

AppTest: Assessing the Usability and Performance Efficiency of BOSESKO for Digital Participation

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Abstract— Software systems need a proper evaluation to avoid errors and problems. This research aims to showcase an evaluation method to test an integrated mobile and web application for gathering valuable feedback from Filipinos nationwide. This application, named "BOSESKO: Building on Opinions and Sentiments for Sustainability and Knowledge Opportunities" – a multilingual, inclusive, deliberative, synoptic, digital participatory toolkit, is intended to act as a central hub to solicit insights on both existing and upcoming policies in the Philippines. AppTest pertains to a comprehensive evaluation of the BosesKo software system. This research hopes to identify the strengths and weaknesses of BOSESKO and improve it, which would serve as a tool to potentially enhance civic engagement in the country by actively involving the general public in policy-making. This study employed a mixed-method approach that seamlessly integrates manual and automated testing techniques. The assessment of BOSESKO is aligned with the ISO 25010 standard, focusing on evaluating usability and performance efficiency. To delve into the usability of BOSESKO, a usability survey was administered to gauge user perspectives on (a) learnability, (b) appropriateness, (c) recognizability, (d) operability, (e) error protection, (f) user interface aesthetics, and (g) accessibility. Additionally, in-depth performance evaluations were conducted using various automated tools, including WebPageTest, PageSpeed Insight, Google Lighthouse, Yellow Lab, and Pingdom. This combination of manual and computerized methodologies provided a robust and thorough analysis of BOSESKO and, in turn, offered valuable insights into the functionality and efficiency of the developed system. As of the time of this writing, about 10,500 users across the Philippines have already engaged with BOSESKO. Initial assessment results of BOSESKO revealed an acceptable user rating with an average weighted mean of 4.36 in terms of usability. Meanwhile, the applied automated tests yielded positive performance scores of 89% and 76% for the web and mobile platforms. However, the evaluation results suggest image and search engine optimization. Overall, these results underscore the robust foundation established by BOSESKO, indicating its considerable potential and strong starting point.

Keywords— usability test, efficiency test, automated testing, ISO25010, software performance

I. INTRODUCTION

The completion of a fully developed system, inclusive of all its features and functionalities, does not mark the end of the entire software development process. It will further require

extensive testing and evaluation to assess its readiness for deployment and public use. Software quality in industrial applications, or even in everyday life, is critical for both developers and users [1]. Software testing is essential for analyzing software quality, minimizing project costs, and ensuring timely delivery. In essence, software testing involves an in-depth evaluation, either manually or by automated methods, to ensure that the system meets outlined standards [2].

Manual testing includes usability inspections, which rely on professional analysis and theoretical concepts supported by study or observation. These inspections frequently use heuristic assessments, cognitive pathways, and rules/checklists to analyze specific navigational faults or behaviors. Furthermore, user-centered procedures that involve users in testing, interviews, and physiological exams are also part of this [3] where the quality of the developed system is gauged by customer satisfaction and approval [2]. Automated testing, on the other hand, addresses the constraints of manual testing by providing repeatable test cases, which is crucial in the increasing complexity of software development. Using automated testing methods to evaluate application quality and functionality has become critical, resulting in increased reliability, reusability, cost savings, greater coverage, and faster results when compared to manual testing [4].

Historically, product quality evaluation was largely concerned with functionality. As the complexity of robust system development has grown over time, an expansion of characteristics and sub-characteristics has been incorporated to comprehensively and rigorously evaluate software quality [5]. Software product quality models have progressed in their ability to adequately represent and convey the abstract concept of software quality since the 1970s [6]. One of these is the most recent standard, ISO 25010 Quality Model, which is deemed to have more features than the other quality models combined [7].

The ISO/IEC 25010 standard within the Quality Model division establishes quality requirements for software development products in eight domains, including functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability [1], [8]. This more sophisticated model provides a holistic view of software quality, supporting companies in obtaining a deeper

grasp of user requirements. It supports well-informed decision-making by allowing for a more complete assessment of the product's strengths and weaknesses in order to improve software quality [5].

Furthermore, this research study seeks to assess the quality of the BOSESKO system—Building on Opinions and Sentiments for Sustainability and Knowledge Opportunities, by integrating the ISO 25010 standard quality model. The evaluation was conducted using a combination of manual and automated testing techniques, consolidating user feedback with statistical data obtained by the automated tools in use.

II. LITERATURE REVIEW

In the field of software development, software testing is widely considered as an essential phase for ensuring that the system conforms to user requirements and specifications [4]. The improvement of product quality is significantly influenced by the pivotal role of software testing. Consequently, various software testing models have been established to set a standard for assessing software products [9]. Quality software is free of errors, specifically bugs and vulnerabilities, such as missed or misinterpreted requirements and errors in design, functional logic, data linkages, process timing, validity checking, and coding errors. The second, more subtle, factor is that the system can handle its technical debt and meets various quality and quality attribute characteristics [10]. There are plenty of quality characteristics that describe the system and serve as the basis and cornerstone for the evaluation of a product's or software's quality. The quality model refers to the collection of qualities used as the foundation for evaluation [11].

An international standard known as ISO/IEC 25010 is used to assess or gauge the quality of software both internally (the software itself) and externally (the software as it relates to hardware, data, and other software integrated in a computer system) [12]. It has been utilized by several researchers in their research for its universality that makes it simple to adapt to the creation of numerous specialized software quality models [13]. This standard breaks software quality down into many sub-aspects, enabling developers to create custom metrics and measurements to precisely evaluate both functional and non-functional needs [14].

According to International Organization for Standardization (ISO) / International Electrotechnical Commission (IEC), there are eight quality attributes that make up the product quality dimension: Functional suitability, Performance efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability [15]. Functional suitability pertains to the degree to which software can offer features that are suitable for use in specific circumstances [16]. Efficiency is the capacity of a user to execute a given activity quickly and accurately, or within the allotted time task [17]. The extent to which a product or system may exchange information with other products, systems, or components while executing a function inside a common environment, hardware, or software is referred to as compatibility [18]. Meanwhile, usability is the extent to which a particular

product may be utilized by certain users to accomplish particular goals while taking into consideration effectiveness, efficiency, and happiness in a specific usage context [19]. Reliability equates to how the software can be used according to the required functionality and the intended level of accuracy. Security is a product-level application that provides services to safeguard against unauthorized access, usage, modification, tampering, or other potentially harmful activities that may compromise confidentiality, non-repudiation, and authentication [20]. The capability of a software product to be effectively and efficiently modified is referred to as its maintainability while portability measures the capacity of a product or component to be transferred successfully and efficiently from one hardware, software, or user environment to another [21].

Various researchers such as [8], [22], [23], and [24] have employed ISO 25010 as the foundational model for conducting quality testing on their respective systems or applications. Comparatively, [25] used the ISO/IEC 25010:2011 product quality characteristics in their study, assessing their developed software from two distinct perspectives—user view and technical view. On a technical point of view, the approach to quality measurement is software-oriented, with automated testing and monitoring tools used to evaluate the system's functional suitability, performance efficiency, reliability, security, and portability. In contrast, measuring tends to be more user-oriented in quality test designs based on users' point of view. This entails using questionnaire data extraction methodologies and subjecting the survey tool to validity, reliability, and feasibility testing.

In the context of usability evaluation, both [26] and [27] employed a questionnaire-based method to assess the usability of their respective developed websites. In this approach, participants were required to complete a usability survey with questions or remarks regarding their experiences with the websites.

In contrast, [28] and [29] concentrated specifically on performance efficiency, utilizing automated testing tools to measure this aspect. Load testing, a type of performance testing, is a series of processes for determining load-related vulnerabilities in a system that is being tested [30]. One well-known and open source web performance testing tool is WebPageTest [31], which can be utilized to assess the website's speed, usability, and resilience [32]. Consequently, [33] used the WebPageTest tool in his study, which is acknowledged as the leading open-source tool for assessing three essential web metrics: loading time, page size, and the number of requests. This tool, which has been widely used by many researchers, facilitates the analysis of web traffic data from a large number of Internet users, making it a valuable resource for determining the efficiency of various web systems. Furthermore, this tool can present test findings that are specific and detailed, allowing researchers to analyze the advantages and disadvantages or elements of the website that must be refined [34]. Another automated tool is Google Lighthouse, as highlighted by [35], due to its advanced metric that assesses SEO, best practices, accessibility, and

performance. The application of it was demonstrated in the study by [36], that produced comprehensive evaluations with ratings for several audit categories and doable recommendations for improvement. On the other hand, PageSpeed Insights evaluates webpage performance and optimization and offers speed scores for desktop and mobile versions [37]. The utilization of PageSpeed Insights in rating loading times, giving ratings, and making recommendations for speed optimization without sacrificing user experience was highlighted by [38]. Additionally, Pingdom is a useful tool for evaluating the effectiveness of websites. It assesses websites using important parameters such as page requests, load times, performance, and page sizes [39]. This is consistent with the methodology used by [40] in their study, which employed similar categories for evaluating websites. In addition, Pingdom provides useful advice to improve loading times. Its capacity to separate loading speeds for distinct website elements, such as images, CSS, JavaScript, and RSS is highlighted in the study by [39]. Furthermore, Pingdom is available as a free online trial edition [41], which makes it an easy-to-use tool for anyone looking to analyze and enhance the effectiveness of their website.

III. METHODOLOGY

The researchers employed the methodological approach implemented by [25] to conduct a thorough assessment of software quality, taking into account both user and technical points of view. The evaluation focused on two ISO 25010 characteristics - the usability and performance efficiency. Usability is categorized under the user perspective, whereas performance efficiency is classified under the technical point of view.

A. Test Design Based on Technical Perspective

To assess the performance efficiency of the system, various open-source automated tools such as WebPageTest, Google Lighthouse, PageSpeed Insights, and Yellow Lab were utilized. Additionally, a proprietary software, Pingdom, was also used to check if disparities would emerge in the results compared to those generated from free tools.

B. Test Design Based on Users' Perspective

A usability questionnaire was utilized to collect user feedback, encompassing statements that correspond to each sub-characteristic of usability. Specifically, there were six (6) statements addressing appropriateness recognizability, four (4) statements for learnability, five (5) statements for operability, another four (4) statements focusing on user error protection, six (6) statements covering user interface aesthetics, and seven (7) statements pertaining to accessibility. In total, the questionnaire comprised 32 items.

To administer the system testing based on the user's perspective, the usability questionnaire was adapted into an online survey instrument using Google Forms. A total of 346 respondents participated, specifically students aged between 19 and 24, coming from different state universities - who were one of the key users of the BOSESKO application. The demographic composition of the respondents comprised

48.1% women, 46.6% men, and the remaining 5.3% were from the LGBTQ+ community.

In conducting usability analysis, quantitative descriptive analysis was used. This involved calculation of the frequency distribution of scores based on the quantitative values assigned to each category on the five-point Likert scale. This was also used in the computation and interpretation of the weighted mean for each sub-characteristic as shown in Table 1.

TABLE 1. LIKERT RATING SCALE

Rating	Scale Range	Verbal Interpretation
5	4.50-5.00	Highly Acceptable
4	3.50-4.49	Acceptable
3	2.50-3.49	Moderately Acceptable
2	1.50-2.49	Unacceptable
1	1.00-1.49	Highly Unacceptable

IV. DISCUSSION

A. Performance Efficiency

1) **WebPageTest:** Figure 1 illustrates the page performance metrics obtained through the WebPageTest tool. One notable observation was the system's slow first-byte time, which is 1.504 seconds, indicating a prolonged server connection and response time. Furthermore, pixels began appearing at 2.700 seconds, with the first contentful paint loading at 2.673 seconds. The speed index was notably slow, requiring 2.750 seconds for the page to appear usable. Additionally, the largest contentful paint (LCP) recorded a high value of 2.673 seconds, attributed to the element involved being an image. Recommendations for optimization were suggested to expedite the image fetching process. On a positive note, there were no instances of cumulative layout shift, and the main thread experienced no significant blockage, taking only 0.945 seconds. Lastly, the page weight was determined to be 1559 KB, highlighting the overall size of the webpage.



Figure 1. Web Application Performance Summary Based on WebPageTest

2) **Google Lighthouse:** Four (4) metrics, namely performance, accessibility, best practices, and search engine optimization (SEO), were evaluated using this automated tool. Figure 2 shows that the system demonstrated satisfactory results, achieving 98% in performance, 83% in accessibility, and a perfect score of 100% in best practices. However, the SEO metric showed a slightly lower result at 80%. According to the tool's assessment criteria, the system's overall performance falls within the 90-100% range, categorizing it as a good score, while the mobile platform as presented in figure 3, got 76%, which needs improvement.

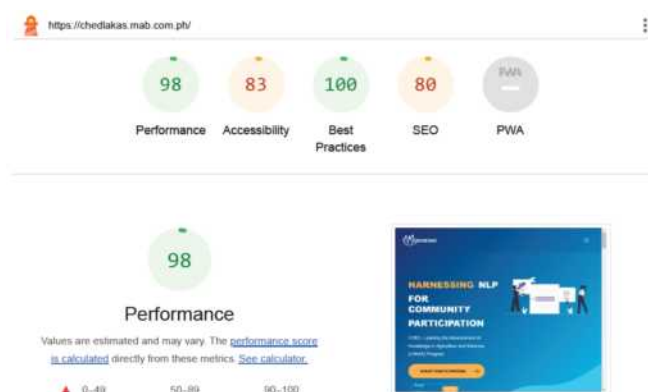


Figure 2. Web Application Performance Summary Based on Google Lighthouse

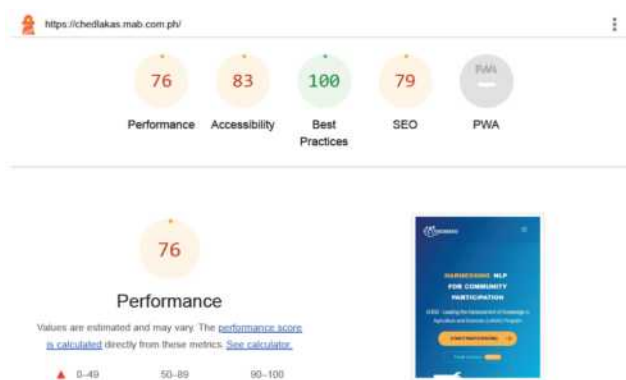


Figure 3. Mobile Performance Summary Based on Google Lighthouse

3) **PageSpeed Insights:** Table 2 presents the results of using PageSpeedInsights which tested the system on both web and mobile platforms. The differences in performance are discernible. The system exhibited a robust performance using the web application with a score of 92, whereas for the mobile platform, it lagged behind with a score of 65. On the other hand, the system demonstrated higher accessibility on mobile devices, yielding an 83 accessibility score compared to the web application with a score of 82. Notably, both platforms excelled in adhering to best practices, securing a perfect score of 100. Examining SEO performance, the web application outperformed the mobile with scores of 80 and 79, respectively. Other metrics, such as first contentful paint, favored the web application, achieving a faster load time of 0.5 seconds compared to the mobile's 1.3 seconds. Moreover, the mobile platform showed considerably higher total blocking time, with 1710 milliseconds, while the web application experienced only 80 milliseconds. Similarly, the speed index favored the web application at 0.9 seconds, contrasting sharply with the mobile's 6.9 seconds. Analyzing the largest contentful paint, the web application achieved a loading time of 1.7 seconds, surpassing the mobile's 2.3 seconds. Meanwhile, no cumulative layout shift occurred for both platforms.

TABLE 2. PAGESPEED INSIGHTS RESULTS

Metrics	BOESKO Web Application	BOESKO Mobile Application
Performance	92	65
Accessibility	82	83
Best Practices	100	100
SEO	80	79
First Contentful Paint	0.5 s	1.3 s
Total Blocking Time	80 ms	1710 ms
Speed Index	0.9 s	6.9 s
Largest Contentful Paint	1.7 s	2.3 s
Cumulative Layout Shift	0	0

4) **Yellow Lab:** Yellow Lab Tools was another tool utilized for software quality testing in the mobile platform. This automated tool as shown in Table 3 assessed the system in detail by following ten (10) metrics and assigning scores ranging from A as the highest to C as the lowest. The system's performance for the seven metrics, including Requests, DOM Complexity, JS Complexity, Bad JS, jQuery, CSS Complexity, and Web Fonts, was deemed excellent, achieving a mark of A. Additionally, page weight and server configuration received a grade of B. Regarding page weight, a notable inadequacy was observed in image optimization, a generally easy method for reducing page weight and load time. The system could save 255 KB by optimizing 8 images, where one oversized image was identified. Regarding server configuration, issues were detected, including one HTTP protocol offender and 11 caching instances being disabled. Lastly, the Bad CSS metric received a C rating. This was due to an unknown parsing error during testing, leading to miscalculations in other CSS metrics and scores.

TABLE 3. YELLOW LAB TOOLS SCORE DETAILS

Metrics	BOESKO Web Application	BOESKO Mobile Application
Page Weight	A	B
Requests	A	A
DOM Complexity	A	A
JS Complexity	A	A
Bad JS	A	A
jQuery	A	A
CSS Complexity	A	A
Bad CSS	C	C
Web Fonts	A	A
Server Configuration	B	B
Global Score	A - 90/100	A - 89/100

5) **Pingdom:** Aside from employing open-source software tools for testing, the researchers utilized Pingdom, a proprietary software, to assess whether there were significant differences in the results. Ultimately, the result generated from this tool as shown in figure 4, closely aligned with those obtained from other tools, yielding a performance score of 88 out of 100, corresponding to a descriptive mark of B which means efficient.



Figure 4. BOSESKO Web Application Performance Summary Based on Pingdom

TABLE 5. USABILITY TEST RESULTS

Sub-Characteristics	Weighted Mean	Verbal Interpretation
Appropriateness	4.40	Acceptable
Recognizability	4.40	Acceptable
Learnability	4.40	Acceptable
Operability	4.30	Acceptable
User Error Protection	4.34	Acceptable
User Interface Aesthetics	4.41	Acceptable
Accessibility	4.28	Acceptable
Overall Weighted Mean	4.36	Acceptable

V. CONCLUSIONS

6) **Performance Efficiency Test Summary:** After conducting a series of performance efficiency tests using five distinct automated tools, the generated results were consolidated in Table 4. For the web platform, five tools were considered: WebPageTest at 76%, Google Lighthouse at 98%, PageSpeed Insights at 92%, Yellow Lab Tools at 90%, and Pingdom at 88%, resulting in an average performance score of 88.33%. In contrast, the mobile platform involved only four tools - WebPageTest with a score of 74%, Google Lighthouse with 76%, PageSpeed Insights with a score of 65%, and Yellow Lab Tools with 89%, yielding an average performance score of 76%. The substantial gap between the web application and mobile efficiency is evident. Thus, further improvements may be made, such as enhancing search engine and image optimization.

TABLE 4. PERFORMANCE EFFICIENCY TEST RESULTS

Tools Used	Performance Score	
	BOSESKO Web Application	BOSESKO Mobile Application
WebPageTest	76%	74%
Google Lighthouse	98%	76%
PageSpeed Insights	92%	65%
Yellow Lab	90%	89%
Pingdom	88%	-
Average Score	89%	76%

B. Usability

Based on the usability test results outlined in Table 5, it was evident that respondents expressed an acceptable level of agreement regarding the system's adherence to usability sub-characteristics. The survey form contains 36 questions, each sub-characteristic having six (6) questions. Notably, the user interface aesthetics received the highest weighted mean of 4.41, closely followed by appropriateness, recognizability, and learnability, scoring 4.40, followed by user error protection with 4.34, then operability with 4.30, and accessibility with 4.28. The respondents somewhat agreed with the system's overall usability, yielding an overall weighted mean of 4.36. Moreover, this result is considered as acceptable based on the criterion previously defined in Table I.

In conclusion, this research discusses the results of AppTest, a comprehensive evaluation of the BosesKo software system, a digital participatory toolkit designed to act as a central hub to solicit insights on existing and upcoming policies in the Philippines. The usability analysis involved 10,500 users, predominantly students from various state universities in the Philippines. Initial findings revealed a commendable user rating, with an average weighted mean of 4.36 across different usability sub-characteristics as evaluated by 346 respondents. The system demonstrated effectiveness in user interface aesthetics, appropriateness, recognizability, learnability, operability, user error protection, and accessibility. These results underscore the potential of BOSESKO to actively engage the public in policy-making, thereby enhancing civic participation.

Further, the performance efficiency assessment, which employed various automated tools, including WebPageTest, Google Lighthouse, PageSpeed Insights, Yellow Lab Tools, and Pingdom, shows that the system exhibited satisfactory scores in performance, accessibility, best practices, and search engine optimization with an average score of 89% and 76% for the web and mobile platform respectively.

However, this research identified areas for improvement, particularly in search engine and image optimization, which will serve as actionable points for further development. Future works may also include evaluating the security and portability of the BosesKo system for a more robust and efficient digital participatory toolkit, thereby fostering increased civic engagement in the policy-making process in the Philippines.

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REFERENCES

- [1] N. Nyári, & A. Kerti, "Review of software quality related iso standards," *Biztonságtudományi Szemle*, vol. 3, no. 2, pp. 61-72, 2021

- [2] A. Mustafa et al., "Automated Test Case Generation from Requirements: A Systematic Literature Review," *Computers, Materials & Continua*, vol. 67, no. 2, pp. 1819–1833, 2021, doi: <https://doi.org/10.32604/cmc.2021.014391>
- [3] L. Alonso-Virgós, J. P. Espada, and R. G. Crespo, "Analyzing compliance and application of usability guidelines and recommendations by web developers," *Computer Standards & Interfaces*, vol. 64, pp. 117–132, May 2019, doi: <https://doi.org/10.1016/j.csi.2019.01.004>
- [4] H. V. Gamido and M. V. Gamido, "Comparative Review of the Features of Automated Software Testing Tools," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 9, no. 5, p. 4473, Oct. 2019, doi: <https://doi.org/10.11591/ijece.v9i5.pp4473-4478>
- [5] L. Pinedo et al., "Software quality models: Exploratory review," *ICST Transactions on Scalable Information Systems*, Sep. 2023, doi: <https://doi.org/10.4108/eetsis.3982>
- [6] T. Galli, F. Chiclana, and F. Siewe, "Software Product Quality Models, Developments, Trends, and Evaluation," *SN Computer Science*, vol. 1, no. 3, May 2020, doi: <https://doi.org/10.1007/s42979-020-00140-z>
- [7] M. Izzatillah, "Quality measurement of transportation service application Go-Jek using ISO 25010 quality model," *Simetris: Jurnal Teknik Mesin, Elektro dan Ilmu Komputer*, vol. 10, no. 1, pp. 233–242, 2019
- [8] M.R.A. Assifa, F. Setiadi, and R.G. Utomo, "EVALUATION OF SOFTWARE QUALITY FOR I-OFFICE PLUS APPLICATIONS USING ISO/IEC 25010 AND KANO MODEL," *JIPI (Jurnal Ilmiah Penelitian dan Pembelajaran Informatika)*, vol. 8, no. 2, pp. 561–571, May 2023, doi: <https://doi.org/10.29100/jipi.v8i2.3561>
- [9] K. Hrabovská, B. Rossi, and T. Pitner, "Software Testing Process Models Benefits & Drawbacks: a Systematic Literature Review," Jan. 2019. Available: <https://arxiv.org/pdf/1901.01450.pdf>
- [10] I. Ozkaya, "Can We Really Achieve Software Quality?," *ieeexplore.ieee.org*, 2021. Available: <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9407296>
- [11] S. Basaran & R.K.H. Mohammed, "Usability evaluation of open source learning management systems," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 6, 2020.
- [12] R. Gustriansyah, N. Suhandi, J. Alie, F. Antony, & A. Heryati, "Optimization of laboratory application by utilizing the ISO/IEC 25010 model," *In Top Conference Series: Materials Science And Engineering, IOP Publishing*, vol. 1088, no. 1, p. 012067, Feb. 2021.
- [13] E. Peters and G. K. Aggrey, "An ISO 25010 Based Quality Model for ERP Systems," *Advances in Science, Technology and Engineering Systems Journal*, vol. 5, no. 2, pp. 578–583, 2020, doi: <https://doi.org/10.25046/aj050272>
- [14] K. Moumane, A. Idri, and F. El Aouni, "ISO/IEC 25010- based Quality evaluation of three mobile applications for reproductive health services in Morocco," Mar. 2023, doi: <https://doi.org/10.21203/rs.3.rs-2720323/v1>
- [15] N. Angraini and A. Kurniawati, "Comparative Analysis of Fintech Software Quality Against MSMEs Using the ISO 25010:2011 Method," *International Research Journal of Advanced Engineering and Science*, vol. 6, no. 3, pp. 167–175, 2021, Available: https://irjaes.com/wp-content/uploads/2021/08/IRJAES-V6N3P145Y2_1.pdf
- [16] B. Nugeraha and A. Kurniawati, "Quality Analysis of Access KRL Applications Use Method ISO 25010:2011," *International Research Journal of Advanced Engineering and Science*, vol. 5, no. 3, pp. 233–240, 2011, Available: https://irjaes.com/wp-content/uploads/2020/10/IRJAES-V5N3P398Y2_0.pdf
- [17] Sunardi, G. F. P. Desak, and Gintoro, "List of Most Usability Evaluation in Mobile Application: A Systematic Literature Review," *IEEE Xplore*, Aug. 01, 2020. doi: <https://doi.org/10.1109/ICIMTech50083.2020.9211160>. Available: <https://ieeexplore.ieee.org/abstract/document/9211160>
- [18] A. Yulianty and A. Kurniawati, "Quality Analysis of Bios Portal Website at Banking Companies Using ISO / IEC 25010:2011 Method," *International Research Journal of Advanced Engineering and Science*, vol. 6, no. 2, pp. 11–16, 2021, Available: <https://irjaes.com/wp-content/uploads/2021/03/IRJAES-V6N2P16Y21.pdf>
- [19] D. Hariyanto, Moch. B. Triyono, and T. Köhler, "Usability evaluation of personalized adaptive e-learning system using USE questionnaire," *Knowledge Management & E-Learning: An International Journal*, vol. 12, no. 1, pp. 85–105, Mar. 2020, doi: <https://doi.org/10.34105/j.kmel.2020.12.005>
- [20] S. Budi, W. Gata, M. Noor, S. Pangabean, and C. S. Rahayu, "News Portal Website Measurement Analysis Using ISO/IEC 25010 And McCall Methods," *Journal of Applied Engineering and Technological Science (JAETS)*, vol. 4, no. 1, pp. 273–285, Oct. 2022, doi: <https://doi.org/10.37385/jaets.v4i1.1094>
- [21] D. Mena and M. Santórum, "Maintainability and Portability Evaluation of the React Native Framework Applying the ISO/IEC 25010," *Advances in intelligent systems and computing*, pp. 429–439, Oct. 2020, doi: https://doi.org/10.1007/978-3-030-59194-6_35
- [22] M. S. D. Sutadewi and T. Yunitsari, "Quality Analysis of PeduliLindungi Application using ISO 25010:2011," *International Research Journal of Advanced Engineering and Science*, vol. 7, no. 1, pp. 212–216, 2022, Available: https://irjaes.com/wp-content/uploads/2022/03/IRJAES-V7N1P143Y2_2.pdf
- [23] F. Handayani and M. Mustikasari, "Quality Assurance of Sayurbox Mobile Application Using Model ISO 25010," *International Research Journal of Advanced Engineering and Science*, vol. 6, no. 3, pp. 176–180, 2021, Available: https://irjaes.com/wp-content/uploads/2021/08/IRJAES-V6N3P148Y2_1.pdf
- [24] A. A. Pratama and A. B. Mutiara, "Software Quality Analysis for Halodoc Application using ISO 25010:2011," *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 8, 2021, doi: <https://doi.org/10.14569/ijacsa.2021.0120844>
- [25] D. A. Suryadi and E. Sulistiyan, "Evaluation of Information Quality Using ISO/IEC 25010:2011 (Case Research: Menu Harianku Application)," *International Journal of Innovation in Enterprise System*, vol. 6, no. 02, pp. 143–156, Jul. 2022, Available: <https://ijies.sie.telkomuniversity.ac.id/index.php/IJIES/article/view/167>
- [26] C. Chang and H. Almaghalsah, "Usability evaluation of e-government websites: A case study from Taiwan," *International Journal of Data and Network Science*, vol. 4, no. 2, pp. 127–138, 2020, Available: <http://m.growingscience.com/beta/ijds/3749-usability-evaluation-of-e-governent-websites-a-case-study-from-taiwan.html>
- [27] M. Mubeen et al., "Usability Evaluation of Pandemic Health Care Mobile Applications," *IOP Conference Series: Earth and Environmental Science*, vol. 704, no. 1, p. 012041, Mar. 2021, doi: <https://doi.org/10.1088/1755-1315/704/1/012041>
- [28] H. Panduwiyasa, Y. Y. Febrian, M. Saputra, and Z. F. Azzahra, "Performance evaluation of ERP based to ISO/IEC 25010:2011 quality model (a case study)," *International Conference on Industrial, Enterprise, and System Engineering*, Jan. 2023, doi: <https://doi.org/10.1063/5.0174711>
- [29] D. Yuniasri, P. Damayanti, and S. Rochimah, "Performance Efficiency Evaluation Frameworks Based on ISO 25010," *IEEE Xplore*, Aug. 01, 2020. doi: <https://doi.org/10.1109/IECCIS49483.2020.9263432>. Available: <https://ieeexplore.ieee.org/abstract/document/9263432>
- [30] C. Parrott, "Distributed Load Testing by Modeling and Simulating User Behavior," *LSU Doctoral Dissertations*, Dec. 2020, doi: https://doi.org/10.31390/gradschool_dissertations.5436. Available: https://repository.lsu.edu/gradschool_dissertations/5436?utm_source=repositary.lsu.edu%2Fgradschool_dissertations%2F5436&utm_medium=PDF&utm_campaign=PDFCoverPages
- [31] M. T. Hossain, R. Hassan, M. Amjad, and Md. A. Rahman, "Web Performance Analysis: An Empirical Analysis of E-Commerce Sites in Bangladesh," *International Journal of Information Engineering and Electronic Business*, vol. 13, no. 4, pp. 47–54, Aug. 2021, doi: <https://doi.org/10.5815/ijieeb.2021.04.04>
- [32] R. M. Abdulla, Hiwa Ali Faraj, K. O. Mohammed, and M. M. Younis, "Usability Evaluation of the Top 10 Universities in Iraq Using Heuristic Methods," *Mağallai' ulūm al-mustashiriyayā*, vol. 34, no. 2, pp. 50–59, Jun. 2023, doi: <https://doi.org/10.23851/mjs.v34i2.1234>
- [33] F. Ishengoma, "Exploring Critical Success Factors Towards Adoption of M-Government Services in Tanzania," *Advances in web technologies and engineering book series*, pp. 225–253, Jan. 2022, doi: <https://doi.org/10.4018/978-1-7998-7848-3.ch009>

- [34] A. C. Barus, E. S. Sinambela, I. Purba, J. Simatupang, M. Marpaung, and N. Pandjaitan, "Performance Testing and Optimization of DiTenun Website," *Journal of Applied Science, Engineering, Technology, and Education*, vol. 4, no. 1, pp. 45–54, Jun. 2022, doi: <https://doi.org/10.35877/454ri.asci841>
- [35] T. Heričko, B. Šumak, and S. Brdnik, "Towards Representative Web Performance Measurements with Google Lighthouse," in *Proceedings of the 2021 7th Student Computer Science Research Conference (StuCoSReC)*, Sep. 2021. Accessed: Nov. 29, 2023. [Online]. Available: <http://dx.doi.org/10.18690/978-961-286-516-0.9>
- [36] K. Chan-Jong-Chu *et al.*, "Investigating the Correlation between Performance Scores and Energy Consumption of Mobile Web Apps," in *Proceedings of the Evaluation and Assessment in Software Engineering*, Apr. 2020. Accessed: Nov. 29, 2023. [Online]. Available: <http://dx.doi.org/10.1145/3383219.3383239>
- [37] A. Mehroof and S. Rai, "Findability and Accessibility of Electronic Thesis and Dissertation Repositories of Newly Established Central Universities in India," *ir.inflibnet.ac.in*, Nov. 2023, Accessed: Nov. 29, 2023. [Online]. Available: <https://ir.inflibnet.ac.in/handle/1944/2425>
- [38] E. Fahlström and F. Persson, "Higher Education Diploma Software Engineering, Emphasis in Web Programming Sustainable Web Design How Much Can Environmental Friendly Design Principles Improve a website's Carbon footprint?," 2023. Available: <https://www.diva-portal.org/smash/get/diva2:1775278/FULLTEXT02>
- [39] B. I. Belinda, A. B. Kayode, N. Solomon, and T. A. F. Bethy, "Analysis of Internal and External Website Usability Factors," *Communications on Applied Electronics*, vol. 7, no. 35, pp. 9–18, Apr. 2021, doi: 10.5120/cae2021652880.
- [40] T. W. Jun, L. Z. Xiang, N. A. Ismail, and W. G. R. Yi, "USABILITY EVALUATION OF SOCIAL MEDIA WEBSITES," Jan. 2021. Accessed: Nov. 29, 2023. [Online]. Available: https://www.irjmet.com/uploadedfiles/paper/volume3/issue_1_january_2021/5580/1628083226.pdf
- [41] F. Noreen *et al.*, "Agility Analysis of Academic Site: Identify Issues of Site by Users," *ResearchGate*, Apr. 2020. https://www.researchgate.net/profile/Irum-Hafeez-Sodhar/publication/341494465_Agility_Analysis_of_Academic_Site_Identify_Issues_of_Site_by_Users/links/5ec41e13458515626cb8204f/Agility-Analysis-of-Academic-Site-Identify-Issues-of-Site-by-Users.pdf



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