximum score of university websites using these tools.
7. [8] University of Benin (UNIBEN) web
Portal
(uniben.waeup.org) "Questionnaire based evaluation method" is used in this paper to evaluate the usefulness of university portal.It focus the usability or
"ease of use" of targeted web
portal from the view of students of this university.
8. [9] Federal Universities of Nigeria
Total (27) universities are evaluated. Online Automated Evaluation Tools are used :
• Achecker
• HERA
• WAVE It shows the variation of no of errors (problems). And compared the results of these tools.It shows all websites have different errors which needs to be managed.
9. [10] Eleven Malaysian Public universities websites Online Automated Evaluation Tools are used:
• LIFT
• BOBBY It checks for the universities filling the usability guideline provided by website content accessibility guide in terms of usability and accessibility. After Evaluation results shows poor score in usability.
10. [11] Top 50 universities of USA are measured against usability and accessibility with automation tools, Size and download speed were determined by Website garage automated tool. Online Automated Evaluation Tools are used:
• LIFT
• BOBBY
• Web Site Garage
(websitegarage.netscape.com) It shows that the web sites of the top USA universities are ranked very low interms of accessibility and low in terms of usability.
11. [12] They focused on Dmoz Asia Category in variety of perspectives includingMaps and Views and Travel and Tourism. They used their own PHP and MySQL based tool
to analyze web usability of Asian web sites, it uses www.dmoz.org to provide a list of categorized web sites from the Asia Region. Asia has web usability problems. Weather category has the highest usability problems. It shows that
It's also possible to evaluate all Dmoz catalogues of Asia web sites.
12. [13] 50 of the most popular websites available on www. Automated Evaluation Tool LIFT They used the LIFT to four point categorization scheme. (Excellent, Good, Fair Poor) and their results shows that among the high traffic sites Amazon ranks in tier1 in both usability and accessibility.
13.

[14]
QUEST University Nawabshah,
• https://www.quest.edu.pk/ Questionnaire based evolution method is used in the Experimental study of website. It is experimental study to check the differences before applying new tends to current design after that.For that purpose they used the website evolution to check its websites three attributes of usability that are effectiveness, efficiency and satisfaction.
14. [15] Four highly reputed Engineering universities of Pakistan:
• Quest Nawabshah
• NUST Islamabad
PIEAS Islamabad
• UET Lahore
Online Automation Evaluation Tools are used
• WAVE
• PowerMapper This study shows the comparison of four university websites and results shown in both the tools are vice versa, In WAVE tool Quest Nawabshah has scored AAA and UET Lahore scored AA and in other Tool PowerMapper It showed the results as UET Lahore has best score AAA and Quest Nawabshah has scored A.
15. [16]
More than 100 Pakistan Private sector Educational websites This study uses
• Trunk test
Methodology proposed by Steve Krug in his book “Don’t make me think”, It is all about HCI in context of mobile and web usability . This paper shows the usability results of more than 100 private sector educational universities of Pakistan on Krugs Trunk Test method and showed the results separately for every province.
16. [21] Six electronic shopping websites are analyzed in this study. Similarweb tool is sued. Low ranking and high ranking websites are identified.
17. [22] 86 websites are analyzed This study uses Google analytics and Similarweb. Website rankings of 86 websites are analyzed.
18. [23] 52 Palestinian University Websites They use questionnaire and automated tools such as:
• Immuniweb
• jmeter This paper shows and compares the user experience and performance of university websites to increase the number of visitors.
19. [24] Usability and Accessibility of Banking websites Questionnaire and tool based method was used, WAVE tool TAW tool and Achecker tool was used to analyze usability and accessibility. And for checking vulnerabilities SSLv3 poodle Vulnerability scanner tool was used. Local and international banking websites are analyzed.

1. METHODLOGY

This study follows a systematic approach in assessing and analyzing the performance of educational websites. The process entails a systematic workflow involving several performance metrics and assessment tools to ensure an all-inclusive evaluation. First, it begins with the selection of educational websites, which were narrowed down to the top universities in Pakistan for relevance to institutions with considerable online presence. Selection criteria included ranking, accessibility, user base, and overall influence in the educational sector.

A tool-based approach then evaluates the website performance to provide objective and measurable analysis. Some of the key performance indicators that are measured with the help of various tools are: Pingdom measures website load time, uptime, response times, and finds out performance bottlenecks in the website. Website Grader evaluates the usability of the overall website, security parameters, mobile accessibility, SEO optimization, and site health. Similarweb measures website traffic metrics, audience engagement, global and country ranking, keyword searches, and social media traffic distribution.

Collected data goes through the process of processing and analysis, allowing for the comparison of performance across educational websites. It identifies main issues concerning performance, such as slow page loading, inefficient SEO implementation, poor mobile compatibility, and low traffic engagement. To benchmark performance among the websites, they are categorized based on performance efficiency. Other aspects involved in analysis from the traffic include visitor engagement, average session duration, bounce rates, and page visits per session. The study on traffic patterns and website usability will determine how the design of a website affects user retention. Factors that contribute to high or low traffic, such as keyword optimization, search engine visibility, and social media reach, are also analyzed.

Based on the identified issues, a detailed set of recommendations is provided to improve website performance. These recommendations are page load speed optimization, mobile responsiveness enhancement, search engine visibility improvement, and UI/UX design refinement. Continuous monitoring and iterative improvement are stressed for long-term efficiency of the website. The methodology concludes by summarizing key findings from the evaluation and providing insights into the effectiveness of different performance evaluation tools in assessing educational websites. The research will help educational institutions optimize their websites to improve user engagement and accessibility. This structured methodology ensures a thorough and systematic evaluation of educational websites, enabling institutions to enhance their digital presence and improve the online learning experience for students.

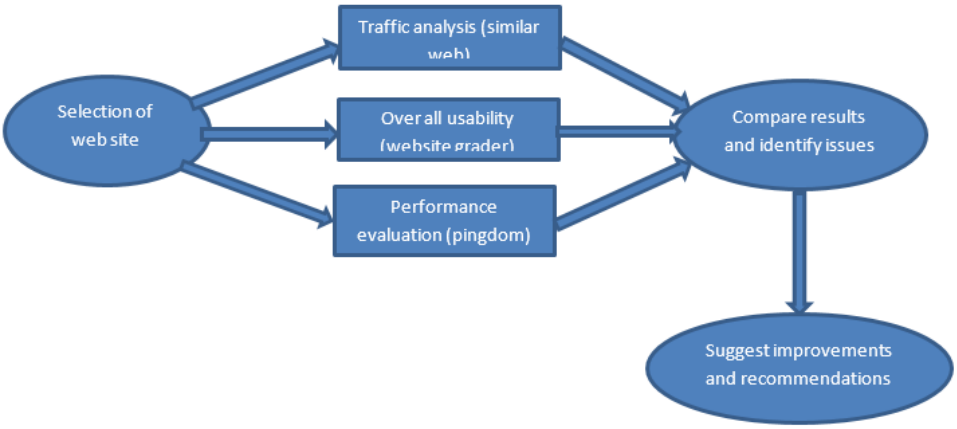

Figure 1:

2. EVALUATION:

List of top universities websites of Pakistan according to "Ranking web of Universities" [20]:

S. No	Name of University	Website
1.	COMSATS Institute of information Technology Islamabad	https://www.comsats.edu.pk/
2.	University of the Punjab (UP)	http://www.pu.edu.pk/
3.	Aga Khan University (AKU)	https://www.aku.edu/Pages/home.aspx
4.	Quaid e Azam University Islamabad (QAU)	https://qau.edu.pk/

5.	Lahore University of Management Sciences (LUMS)	https://lums.edu.pk/
6.	University of Agriculture Faisalabad (UAF)	http://web.uaf.edu.pk/
7.	International Islamic University Islamabad (IIU)	https://www.iiu.edu.pk/
8.	National University of Sciences and Technology (NUST)	https://nust.edu.pk/
9.	University of Engineering and Technology Lahore (UET)	https://uet.edu.pk/
10.	Bahauddin Zakariya University (BZU)	https://www.bzu.edu.pk/

Step 1: Traffic Analysis by using Similar Web https://pro.similarweb.com/#/digitalsuite/home

S. NO	UNIVERSITY	TOTAL VISITS	DESKTOP	MOBILE	GLOBAL RANK	COUNTRY RANK	MONTHLY VISIT	VISIT DURATION	TRAFFIC SHARE	ORGANIC SEARCH
1.	https://www.comsats.edu.pk/	908274	80.51	38.13	104312	627	302758	0:09:17	93.24	56%
2.	http://www.pu.edu.pk/	1.736 M	22.34	77.66	73723	446	578979	0:05:53	83.9	69.88
3.	https://www.aku.edu/Pages/home.aspx	2.536 M	30.5	64.95	61516	437	845508	00 06 06	60.62	50.41
4.	https://qau.edu.pk/	253501	30.37	69.63	434248	3983	84500	00 05 17	90.61	76.15
5.	https://lums.edu.pk/	2.541 M	62.23	37.77	51315	255	847178	00 10 42	78.56	33.36
6.	http://web.uaf.edu.pk/	37677	53.91	46.09	NA	NA	12559	00 02 01	95.96	61.22
7.	https://www.iiu.edu.pk/	323970	32.66	67.34	269406	2780	107990	00 06 39	68.59	74.6
8.	https://nust.edu.pk/	2.326 M	60.87	39.13	63692	319	775666	00 09 41	84.75	38.44
9.	https://uet.edu.pk/	334576	39.54	60.46	363852	3500	111526	00 05 34	85	58.49
10.	https://www.bzu.edu.pk/	210235	31.49	68.51	617502	6093	70078	00 06 53	94.68	77.5
11.										

Step 2: Traffic Analysis by using Pindom https://my.pingdom.com/app/3/home

University	Performance grade	Load time	page size	requests	overall grade
https://www.comsats.edu.pk/	67	10.47	8.7	96	D
http://www.pu.edu.pk/	77	4.75	5.16	91	C
https://www.aku.edu/Page	72	998	1.33	81	C
https://qau.edu.pk/	83	7.43	3.36	145	B
https://lums.edu.pk/	68	21.45	7.26	237	D
http://web.uaf.edu.pk/	73	4.49	3.89	66	C
https://www.iiu.edu.pk/	70	4.19	2.51	81	C
https://nust.edu.pk/	69	7.62	4.11	97	D

https://uet.edu.pk/	73	10.71	4.9	129	C
https://www.bzu.edu.pk/	77	1.23	6.3	33	C

Step 3: Usability metrics by using Website grader https://website.grader.com/tests

university	page size	page request	page speed	Performance	seo	mobile	security	overall performance
https://www.comsats.edu.pk/	10.6	180	20.6	3	25	30	0	58
http://www.pu.edu.pk/	5.3	94	9	3	25	20	0	48
https://www.aku.edu/Pages/home.aspx	3.2	119	9.6	10	25	20	5	60
https://qau.edu.pk/	2.5	130	16.8	13	20	30	5	68
https://lums.edu.pk/	72.3	334	51.3	5	20	20	10	55
http://web.uaf.edu.pk/	4	66	10.2	9	20	30	5	64
https://www.iiu.edu.pk/	2.2	78	10.7	9	20	20	10	59
https://nust.edu.pk/	1.6	49	11.5	14	20	20	10	64
https://uet.edu.pk/	3.1	76	12.4	13	20	30	10	73
https://www.bzu.edu.pk/	6.6	40	8.3	6	30	30	10	76
standard values	3mb	as low as possible	5.3 s	30	30	30	10	100

3. DISCUSSION ON RESULTS:

1. Traffic analysis results from Similar Web tool:

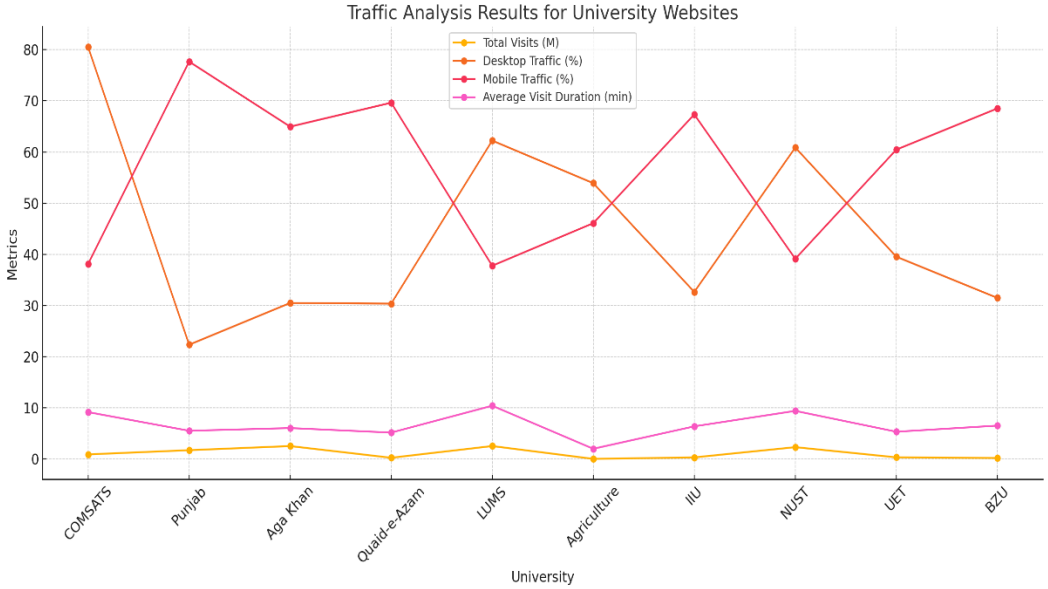

Figure 2: Traffic Analysis Results for University Websites

- **Traffic Analytics:**

LUMS and NUST rank first in overall visits, respectively, with 2.541 million and 2.326 million visits. This will reflect a robust and active user set for both these institutes and rank them among the most visited educational websites.

COMSATS leads the pack with 80.51% desktop traffic, showing the largest percentage preference towards desktops. By contrast, for University of Punjab (UoP), mobile traffic leads at 77.66%, and it therefore has a greater share of visitors coming on the website through mobile devices.

- **Engagement metrics:**

LUMS has the highest average visit duration, which is 10:42, and this provides a strong indication of user engagement, and it is also an effective website experience that leads to a higher visit duration.

COMSATS and NUST also exhibit quite high engagement with visit durations near 9 minutes, and it may be interpreted that users are highly interactive with the content on these sites.

- **Organic Search:**

Bahauddin Zakaria University (BZU) is leading the pack with a high percentage of organic search at 77.5%. The result here reflects the proper optimization of the search engine on the part of the university in bringing traffic to its website.

Performance evaluation results from Pingdom tool:

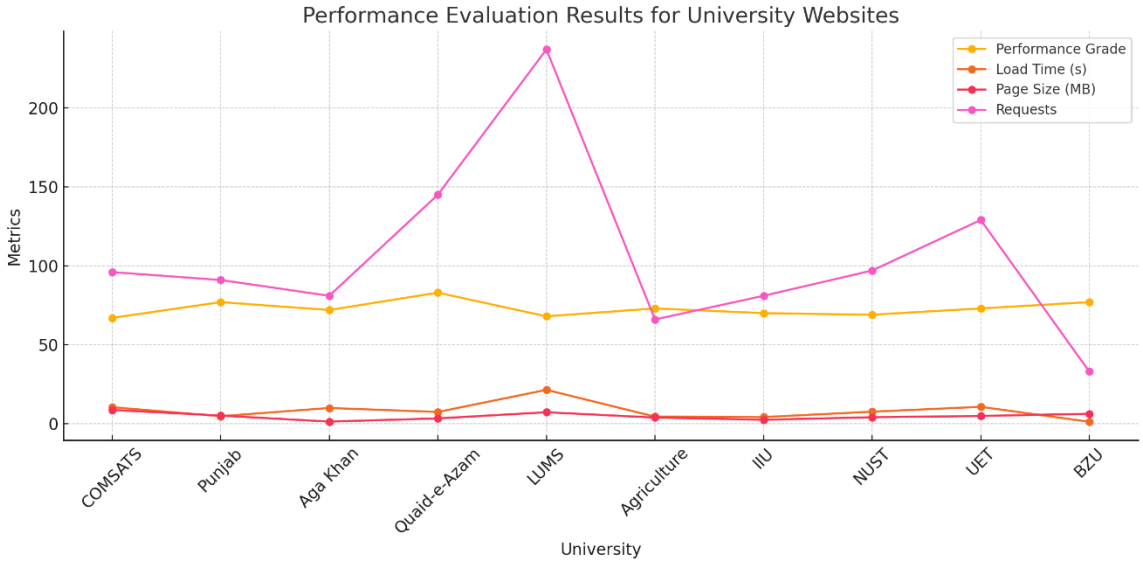

Figure 3: Performance Evolution Results for University Websites

Performance Grades:

- **Quaid-e-Azam University (QAU)** achieves the highest performance grade of 83 (B), demonstrating good website optimization that ensures efficient loading times and reliable performance.
- In contrast, **LUMS** and **NUST** scored lower, with grades of 68 and 69, respectively. These scores highlight areas where performance optimization could be improved to enhance user experience, especially considering the high traffic on these sites.

Load Times and Requests:

- **BZU** stands out with the fastest load time of just 1.23 seconds and a minimal number of requests (33), indicating that the website is optimized for quick access and efficient data retrieval.
- On the other hand, **LUMS**, despite its high traffic, has a concerning load time of 21.45 seconds with 237 requests. This performance bottleneck is indicative of issues that may lead to slow loading

speeds, potentially affecting user experience and site performance during peak traffic periods.

3. Usability and Overall Performance results from Website Grader tool:

Overall Scores:

- **BZU** achieved the highest score of 76/100, showcasing a well-balanced performance across key metrics such as SEO, mobile usability, and security. This score suggests that the university's website is well-optimized and offers a positive user experience overall.
- **University of Punjab (UoP)**, however, scored the lowest with 48/100, indicating poor optimization and usability. This score highlights significant areas for improvement, particularly in user experience, mobile responsiveness, and overall site performance.

Specific Metrics:

- Most of the evaluated websites showed critical vulnerabilities in **security**. For example, both **COMSATS** and **UoP** scored 0 in security, pointing to severe risks that could compromise the integrity of these websites and expose them to potential cyber threats.
- **Page speed** varied significantly across the websites, with **BZU** and **UoP** both requiring improvements. **BZU** took 8.3 seconds to load, while **UoP** took 9 seconds, which are relatively slow speeds that could negatively impact user experience and overall site performance.

4. SUGGESTED IMPROVEMENTS AND RECOMMENDATIONS

1. Traffic and Engagement:

- The analysis highlights the importance of understanding audience preferences, particularly in terms of device usage. For websites like **UoP**, which show a dominant mobile user base, further optimization for mobile devices is crucial. Enhancing mobile performance, including faster load times and better mobile-friendly design, could significantly improve user engagement and overall site effectiveness.

2. **Performance:**

- Websites with high request volumes and long load times, such as **LUMS**, should focus on optimizing performance to improve user experience. This can be achieved by optimizing images to reduce file sizes, reducing server response times, and implementing caching strategies to ensure faster loading speeds. These measures can reduce latency and improve site accessibility, even during high traffic periods.

3. **SEO (Search Engine Optimization):**

- Some universities show lower organic search percentages, indicating that their websites may not be fully optimized for search engines. To improve organic traffic, these institutions should focus on enhancing their **keyword targeting** and ensure that proper **metadata practices** are in place. This includes optimizing title tags, meta descriptions, and headers to improve visibility and ranking on search engine results pages.

4. **Security:**

- The low security scores observed across many of the university websites are concerning. To address this, institutions should implement **HTTPS** encryption to secure communication between users and servers. Additionally, improving **vulnerability scanning** and ensuring that **server patches** are regularly updated will help protect against potential security breaches and enhance the overall trustworthiness of the website.

5. **General Usability:**

- Websites with large page sizes, such as **LUMS** (which has a page size of 72.3MB), should consider compressing resources, including images, scripts, and CSS files. This will help reduce page load times, resulting in a smoother user experience. Optimizing page size also improves performance on mobile devices, where users may face slower connection speeds.

6. **Areas for Improvement:**

- **Load Times:** Slow load times, especially for **LUMS**, remain a significant barrier to an optimal user experience. Websites should prioritize improving

their loading speeds through various optimization strategies, such as lazy loading, image compression, and server-side improvements.

- **Mobile Optimization:** Mobile usability across different university websites is inconsistent. Some institutions are performing better than others in terms of mobile responsiveness, but there are notable gaps for some universities. Improving mobile usability with responsive design and faster loading times can help cater to the increasing number of mobile users accessing educational websites.

7 **Security:** A key area of concern for most websites is the lack of adequate security measures. Many websites scored poorly in the **Website Grader** analysis for security, which indicates vulnerabilities that need immediate attention. Enhancing security protocols and adopting stronger measures to safeguard against cyber threats will increase the website's integrity and user trust.

OUTCOME OF RESEARCH

The online tools Pingdom, Website Grader, and SimilarWeb are widely used to evaluate different aspects of website performance, usability, and overall effectiveness. These tools provide detailed reports on how well websites perform in terms of user experience, speed, SEO, security, and mobile usability. When analyzing the usability of educational websites for universities, the findings indicate that none of the university websites fully meet usability standards according to the tools used.

Desktop usability scores from SimilarWeb reveal that Comsats University has a high score of 80. In contrast, Punjab University received the lowest score at 22. This points to the drastic differences in user experience quality across educational websites. Punjab University received the highest score for mobile usability at 77, while LUMS University received the lowest score at 37. This means that although some universities are optimizing their websites for mobile users, others have a lot to do in this regard.

According to Pingdom, a tool that measures website performance and assigns grades based on speed, reliability, and overall functionality, all the websites examined were satisfactory. Quaid-e-Azam University had the highest score of 83, showing solid website performance, while LUMS scored the lowest with 68. These scores provide a clear indication of the varying degrees of website performance among different universities, with some institutions demonstrating stronger online infrastructures than others.

Quaid-e-Azam University received a B grade in the overall grading system, which reflects that it performed quite well on all aspects of the evaluation. Punjab University, Aga Khan University, Agriculture University, International Islamic University, UET, and Bahauddin Zakaria University received C grades, meaning they have an average performance with some noticeable scopes for improvement. LUMS and NUST University received D grades, meaning that their websites have considerable shortcomings in terms of performance and usability.

Website Grader, another tool that assesses websites based on performance, SEO, security, and mobile usability, provided a broader perspective on overall website quality. The highest score, 76, was earned by Bahauddin Zakaria University, while Punjab University received the lowest score of 48. This score reflects the challenges faced by some universities in terms of optimizing their websites for security, SEO, and mobile-friendliness. Overall, these ratings emphasize the role of universities to improve the user-friendliness and functionality of their websites so that students, faculty, and visitors can get the best out of them.

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