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Web Engineering Methods in Building a Web-Based School Academic Information System

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Abstract

The advancement of computer technology has paved the way for the development of computer-based information systems, significantly enhancing the efficiency and speed of data processing tasks. In educational settings, particularly in secondary vocational schools, there is a pressing need to transition from traditional manual data handling methods to more sophisticated, automated systems. This study focuses on the development of an academic web application aimed at improving the data processing quality in a secondary vocational school where data is currently managed manually using paper and pen. The existing manual method of processing academic data could be more efficient, prone to errors, and susceptible to data loss. This antiquated approach hinders the school's ability to manage academic information effectively, leading to delays and inaccuracies in data reporting and access. There is a clear necessity for a system that can streamline data processing, ensure data security, and provide easy access to information. The method employed to design this academic information system is web engineering. Web engineering combines engineering principles, management practices, and systematic approaches to create high-quality web-based applications. The development process includes several critical activities: formulation, planning, analysis, engineering, page generation, and testing. The system is implemented using PHP and MySQL, which were chosen for their robustness and reliability in web application development. The development and implementation of the academic information system have demonstrated significant improvements in data processing quality. The system allows for efficient, accurate, and secure handling of academic information. It facilitates quick access to data from any location, enhancing the practicality of data management. Testing confirmed that all system functions met the predefined requirements, ensuring that the application operates as intended. The introduction of this web-based system has effectively addressed the deficiencies of the previous manual method, providing timely and accurate reporting. This improvement has enhanced the services provided to students, teachers, and principals, leveraging modern technology to achieve greater efficiency in educational administration.

Keywords

Academic, MySQL, PHP, System Information, Web engineering

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Introduction

Information technology is currently developing rapidly, so many changes are occurring in human life. With the development of information technology, every job can be realized more effectively and efficiently. In the era of the 1980s, when computers were still not used, conveying information and processing data felt very slow and required a lot of time and energy. With the existence of information technology, all activities can be speeded up easily. especially in the field of data processing systems, so that they can produce precise and accurate information.

An academic information system is a system that provides information services in the form of academic-related data. In this case, the services provided are data storage for new students, class determination, lesson schedules, teaching schedules, homeroom teacher distribution, and assessment processes. (Imelda & Erik.M, 2014).

This research was conducted at SMK Negeri 1 Indralaya Selatan. The system applied at this Vocational School in processing data, especially in the academic field, is still done by recording it in books and storing it in archives. So, the use of computers in schools still needs to be improved, such as computers only being used as learning media and data storage tools and the use of the internet only as a medium for searching for information. From this background, it is appropriate to create a computer-based system that is easy to operate and is able to anticipate and serve information needs so that the system that will be made can help the work of administrative staff at SMK Negeri 1 Indralaya Selatan, especially in processing academic data.

This system was created using the PHP and MySQL programming languages. PHP is a server-side scripting language used in Web development, inserted into HTML documents specifically designed for web applications (Peranginanin, 2006).

According to the official PHP document, PHP stands for Hypertext Preprocessor, which is a language in the form of scripts that are placed on the server and processed on the server. The results are sent to the client, where the user uses a browser (Kadir, Abdul. 2001).

The research was limited to processing academic data consisting of teacher data, student data, subject data, and student grade data schedules and producing information in the form of teacher list reports, student lists, subject reports, schedule reports consisting of teacher schedules, class schedules, daily schedules, and Grade Reports, where the processing of academic data uses Intranet media.

This research aims to create an academic information system for processing student data, teacher data, subjects, schedules, and student report cards. The system development method used is the web engineering method. This method is very good for web developers who are creating webs and as a guide in a good web development process. Web engineering is an application that uses a systematic, disciplined, and measurable approach to the development, operation, and maintenance of web-based applications. (Simarmata, Janner. 2010).

The web engineering method covers Web Engineering activities, namely Formulation, Planning, Analysis, Engineering, and testing.

Methodology Research

To improve the quality of learning at SMK Negeri 1 Indralaya Selatan and facilitate the work of the administration section in collecting student data, as well as in making all reports, the author tried to design and create an application program using the PHP programming language to support the presentation of the information system. The alternative solution to this problem uses the Web Engineering method, where there are several alternatives, namely:

Formulation Stage

This formulation activity is intended to formulate the goals and measurements of web-based applications and determine system boundaries. The goals to be achieved can be divided into 2 categories, namely:

a. Informative purposes
   Providing certain information to users in the form of text or images. In this case, the information provided is in the form of teacher reports, student reports, subject reports, grade reports, and schedule reports, where the schedule report consists of class schedules and daily schedules.

b. Functional goals
   The ability to perform a function required by the user. For example, by using this application, a teacher can obtain all student data at SMK Negeri 1 Indralaya Selatan. In this case, the admin section is responsible for inputting data, while other users (students and teachers) are information users and not information managers.

Planning

Planning involves calculating the estimated number of developers, predicting development time, and establishing the development schedule for future versions if needed (Smith & Johnson, 2022). The educational institution will set the policy on the number of developers and their respective departments for ongoing web development. The researcher will determine the estimated development time, with the author's target set at 3 months for the current phase. Evaluations are necessary to anticipate potential risks during project development (Lee et al., 2023). However, the author aims to minimize these risks by implementing a solid strategy to ensure the website's continued operation.

Analysis

The analysis activity is to identify information that will be displayed on the web-based application. Software requirements analysis is carried out to identify existing problems that may arise later, as well as matters that require attention in software development, so that the software and delivery of information regarding the South Indralaya 1 Vocational School Website can be as desired.

Engineering

There are two jobs carried out in parallel, namely web architecture and system design/

a. System Architecture

System architecture defines and illustrates the organization of an information system in stages in the form of modules and sub-modules. The architecture of this system is shown by the relationship of data elements between its modules. In this way, system architecture can provide a complete system explanation in terms of data elements, modules, and relationships between modules.

b. System planning

The design process is needed to produce a good system design because the right design will make a system stable and easy to develop in the future. Poor design will result in the system being built having to be completely overhauled, or the system being built will require too much of what is needed.

Data Structure Design

Use Case Diagrams

The Use Case Diagram describes the entire process of the Web-based Academic Information System activities at SMK Negeri 1 South Indralaya, which involves several actors, including Students, Administrators, Teachers, and School Principals, as shown in Figure 1.

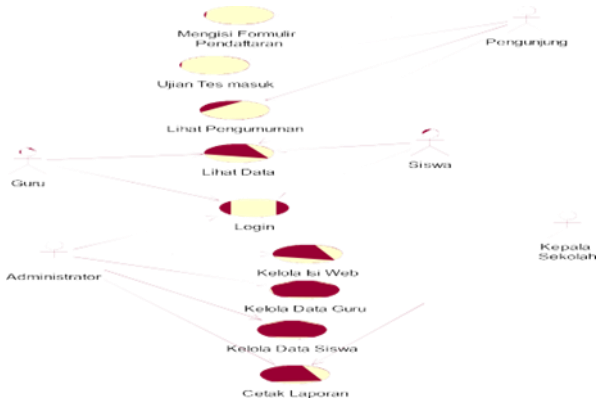

Figure 1. Use Case Diagram for Academic Information Systems

Class Diagram

In a database, several tables group data according to their groups. The author uses a class diagram to illustrate the connection between each table, as shown in Figure 2.

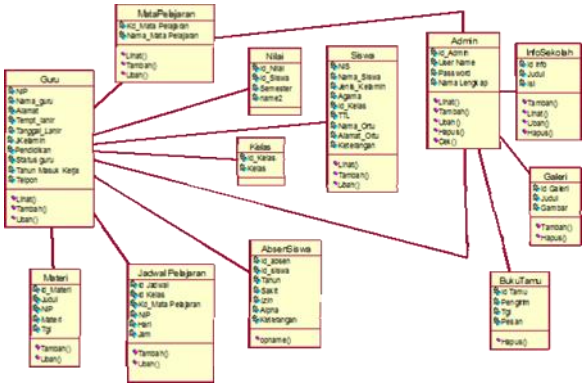

Figure 2. Class Diagram of the School Academic System

Testing Processing

The web-based academic information system underwent a thorough and structured testing process to ensure it met all requirements and functioned correctly. The process began with verifying functional and non-functional requirements.

Unit testing followed, using frameworks like PHPUnit to detect and fix bugs early (Pressman & Maxim, 2020). Integration testing checks the interaction between modules, while system testing evaluates the entire application's performance, including UI, APIs, and databases (Graham et al., 2019). Performance testing identified bottlenecks under different loads (Gove, 2021), and security testing addressed vulnerabilities like SQL injection and XSS (Myers et al., 2020).

Usability testing gathered user feedback for improvements, compatibility testing ensured consistent functionality across platforms, and regression testing confirmed the stability of existing features after code changes. Finally, acceptance testing by end-users verified that the application met their needs before deployment, which was also tested to ensure a smooth transition to production (Black, 2020). This comprehensive approach ensured that the application was reliable, secure, and user-friendly.

Results and Discussion

After designing, the next stage is to realize it in a programming language so that all created variables and processes can be carried out according to their function.

The results of the research conducted regarding the Academic Information System at SMK Negeri 1 Indralaya Selatan are expected to be able to help the school, especially in processing the web-based academic data obtained.

Main menu form

The main menu, with the file name "Index.bak," is a main form that connects links to the next pages. This main menu display is the main page when the user opens this website; it provides a brief explanation about this website, as shown in Figure 3

Figure 3. Main Menu Display

Admin Menu

Teacher Input Menu

The admin uses this teacher input menu to input teacher data and can also change or delete teacher data, as shown in Figure 4.

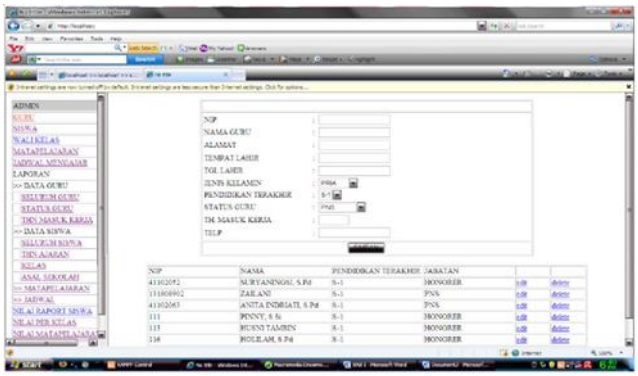

Figure 4. Teacher Data Input Menu Display

Student Input Menu

The admin uses this student input menu to input Student data and can also change or delete student data, as shown in Figure 5.

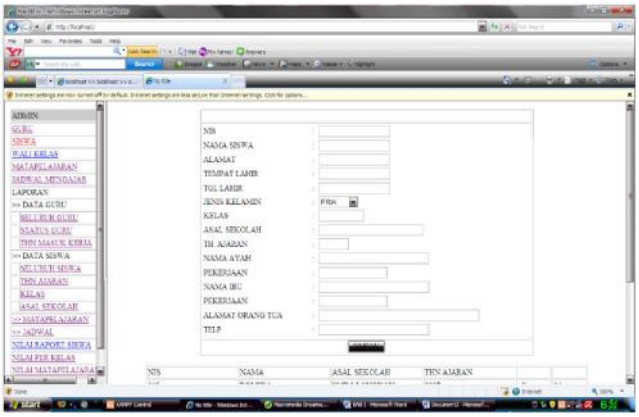

Figure 5. Student data input menu display

Subject Input Menu

The admin uses this Subject input menu to enter Subjects and can also change or delete Subject data, as shown in Figure 6.

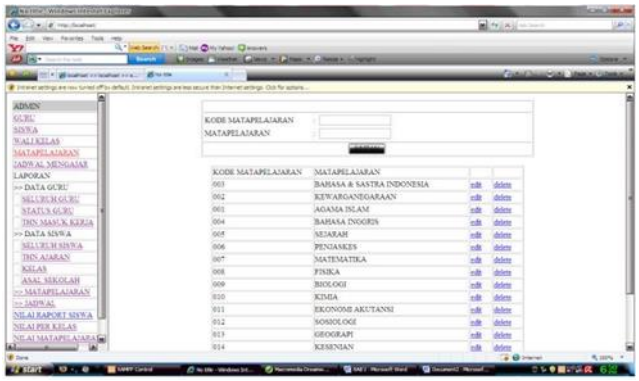

Figure 6. Subject Input Menu Display

Student Report Value Input Menu

This student report card value input menu is used by the admin to view students' grades. Subject grades are filled in by the teacher concerned, and other grades are filled in by the respective homeroom teachers, as shown in Figure 7.

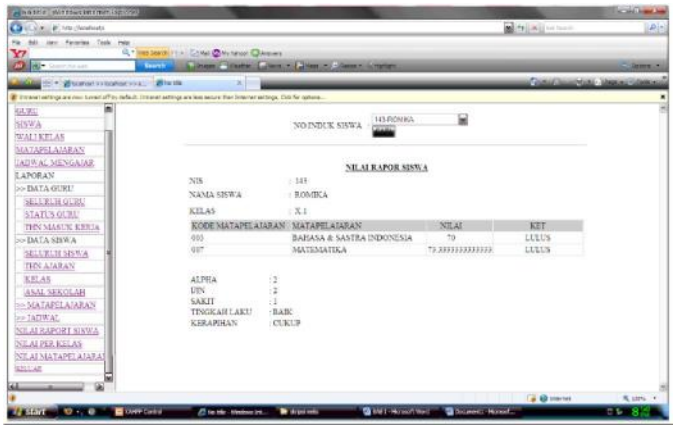

Figure 7. Display of the Student Report Card Value Input Menu

Teaching Schedule Input Menu

The admin uses this Teaching Schedule input menu to enter the teacher's Teaching Schedule and can also change or delete it, as shown in Figure 8.

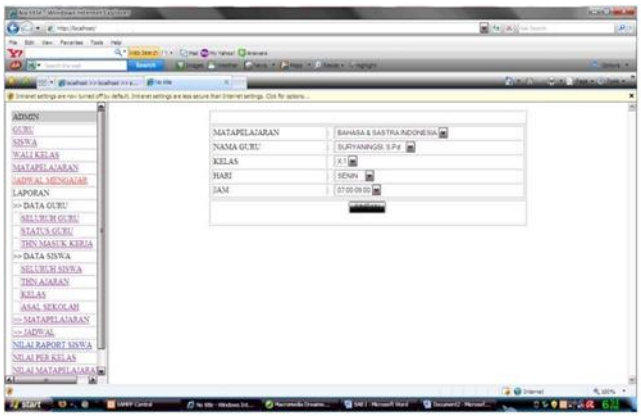

Figure 8. Teaching Schedule Input Menu Display

Teacher Menu Display

On this page, the teacher can display the sub-menu teacher, as shown in Figure 9.

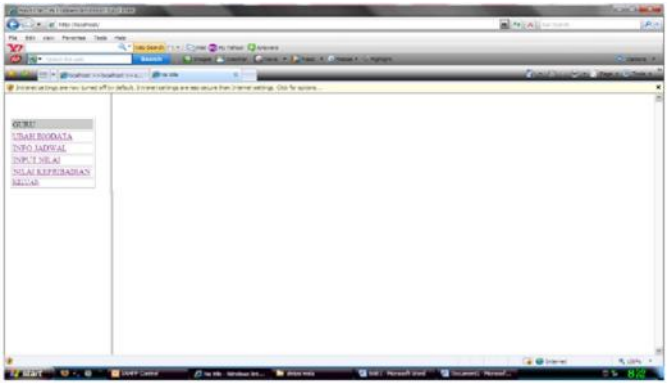

Figure 9. Teacher Menu Display

Value Entry Menu

On this page, teachers can enter students' grades at SMK Negeri 1 Indralaya Selatan, as shown in Figure 10.

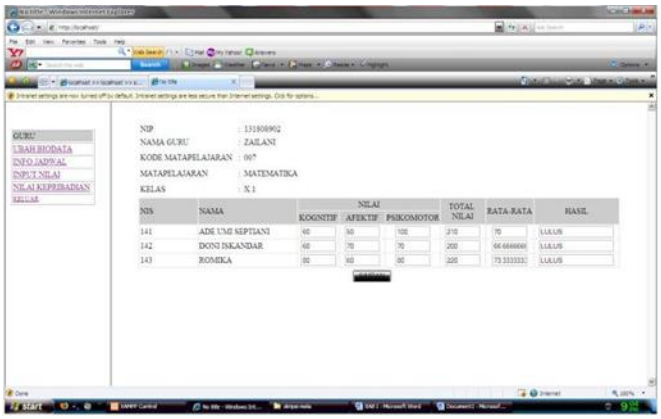

Figure 10. Value entry menu display

Student Menu

The student menu is a special page form for student activities on the website. It contains several other menu forms that can be linked to display, as shown in Figure 11.

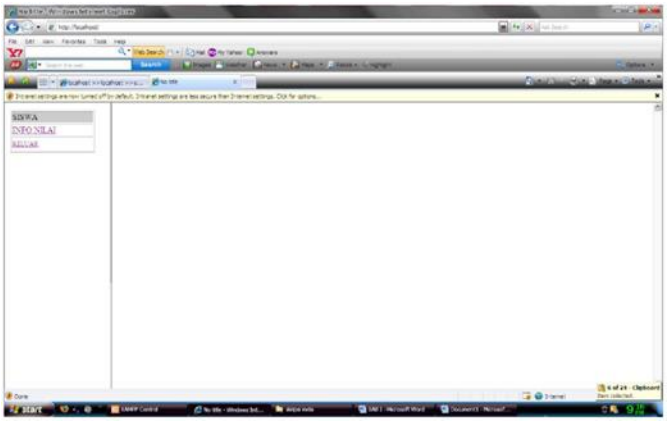

Figure 11. Student menu display

Student Grades Menu

This page contains student grades filled in by the teacher, which students can see via the student login on the SMK Negeri 1 Indralaya Selatan website, as shown in Figure 12.

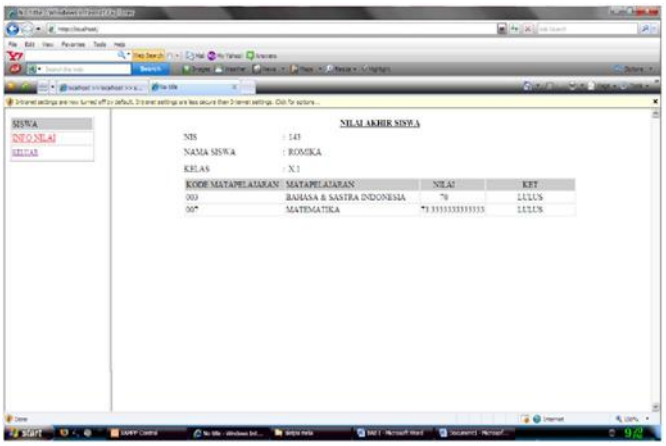

Figure 12. Value Menu Display

Testing Results

Usability testing was conducted with 100 participants to evaluate the user-friendliness and overall user experience of the web-based academic information system. The primary goal was to assess the system's intuitiveness, design consistency, and ease of use. The following table summarizes the key performance metrics observed during the web-based testing, as shown in Table 1.

Table 1. Summarizes the key performance metrics observed during the web-based testing

Feature	Functionality	Result	Remarks
Main Menu	Initial page and navigation	Functioning as expected	No issues noted
Teacher Input Menu	Data entry and management	Functional	User-friendly interface
Student Input Menu	Student data management	Operational	Minor UI enhancements needed
Subject Input Menu	Subject data management	Effective	Interface needs polishing
Student Report Value Input Menu	Grades entry and review	Working well	Accurate data retrieval
Teaching Schedule Input Menu	Schedule management	Smooth operation	No errors observed
Teacher Menu Display	Teacher-specific options	Effective	Positive feedback received
Value Entry Menu	Grade input for students	Accurate and accessible	User feedback positive
Student Menu	Student activity access	Functional	No performance issues
Student Grades Menu	Viewing of student grades	Accurate and timely	Well-received by users

The accompanying tables and graphs provide a detailed view of these usability metrics, underscoring the system's strengths and identifying areas where further enhancements could be made, as shown in Table 2.

Table 2. Usability Metrics

Usability Metric	Excellent (%)	Good (%)	Average (%)	Poor (%)
Ease of Navigation	50%	30%	15%	5%
Design and Layout	45%	35%	15%	5%
User Interface Consistency	55%	25%	15%	5%
Accessibility Across Devices	40%	30%	20%	10%
Overall User Experience	50%	30%	15%	5%

Ease of Navigation

The majority of users, specifically 80%, rated the navigation of the web-based academic information system as either "Excellent" or "Good." This high rating indicates that most participants found the system straightforward to use, enhancing their overall experience.

Design and Layout
User feedback on the design and layout was overwhelmingly positive, with 80% of respondents expressing satisfaction. This suggests that the system's visual elements are well-received and contribute to a favorable user experience.

User Interface Consistency
Consistency in the user interface was also highly rated, with 80% of users noting that the design remained coherent across different sections of the application. This consistency helps users navigate and interact with the system seamlessly.

Accessibility Across Devices
While 70% of users rated the system's accessibility across various devices as "Excellent" or "Good," 10% reported experiencing issues. This highlights the need for improvements to enhance cross-device compatibility and ensure a consistent experience for all users.

Overall User Experience
Overall, 80% of users rated their experience with the system as either "Excellent" or "Good." This reflects a high level of satisfaction and indicates that the system generally meets user expectations.

The system's ability to provide real-time access to academic information significantly improved the data management process compared to the previous manual method. Furthermore, the robust security measures implemented in the system ensured that all data remained secure and protected.

Overall, the introduction of this web-based academic information system has streamlined academic data processing, enhanced the accuracy and timeliness of information retrieval, and improved the overall user experience for both teachers and students. This study demonstrates the potential of leveraging modern web technologies to enhance educational administration and suggests avenues for future improvements and feature expansions.

Conclusion

With thorough analysis, the web-based academic information system has greatly enhanced the efficiency, accuracy, and security of data management at the secondary vocational school. Transitioning from a manual, paper-based system to an automated digital platform has improved data processing, user experience, and real-time access to information. The system has reduced administrative workload, minimized errors, and provided a secure environment for data. It is scalable and flexible, allowing for future enhancements. This system's success serves as a model for other educational institutions, highlighting the benefits of integrating technology into academic administration. Future developments could include advanced analytics, attendance tracking, and additional communication tools.

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