Vol.1 No.1 October 2024: xx-xx
International Journal of Computer Science and Humanitarian AI (IJCSHAI)
e-ISSN: xxxx-xxxx
DOI: 10.21512/ijcshai.v1i1.12152

Assessing University Website Performance: A Comparative Analysis Using GTmetrix

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***Abstract*— As the reliance on websites to disseminate information increases, universities are no exception, using websites as an important platform for their information systems. However, ensuring optimal website performance is imperative, as slow or unresponsive websites can lead to decreased user satisfaction and affect the university's reputation. This study aims to analyze and compare the performance of university information system websites from Indonesia's top five universities against the world's leading institutions in Computer Science and Information Systems based on QS World University Rankings by Subject 2023. Utilizing GTmetrix, a comprehensive performance assessment tool, key performance metrics such as First Contentful Paint (FCP), Speed Index (SI), Largest Contentful Paint (LCP), Time to Interactive (TTI), Total Blocking Time (TBT), and Cumulative Layout Shift (CLS) were evaluated. The findings reveal a significant performance gap between the top universities globally and in Indonesia. While global universities demonstrate good performance across various metrics, Indonesian universities exhibit areas in need of improvement, particularly in metrics like FCP, SI, LCP, TTI, and CLS. Nevertheless, Indonesian universities excel in blocking time, suggesting strategic strengths that can be leveraged for overall performance enhancement. This study underscores the importance of regular attention to website performance to enhance user experience and maintain the university's reputation within the academic community.**

Keywords*— Website Performance, Comparative Analysis, GTmetrix evaluation*

I. INTRODUCTION

With the advancement of technology, the use of websites has become a common practice for disseminating information to the public [1]. Universities are no exception, as they also utilize this media as a platform for their information systems, which encompass various aspects of their institution such as students, departments, faculties, and more. There are several aspects that need to be developed and maintained to ensure users remain comfortable while using website platforms, one of which is the performance of the website itself .

In this case, slow or unresponsive websites can decrease user satisfaction [2]. It also have an adverse effect on the reputation of the university owning the website [3]. Therefore, there is a need for a comparative analysis of website performance among campuses to assess the optimal performance of each website.

This research aims to analyse and compare the performance of university information system websites from Indonesia's five leading universities against world's five leading universities in "Computer Science and Information Systems" based on QS World University Rankings by Subject 2023 That includes the website from Universitas Indonesia, Bandung Institute of Technology (ITB), Bina Nusantara University (BINUS), etc [4].

The website quality of a university can greatly influence delivery of information services and more to the extent of satisfaction of the stakeholders. In addition, students of this generation are also depended on these social media to get information about their universities [5]. Therefore, checking and confirming the sites used is well developed and can effectively support the decision-making process is very crucial [6]. Thus the communication and normal analysis of the website yield has to be done frequently for any university since it determines the universities performance and reputation within the academic circle [7].

II. LITERATURE REVIEW

A. Website

Websites have taken a path of significant development since their inception, transitioning from simple web pages with no dynamic interactions to conduits of current day's communication and sharing of information[8]. In the past websites were only a combination of plain text and simple images but they have evolved into complex objects which contain multimedia components and can present a unique face to the user [9]. Websites are central to the sharing of information, business transactions, and coordination activities in the present digital world; thus, understanding their design aspects, user influences and effectiveness criteria are crucial [10]. Hence, this research concludes that by adopting these aspects would assist organizations in enhancing the user interaction hence endorsing the

achievement of their strategic goals within the digital environment[11].

B. Comparative Website Analysis

Comparative web analysis is the process of comparing the performance of the various area on the websites[12]. Organization factors include features such as loading time, ease of access, site structure and user engagement through indexes such as First Contentful Paint (FCP) and Speed [13]. Hence, the identification of similarities and differences of websites of different organizations helps organizations to understand how to optimize user interaction on websites and make the necessary improvements to increase [14].

C. GTMetrix

For the purpose of this work, the GTmetrix tools were selected as the means to analyze the performance of the respective websites. Compared to other tools, GTmetrix offers broad coverage of website performance analysis regarding timely performance, penetration, optimization, and other indicators such as speed index, total blocking time, cumulative layout shift, and others[15]. GTmetrix is web based tools and works automatically, the data can also be displayed in an easily comprehensible manner[16].

D. Review of Related Works

Previous studies have also widely explored the aspect of the comparison of website performance and the knowledge gathered by earlier researchers may be useful in the present research on benchmarking methods, user experience and crucial impact of infrastructure in the context of the existing and emerging online platforms[7], [17], [18]. This discusses is among the heavily researched areas across multiple areas of specialization, fields, and disciplines, including academia, e-commerce, information technology, among others.

The field of university performance studies has engaged several scholars and most of them have tended to focus on the analysis of existing university websites. For instance, Suliman in his study had used Teuku Umar University and Samudera Universities websites for the analysis of the performance[7]. There being small variations, it became evident that the two websites had similar loading speeds although Samudera University registered a little better performance. In summary, the study points out potential link between website performance and links and/or other page constituents that have to reduce in order to increase user satisfaction[7].

Likewise, assessing the performance of the website A 'Isyiyah Surakarta of University', a work by Mutia Dawis A and Setiawan I employed GTMetrix. The study also sought to evaluate the site comprehensiveness, and give suggestions on how it could be improved[17]. Nonetheless, there were some drawbacks of the website, for instance, some menus Samba while fully functional had no content. With respect with the website assessment, this study adds up to the alike literature stressing the relevance of the constant update as the way to adjust for fulfilling the clients' as well as organizational expectations and goals in higher education institutions[17].

Therefore, based on previous related studies, this current study on benchmarking university websites has solid theoretical support. In line with the last one, this research aims to develop recommendations for improving website performance based on the insights derived from the literature review.

III. Methodology

A. Type of Research

This study employs quantitative method to assess and compare the functionalities of university information systems websites. Quantitative research entails the usage of numbers in accumulating and analyzing data with the intention of arriving at statistical inferences[19]. This kind of research gathers and evaluates the quantitative data concerning the website's activity in order to draw conclusions about the efficiency of the university's online representation.

B. Search Strategy

The strategy used to collect data in this research is divided into two stages: those are preparation and implementation. The planning section deals with determining the websites to be used in this study as shown in the figure 1, while the project section deals with strategies for testing on GTmetrix as well as the collection and analysis of data as shown on the figure 2. The detail from each of the flow will be explained in the fourth section which is the result and discussion

Figure 1: Preparation Stage

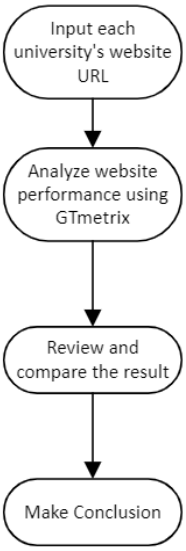

Figure 2: Implementation Stage

C. Website Performance's Metrics

In this study, we employ a series of key performance metrics to conduct a comprehensive comparative analysis of website performance using GTmetrix tools. These metrics include :

a. First Contentful Paint (FCP)

This relates to the time it takes for the first text, picture or some other object to be loaded on the webpage. Low FCP value means faster rendering of the first content on the webpage[13].

Figure 3: FCP Metrics

b. Speed Index (SI)

This metric measures the number of changes that the different parts of the web page go through as the page loads, which measures layout changes during load. This can further result to having negative experience with the users where you find instances like the following as shown below, when one is attempting to touch on the elements within the page[13].

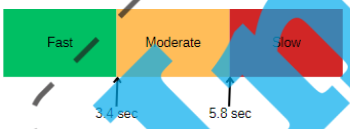

Figure 4: SI Metrics

c. Largest Contentful Paint (LCP)

This metric characterizes the time the largest content item takes to be loaded into the page, which may be a large image, video or another large object that the user's focus may shift towards. [13].

Figure 5: LCP Metrics

d. Time To Interactive (TTI)

This metric is particularly aimed to quantify time that is required to pass before the website is in the state ready to process user inputs. [20].

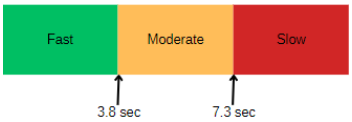

Figure 6: TTI Metrics

e. Total Blocking Time (TBT)

This refers to the time that the webpage takes to be hidden and unavailable for user input and participation [13].

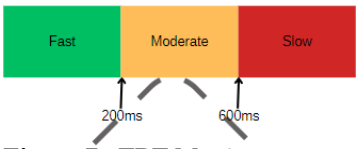

Figure 7 : TBT Metrics

f. Cumulative Layout Shift (CLS)

These metrics indicate how much the arrangement of content on a given Web page changes during the loading process. This helps in getting information about the stability of the webpage's format which reveals whether it is changing frequently as content loads. A greater CLS value indicates layout instability or dramatic layout shifts, which may be unbearable when some items move or realign as the users view the page.[13].

Figure 8: CLS Metrics

In Conclusion, each of the covered metrics offers important and unique details about the website's performance, including the time it takes to display the first contentful paint, the overall speed index, and the time to interactivity[13], [20]. Further, measurements like total blocking time and cumulative layout shift give us details of user engagement and visual mobility respectively[13]. We hope that by using these measures, we will be able to assess and analyze how effectively university websites are functioning in terms of providing the appropriate stream of service for their user groups.

IV. Result and Discussion

In this paper we will carry out a comparative analysis of 10 university websites using Gtmetrix. Among them, 5 are from the list of Top 5 universities in Indonesia and the

remaining 5 are from the list of Top 5 universities globally. This will make it easy to compare the performance of university websites at the national levels and internationally.

A. Preparation

a. Conduct a survey to identify the top 5 ranked universities globally by utilizing the QS World University Rankings website. The top 5 universities will be selected from the ranking list.
b. Change the region on the QS World University Rankings website to Indonesia to obtain information on the top 5 universities in Indonesia. Then, select the top 5 universities from that ranking.
c. The top 5 global universities selected for performance testing are Massachusetts Institute of Technology (MIT), University of Cambridge, University of Oxford, Harvard University, and Stanford University, alongside the top 5 universities in Indonesia: Universitas Indonesia, Bandung Institute of Technology (ITB), Bina Nusantara University (BINUS), Gadjah Mada University, and Institut Teknologi Sepuluh Nopember (ITS Surabaya).

B. Implementation

The performance testing of the specified university websites will be carried out using GTmetrix. This involves inputting each university's website URL into GTmetrix's address bar on the homepage for performance analysis. Figure 1 illustrates GTmetrix analyzing the performance of the Bina Nusantara (BINUS) website.

The testing will begin with evaluating the performance results of the selected university websites, such as Massachusetts Institute of Technology (MIT), University of Cambridge, University of Oxford, Harvard University, and Stanford University. Subsequently, we will review the average performance results of each website and compare the findings[17].

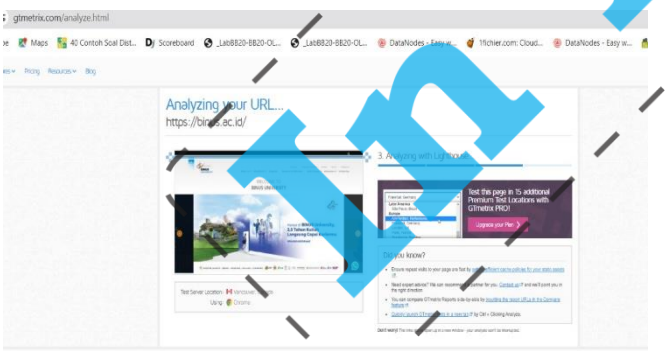

Figure 9: Examples of Testing with GTMetrix

Figure 9 illustrates how GTmetrix evaluates a website's performance for analysis. Typically, GTmetrix takes 30-60 seconds for each check in one process. However, since this comparison involves 10 websites, GTmetrix will be used 10 times to assess each designated website.

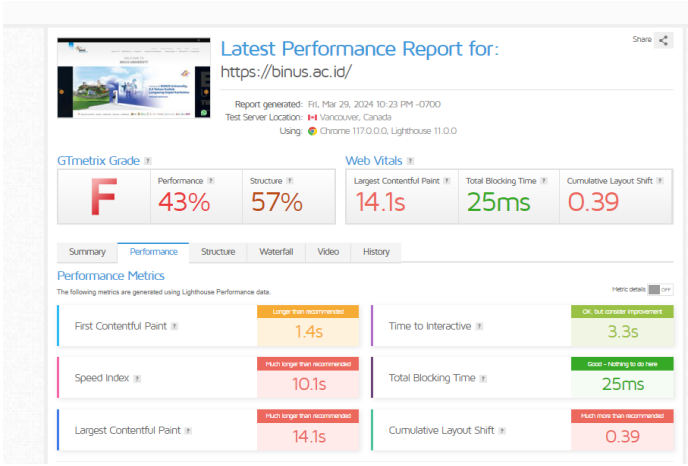

Figure 10: The performance analysis results obtained from GTmetrix for the Bina Nusantara (BINUS) website

From the analysis using GTmetrix, it can be seen that the total grade of a website under analysis and its performance evaluation will be based on scores such as First Contentful Paint, Speed Index, Largest Contentful Paint, Time to Interactive, Total Blocking Time, and Cumulative Layout Shift. These scores will be used for comparison among the 10 websites.

Table 1: Comparison of performance among the top 5 universities globally.

The top 5 universities globally	RANK	First Contentful Paint	Speed Index	Largest Contentful Paint	Time to Interactive	Total Blocking Time	Cumulative Layout Shift
Massachusetts Institute of Technology (MIT)	A	675 ms	780 ms	675 ms	1000 ms	27 ms	0
University of Cambridge	B	1300 ms	1700 ms	1700 ms	1600 ms	55 ms	0.12
University of Oxford	A	796 ms	1300 ms	917 ms	840 ms	0 ms	0
Harvard University	B	280 ms	1500 ms	480 ms	2400 ms	404 ms	0
Stanford University	A	481 ms	612 ms	687 ms	1100 ms	47 ms	0

Table 1 displays performance data from the top 5 universities globally, with performance grades ranging from the lowest grade of B to the highest grade of A. However, there is one university among the top 5 universities globally that has a moderate blocking time of 404ms. The average performance values for First Contentful Paint across these 5 websites are 706.4ms, Speed Index is 1178.4ms, Time to Interactive is 1388ms, Total Blocking Time is 106.6ms, Largest Contentful Paint is 891.8ms, Total Blocking Time is 106.6ms, and Cumulative Layout Shift is 0.024.

Based on the data obtained, it can be concluded that the performance of the 5 websites from the top 5 prestigious universities in the world is good, fast, and highly satisfactory.

Table 2. Comparison of performance among the top 5 Indonesia University.

Top 5 Indonesia University	RANK	First Contentful Paint	Speed Index	Largest Contentful Paint	Time to Interactive	Total Blocking Time	Cumulative Layout Shift
Universitas Indonesia	E	7000 ms	9900 ms	7900 ms	9000 ms	12 ms	0.03
Bandung Institute of Technology (ITB)	F	2500 ms	25900 ms	4900 ms	6500 ms	66 ms	0.35
Bina Nusantara University (BINUS)	F	1400 ms	10100 ms	14100 ms	3300 ms	25 ms	0.39
Gadjah Mada University	E	2500 ms	5900 ms	3600 ms	3400 ms	0 ms	0.49
Institut Teknologi Sepuluh Nopember (ITS)	E	2900 ms	5500 ms	3800 ms	4600 ms	0 ms	0.49

Table 2 displays performance data from the top 5 universities in Indonesia with performance grades ranging from the lowest grade of F to the highest grade of E. The average performance values for First Contentful Paint across these 5 websites are 3060ms, Speed Index is 11480ms, Time to Interactive is 5360ms, Total Blocking Time is 20.6ms,

Based on the data obtained, it can be concluded that the performance of the 5 websites from the top 5 top universities in Indonesia is bad, moderate, and need improvement. However, Indonesia top 5 university falls into the "good" category in terms of blocking time.

Table 3: Comparison of the average scores of the top 5 university globally and the top 5 universities in Indonesia.

Category	The average score of the top 5 universities globally.	The average score of the top 5 universities globally.
First Contentful Paint	706,4 ms	3.060 ms
Speed Index	1178,4 ms	11.480 ms
Largest Contentful Paint	891,8 ms	6820 ms
Time to Interactive	1.388 ms	5.380 ms
Total Blocking Time	106,6 ms	20,6 ms
Cumulative Layout Shift	0.024	0.346

It can be seen that the performance of the top 5 university websites in Indonesia is significantly lower compared to the performance of the top 5 websites globally. In terms of First Contentful Paint, Speed Index, Largest Contentful Paint, Time to Interactive, and Cumulative Layout Shift, it can be observed from the comparison of their average scores that they lag significantly behind. However, it can be noted here that the top-ranking 5 universities in Indonesia excel and fall into the "good" category in terms of blocking time.

V. Conclusion

This research uses numbers to study and compare how well university websites work. We used GTmetrix tools to check things like how fast the website shows its first content (FCP), how stable it is when loading (SI), how long it takes for big content to show up (LCP), how quickly it responds to users (TTI), how long it gets blocked and can't be used (TBT), and if things move around while it's loading (CLS)[13], [20]. We looked at these things for universities worldwide and in Indonesia.

The results indicate a significant performance gap between the top 5 universities globally and in Indonesia. The global universities exhibit good, fast, and highly satisfactory performance across various metrics, with performance grades ranging from B to A. In contrast, the top 5 universities in Indonesia demonstrate a need for improvement, particularly in metrics like FCP, SI, LCP, TTI, and CLS, where they lag significantly behind global counterparts.

However, it is noteworthy that Indonesian universities excel in blocking time, falling into the "good" category. This highlights a strategic area of strength that can be leveraged for overall performance enhancement.

In conclusion, while global universities showcase superior performance in most metrics, Indonesian universities demonstrate competence in specific areas, indicating opportunities for targeted improvements to enhance overall website performance and user experience.

References

[1] N. Huda and M. Megawaty, "Analisis Kinerja Website Dinas Komunikasi dan Informatika Menggunakan Metode Pieces," *Jurnal Sisfokom (Sistem Informasi dan Komputer)*, vol. 10, no. 2, pp. 155–161, Jul. 2021, doi: 10.32736/sisfokom.v10i2.1018.

[2] R. R. Taufik Bau and A. Muh Akbar Saputra, "Analisis Kendala Dari Hasil Evaluasi EUCS: Upaya Mengantisipasi Potensi Kekurangan Pada Pengembangan Sistem Informasi Di Masa Depan Analyzing Constraints From EUCS Evaluation Results: Anticipating Potential Flaws In The Future Development Of Information Systems," 2023.

[3] M. Miao, T. Jalees, S. I. Zaman, S. Khan, N. ul A. Hanif, and M. K. Javed, "The influence of e-customer satisfaction, e-trust and perceived value on consumer's repurchase intention in B2C e-commerce segment," *Asia Pacific Journal of Marketing and Logistics*, vol. 34, no. 10, pp. 2184–2206, Nov. 2022, doi: 10.1108/APJML-03-2021-0221.

[4] "QS World University Rankings by Subject 2023: Computer Science and Information Systems."

[5] J. Abbas, J. Aman, M. Nurunnabi, and S. Bano, "The impact of social media on learning behavior for sustainable education: Evidence of students from selected universities in Pakistan," *Sustainability*

(Switzerland), vol. 11, no. 6, 2019, doi: 10.3390/su11061683.

[6] K. Palacios-Zamora, J. Cordova-Moran, D. Mendoza-Cabrera, and S. Pacheco-Mendoza, "INTERNATIONAL JOURNAL ON INFORMATICS VISUALIZATION journal homepage : www.joiv.org/index.php/joiv INTERNATIONAL JOURNAL ON INFORMATICS VISUALIZATION Measurement on University Websites: A Perspective of Effectiveness," 2023. [Online]. Available: www.joiv.org/index.php/joiv

[7] Suliman, "Analisis Performa Website Universitas Teuku Umar Dan Universitas Samudera Menggunakan Pingdom Tools Dan Gtmetrix Suliman," Jan. 2020. [Online]. Available: http://e-jurnal.stmikbinsa.ac.id/index.php/simkom24

[8] Julianto V, Suprianto A, Prastyaningsih Y, and Yuliyanti W, "PELATIHAN PEMBUATAN DAN PENGELOLAAN WEBSITE SEKOLAH SEBAGAI MEDIA INFORMASI UNTUK OPERATOR SEKOLAH SE-KECAMATAN BATU AMPAR," vol. 1, Jul. 2021.

[9] T. Tesfaye Haile, "Web's Progression: Moving from Passive Content Consumption to Active Content Creation and Content Validation," *International Journal of Business and Management*, vol. 18, no. 6, p. 135, Nov. 2023, doi: 10.5539/ijbm.v18n6p135.

[10] U. A. Abdurakhimovich, "The Vital Role of Web Programming in the Digital Age," *JURNALI*, vol. 1, no. 6, 2023.

[11] A. Pateli, N. Mylonas, and A. Spyrou, "Organizational adoption of social media in the hospitality industry: An integrated approach based on DIT and TOE frameworks," *Sustainability (Switzerland)*, vol. 12, no. 17, Sep. 2020, doi: 10.3390/su12177132.

[12] B. Kang, J. Lee, S. H. Kim, and B. K. Jeong, "Destination website benchmarking: A comparative analysis of MICE destinations of Japan and five emerging destinations in East Asia," *Journal of Convention and Event Tourism*, vol. 25, no. 1, pp. 10–32, 2024, doi: 10.1080/15470148.2023.2255732.

[13] Y. Kravchenko, O. Leshchenko, O. Trush, N. Dakhno, and P. Krasnopyorov, "Optimizing and Improvement a Web Application Using Open Source Tools," 2023.

[14] A. COCIORVA, "Website Performance Measurements and Related Analysis," *Informatica Economica*, vol. 27, no. 4/2023, pp. 16–31, Dec. 2023, doi: 10.24818/issn14531305/27.4.2023.02.

[15] M. Kinnunen, "Evaluating and Improving Web Performance Using Free-to-Use Tools," 2020.

[16] R. Nanda Bija, A. Posyalam Talaohu, and A. Munandar, "ANALISIS KUALITAS WEBSITE BURSA EFEK INDONESIA DENGAN MENGGUNAKAN METODE GTMETRIX," 2024. [Online]. Available: http://gtmetrix.com/

[17] A. Mutia Dawis and I. Setiawan, "EVALUATION OF THE WEBSITE 'AISYIYAH SURAKARTA of UNIVERSITY PERFORMANCE BASED ON SEARCH ENGINE OPTIMIZATION USING AUTOMATED SOFTWARE TESTING GTMetrix," Surakarta, 2022. [Online]. Available: https://ijcis.net/index.php/ijcis/index

[18] B. Williamson, "Policy networks, performance metrics and platform markets: Charting the expanding data infrastructure of higher education," *British Journal of Educational Technology*, vol. 50, no. 6, pp. 2794–2809, Nov. 2019, doi: 10.1111/bjet.12849.

[19] H. Mohajan, "Munich Personal RePEc Archive Quantitative Research: A Successful Investigation in Natural and Social Sciences," 2020.

[20] I. Armaini, M. H. Dar, and B. Bangun, "Evaluation of Labuhanbatu Regency Government Website based on Performance Variables," *Sinkron*, vol. 7, no. 2, pp. 760–766, May 2022, doi: 10.33395/sinkron.v7i2.11404.