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Analysis of Internal and External Website Usability Factors

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ABSTRACT
End-user feedback on products is vital to enhance their speed and performance. These evaluations reveal satisfaction levels of end-users, which center on the ease of use and understandability of such applications. This study evaluates the internal and external attributes of the usability of four (4) websites using three automated tools namely Gtmetrix, Website grader, and Pingdom along with the administration of survey questionnaire. The internal attributes were measured for factors such as performance, page size, load time, and page requests using automated tools while the external attributes were measured using surveys on ease of navigation, organisation of information, and other factors. The scores from the survey were tested for reliability using the Cronbach Alpha technique and modeled in IBM SPSS Statistics 26.0 software. Results obtained from the survey-based approach showed that all four websites have good usability features and hence passed the test. Nonetheless, two other websites ranked low when evaluated with automated tools.

Keywords
Usability, survey, external attributes, internal attributes, Gtmetrix, Website grader, Pingdom, Performance, load time, page request, page size, website

1. INTRODUCTION
Websites are used by organisations to market their information, products, and services; therefore, it should be easy for clients to understand and highlight solutions that satisfy user requirements. Usability is a software quality attribute that can be used to measure website accessibility. As an important quality attribute, Usability evaluation must be performed appropriately and frequently to ensure user satisfaction [24]. According to [19], Usability is the ease of use of a product, its efficiency, and error tolerance; these are in addition to the easy navigation, memorability, learnability, readability, and satisfaction as affirmed in [17]. Hence, Usability has been grouped by [7] under 5 E's: Efficiency, Engaging, Easy to Use, Effectiveness, and Error Tolerance. Websites are designed for organisations to ensure suitability, profitability, and accessibility [26]; therefore, a less usable website can cause an organisation to lose potential clients. The usability evaluation of websites is significant to improve performance and speed such that the standard against competitors in the industry is raised [11]. Among many methods proposed to measure website usability include heuristic evaluation which ensures usability problems are identified and solved to enhance the optimal use of a website [16]. Other methods include surveys and the use of automated tools.

Surveys are used for extracting, recording, and assembling user scores to evaluate satisfaction and perceive their opinion on the use of websites but some responses are unreliable and inconsistent [5][11]. Hence to evaluate the reliability of the survey, the Cronbach Alpha technique was adopted [3]. It has a level of reliability scale that ranges from 0 to 1. Responses from the survey are said to be reliable when the Cronbach Alpha value is closer to 1 [23]. According to [25], usability can be calculated using the System Usability Scale (SUS) score after the reliability ascertaining survey scores. This score helps to grade and rate the value of usability after the website is evaluated. The higher the usability value, the better the grade; therefore, the better the rating [6].

Automated tools aid in measuring website internal factors which cannot be evaluated by users such as load time, number of requests, and page size. This research uses Gtmetrix, Website grader, and Pingdom tools to evaluate these factors.

The rest of the paper is organised as follows: Section 2 discusses Related Works. The methodology used is discussed in Section 3. Results and discussion are found in Section 4 while Section 5 covers the conclusion and future work.

2. RELATED WORKS
Researchers over the years have evaluated software usability using various techniques such as automated tools and the administration of surveys. Automated tools measure the internal attributes that cannot be perceived by users while the surveys evaluate the external attributes based on user satisfaction. Authors in [23] conducted a website usability study where they evaluated chosen websites of universities in Bangladesh. They used two automated tools namely the Html toolbox and webpage analyser along with surveys. The outcome of the study showed that users were dissatisfied with

the overall level of usability of the websites due to the existence of weaknesses in the design, interface, and performance. The findings from the study were thereby used to provide recommendations for usability enhancement.

In [23], the authors evaluated the usability of the Information Technology faculty educational portal at Benghazi. The analysis was done based on a survey-based method and an online automated tool-based method. The research presented the usability factors to be on the acceptable level of performance and the faculty portal was concluded to be acceptable and usable. Consequently, suggestions for improving the weaknesses of the website usability were proposed.

Research was performed by authors in [1] to evaluate the usability and accessibility of websites of federal universities in Nigeria to determine their compliance with international accessibility guidelines. The evaluation was done using three (3) automated tools including achecker, wave, and hera on thirty-six (36) universities' websites. The results showed that no university's website satisfied the usability criteria of the international accessibility guidelines. It also showed that persons with disabilities would find it difficult to access the websites. Practical suggestions were made to improve the websites.

A study by [21] used a survey-based approach to evaluate the web portal of the University of Benin. The survey consisted of five sections with twenty-seven questions. One hundred (100) respondents filled the survey and the scores were gathered and analysed. The usefulness of the university's web portal design and the interface was seen to be merely effective and less efficient. However, its overall usability level was seen to be acceptable.

In [17] the authors compared usability factors such as performance, speed, number of requests, load time, page size, user experience, mobile readiness, navigation, design, content, Search Engine Optimization (SEO), security, heat maps, clickstream and accessibility of twenty-one (21) automated testing tools to determine their capacity. The research further evaluated the performance of different websites of Universities in Punjab using automated tools such as Pingdom, GTMetrix, Website Grader, and Site Speed Checker Tool. The results were analysed and showed the website with the highest usability score.

The researcher in [20] presented a study on the usability and accessibility of seventy-five (75) e-government websites in Tanzania. The researcher used automated tools such a Pingdom, Google Speed Insight, Wave, and Acunetix. The results revealed several usability issues on factors such as loading time and broken webpage links. Based on the results, recommendations were provided on ways to improve usability.

A study by [18] was on the investigation of the usability of a library website with different end-user groups based on its efficiency, satisfaction, and effectiveness. The evaluation was done based on performing formal usability testing such as think-aloud protocol, log analysis, and surveys. The results indicated that the respondents graded the website as not usable. Based on the weaknesses, recommendations were presented for improving the website's usability.

In [27], they conducted a study to evaluate the usability of the Muhammadiyah Magelang University website using a survey. The survey consisted of seventeen (17) questions and was filled by ninety-five (95) respondents. The questions were grouped into five usability factors consisting of learnability, efficiency, memorability, error, and satisfaction. The results proved the website to be easy to use; however, there were some weaknesses in the website that needed fixing.

An analysis was performed by [29] to rate the usability of the New Student Acceptance (NSA) system in Pringgarata based on usability testing methods such as effectiveness, efficiency, and user satisfaction. The study used the System Usability Scale (SUS) surveys and Likert scale. The outcome of the study showed that the NSA system was usable. The researchers further recommended ways to make the pages on the system more interesting to users.

Authors in [15] performed social media website usability analysis using automated tools such as Pingdom, Gtmetrix, and website grader. The outcome showed that some of the websites scored poorly when evaluated for parameters such as performance and mobile readiness and therefore need to be addressed.

Usability analysis was carried out by [4] on the payroll information system of PT Karya Prima Usahatama company. The analysis was done based on a survey-based method on seventy-five (75) respondents. The reliability of the survey was calculated using Cronbach Alpha's mathematical method and then modeled using SPSS software. The results showed that the payroll system was able to be understood, studied, used, and attractive to users.

From the related works, it is evident that websites have been mostly evaluated for usability based on automated tools and surveys. Some of the researchers applied only automated tools whiles others used only surveys. There were a couple of researchers who used both methods. This research seeks to evaluate the internal and external factors of four (4) websites by the use of automated tools and surveys.

3. RESEARCH METHODOLOGY

Usability is a significant software quality attribute and is vital in software development. It is the ease of use of software and the ability to tolerate error. Website Usability evaluation is significant because it helps to evaluate performance as well as user satisfaction. Once users find a website not usable and difficult to navigate, they leave immediately. This research evaluates the Usability of four (4) websites based on usability test tools and administration of survey. The usability test tools will check for factors such as performance, load time, speed, number of requests, and page size while the survey will take responses from users such as the navigation, clarity of information, right presentation of content, and other responses. The websites being evaluated for usability are listed in Table 1.

Table 1. List of Websites

Name	Website URL
FUTA	https://www.futa.edu.ng/
UMaT	https://www.umat.edu.gh/
Yahoo	https://www.yahoo.com/
Google	https://www.google.com/

3.1 Automated Tools Usability Evaluation

The first part of the study was carried out using Usability testing tools to evaluate websites for factors such as page size, load time, number of requests, speed, and performance. The testing tools used are Gtmetrix, Website grader, and Pingdom.

- Gtmetrix

Gtmetrix is a performance analysis tool used for evaluating the usability of web-based applications. It does the evaluation using factors such as performance, speed, page size, load time, and the number of requests. After evaluation, slow web-based applications are given suggestions on how to improve speed.

- Website Grader

Website grader is an evaluation tool used for generating the usability of web-based applications. It uses factors such as performance, speed, page size, load time, number of requests, Search Engine Optimization (SEO), mobile readiness, and security. It is useful for evaluating e-commerce websites since it takes into account the website traffic, findability in search engines, blogosphere, social media, and other marketing factors [17]. It also evaluates the website for legibility of font size, responsiveness, and other factors. After evaluation, web-based applications are given suggestions on how to improve scores to drive more traffic. It is a useful tool for website usability evaluation.

- Pingdom

Pingdom is a web performance and digital monitoring tool used to generate reports such as the time it takes to load the website, page size, and other web requests. It evaluates websites using their performance, page size, load time, and page requests. Pingdom checks the loading speed of websites and suggests how to make it faster. It also provides a detailed report on the load time of each element of the website being tested such as images, CSS, JavaScript, and RSS [12].

3.2 Survey-based Usability Evaluation

The second part of the study was done by administering a survey with ten (10) questions as shown in Table 2 to users. The survey was filled using a scale defined from 1 to 5, with 1 as Strongly Disagree, 2 as Disagree, 3 as Neutral, 4 as Agree, and 5 as Strongly Agree.

The administered survey was modeled according to two usability models, namely the ISO 9126 and ISO 9241-11. The former is composed of four attributes: understandability, learnability, operability, and compliance [13] and the latter comprises three attributes: effectiveness, efficiency, and satisfaction [14].

Table 2. Questions and Usability Item

No	USABILITY ITEM		Question
	ISO 9241-11	ISO 9126	
1	Effectiveness	Learnability	It is easy to navigate within the website
2			It was easy to find the information I need
3	Satisfaction	Understandability	The organisation of information on the website is clear
4		Operability	The interface of the website is pleasant
5			I found the images on the website useful
6			Content on the website was presented in the right manner
7			The size of web controls was appropriate
8	Efficiency		It took less time to load the website
9		Compliance	The website has all the functions I expect it to have
10	Satisfaction		Overall, I am satisfied with the website

The scores from the survey were tested for Reliability using Cronbach Alpha mathematical method which is expressed in (1) as:

$$\alpha = N\bar{c}/(\bar{v} + (N-1) * \bar{c}) \quad (1)$$

where α = Cronbach Alpha;
N = Number of items;
$\bar{c}$ = Covariance between the items; and
$\bar{v}$ = average variance.

This was implemented in IBM SPSS Statistics 26.0 software. The value for Cronbach Alpha ranges between 0 and 1 and signifies high reliability when the value is closer to 1 as shown in Table 3.

Table 3. Cronbach Alpha's Score and Reliability [23]

Cronbach Alpha's Score	Level of Reliability
$\alpha \geq 0.9$	Excellent (Very Reliable)
$0.9 > \alpha \geq 0.8$	Good (Reliable)
$0.8 > \alpha \geq 0.7$	Acceptable (Quite Reliable)
$0.7 > \alpha \geq 0.6$	Questionable (Rather Reliable)
$0.6 > \alpha \geq 0.5$	Poor (Less Reliable)

The usability of the websites was individually calculated using (2) as:

$$\text{Usability} = \text{Total Score}/\text{Maximum Score x } 100 \quad (2)$$

The usability value was graded after calculation using the System Usability Scale (SUS) as shown in Table 4.

Table 4. Cronbach Alpha's Score and Reliability [6]

SUS Score	Grade	Rating
> 80.3	A	Excellent
68 – 80.3	B	Good
68	C	Okay
51 - 68	D	Poor
< 51	F	Awful

4. RESULTS AND DISCUSSIONS

4.1 Results of Automated Tools Usability Evaluation Approach

The Usability tools applied in the research are Website Grader, Pingdom, and Gtmetrix.

4.1.1 Usability Evaluation using Pingdom Tool

Pingdom Tool was used to evaluate the Usability of the websites as shown in Table 5. The evaluation was done based on four factors namely: Performance, Page Size, Load Time, and Page Requests.

Table 5. Application of Pingdom Tool on Websites

Web Page	Perfor-mance	Page Size (MB)	Load Time (sec)	Page Requests	Grade
UMaT	75	4.90	2.300	128	C
FUTA	64	6.10	1.690	158	D
Yahoo	69	2.10	2.070	166	D
Google	79	0.67	0.625	32	C

It is seen from Table 5 that the website with the highest Performance score was Google. FUTA had the highest Page size while Google had the lowest. The load time of the websites was seen to range between 0 and 2.5 with Google having the lowest load time and UMaT having the highest load time. Google had the lowest score for Page Requests followed by UMaT, FUTA, and lastly, Yahoo.

4.1.2 Usability Evaluation using Gtmetrix Tool

Gtmetrix Tool was used to evaluate the Usability of the websites based on four factors namely: Performance, Total Page Size, Fully Loaded Time, and Total Request. This is shown in Table 6.

Table 6. Application of Gtmetrix Tool on Websites

Web Page	Perfor-mance	Total Page Size (MB)	Fully Loaded Time (sec)	Total Requests	Grade
UMaT	61	3.320	5.50	132	D
FUTA	58	5.790	7.20	215	D
Yahoo	99	1.660	8.30	296	A
Google	100	0.422	0.45	18	A

From Table 6, Google was seen to have the highest Performance score. FUTA had the highest Page size followed by UMaT whiles Google had the lowest. The load time of the websites was seen to range between 0 and 8.5. Google was seen to have the lowest load time followed by UMaT. Yahoo had the highest load time score. Google had the lowest score for Page Requests followed by UMaT, FUTA, and lastly, Yahoo.

4.1.3 Usability Evaluation using Website Grader Tool

The website grader tool, as shown in Table 7, evaluates the four websites using seven factors which include: Performance, SEO, Mobile, Security, Page Size, Page Requests, and Page Speed.

Table 7. Application of Website Grader Tool on Websites

Web Page	Performance (30)	SEO (30)	Mobile (30)	Security (10)	Overall (100)	Page Size (MB)	Page Requests	Page Speed (sec)
UMaT	8	30	20	5	63	3.700	124	12.7
FUTA	6	25	10	5	46	6.100	183	19.1
Yahoo	14	30	30	10	84	0.902	106	7.5
Google	27	25	30	10	92	0.471	31	5.0

From Table 7, Google was seen to have the highest performance value followed by Yahoo, UMaT, and then FUTA. Yahoo, UMaT, and Google had the same score for SEO whiles FUTA had the lowest score. Yahoo and Google had the same score for Mobile readiness, followed by UMaT and then FUTA. Google and Yahoo had the same score for Security followed by FUTA and UMaT. Google was seen to have the lowest score for Page size, followed by Yahoo, UMaT, and lastly FUTA. The website with the lowest Page requests was Google, followed by Yahoo; UMaT came next, followed by FUTA. Google was seen to have the lowest value for Page speed.

4.1.4 Overall Performance Evaluation using Automated Tools

The overall performance of the automation based on usability tools was calculated and shown in Figure 1. UMaT recorded a total performance of 165.63 representing 20%. FUTA also recorded an overall performance of 144.23 representing 18%. Yahoo had 219.85 as the overall performance record with 27%. Lastly, Google had 279 as the overall performance and a percentage of 35.

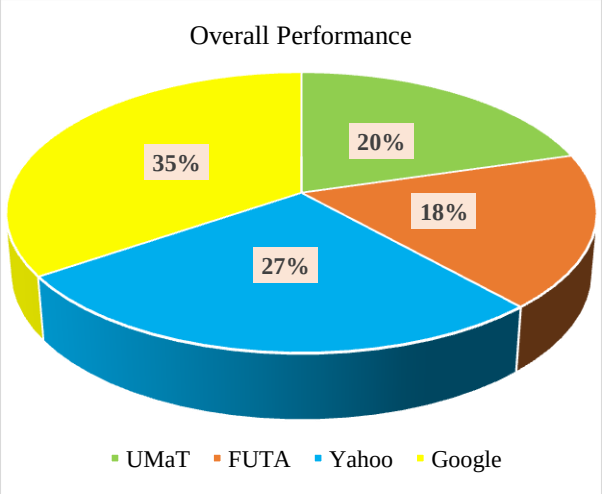

Fig 1: Overall Performance of Websites from Automated Tools

Figure 1 shows that Google had a higher performance value followed by Yahoo. FUTA recorded the lowest performance value.

4.2 Results of Survey -based Usability Evaluation Approach

To assess the Usability of the websites, a survey was administered to persons in Nigeria and Ghana through email. To maximise the response rate, the people were assured that the responses and identities would be treated with utmost confidentiality since the research is for academic purposes. A total of 100 users were given the survey with the response rate being 65%. The reliability of the survey was initially calculated using Cronbach's Alpha model in IBM SPSS Statistics 26.0 software. A summary showing the number of users who were administered the survey is shown in Table 8 while Table 9 shows the reliability statistics of the scores from the survey.

Table 8. Case Processing Summary for Survey

		Number	%
Cases	Valid	64	98.5
	Excluded[a]	1	1.5
	Total	65	100.0

Table 8 shows the total number of respondents and their percentage. The excluded listwise deletion value is 1 which shows that only one value was redundant and hence, excluded. This makes the percentage of valid values 98.5% and excluded values, 1.5%.

Table 9. Reliability Statistics of Survey Score

Website	Cronbach's Alpha
https://www.futa.edu.ng/	0.860
https://www.umat.edu.gh/	0.964
https://www.yahoo.com/	0.974
https://www.google.com/	0.983
Number of Items = 10	

Table 9 shows that the score from the survey for FUTA website has a Cronbach Alpha value of 0.860. This shows the reliability statistic of the survey as "Very Reliable". UMaT's website is also in the "Very Reliable" category since Cronbach Alpha's value is 0.964. Cronbach Alpha's value is shown as 0.974 for Yahoo. This shows that the score from the survey is also "Very Reliable". Google had the value of Cronbach Alpha as 0.983. This shows the reliability of the survey as "Very Reliable".

The websites were calculated for usability by summing up the scores for each of the ten questions. The sum was multiplied by the scale of 1 as Strongly Disagree, 2 as Disagree, 3 as Neutral, 4 as Agree, and 5 as Strongly Agree to get the Total Score.

4.2.1 Usability Evaluation for FUTA

To evaluate the Usability of FUTA website, the statistics from the survey was calculated to get the value for the total score. This is shown in Table 10.

Table 10. Survey Statistics for FUTA Website

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Easy to Navigate	22	30	11	2	0
Easy to find Information	17	30	11	5	2
Clear organisation of Information	16	33	9	7	0
Pleasant Interface	15	21	18	6	5
Useful Images	17	32	10	5	1
Right Presentation of content	17	34	11	2	1

Appropriate Size of web controls	16	26	18	4	0
Less Load time	15	24	17	7	2
Meet Expected Functions	12	21	19	8	5
Overall Satisfaction	14	20	14	6	1
Sum	**161**	**271**	**138**	**52**	**17**
Total Score	161*5 = 805	271*4 = 1084	138*3 = 414	52*2 = 104	17*1 = 17
Sum of Total Score = 2424					

Based on Table 10, it can be said that the scores for Strongly Agree are 161, scores for Agree are 271, scores for Neutral are 138, scores for Disagree are 52, and scores for Strongly Disagree are 17.

$$\text{Usability} = \text{Total Score}/\text{Maximum Score} \times 100$$

Maximum Score
= Number of Respondents x Number of Surveys x 5

$$= 65 \times 10 \times 5$$

$$= 3250$$

$$\text{Usability} = 2424/3250 \times 100$$

$$= 74.6$$

The percentage value of FUTA website based on the scores from the survey was calculated as 74.6%. This falls in the "Good" category of the SUS score. This shows that the website can be easily understood and used by users.

4.2.2 Usability Evaluation for UMaT

The Usability Percentage of UMaT website was calculated by evaluating the survey statistics to get the total score as shown in Table 11.

Table 11. Survey Statistics for UMaT Website

Question	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Easy to Navigate	15	34	9	2	5
Easy to find Information	20	28	11	0	6
Clear organisation of Information	17	30	11	1	6
Pleasant Interface	14	28	11	3	9
Useful Images	15	34	9	1	6
Right Presentation of content	14	28	14	0	9
Appropriate Size of web controls	15	24	18	2	6
Less Load time	18	22	10	7	8
Meet Expected Functions	14	21	22	2	6
Overall Satisfaction	14	27	14	2	8
Sum	**156**	**276**	**129**	**20**	**69**
Total Score	156*5 = 780	276*4 = 1104	129*3 = 387	20*2 = 40	69*1 = 69
Sum of Total Score = 2380					

Based on Table 11, it can be said that Strongly Agree has 156 scores, Agree has 276 scores, Neutral has 129 scores, Disagree has 20 scores whereas scores for Strongly Disagree are 95.

$$\text{Usability} = \text{Total Score}/\text{Maximum Score} \times 100$$

Maximum Score
= Number of Respondents x Number of Surveys x 5

$$= 65 \times 10 \times 5$$

$$= 3250$$

$$\text{Usability} = 2380/3250 \times 100$$

$$= 73.2$$

The percentage value of UMaT website based on the scores from the survey was calculated as 73.2%. This falls in the "Good" category of the SUS score. This shows that the website can be easily understood and used by users.

4.2.3 Usability Evaluation for Yahoo

The Usability Percentage of Yahoo website was calculated by evaluating the survey statistics to get the total score as shown in Table 12.

Table 12. Survey Statistics for Yahoo Website

Question	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Easy to Navigate	25	26	5	0	9
Easy to find Information	24	26	6	1	8
Clear organisation of Information	19	32	6	0	8
Pleasant Interface	18	29	9	1	8
Useful Images	17	26	10	2	10
Right Presentation of content	18	30	9	0	8
Appropriate Size of web controls	16	25	13	2	9
Less Load time	13	22	12	8	10
Meet Expected Functions	14	20	21	1	9
Overall Satisfaction	20	28	6	2	9
Sum	**184**	**264**	**97**	**17**	**88**
Total Score	184*5 = 920	264*4 = 1056	97*3 = 291	17*2 = 34	88*1 = 88
Sum of Total Score = 2389					

Based on Table 12, it can be said that the scores for Strongly Agree are 184, scores for Agree are 264, scores for Neutral are 97, scores for Disagree are 17, and scores for Strongly Disagree are 88.

$$\text{Usability} = \text{Total Score}/\text{Maximum Score} \times 100$$

$$\text{Maximum Score} = \text{Number of Respondents} \times \text{Number of Surveys} \times 5$$

$$= 65 \times 10 \times 5$$

$$= 3250$$

$$\text{Usability} = 2389/3250 \times 100$$

$$= 73.5$$

The percentage value of Yahoo website based on the scores from the survey was calculated as 73.5%. This falls in the "Good" category of the SUS score. This shows that the website can be easily understood and used by users.

4.2.4 Usability Evaluation for Google

The Usability Percentage of Google website was calculated by evaluating the survey statistics to get the total score as shown in Table 13.

Table 13. Survey Statistics for Google Website

Question	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Easy to Navigate	29	25	1	0	10
Easy to find Information	30	23	3	0	9
Clear organisation of Information	29	22	4	0	10
Pleasant Interface	26	23	6	1	9
Useful Images	22	27	5	2	9
Right Presentation of content	21	24	9	0	11
Appropriate Size of web controls	22	25	9	0	9
Less Load time	24	22	5	4	10

Meet Expected Functions	23	18	15	0	9
Overall Satisfaction	30	23	2	1	9
Sum	**256**	**232**	**59**	**8**	**95**
Total Score	256*5 = **1280**	232*4 = **928**	59*3 = **177**	8*2 = **16**	95*1 = **95**
Sum of Total Score = 2496					

Based on Table XIII, it can be said that the scores for Strongly Agree are 256, scores for Agree are 232, scores for Neutral are 59, scores for Disagree are 8, and scores for Strongly Disagree are 95.

$$\text{Usability} = \text{Total Score}/\text{Maximum Score} \times 100$$

$$\text{Maximum Score} = \text{Number of Respondents} \times \text{Number of Surveys} \times 5$$

$$= 65 \times 10 \times 5$$

$$= 3250$$

$$\text{Usability} = 2496/3250 \times 100$$

$$= 74.8$$

The percentage value of Google website based on the scores from the survey was calculated as 76.8%. This falls in the "Good" category of the SUS score. This shows that the website can be easily understood and used by users.

4.2.5 Evaluation for the Four (4) Websites based on Surveys

The survey-based usability evaluation approach was graphically represented in Figure 2. It is seen that the overall Usability score from the survey approach for UMaT is 74.6, FUTA is 73.2, Yahoo is 73.5 whereas Google had 74.8.

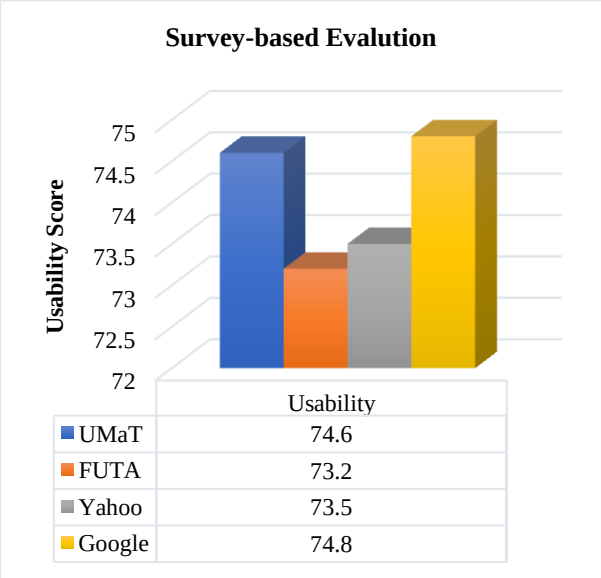

Fig 2: Evaluation of Websites from Survey Approach

4.3 Discussions

The research evaluates website usability using two approaches: automated tools approach and survey approach. Results obtained from both approaches showed that users are satisfied with the usability of the websites. The findings showed that usability evaluation based on all four (4) automated tools proved Google website to have the best Performance rating, lowest Page Size, lowest Load Time and lowest Page Requests score.

Yahoo ranked second for having the best Performance rating, Page Size, Load Time and Page Requests on the Website grader tool; it ranked third for Performance, second for Page Size, third for Load Time and fourth for Page Requests on Pingdom tool; Yahoo also ranked second for Performance, second for Page Size, fourth for Load Time and Page Requests on Gtmetrix tool.

FUTA ranked fourth for Performance rating, Page Size, Load Time and Page Requests on Website grader tool; it ranked fourth for Performance and Page Size, second for Load Time and third for Page Requests on Pingdom tool; it also ranked fourth for Performance and Page Size, third for Load Time and Page Requests on Gtmetrix tool.

UMaT ranked third for Performance rating, Page Size, Load Time and Page Requests on Website grader tool; it ranked second for Performance, third for Page Size, fourth for Load Time and second for Page Requests on Pingdom tool; it also ranked third for Performance and Page Size, second for Load Time and Page Requests on Gtmetrix tool.

The findings also showed that usability evaluation based on the survey proved all websites to be easily used and understood by users since the percentage score falls under the Good category of SUS score. FUTA had 74.6%, UMaT had 73.2%, Yahoo had 73.5% and Google had 76.8%.

5. CONCLUSION AND FUTURE WORK

Results from the study reveal that all four websites have good usability features from the user perspective and hence have passed the usability test based on the survey approach. Nonetheless, FUTA and UMaT websites have to be improved since they ranked poor when evaluated with automated tools. The website designers have to pay more attention to improving the internal factors of the websites such as performance, page size, page request, and load time among other factors. These internal factors can be fixed even after deployment has been made although they can be fixed during the design and development stages.

It can be concluded that the developers of FUTA and UMaT websites pay more attention to the external features thereby, ignoring the internal features. Hence it is recommended that the internal usability factors be addressed.

The future work will evaluate the internal usability factors of the websites using more automated tools to measure the broken lines, accessibility errors, and security vulnerabilities in addition to the performance, page size, page request, and load time. The external usability factors will also be evaluated

based on monitoring the real-time interaction of users on the websites. This will help assess the user experience in Human-Computer Interaction (HCI) on the website's interfaces. The real-time monitoring will measure time spent to complete tasks, time spent recovering from errors, and the number of errors encountered.

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