

Evaluating Performance of Academic Websites Using Web Analytic Tools

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Abstract: The usability is recognized as a pivotal prominence feature of website and the quality affirmation of a website is contingent on automation analysis tools that declined the expenditure and boost the efficacy. The interpretation of a website can be a crucial component in its success. The usability analysis tools are used to regulate the website's usability and their productiveness. The aim of this research paper is to estimate and relate the consequences of twelve universities of Punjab using automated testing tools to govern their SEO (Search Engine Optimization), speed, a number of requests, performance, load time, security, page size and mobile adaptive. The results are analyzed in 2018 and compared with the previous results which were collected in the year 2016. The performance is assessed using three automated Usability Testing tools, Pingdom, GTMetrix and Website Grader. The results showed that ten universities have enhanced with respect to given measures in the year 2018 as paralleled with 2016.

Keywords — Usability, load time, speed, performance, GTMetrix, Website

I. INTRODUCTION

A Website is an assortment of Web pages comprising pictures, words, audio, and video etc. Thus Web is an extensive group of thoroughly unrestrained records. At present the Web is not simply a resource of information but also an automated tool in numerous applications. One should be very prudent while designing the Website due to the increasing popularity of the Web. Poor and careless web design decreases public efficacy and does not serve the purpose. One has to go for certain principle to achieve the good quality Web design. In spite of several directions, concepts, and approaches, still designing a quality Web design is a complex problem. Usability is now engaged by web professionals who will enhance websites for users. The approach used for confirming usability is the paramount vital goal line of Web page research. Usability is defined in ISO 9241-11 as “the degree to which a product can be used by stated users to accomplish specified context of use” [1-2]. The notion of usability can be defined as “how well and how easily a user, without recognized training, can interrelate with an information organism of a website” [2]. A different conclusion may be attained for the development [3].

Usability is a quality facet that measures how easy user interfaces are to use. The word “usability” also refers to techniques for improving ease-of-use in the course of the design process. Several estimation approaches have been recognized to examine the usability of websites under the

categories of user testing techniques, the tool based testing methods and assessor based testing methods [5]. The quality of the website can be measured primarily in operation and usability. All recommendations deliver a procedure for retrieving the content of Website. The qualitative methods [4-5] are used to accomplish quality in the functionality of the website. The concept of usability is a crucial feature to relate a website. The effectiveness of usability is being contingent on the website organization. Organization of the website [6] must be in such a manner that the user can simply interrelate a website without any recognized exercise. An effective web scheme [7] is one that creates it easier for users to navigate through the diverse pages on the site. The website structure [8] is epitomized by the directed graph wherever each node signifies a web page and edges represent the link to corresponding web pages. It is already explored that web link structure can also be used for page status and web page organization [9]. World Wide Web Consortium (W3C) [10] defines a set of strategies for quality of Web design. These works based on the directional association among web pages. The present study emphasizes on usability measures and, more certainly, the internal attributes of a system that affect user performance and throughput in academic organizations.

The rest of the paper is arranged as follows: the second section confers the related work, the third section addresses methodology, the fourth section defines the results and

discussion of the results and the sixth segment comprises the conclusion of the paper.

II. RELATED WORK

This section includes some established literature which covers website usability of academic institutions.

Anwarul et al. [11] used two online automated tools to estimate nine universities of websites in Jordan i.e. HTML toolbox and web page analyzer. The consequence attained from the assessment was used to offer recommendations to increase the usability factor of the websites. The outcome from the research indicated that there were several weaknesses in some part of the design, interface, and performance of the websites.

Nasser et al. [12] evaluated the usability of a departmental website at the University of Benghazi. The questionnaire-based method and an online automated tool: HTML toolbox, were used for assessment. It was described that an acceptable phase of performance was achieved from the evaluation. Consequently, recommendations were applied based on the finding made.

F. O. Oliha [13] used two automated tools named Webpage Analyzer and HTML toolbox to assess the usability of two Nigerian Polytechnic websites. The estimation consequence indicates that there was particular a fault in the design and interface of the website but the overall website's usability was good and adequate.

Mustafa et al. [14] have mainly applied two techniques the user based method and tool-based methods for their study in 2008, to identify the usability difficulties in Jordan's university websites using two online automated tools called HTML toolbox and web page analyzer along with the questionnaire which was given to the website's users. In this research, they have used the aforementioned tools to measure the internal aspect of the websites such as HTML code errors, however questionnaire was used to measure the user satisfaction.

Ahmad. Al-Ananbeh [15] automatically assessed eighty websites of Arabic Universities. The main objective of the authors was to study and calculate whether there is any implication among the search engine optimization and usability. Three tools entitled Page Rank Checker, HTML Toolbox and SEO Page Rank were used to move out the valuation procedure and allowing the usability assessment measures, three internal aspects were designated such as; capacity time, HTML faults checking and browser compatibility problems. The outcomes indicated that evaluation of the Universities differ and alter in terms of levels based on the designed metrics.

Sukhpuneet Kaur et al. [2] made use of two online automated tools to catch out the usability level of the

Universities of the Punjab. The two tools used by the authors are; 1) Qualidator tool (which checks Usability, Availability and technical quality and 2) Site Analyzer (which estimates the different number of factors, for example, Content, Design, Performance, SEO (Search Engines Optimization) and Page Analysis). Consequently, examining the Informative websites of Punjab, this paper gives the grades based on assessment criteria.

Rahman et al. [16] explored the factors which are influencing the usability of academic websites. Authors find out the important factors for achieving usability of websites i.e. Navigation, searching and interface, attractiveness, Accuracy, currency and authority of information, Accessibility, understand ability, learnability and operability of a university websites. Authors recommended designers to implement these attributes in developing academic websites.

III. RESEARCH APPROACH

The major purpose that usability is essential as there are associated websites that individuals will go to the resulting site if the major one, they visited, is not operational. People leave website instantly if they are incapable to find out how to traverse the site rapidly. Usability testing is a technique used to evaluate a product (a website) by testing is on users. Usability testing is the vital aspect of all websites. A website usability test is conducted to find out the problems which are prevalent in the websites. There are numerous tools available which allow website owners and visitors to conduct tests on a website. The table 1 shows the comparative analysis of usability web testing tool against different factors. Through this table, we can find out the useful tools which will be helpful for us for improving the academic website. Web developers follow these tools to improve their site and become popular in web market. In this paper, three automated website evaluation tools are used to test the level of usability of different university websites.

A. TOOL BASED WEB ASSESSMENT

The three automated tools used in this paper are Pingdom tool, a Website Grader tool, and a GTMetrix tool. Automated tools are used to generate and emulate the load of end users. These kinds of examinations are very useful to verify, in the test plan, new releases of the applications or to stress it with a greater load [17].

Table 1: Comparative Analysis of Usability web testing tools

Tools\ Parameter	Performance	No. of Requests	Load time	Page size	User Experience / Interaction	Mobile	Navigation	Speed	Design	Content	SEO	Security	Heat Maps	Click Stream Analysis	Accessibility
Website Grader	✓		✓	✓		✓					✓	✓			
Site Analyzer	✓			✓				✓	✓	✓					✓
Qualidator	✓										✓				✓
SEO WebPage Analyzer	✓							✓	✓	✓	✓				✓
Pingdom	✓	✓	✓	✓											
GTmetrix	✓	✓	✓	✓											
PageSpeed Insight					✓			✓							
Site Speed Checker	✓	✓	✓					✓							
Loop11							✓						✓		
CrazyEgg					✓								✓	✓	
Webpage Test		✓	✓	✓											
ClickHeat													✓	✓	
Feedback Army					✓										
SilverBack														✓	
Userfly					✓								✓	✓	
Usabilla					✓										
Clickdensity								✓	✓						
4Q								✓							
ClickTale					✓	✓	✓						✓		
Web Page Analyzer	✓		✓	✓											
ChalkMark													✓	✓	

1. Pingdom: Pingdom is fundamentally an inspection facility which retains the tab on a server, a network, and the website as well. The website speed analysis tool by Pingdom works online and is presented their results. An additional usable report which Pingdom tools fetch is concerning page exploration, which deals with statistics and calculates the time it takes the website to load, page size and user requests. The Pingdom tool evaluates the loading speed of a website and proposes the solutions make them faster. This tool identifies what is fast in a given web page, slow, too big and what best practices designers are not resulting. After entering URL of a website, the tool checks the total number of HTTP requests, total loading time of the page and the total size of the webpage. The tool furthermore provides a comprehensive structure of the components that contribute to the overall magnitude of the site [18].

2. Website Grader: Website Grader is an open online tool that scores the site compared to basic metrics like performance, mobile adaptive, SEO (Search Engine Optimization) and security. Website Grader is a free online marketing and SEO tool. Website Grader considers the different factors like website traffic, searching capability, social impact and extra publicizing features [2]. This tool can easily find out how effective your website is? Website Grader tool analyzes the website against the key metrics like Performance, Mobile, SEO, Security and Overall [19].

3. GTMetrix: GTMetrix is a free tool that scores your website's speed. The GTMetrix tool investigates the page speed score of a website and advice on what way to mark them quicker. After entering the URL of a website, the tool checks the number of user visiting the websites, how long the page will load and the total page size. Therefore, this tool offers the overall structure of the components that contribute to the total site's size [20].

B. MEASURES OF USABILITY DIMENSIONS

This paper extends their results and exactly measure on the association between usability dimensions in academic websites. In analyzing the performance of websites, the twelve university websites are considered for assessment which was centered on four categories as presented in Table 2:

- a) State Universities
- b) Central Universities
- c) Deemed Universities
- d) Private Universities

Table 2: List of Universities of Punjab

University Website	Educational Sites of Punjab	URL of website	University Symbol
State Universities	Guru Nanak Dev University, Amritsar	http://online.gndu.ac.in/	U1

University Website	Educational Sites of Punjab	URL of website	University Symbol
	I.K. Gujral Punjab Technical University, Kapurthala	http://ptu.ac.in/	U2
	Punjab University, Chandigarh	http://pu.ac.in	U3
	Punjabi University, Patiala	www.punjabiversity.ac.in	U4
	DAV University, Jalandhar	www.davuniversity.org	U5
	The Baba Farid University of Health and Medical Sciences, Faridkot	http://bfuhs.ac.in	U6
	Rajiv Gandhi National University of Law, Patiala	http://rgnul.ac.in	U7
	Guru Angad Dev Veterinary and Animal Science University, Ludhiana	http://gadvasu.in	U8
Central University	Central University of Punjab, Bhatinda	http://cup.ac.in	U9
Deemed Universities	Sant Longowal Institute of Engineering & Technology, Longowal, Sangrur	http://sliet.ac.in	U10
	Thapar University, Patiala	http://thapar.edu	U11
Private Universities	Lovely Professional University, Phagwara	http://lpu.in	U12

The extent of a web page is based on all its descriptions, sounds, and word-based modules. The size of the webpage is acquired by calculating its bytes and it is a vital concern to increase site efficiency.

In this paper, to measure the performance of websites, three web testing tools were considered centered on different measures'. Table 3 contributes the analysis of the three different Automated Website Evaluation Tools based on various criteria's.

The Pingdom and GTMetrix tools are outlined on three collective restrictions, i.e., how many users browse the websites which are called the number of requests, how much time webpage require loading, and what is the web page size.

Table 3: Comparative analysis of Web testing tools w.r.t to different criteria's

Tools	Criteria's							
	Performance	No. of Requests	Load Time	Page Size	Mobile	Security	SEO(Search Engine Optimization)	Page Speed Score
Pingdom	✓	✓	✓	✓	×	×	×	×
Website Grader	✓	×	×	×	✓	✓	✓	×
GTMetrix	×	✓	✓	✓	×	×	×	✓

IV. RESULTS AND DISCUSSION

The outcomes of Pingdom, Website Grader and GTMetrix tool are collected in the year 2016 and 2018, so that we can Find out the performance of websites in both respective years.

a) **Pingdom Tool Results:** Table 4 signifies the data collected from the Pingdom tool in the year 2016 and 2018.

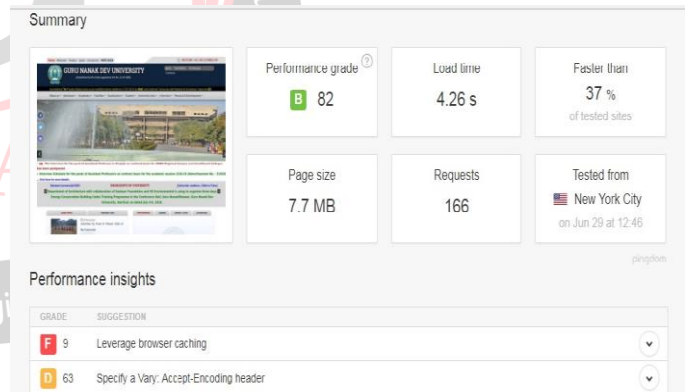
Table 4: Pingdom tool result

University/Years	Performance Grade		Requests		Load Time		Page size	
	2016	2018	2016	2018	2016	2018	2016	2018
U1	77	82	40	166	1.64s	4.26s	1.8 Mb	7.7mb
U2	80	82	36	87	5.33s	6.56	1.8 Mb	7.2mb
U3	85	87	17	16	3.55s	1.83s	595.7kb	241.9kb
U4	78	94	78	16	10.47s	2.11s	2.0 Mb	404.4kb
U5	79	73	83	169	1.26s	8.52s	16.1 Mb	3.3mb
U6	83	73	11	99	840ms	9.17s	173.7kb	6.9mb
U7	76	77	111	117	10.55s	5.54s	11.8mb	14.6mb
U8	81	95	90	60	1.17s	4.81s	2.3mb	3.3mb
U9	81	78	42	12	14.17s	4.49s	10.7 Mb	308kb
U10	80	83	27	44	10.79s	8.28s	11.0 Mb	3.9mb
U11	74	81	53	161	3.39s	7.19s	1.3 Mb	2.8mb
U12	85	75	124	135	19.21s	9.56s	9.1mb	5.1mb

Discussion:

From the Pingdom tool, we can analyze the results of different factors with respect to the Universities of Punjab in the years 2016 and 2018. The criteria's which are to be considered in the Pingdom tool is Performance Grade, the number of requests, website loading time and Page size. In U1(www.online.gndu.ac.in) website, performance grade is improved in 2018 as compared to 2016. The number of requests and the hit ratio is higher in number in 2018 than 2016 because the number of users is visiting the websites in great extent in 2018 but the loading time of U1 website is increased now because of the size of the webpage increases.

Figure 1: Pingdom snapshot



The heavier the site page, the slower the loading time. The summary report of Table 4 is presented in the following Table5.

Table 5: Website evaluation using the Pingdom tool

Criteria	Website			
	2016	Score	2018	Score
Performance	U3, U12	85	U6	100
Requests	U12	124	U1	166
Load Time	U6	840ms	U3	1.83s
Page Size	U6	173.7kb	U3	241.9kb

The snapshot of the Pingdom tool is shown in Figure 1.

b) **Website Grader Results:** This tool evaluated the different parameters of website which is performance, mobility, loading time and performance of website. Website Grader delivers the outcomes which are determined out of 30 and crucial factor security is considered out of 10 and the whole calculation of the website is designed out of 100. Resulting Table 6 presented the functioning of Website Grader Tool with respect to different measures.

Table 6: Results of Website Grader Tool

University/ Years	Performance		Mobile		SEO		Security		Overall	
	2016	2018	2016	2018	2016	2018	2016	2018	2016	2018
U1	19/30	17/30	15/30	30/30	15/30	15/30	0/10	0/10	49	62-Ok
U2	11/30	22/30	0/30	30/30	10/30	20/30	10/10	10/10	31	82-Good
U3	25/30	30/30	15/30	15/30	5/30	5/30	0/10	0/10	45	50-Ok
U4	11/30	22/30	30/30	30/30	30/30	10/30	10/10	0/10	81	62-Ok
U5	10/30	10/30	30/30	0/30	20/30	15/30	0/10	10/10	60	35-Ok
U6	27/30	12/30	0/30	0/30	10/30	10/30	0/10	0/10	37	22-Could be better
U7	7/30	10/30	30/30	30/30	5/30	5/30	10/10	10/10	52	55-Ok
U8	17/30	24/30	0/30	30/30	0/30	15/30	0/10	10/10	17	79-Good
U9	9/30	20/30	0/30	0/30	10/30	15/30	0/10	0/10	19	35-Better
U10	12/30	12/30	0/30	0/30	10/30	15/30	0/10	0/10	22	27-Better
U11	15/30	17/30	0/30	30/30	10/30	25/30	0/10	0/10	25	72-Ok
U12	24/30	12/30	15/30	30/30	20/30	25/30	10/10	10/10	69	77-Good

Discussion:

In U1 website, the performance is somewhat reduced in 2018 as compared to 2016 but the traffic from mobile devices is growing fast and U1 has a fully responsive design in 2018 rather than 2016, search engine optimization is identical in both years which mean website is easy for users to discover and easy to understand and no variation in security. The overall grading of the website is changed for U1, i.e. 62 in 2018 and 49 in 2016.

In the U2 website, the performance is improved and it has the fully responsive design in 2018. SEO (Search Engine Optimization) is fast in 2018 than in 2016. The outcome of

Table 6 is characterized in Table 7 and the snapshot of the Website Grader tool is shown in Figure 2.

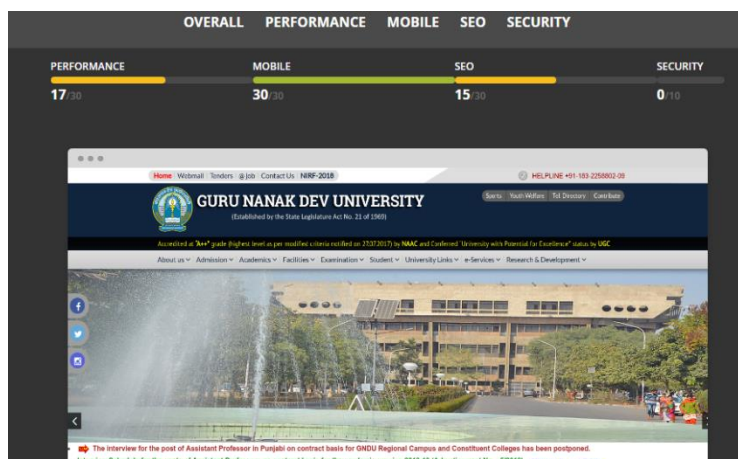
We have explored the universities of Punjab using a Website Grader tool in the years 2016 and 2018. In 2016, we found that the website of U4 is top in rank among other universities and in 2018, U1, U2, U3, U4, U5, U7, U8, U11; U12 websites have attained more popularity than other universities.

Table 7: Website Evaluation using a Website Grader tool

Criteria	Website			
	2016	Score	2018	Score
Performance	U6	27/30	U3	30/30
Mobile	U4,U5,U7	30/30	U1,U2,U4,U7,U8,U11,U12	30/30
SEO	U4	30/30	U11,U12	30/30
Security	U2,U4,U7,U12	10/10	U2,U5,U7,U8,U12	10/10
Overall	U4	81	U2	82

*U1-www.online.gndu.ac.in, U2-www.ptu.ac.in, U3-www.puchd.ac.in, U4-www.punjabiversity.ac.in, U5-www.davuniversity.org, U6- www.bfuhs.ac.in, U7-www.rgnul.ac.in, U8-www.gadvasu.in, U11-www.thapar.edu, U12-www.lpu.in

Figure 2: Website Grader Snapshot



c) **GTMetrix Tool Results:** The GTMetrix tool is an online speed testing tools which allow webmasters to

test their site loading time. It is a useful performance analysis tool. The results are stored in Table 8.

Table 8: Results of the GTMetrix Tool

University/Years	Page speed score		Requests		Load Time		Page size	
	2016	2018	2016	2018	2016	2018	2016	2018
U1	45%	28%	39	163	1.2s	10.8s	1.75mb	8.71mb
U2	87%	46%	36	88	6.7s	8.4s	1.79mb	4.85mb
U3	75%	91%	15	14	3.3s	2.4s	138kb	106kb
U4	75%	96%	77	11	8.5s	4.3s	2.01mb	410kb
U5	91%	33%	85	175	9.3s	7.9s	2.26mb	3.38mb
U6	62%	13%	11	89	1.4s	3.2s	171kb	6.39mb
U7	57%	0%	111	119	10.1s	8.2s	11.2mb	15.2mb
U8	61%	78%	90	61	4.3s	1.8s	2.25mb	3.30mb
U9	68%	76%	42	13	12.1s	4.1s	10.7mb	315kb
U10	83%	44%	22	45	6.4s	15.7s	3.48mb	3.86mb
U11	68%	43%	51	152	4.9s	8s	1.27mb	2.71mb
U12	69%	75%	125	137	49.1s	12.8s	8.65mb	5.07mb

*U1-www.online.gndu.ac.in,U3-www.puchd.ac.in,U4-www.punjabiversity.ac.in, U5-www.davuniversity.org,U8- gadvasu.in, U12-www.lpu.in

Discussion:

In 2016, the U5 website (www.davuniversity.org) score 91% in Page Speed Score and U4 website (www.punjabiversity.ac.in) score 96% in 2018. The no. of requests to a website U12 (www.lpu.in) is higher, but in 2018 U5 website (www.davuniversity.org) score higher in terms of number of requests. The loading time of U1 website (www.online.gndu.ac.in) is faster than others, but in 2018, U8 website loading time is fast. The U3 website (www.puchd.ac.in) page sizes remain same in 2016 and in 2018. The table 9 shows the result of evaluation of the website using the GTMetrix tool and the snapshot of the GTMetrix tool is shown in Figure 3.

Figure 3: The Snapshot of the GTMetrix Tool

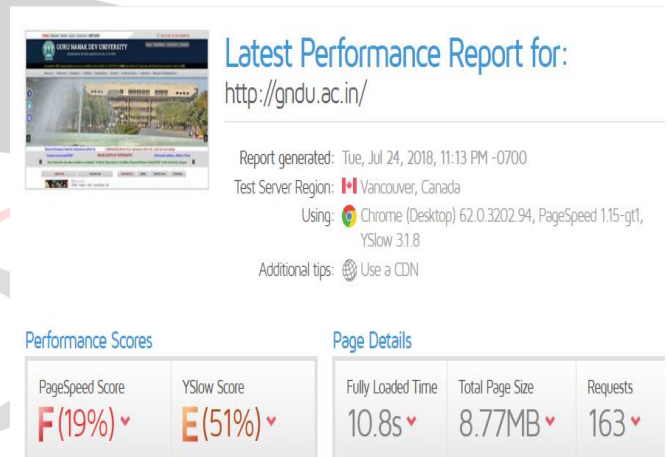


Table 9: Website Evaluation using GTMetrix Tool

Criteria	Website			
	2016	Score	2018	Score
Page Speed Score	U5	91%	U4	96%
Requests	U12	125	U5	175
Load Time	U1	1.2s	U8	1.8s
Page Size	U3	138kb	U3	106kb

The final outcome of Pingdom, Website Grader and GTMetrix tools provides the comparative study of web performances in the years 2016 and in 2018 are finalized in Table 10 and Table 11

Table 10: Outcome of Web Performance in 2016

Tools/Criteria's	2016							
	Performance	No. of Requests	Load Time	Page Size	Mobile	Security	SEO (Search Engine Optimization)	Page Speed Score
Pingdom	U3, U12	U12	U6	U6				
Website Grader	U6				U4, U5, U7	U2, U4, U7, U12	U4	
GTMetrix		U12	U1	U3				U5

*U1-www.online.gndu.ac.in, U2-www.ptu.ac.in, U3-www.puchd.ac.in, U4-www.punjabiversity.ac.in, U5-www.davuniversity.org, U6-www.bfhu.ac.in, U7-www.rgnul.ac.in, U12-www.lpu.in

Table 11: Outcome of Web Performance in 2018

Tools/Criteria's	2018							
	Performance	No. of Requests	Load Time	Page Size	Mobile	Security	SEO (Search Engine Optimization)	Page Speed Score
Pingdom	U6	U1	U3	U3				
Website Grader	U3				U1,U2,U4, U7,U8,U11, U12	U2,U5,U7, U8,U12	U11,U12	

GTMetrix		U5	U8	U3			U4
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*U1-www.online.gndu.ac.in, U2-www.ptu.ac.in, U3-www.puchd.ac.in, U4-www.punjabiversity.ac.in, U5-www.davuniversity.org, U6-www.bfuhs.ac.in, U7-www.rgnul.ac.in, U8-www.gadvasu.in, U11-www.thapar.edu, U12-www.lpu.in

V. CONCLUSION

Usability assessment of the websites is an evolving field and it cannot be ignored. This paper conferred a study to explore the usability of twelve universities of Punjab and a comparative study of automatic performance evaluation tools for websites has been presented. Our research work comprises of the analysis of different automated testing tools. The comparative study of different web testing tools with respect to different criteria's has been presented and the web monitoring tools like Pingdom, Website Grader, and GTMetrix tools were selected and used to evaluate the web performances. The comparative study had been done to measure the twelve universities of Punjab with respect to different parameters in the years 2016 and 2018.

The results show that the web is being accessed more and more on mobile devices and more responsive web designed in 2018 as compared with 2016. As we can see from the website of U1 (Guru Nanak Dev University, Amritsar), having URL www.gndu.ac.in in 2016 is now switched to the URL www.online.gndu.ac.in in 2018 which is mobile responsive. The ability of searching which is easy to find information on websites is better in 2018 for U11 (www.thapar.edu) and U12 (www.lpu.in) sites. Usage of these automated tools would perhaps benefit the website administrator to enrich the website to a completely global standard. The webmasters can monitor the website by using open source tools. The consequence indicates that the website needs improvement to enhance its usability with respect to different criteria's.

ACKNOWLEDGMENT

Authors are greatly thankful to the Department of RIC, IKG Punjab Technical University, Kapurthala, Punjab, India for providing an opportunity to conduct this research work.

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