WEB-BASED STUDENT ACADEMIC GRADE PROCESSING INFORMATION SYSTEM

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Abstract. The processing of student academic grades at UPT SMP Negeri 1 Binamu is still done conventionally with manual documentation, so that the grade processing process becomes less effective, less efficient and access to values in the previous semester is difficult, large document storage space is needed and the risk of losing documents. Therefore, a system is needed that can facilitate the processing of student grades and access to student grade archives then the system is tested to determine its feasibility. The type of research used is Research and Development (R&D) with the Waterfall development model. The data collection techniques used are interviews, and questionnaires. The system implementation uses MySQL, Express, React, and Node.js technology stacks using the JavaScript programming language that implements the REST API architecture. System testing uses the ISO/IEC 25010 standard, namely functional suitability, obtaining a value of 1; performance efficiency, loading pages in less than 10 seconds; usability, obtaining very good results; compatibility, operating well; reliability, obtaining a value of 100%; maintainability, meeting standards; security, obtaining a level 1 (low) vulnerability level; and portability, operating well, so that the overall test shows decent system testing results.

1 Introduction

The development of information and communication technology has its own benefits in educational activities [1]. The application of information and communication technology in education can facilitate school management work in accessing and managing information data [2]. The process of managing data such as recording activities, storing files, and categorizing files is a work that requires a lot of time and space and the preparation of files that are usually not neatly arranged, so it requires a system that is able to categorize, process, and store data [3]. Information systems provide convenience in information processing such as management, collection, processing, storage, analysis, and dissemination of information data in an organization [4, 5].

Information systems have a big impact and an important role in supporting the quality of education, one of the uses of information systems in educational institutions is grade processing [6]. When grades are needed in making student report cards or exposing student

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grades, it is considered less efficient if you still use conventional methods that require relatively long energy and time. Therefore, it is necessary to utilize technological advances that are able to maximize data processing processes such as student grade processing information systems [7]. A study at Kiddy ABC Islamic School Kindergarten (TK), Bekasi Regency, West Java Province, has developed a web-based grade processing system that assists homeroom teachers and school administrators in processing student grades and report cards efficiently and effectively using the PHP programming language with Black Box Testing System [8]. Research at Nature Islam Elementary School, Tangerang Regency, Banten Province, has created a student grade processing information system in the form of a web-based application that makes it easier for school admins, homeroom teachers, and subject teachers to manage student data, student grade data, subject schedules, and make grade reports quickly using the PHP programming language with Black Box Testing System testing [9]. Another research at Madrasah Ibtidaiyah (MI) Darussalam Tlogoboyo, Demak Regency, Central Java Province, resulted in a web-based student grade data processing information system that successfully assisted admins, teachers, and students in managing student grade data and producing grade report cards quickly using the PHP CodeIgniter framework whose system was tested using Black Box Testing [10]. However, there has been no research on the development of a web-based academic grade processing information system that combines MySQL, Express, React, and Node.js technologies in the application of REST API architecture with ISO/IEC 25010 system testing.

Based on the results of interviews conducted by the author with Mrs. Hatifah, S.Pd., as Vice Principal of Curriculum Affairs UPT SMP Negeri 1 Binamu, the author obtained the fact that the process of processing student grades is carried out conventionally because the grades of student learning outcomes are written into paper and then managed using the Microsoft Excel application by each subject teacher and then given to the homeroom teacher. Furthermore, homeroom teachers collect documents and soft files of student grades from each subject teacher into one soft file and then process them to produce report cards. In the process of collecting these values, homeroom teachers must search and open the documents that have been given one by one and then put them together into a separate soft file to be processed into report cards. The report card grades are entered one by one into the composition of the student's report card. Because the process of entering grades at UPT SMP Negeri 1 Binamu is still done conventionally, the documentation process is also still manual, so that the grade processing process becomes less effective and efficient and access to values that have been entered during the previous semester is difficult, large document storage space is needed and there is a risk of losing student grade documents. Thus, the author will develop an information system for processing student academic grades, namely the web Academic Grade Information System UPT SMP Negeri 1 Binamu.

Quality analysis of web-based Academic Grade Information Systems there are several software quality models that have been developed. One of them is ISO/IEC 25010 which is specifically used in the industrial world to test the quality of a software [11]. ISO/IEC 25010 has 8 testing aspects in determining the quality of a software, namely functional suitability, performance efficiency, usability, compatibility, reliability, maintainability, security, and portability [12]. Thus, the author uses the ISO/IEC 25010 model as a method to analyze the quality of the Academic Grade Information System web. In developing a web, there are various technologies and web frameworks that can be used, one of the most popular is Node.js which runs the JavaScript programming language on the server side using Express and the client side using React. A widely used client-server communication method is the REST API architecture because it can be used on many platforms and many programming languages [13].

Therefore, the author intends to develop a web-based UPT SMP Negeri 1 Binamu Academic Grade Information System. The information system developed must be in

accordance with user needs so that the system will be tested to determine its quality [14], using the ISO/IEC 25010 software testing standard. The information system developed uses MySQL, Express, React and Node.js technology stacks with the application of the REST API model architecture. This web-based Academic Grade Information System is expected to be able to facilitate teachers in the process of processing student grades and make it easier when accessing student grade archives quickly and accurately.

2 Method

The type of research used in this study is Research and Development (R&D). This type of research is used to make new products or develop existing products to be better and test the products that have been developed [15]. This research aims to produce a product, namely a web-based Academic Grade Information System at UPT SMP Negeri 1 Binamu, Jeneponto Regency. The data collection technique was carried out by means of interviews and questionnaires.

The software development model used is SDLC (Software Development Life Cycle), namely the Waterfall model. The Waterfall model has 5 stages of development, namely requirements, design, implementation, verification, and maintenance [16]. The developed system was tested using the ISO/IEC 25010 model which consists of 8 aspects of testing, namely functional suitability, performance efficiency, usability, compatibility, reliability, maintainability, security, and portability [12].

The developed system uses the REST API architecture design for client-server communication. The client sends a request to the server and the server works on the request and then replies with a response. The communication that occurs uses the HTTP standard. The client uses HTTP methods GET, POST, PUT, and DELETE to communicate with the server and then returns a response in the form of JSON [17, 18].

Fig. 1. REST API Architecture

System design uses Use Case Diagrams to provide a general illustration of the interaction between users and the system to achieve certain goals [19].

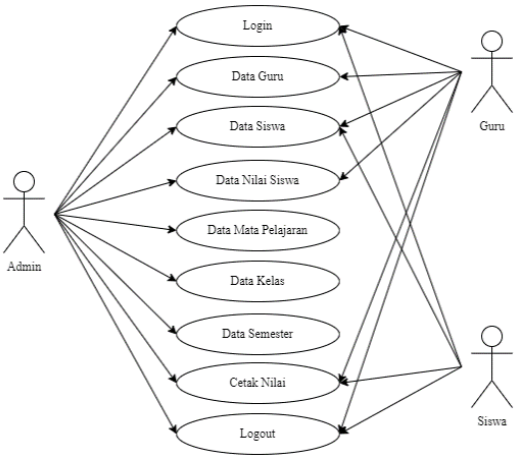


Fig. 2. Use Case Diagram of Information System

The process and data flow of a system is represented graphically by symbols along with structured analysis commonly known as Data Flow Diagram (DFD) [20].

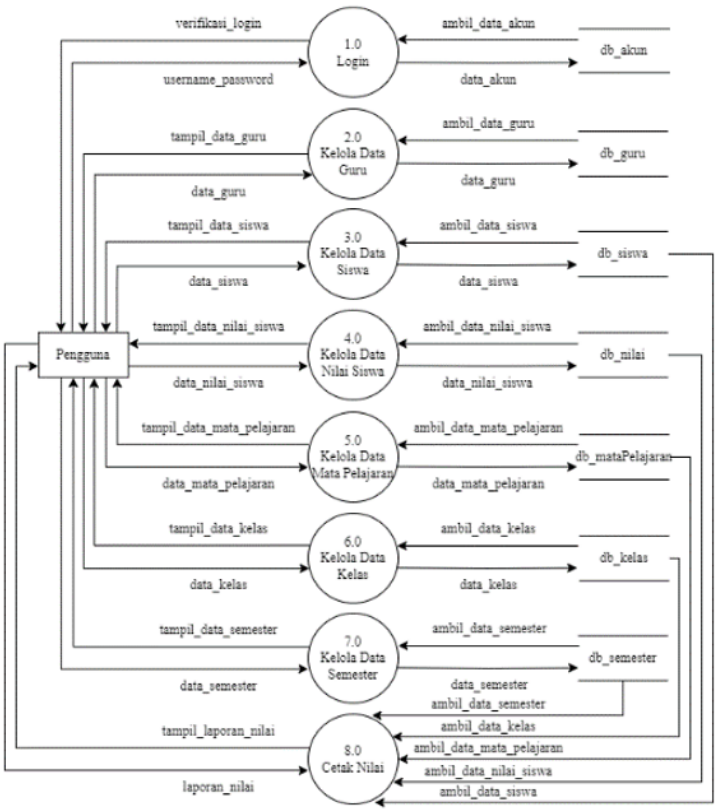


Fig. 3. Data Flow Diagram (DFD) of Information System

3 Results and Discussion

Research with the title Web-Based Student Academic Grade Processing Information System at UPT SMP Negeri 1 Binamu, Jeneponto Regency has produced a web-based system that can assist teachers in processing student grades and facilitate access to archives of student values quickly and accurately. The information system was developed using the SDLC (Software Development Life Cycle) development model, namely the Waterfall model. The Waterfall model has sequential stages so that the process is simple in software development [16]. The following are the results of system development using the Waterfall model:

3.1 Requirement

The requirements analysis stage is carried out by analyzing and collecting information about the system through interviews with Mrs. Hatifah, S.Pd., as Vice Principal of Curriculum Affairs UPT SMP Negeri 1 Binamu to obtain information on system needs. The result of the system requirements analysis is that the student academic grade information system is needed to assist in the process of processing student grades and accessing archives of student values. The data used by users to access the information system is username and password. Users in the information system consist of 3 levels of users, namely: admin, able to process student data, teacher data, class data, subject data, and print student grades; teachers, able to process

student grade data, view student data and teacher data, and print student grades; and students, able to view student data and print student grades.

3.2 Design

After the requirements analysis stage is complete, the next step is to create a system design. The system design includes the REST API system architecture as shown in Figure 1, Use Case Diagram modelling as shown in Figure 2, and Data Flow Diagram (DFD) modelling as shown in Figure 3.

3.3 Implementation

Implementation of system design using JavaScript programming language with MySQL, Express, React and Node.js technology stacks by implementing REST API architecture. Implementation of program code using Visual Studio Code. The following are the results of the system design implementation:

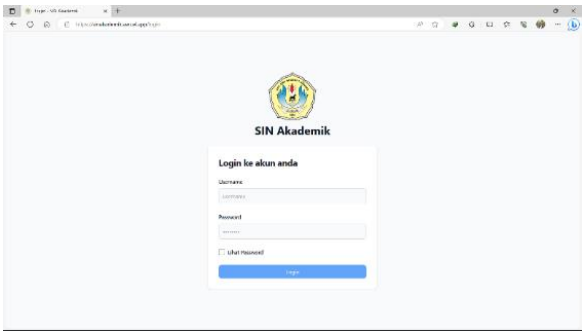


Fig. 4. Login Page Display

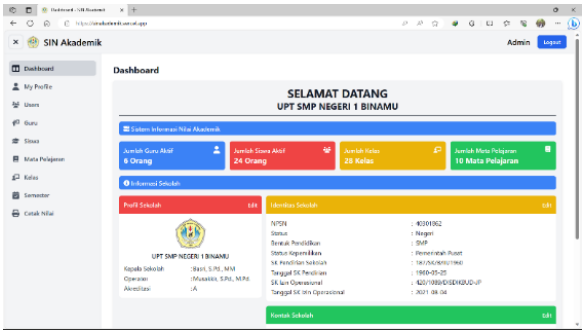


Fig. 5. Admin Page Display

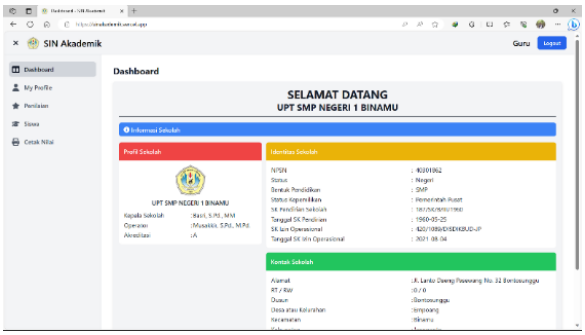


Fig. 6. Teacher Page Display

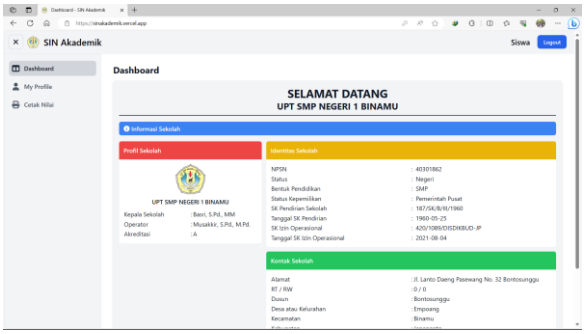


Fig. 7. Student Page Display

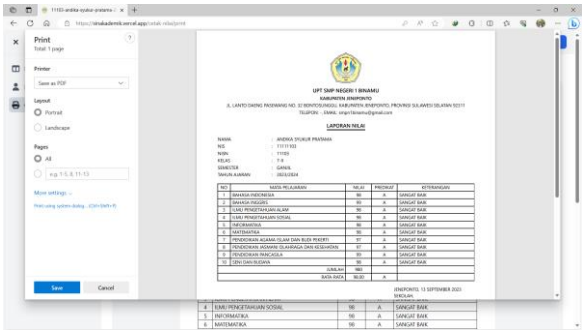


Fig. 8. Grade Print Page Display

3.4 Verification

System testing is carried out using the ISO/IEC 25010 model which is based on 8 aspects of testing. The following are the results of system testing:

3.4.1 Functional Suitability

Testing the functional suitability aspect was carried out by 2 software expert lecturers. Based on the results of testing the functional suitability aspects carried out by 2 software expert lecturers using a Guttman scale. The recapitulation of test results from software expert lecturers is shown in Table 1.

Table 1. Recapitulation of Functional Suitability Testing

Validator	Answer		Total Features (P)	Total Successful Features (I)
	Yes	No		
1	128	0	128	128
2	128	0	128	128
Average			**128**	**128**

Based on the average score of the recapitulated results of the software expert evaluation, the Feature Completeness value can be determined using the following formula from Acharya & Sinha [21].

$$X = I/P \quad (1)$$
$$X = 128/128$$
$$X = 1$$

Based on the results of the Feature Completeness (X) calculation, it is then measured using the Feature Completeness interpretation ($0 \leq X \leq 1$). Because the X value is 1, then testing the system on the functional suitability aspect gets feasible results.

3.4.2 Performance Efficiency

Testing the performance efficiency aspect is carried out using the Google Lighthouse tool to determine the performance and loading time of each web page of the system. The results of testing the performance efficiency aspect of the system are shown in Table 2.

Table 2. Performance Efficiency Testing Results

Tested Web Page	Performance Score	Page Loading Time
Login Page	100%	0.8 seconds
Dashboard Page	100%	0.7 seconds
My Profile Page	100%	1.1 seconds
Users Page	100%	0.9 seconds
Teacher Page	100%	0.9 seconds
Student Page	100%	0.8 seconds
Subject Page	100%	1.1 seconds
Class Page	100%	0.8 seconds
Semester Page	100%	0.8 seconds
Valuation Page	100%	0.9 seconds
Grade Print Page	100%	0.8 seconds
Average	**100%**	**0.87 seconds**

Based on the test results in Table 2, where the average value of web page loading time is less than 10 seconds, the system test on the aspect of performance efficiency obtained good results.

3.4.3 Usability

Testing the usability aspect is carried out by users through direct trials of the system then filling out the USE Questionnaire from Arnold [22] to answer as many as 30 questions using a Likert scale. The questionnaire was given to 30 respondents consisting of teachers and students at UPT SMP Negeri 1 Binamu. The evaluation results from system users are shown in Table 3.

Table 3. Respondent Evaluation Results

Respondents	Score Results	Maximum Score
30	4152	4500

Based on the results of the respondent's evaluation, the percentage value of usability can be found using the following formula.

$$\textit{Usability Percentage (\%)} = (\textit{Score Results}/\textit{Maximum Score}) \times 100\% \quad (2)$$

$$\textit{Usability Percentage (\%)} = (4152/4500) \times 100\%$$

$$\textit{Usability Percentage (\%)} = 92.3\%$$

The results of the usability percentage are then compared using the usability scale in Table 4.

Table 4. Usability Percentage Conversion

Usability Percentage	Category
81%-100%	Very Good
61%-80%	Good
41%-60%	Moderate
21%-40%	Poor
<21%	Awful

Based on the results of the calculation of the usability percentage, a percentage value of 92.3% was obtained, so that system testing in the usability aspect obtained very good results.

3.4.4 Compatibility

Compatibility testing was conducted directly by the author using the PowerMapper web tool which runs the system on different browser versions. The results of testing the compatibility aspect of the system are shown in Figure 9.

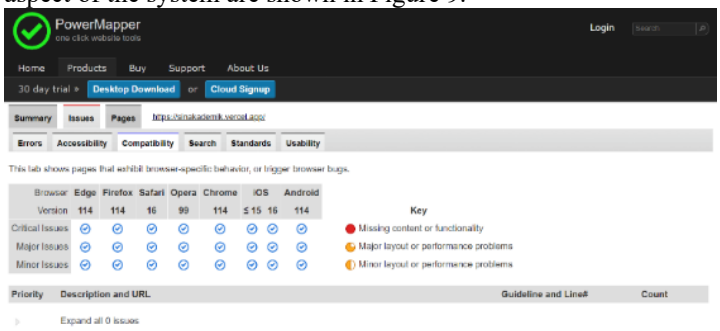


Fig. 9. Compatibility Testing Results

Based on the test results in Figure 9 which operate properly without any warnings, the system test on the compatibility aspect is successful.

3.4.5 Reliability

Testing the reliability aspect was carried out directly by the author using the K6 Grafana Labs tool under the condition of 20 virtual users accessing the system for 5 minutes 30 seconds.

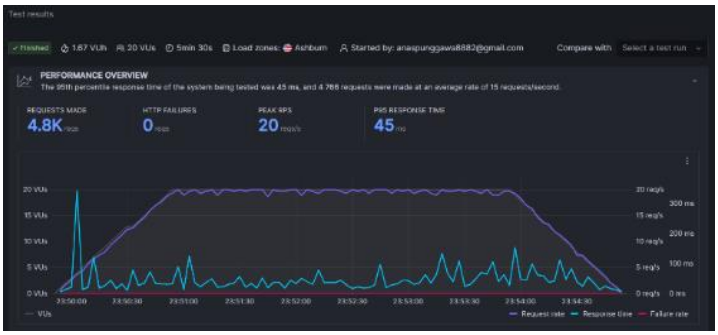


Fig. 10. Compatibility Testing Results

Based on the test results in Figure 10, there are 4766 requests made without any request failures. Then the test results can be obtained reliability value using the following Nielson formula [23].

$$Reliability = 1 - (Number\ of\ Failed\ Requests / Number\ of\ Requests) \quad (3)$$

$$Usability\ Percentage\ (\%) = 1 - 0/4766$$

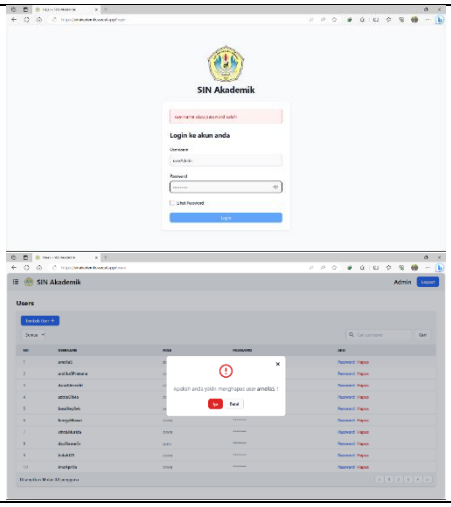
$$Usability\ Percentage\ (\%) = 1$$

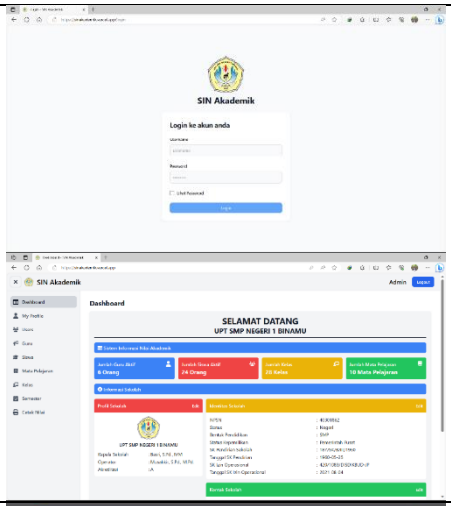
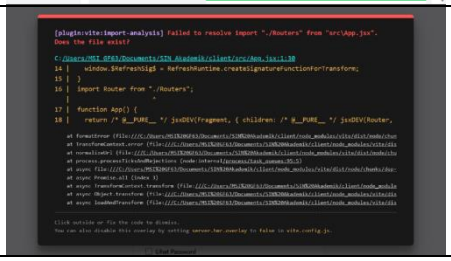
Based on the results of the Reliability calculation is 1 and then converted into percent, the result is 100%. Because the system test results meet Telcordia standards greater than 95% [24], the system test on the reliability aspect is successful.

3.4.6 Maintainability

Testing the maintainability aspect was carried out directly by the author in the field operationally against the system to determine the effectiveness and efficiency in making system modifications for the needs of repair, renewal or adjustment to environmental changes using the Land testing instrument. The results of testing the maintainability aspect of the system are shown in Table 5.

Table 5. Maintainability Testing Results

Valuation Aspect	Result
Instrumentation, the system provides a warning to the user when performing the function of deleting data and when an error occurs	

Consistency, the system has a consistent model and appearance form on each page of the system	
Simplicity, the system uses the REST API concept, making it easier for the system to manage, repair and develop more effectively and efficiently	

Based on the test results in Table 5 that fulfill all three aspects of the evaluation, the system test on the maintainability aspect successfully meets the standard.

3.4.7 Security

Based on the results of testing the security aspect in Figure 11 which is carried out using the Acunetix Web Vulnerability Scanner tool to determine the level of vulnerability of the system consisting of Level 3 (High), Level 2 (Medium), Level 1 (Low), and Informational [25], the results of testing the level of vulnerability level 1 (low) are obtained. Because the system test results are at level 1 (low), the system test on the security aspect is successful.

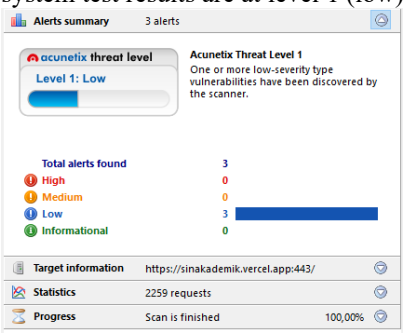


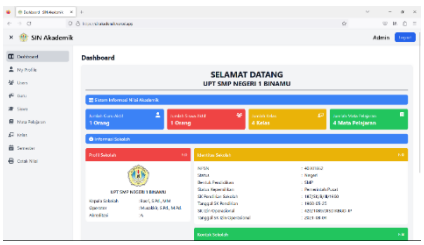
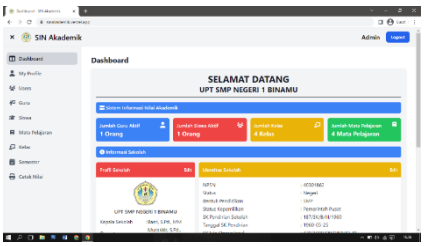
Fig. 11. Security Testing Results

Based on the test results in Figure 9 which operate properly without any warnings, the system test on the compatibility aspect is successful.

3.4.8 Portability

Portability testing is done by running the system on various desktop and mobile devices.

Tabel 6. The results of testing the portability aspect of the system

Device	Browser	User Interface	Error
Laptop MSI GF63 Thin 9RCX (Windows 11)	Firefox		No Error
Laptop Acer Aspire ES1-131 (Windows 10)	Google Chrome		No Error
Smartphone Redmi Note 7 (Android 10)	Opera		No Error
Smartphone Xiaomi Mi Note 10 (Android 11)	Edge		No Error
Smartphone Redmi Note 12 (Android 12)	Mi Browser		No Error

Based on the test results in Table 6, which operate well without errors, the system test on the portability aspect is successful.

Based on the results of system testing using the ISO/IEC 25010 model on 8 aspects of testing, the system produces results that are suitable for use in processing academic grades.

3.5 Maintenance

The final stage of system development is system usage. The information system for processing student academic grades that has been developed is then used by users in managing data and information at UPT SMP Negeri 1 Binamu. The system can be used properly by users after being given training on how to use the information system.

4 Conclusion

Based on the results and discussion that has been conducted, it can be concluded that:
1. The results of the development of a web-based student academic grade processing information system at UPT SMP Negeri 1 Binamu were made using the Research and Development (R&D) research type with data collection techniques through interviews and questionnaires. The development of this information system uses the Waterfall development model. This system uses MySQL, Express, React and Node.js technology stacks using the JavaScript programming language and implementing the REST API architecture. This system is used by 3 levels of users, namely admin, teachers and students. This information system is used for processing student grades, storing student grade processing results, printing student grade processing results, and accessing student grades.
2. The results of testing the web-based Academic Grade Information System at UPT SMP Negeri 1 Binamu using the ISO/IEC 25010 quality standard which consists of 8 testing aspects. The test results on functional suitability obtained a value of 1 which showed feasible results, performance efficiency managed to load the page in less than 10 seconds, usability resulted in a very good category, compatibility obtained the results of operating well in different browser versions, reliability obtained a percentage value of 100%, maintainability obtained the results met the standards, security obtained the results of level 1 vulnerability (low), and portability obtained the results of operating well without errors found. Based on the overall results of system testing, the system shows feasible results.

Based on the results and discussion, the following suggestions are given:

1. Development for mobile application versions (Android and IOS).
2. Can add a notification feature so that students can find out the value of subjects that have been added by the teacher.

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