# IJIE (Indonesian Journal of Informatics Education)

# Evaluation of Website-Based Information System to Monitor Student Learning Progress in Schools Using ISO/IEC 9126 Standards and GTMetrix

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**Abstract:**

This study evaluates a previously developed website-based information system using ISO/IEC 9126 Standards and GTMetrix. The testing of the website-based information systems using ISO/IEC 9126 is conducted by information system experts, users, and through GTMetrix testing. The users involved in the testing include administrators, teachers, and student parents. The evaluation of information system experts includes four quality measures: functionality, reliability, usability, and portability. Meanwhile, user testing encompasses three dimensions: functionality, usability, and portability. Additionally, GTMetrix testing focuses on efficiency as a measure of quality, aimed at assessing the performance of the developed website-based information system. The obtained results from the evaluation indicate that information system experts achieved a score of 91.17%, administrator users scored 95.11%, teacher users scored 91.35%, student parents scored 83.4%, and the GTMetrix testing specifically yielded a score of 86.13%, corresponding to a Grade B rating. Based on the evaluation results using ISO/IEC 9126, it is evident that testing the website-based information system using ISO/IEC 9126 has fulfilled the expectations of users, especially parents and the school.

# Introduction

Information technology can provide various information and communication to be fast, precise, and accurate; besides that, human activities become smooth and fulfilled. With the impact offered by information technology, it can make it easier for humans to get information anywhere and anytime (Riwayadi, 2013).

One form of advances in information technology is the existence of information systems. Information systems are a combination of people, hardware, software, and database that can be used to share information with an organization (O'Brien & Marakas, 2011). In general, information systems can help carry out various functions such as business processes, data management, and decision-making and allow the distribution of information to be carried out quickly.

Information systems have many benefits that are felt in various fields, one of which is in the area of Education. The use of information systems in education can create accuracy, speed, and completeness in an integrated system so as to create organizational processes in educational institutions that are more efficient and structured. Many educational institutions have developed information technology to support their education management information system, even though it is not evenly distributed at all levels of education (Darwis & Mahmud, 2017). There are schools that have not utilized an information system that is considered inefficient in organizing data. Data that is not organized and not centralized in a system can cause errors when processing data, so that errors occur in the data submitted (Zakia, 2019). People need information distribution that is easy, effective, and accessible anywhere and anytime. Still, some schools have not been able to distribute information online, so the delivery of information is not optimal (Kristanto & Triyono, 2017).

The existence of information can help parents to increase their role in monitoring children's learning development at school. Indirectly, parents have a role in monitoring the learning development of their children both at home and at school. One of the factors that affect children's learning development is the role of parents, and parents are the first people who should put the foundation of education on their children. One of the low student learning motivations is influenced by the lack of attention from parents, and parents are the first people who lay the foundation of education for children. Therefore, the lack of parental roles can affect the lack of children's learning motivation (Hero & Sni, 2018).

Based on the results of an interview at one of the elementary schools in Surakarta City, there were several problems, including the difficulty of the school in sharing information related to student learning development with each parent. The school still uses conventional methods such as the homeroom teacher sending invitation letters to parents to discuss student learning development at school, and not all parents have free time to visit at school, some parents encounter obstacles in this case, such as there is a job that cannot be abandoned, or parents have other activities.

In making it easier for the school to share information related to the results of student learning development at school, an information system is needed that can share the information needed, especially by parents. Website-based information systems can make it easier for the school to manage data and help parents in being able to monitor and control the development of children's learning processes at school and avoid communication errors between parents and the school (Firmansyah et al., 2021). The use of information systems can help teachers and schools in reporting student academic activities and make it easier for parents to monitor student activities at school (Megawaty, 2020).

# Research Method

This research uses a quantitative approach method that aims to evaluate a website-based information system that has been developed previously by using the ISO/IEC 9126 Standard to find out whether the website-based information system developed is in accordance with user expectations and the purpose of developing the software. The ISO/IEC 9126 standard is one of the references for feasibility tests that are often used to test a product. The International Organization of Standards (ISO) has defined that the use of ISO Standards relates to software quality. There are acceptable factors for a product, such as internal quality models and external quality models (Botella et al., 2004). The website-based information system that has been developed previously was developed using one of the Software Development Life Cycles (SDLC), namely Rapid Application Development (RAD) using the PHP programming language and the Laravel framework that applies the Model–View–Controller (MVC) architecture. The rapid

application development method has the following stages: (1) requirement planning, (2) RAD Design Workshop, (3) Implementation, in this study the collection of software evaluation data was carried out in the implementation stage.



Figure 1. Quality Measures On ISO/IEC 9126 Standards

In this study, the data collection technique used questionnaires and observations described in the following analysis techniques:

    1.    Questionnaire Analysis Techniques

Determination of questionnaire scores in this study using a Likert scale. The Likert scale is a research scale that is used in the questionnaire. The Likert scale serves to measure the attitude, opinion, and perception of the respondent, where each answer from the item instrument has a question from positive to negative. In this study, researchers used five scales where the form of scale answers include: strongly agree, agree, simply agree, disagree, and strongly disagree. Each Likert scale answer has a score range between 1 and 5.

This study used questionnaires to test information system experts who took measures of functionality, reliability, usability, and portability. Meanwhile, testing on users takes measures of quality functionality, usability, and portability which are divided into three tests: administrator user testing, teacher user testing, and student-parent user testing. The quality measures taken in this study have several sub-aspects used in this study is (1) functionality (suitability, accurateness, interoperability, security, and functionality compliance), (2) reliability (maturity, fault tolerance, recoverability, and reliability compliance), (3) usability (understandability, learnability, operability, attractiveness, and usability compliance), and (4) portability (adaptability, installability, replaceability, and portability compliance).

$$Percentage\ (\%) = \frac{the\ sum\ score\ obtained}{the\ sum\ of\ ideal\ score} \qquad (1)$$

The calculation of the questionnaire score uses a calculation formula based on (Sugiyono, 2013) which can be seen in equation (1). Each sub-aspect will be calculated based on the formula used and then calculated on average to get a quality measure score. Then calculate the average score based on each quality measure taken to get the examiner's score results and interpreted based on Table 1.

Table 1. Measurement Interpretation

| Score | Criteria |
|---|---|
| 81% - 100% | Very Decent |
| 61% - 80% | Decent |
| 41% - 60% | Decent Enough |
| 21% – 40% | Not Worth It |
| 0% - 20% | Very Unworthy |

    2.    Observational Analysis Techniques

In this study, the observation technique used GTMetrix software to assess the quality of efficiency.  GTMetrix software serves to determine the performance and performance of a website (Kaur et al., 2016). The website-based information system tested was developed using the PHP programming language and the Laravel framework.

In this study, we took an assessment of the performance matrix and structure matrix, each matrix has a weight, performance by 70% and structure by 30%. The test is carried out by testing all pages of the website-based information system, then calculating the average of each matrix to get an average score of performance and structure.

The average score is then calculated based on each weight, namely the average performance score multiplied by 70% and the average structure score multiplied by 30% and added up to get the total score from GTMetrix. From the total GTMetrix score, it can be interpreted based on Table 2 to find out the Grade of GTMetrix.

Table 2. Grade GTMetrix

| Grade | Total Score |
|-------|-------------|
| A | 90% ≤ Score ≤ 100 % |
| B | 80% ≤ Score ≤ 90% |
| C | 70% ≤ Score ≤ 80% |
| D | 60% ≤ Score ≤ 70% |
| E | 50% ≤ Score ≤ 60% |
| F | 0% ≤ Score ≤ 50% |

## Result and Discussion

This study aims to evaluate a website-based information system that functions to monitor student development in schools using the ISO/IEC 9126 Standard.

### Result

    a.    Black Box Testing Result

Testing a website-based information system using the black box testing method aims to find out whether the information system application developed has run well before being tested by an information system expert. Testing using black box testing is carried out by researchers where the application developed will be tested for every function. Based on the test results using black box testing, it was found that every function in the application has run well. With these results, the application can be tested by an information system expert.

    b.    Information System Expert Testing

Testing by information systems experts takes 4 quality measures and their sub-aspects: functionality, reliability, suitability, and portability using a questionnaire consisting of 40 questions divided into several quality measurement sub-aspects.

Functionality testing has 22 statement items that are divided into sub-aspects, namely suitability, accurateness, interoperability, security, and functionality compliance. In the functionality test, an average score of all sub-aspects was obtained at 100%. Reliability testing has 7 statement items that are divided into sub-aspects, namely maturity, fault tolerance, recoverability, and reliability compliance. In the reliability test, an average reliability score of 96.67% was obtained. Usability testing has 6 statement items that are divided into sub-aspects, namely understandability, learnability, operability, attractiveness, and usability compliance. In the usability test, an average reliability score of 92% was obtained. Portability testing has 5 statement items that are divided into sub-aspects, namely adaptability, installability, replaceability, and portability compliance. In the portability test, an average reliability score of 100% was obtained.

Table 3. Sub-aspects Test Result by Information System Expert

| Functionality sub-aspects | Functionality Score | Reliability sub-aspects | Reliability Score | Usability sub-aspects | Usability Score | Portability sub-aspects | Portability Score |
|---|---|---|---|---|---|---|---|
| Suitability | 100% | Maturity | 100% | Understandability | 80% | Adaptability | 100% |
| Accurateness | 100% | Fault Tolerance | 86,67% | Learnability | 80% | Installability | 100% |
| Interoperability | 100% | Recoverability | 100% | Operability | 100% | Replaceability | 100% |
| Security | 100% | Reliability Compliance | 100% | Attractiveness | 100% | Portability Compliance | 100% |
| Functionality Compliance | 100% | | | Usability Compliance | 100% | | |
| **Average** | **100%** | | **96,67%** | | **92%** | | **100%** |

After calculating the average score for each sub-aspect of quality measures, the subsequent task is to determine the average score of the quality measure aspects. This step is taken to obtain the information system expert's evaluation score results in entirety.

Table 4. Information System Expert Test Results

| Quality Aspects | Average Score |
|---|---|
| Functionality | 100% |
| Reliability | 96,67% |
| Usability | 92% |
| Portability | 100% |
| **Average** | **97,17%** |

Based on testing conducted by information system experts, a score of 97.17% was obtained, so that it can be categorized into very decent criteria. Following this expert evaluation, the tested application is suitable/eligible for further testing by its intended users (administrator, teacher, and parent).

c.  Administrator User Testing

Administrator testing was carried out by a school operator who took 3 measures of quality and their sub-aspects, namely functionality, suitability, and portability using a questionnaire consisting of 27 questions divided into several sub-aspects.

Functionality testing has 17 statement items that are divided into sub-aspects, namely suitability, accurateness, interoperability, security, and functionality compliance. In the functionality test, an average score of 95.33% was obtained. Usability testing has 5 statement items that are divided into sub-aspects, namely understandability, learnability, operability, attractiveness, and usability compliance. In the usability test, an average reliability score of 100% was obtained. Portability testing has 5 statement items divided into sub-aspects: adaptability, install ability, replaceability, and portability compliance. In the portability test, an average reliability score of 90% was obtained.

Table 5. Test Result by System Administrators

| Functionality sub-aspect | Functionality Score | Usability sub-aspect | Usability Score | Portability sub-aspect | Portability Score |
|---|---|---|---|---|---|
| Suitability | 80% | Understandability | 100% | Adaptability | 80% |
| Accurateness | 96,67% | Learnability | 100% | Installability | 80% |
| Interoperability | 100% | Operability | 100% | Replaceability | 100% |
| Security | 100% | Attractiveness | 100% | Portability Compliance | 100% |
| Functionality Compliance | 100% | Usability Compliance | 100% | | |
| **Average** | **95,33%** | **Average** | **100%** | **Average** | **90%** |

Once the average score for each sub-aspect of quality measures has been computed, the subsequent step involves calculating the average of the quality measure aspects. This is done to determine the overall average score for the administrator's test results.

Table 6. The Average of System Administrators Test Result

| Quality Aspect | Average Score |
|---|---|
| Functionality | 95,33% |
| Usability | 100% |
| Portability | 90% |
| **Average** | **95,11%** |

Based on testing conducted by administrators, the test score of 95.11% was obtained, so it can be categorized into very decent criteria.

    d.    Teacher User Testing

Teacher testing was carried out by 2 schoolteachers who took 3 measures of quality and their sub-aspects, namely functionality, suitability, and portability using a questionnaire consisting of 23 questions divided into several sub-aspects.

Functionality testing has 13 statement items that are divided into sub-aspects, namely suitability, accurateness, interoperability, security, and functionality compliance. In the functionality test, an average score of functionalities was obtained of 95.8%. Usability testing has 5 statement items that are divided into sub-aspects, namely understandability, learnability, operability, attractiveness, and usability compliance. In the usability test, an average reliability score of 92% was obtained. Portability testing has 5 statement items that are divided into sub-aspects, namely adaptability, installability, replaceability, and portability compliance. In the portability test, an average reliability score of 86.25% was obtained.

Table 7. Test Result by Teachers

| Functionality sub-aspects | Functionality Score | Usability sub-aspects | Usability Score | Portability sub-aspects | Portability Score |
|---|---|---|---|---|---|
| Suitability | 84,67% | Understandability | 84% | Adaptability | 85,33% |
| Accurateness | 86,67% | Learnability | 86,67% | Installability | 81,33% |
| Interoperability | 82,67% | Operability | 84% | Replaceability | 78,67% |
| Security | 85,33% | Attractiveness | 88% | Portability Compliance | 82,33% |
| Functionality Compliance | 77,33% | Usability Compliance | 80% | | |
| **Average** | **83,33%** | **Average** | **84,53%** | **Average** | **86,25%** |

After calculating each sub-aspect of the quality measures, the subsequent step involves computing the average of the quality measure aspects. This is done to derive the results of the teacher user scores.

Table 8. The Average of Teachers Test Result

| Ukuran Kualitas | Score |
|---|---|
| Functionality | 95,8% |
| Usability | 92% |
| Portability | 86,25% |
| **Average** | **91,35%** |

The result obtained from the testing conducted by teachers amounted to 91,35% can be shown in Table 8 which can be categorized as very decent criteria.

    e.    Student Parent User Testing

Parental testing takes 3 measures of quality along with its sub-aspects, namely functionality, suitability, and portability using a questionnaire consisting of 18 questions divided into several sub-aspects. Testing of parent users was carried

out online where researchers provided website addresses and questionnaire forms in the form of google forms through the WhatsApp group of grade 6 parents. As many as 15 parents filled out the questionnaire.

Functionality testing has 13 statement items that are divided into sub-aspects, namely suitability, accurateness, interoperability, security, and functionality compliance. In the functionality test, an average score of functionalities was obtained at 83.33%. Usability testing has 5 statement items that are divided into sub-aspects, namely understandability, learnability, operability, attractiveness, and usability compliance. In the usability test, an average reliability score of 84.53% was obtained. Portability testing has 5 statement items that are divided into sub-aspects, namely adaptability, install ability, replaceability, and portability compliance. In the portability test, an average reliability score of 82.33% was obtained.

Table 9. Test Result by Parents

| Functionality sub-aspects | Functionality Score | Usability sub-aspects | Usability Score | Portability sub-aspects | Portability Score |
|---|---|---|---|---|---|
| Suitability | 84,67% | Understandability | 84% | Adaptability | 85,33% |
| Accurateness | 86,67% | Learnability | 86,67% | Installability | 81,33% |
| Interoperability | 82,67% | Operability | 84% | Replaceability | 78,67% |
| Security | 85,33% | Attractiveness | 88% | Portability Compliance | 84% |
| Functionality Compliance | 77,33% | Usability Compliance | 80% | | |
| **Average** | **83,33%** | **Average** | **84,53%** | **Average** | **82,33%** |

After deriving the average scores for each sub-aspect of quality measures, the subsequent step involves determining the average across the quality measure aspects to ascertain the results of parental user scores.

From the evaluation carried out by parents, 83.4% of the results were obtained, classifying them as falling under the category of being very decent criteria.

Table 10. The Average of Parents Test Result

| Quality Aspect | Average Score |
|---|---|
| Functionality | 83,33% |
| Usability | 84,53% |
| Portability | 82,33% |
| **Average** | **83,4%** |

f.    GTMetrix Testing

This test aims to get an assessment of the quality measure of efficiency with the help of GTMetrix software. In this study, it took the value of 2 main matrices, namely performance and structure where each matrix has a weight of 70% (performance) and 30% (structure). The evaluated system is deployed on a virtual private server with the specifications in Table 11.

Table 11. Virtual Private Server Specifications

| Proccessor | Memory | Storage |
|---|---|---|
| 1 CPU | 1024 MB | 20 GB |

In this research, all pages within the information system underwent testing using GTMetrix, as illustrated in Figure 2. Then the average is calculated to get temporary results of performance scores and structure scores.

The temporary results of the two scores are then calculated based on the weight of each matrix, namely the average performance score multiplied by 70% and the average score multiplied by 30% then from the calculation score the weights are added together to get the total test score.
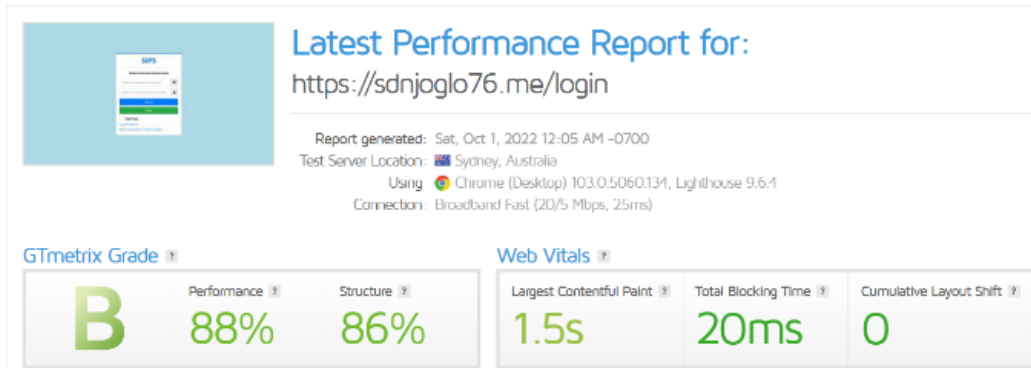
Figure 2. Example of Testing Website Pages Using GTMetrix

| No | Halaman | Skor Peformance | Skor Structure |
|---|---|---|---|
| 1 | Login | 88% | 86% |
| 2 | Daftar | 68% | 89% |
| 3 | Lupa Pasword | 87% | 91% |
| 4 | Pengaturan Akun | 84% | 87% |
| 5 | Dashboard Orang Tua | 83% | 87% |
| 6 | Penilaian Harian | 82% | 88% |
| 7 | Nilai Tugas | 79% | 89% |
| 8 | Nilai Semester | 84% | 89% |
| 9 | Statistik | 91% | 88% |
| 10 | Presensi | 90% | 89% |
| 11 | Obrolan Orang Tua | 91% | 88% |
| 12 | Notifikasi | 76% | 88% |
| 13 | Profil Siswa | 63% | 87% |
| 14 | Dashboard Guru | 96% | 89% |
| 15 | Penilaian Tugas Guru | 64% | 88% |
| 16 | Input Penilaian Tugas Guru | 95% | 89% |
| 17 | Nilai Tugas Siswa | 66% | 89% |
| 18 | Penilaian Harian Guru | 88% | 89% |
| 19 | Input Penilaian Harian Guru | 92% | 85% |
| 20 | Nilai Penilaian Harian Siswa | 94% | 86% |
| 21 | Penilaian Semester Guru | 87% | 89% |
| 22 | Daftar Mata Pelajaran Guru | 90% | 89% |
| 23 | Daftar Kompetensi Dasar Guru | 87% | 88% |
| 24 | Daftar Kelas Guru | 96% | 87% |
| 25 | Daftar Siswa Pada Kelas Guru | 86% | 89% |
| 26 | Daftar Pertemuan Guru | 88% | 88% |
| 27 | Daftar Presensi Peserta Didik | 92% | 89% |
| 28 | Input Presensi Peserta Didik | 88% | 89% |
| 29 | Obrolan Guru | 95% | 88% |
| 30 | Dashboard Admin | 94% | 90% |
| 31 | Nilai Siswa | 89% | 89% |
| 32 | Input Penilaian Harian Admin | 93% | 86% |
| 33 | Input Nilai Tugas Admin | 93% | 89% |
| 34 | Input Nilai Semester Admin | 93% | 89% |
| 35 | Daftar Nilai Siswa | 87% | 89% |
| 36 | Daftar Mata Pelajaran Admin | 81% | 87% |
| 37 | Daftar Kompentesi Dasar Admin | 88% | 89% |
| 38 | Daftar Tingkat Kelas | 94% | 89% |
| 39 | Daftar Kelas | 94% | 89% |
| 40 | Daftar Siswa Pada Kelas Admin | 81% | 86% |
| 41 | Input Kelas | 94% | 85% |
| 42 | Data Siswa | 77% | 89% |
| 43 | Daftar Pertemuan Admin | 79% | 89% |
| 44 | Daftar Presensi Siswa Admin | 80% | 82% |
| 45 | Input Presensi Siswa Admin | 77% | 88% |
| 46 | Data Admin | 89% | 88% |
| 47 | Data Guru | 88% | 87% |
| 48 | Data Orang Tua | 54% | 89% |
| | **Rata - Rata** | **85,31%** | **88,04%** |

Figure 3. Page Test Result Using GTMetrix

The test was carried out by testing all website pages as many as 48 pages, obtained an average performance score of 85.31% and an average structure score of 88.04%. The result of the average score is calculated based on the weight as in Table 12.

Table 12. GTMetrix Score Result

| Matrix | Score x Weight | Final Score |
|---|---|---|
| Performance | 85,31% x 70% | 59,72% |
| Structure | 88,04% x 30% | 26,41% |
| **Total Skor** | | **86,13%** |

After undergoing testing with GTMetrix, the information system scored 86.13%, which qualifies it for a Grade B classification.

## Discussion

The results of the evaluation using the ISO / IEC 9126 Standard were tested on information system experts, users, and testing using GTMetrix software. Testing by information system experts takes four measures of quality, namely functionality, reliability, usability, and portability. User testing is divided into three users, namely administrators, teachers, and parents which take three quality measures, namely functionality, usability, and portability. Meanwhile, testing using GTMetrix takes a measure of quality efficiency and serves to assess the performance of a website-based information system.

From the test results that have been carried out, the test score by information system experts got a score of 97.17%, a test score by administrator users of 95.11%, a test score by teacher users of 91.35%, a test score by parents of students of 83.4%, and a test score using GTMetrix got a score of 86.13% or Grade B.

Table 13. Test Result Using ISO/IEC 9126 Standard

| Tester | Score | Category |
|---|---|---|
| Information System Expert | 97,13% | Very Decent |
| Administrator | 95,11% | Very Decent |
| Teacher | 91,35% | Very Decent |
| Parents | 83,4% | Very Decent |
| GTMetrix | 86,13% | Grade B |

The criteria for the system have been rated as very decent based on all the tests conducted by information system experts, administrators, teachers, and parents of students. This indicates that the system has been effective and functioning well, enabling the application to be utilized by the school and parents for exchanging information related to student learning development at school. The system evaluation based on the ISO/IEC 9126 Standard results in a product of good quality, consistent with Djouab and Bari's (2016) belief that utilizing the ISO/IEC 9126 Standard for software testing can be the key to successful software development with good quality.

From testing by users (administrators, teachers, and parents of students) the results were obtained very decent, the website-based information system that was tested was found that the software tested had met the expectations of users, especially parents and the school and the software had fulfilled the purpose of developing a website-based information system.

The GTMetrix software testing resulted in a score of 86.13% or Grade B, indicating that the performance and efficiency of the tested information system are on par with websites that exhibit good performance. The information system was developed using the PHP programming language and Laravel framework, implementing the model-view-controller (MVC) concept. This showcases that information systems developed in this manner can operate optimally, aligning with Simanjuntak and Kasnady's (2016) perspective that employing the MVC concept in the PHP programming language enhances its performance and allows it to run optimally.

Table 13 demonstrates that testing information systems yields varying scores from each tester, which aligns with Djouab and Bari's (2016) perspective that utilizing ISO/IEC 9126 can measure diverse views on product quality.

# Conclusion

Based on research that has been carried out by evaluating a website-based information system using the ISO/IEC 9126 Standard, the conclusion was reached that the information system has met user expectations and met the purpose of developing a website-based information system. The results of testing from a website-based information system, namely testing information system experts using questionnaires that take measures of quality functionality, reliability, usability, and portability, got a score of 97.13% including very decent criteria. Testing on users takes three measures of quality: functionality, usability, and portability which are divided into three tests, testing on administrators getting a score of 95.11%, testing on teachers getting a score of 91.35%, and testing on parents of students getting a score of 83.4%, from testing by users it can be categorized into very decent criteria. Meanwhile, testing using GTMetrix software aims to assess the performance of a website-based information system that takes a measure of quality efficiency to get a score of 86.13% or Grade B category. Testing using the ISO/IEC 9126 Standard can create a product with good quality and can measure a different view of the product being tested.

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