

Designing a Student Learning Outcome Reporting Application using the V-Model Method at SMAS Dr. Wahidin Sudirohusodo Medan

Naufal Dhiya Putra Dalimunthe^{1*}, Huliman², Hendri³

^{1,2,3}Informatics Engineering, STMIK Time, Medan, Indonesia
naufaldhiyaputradalimunthe@gmail.com^{1*}, dr.huliman@gmail.com², h4ndr7@hotmail.com³

Abstract

Student learning outcome reporting is a crucial aspect of the education system to monitor and evaluate academic achievements. However, the semi-computerized reporting process at SMAS Dr. Wahidin Sudirohusodo Medan creates several challenges, such as potential input errors and limited access to information for parents. This study aims to design and develop a web-based student learning outcome reporting application using the V-Model method to improve efficiency and transparency in academic information delivery. The V-Model method was chosen because it provides structured phases and emphasizes testing at each stage of development. The study covers system analysis, website-based system design using PHP and MySQL, as well as implementation and testing of modules such as school identity management, departments, classes, academic years, students, KKTP, subjects, homeroom teachers, and electronic report cards. The developed application enables teachers and homeroom teachers to input and manage student grades digitally, while students and parents can access report information anytime in real time via the internet. The findings indicate that this application accelerates the reporting process, minimizes errors, and enhances parental involvement in the education process. Thus, this application is expected to serve as an effective and sustainable solution to support digital transformation in schools.

Keywords: *Electronic Report Card, V-Model, Web Application, Learning Outcome Reporting*

1. Introduction

Education is a complex process involving various stakeholders, including students, teachers, and parents. Parental involvement in the teaching and learning process is vital to improving student achievement. Research indicates that parental engagement contributes positively to student performance [1]. Parents involved in their children's education tend to communicate frequently with teachers, monitor their child's progress, and provide academic support at home. This helps students focus more on learning, increases motivation, and leads to better outcomes.

In Indonesia, parental involvement in education is relatively high. About 85% of parents assist their children with homework, 78% attend parent-teacher meetings, and 65% help their children prepare for exams. Higher parental engagement is strongly correlated with better student achievement [2].

Despite this, not all parents have sufficient time, resources, or knowledge to engage effectively. Factors such as work commitments, limited education, or restricted access to information hinder parental involvement. At present, SMAS Dr. Wahidin Sudirohusodo Medan still applies a semi-computerized reporting system using physical report cards.

Electronic report cards offer significant potential benefits to enhance parental involvement in the learning process. They provide easier and faster access for parents to review their children's academic performance from any location at any time [3]. Moreover, electronic report cards offer more detailed and comprehensive information compared to conventional report cards. By utilizing technology, report cards can be generated quickly, reducing the time and effort required for managing and accessing student academic records [4].

As a summative assessment reporting tool, electronic report cards are expected to bring various advantages. Students can easily access their academic information through electronic devices anytime and anywhere. Parents, in turn, can monitor their children's progress seamlessly. With continuous development, electronic report cards hold great potential to improve the quality of education in Indonesia, contributing to national education goals such as enhancing student achievement, improving educational standards, and fostering a character-driven society [5].

2. Literature Review

2.1. System Design

System design in informatics is a systematic process aimed at creating technological solutions that meet user needs. It begins after system analysis, where requirements and specifications have been identified. In this context, system design includes developing system models, design specifications, and implementation strategies. It is a crucial phase before an application is developed [7].

2.2. Application

An application is a software program that operates within a specific system and is developed to perform certain functions [6]. In education, applications are widely used to facilitate teaching and learning processes, data management, and communication between students, teachers, and parents. They may take the form of desktop, web, or mobile applications, each with its advantages and limitations.

In software development, adopting an appropriate methodology is vital. The V-Model is one such methodology, emphasizing continuous testing throughout the development process, ensuring that each feature is validated according to user requirements.

2.3. V-Model Method

The V-Model is one of the approaches in software development that emphasizes the simultaneous relationship between development and testing. It is considered an extension of the Waterfall model, as its stages are largely similar to those found in the Waterfall process [8]. The V-Model derives its name from its “V” shape, in which each development phase on the left side corresponds to a testing phase on the right side. The structure of the V-Model can be seen in Figure 1 below.

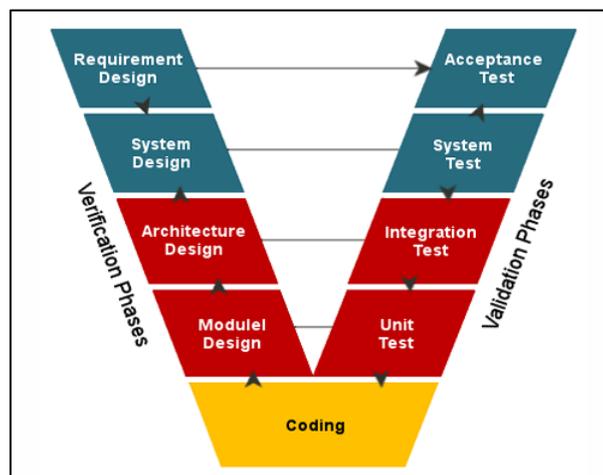


Fig. 1: V-Model Method

Essentially, the V-Model consists of two main parts: the development phases, which include module design, architecture design, system design, and requirement design; and the testing phases, which cover unit testing, integration testing, system testing, and acceptance testing. Requirement analysis serves as a crucial first step, where user needs are identified in detail to ensure that the final product meets expectations. During the system design stage, the software architecture and user interface are designed, followed by the implementation phase where the source code is written [8].

One of the strengths of the V-Model lies in its emphasis on systematic testing. Each development phase corresponds to a matching testing phase, allowing every feature to be thoroughly verified. For instance, each implemented module undergoes unit testing to ensure it functions correctly, followed by integration testing to examine interactions between modules, helping to detect potential issues when modules work together.

The application of the V-Model is highly effective in software development projects that require comprehensive documentation and strict compliance with standards. It is also suitable for projects where user requirements are clearly defined and are not expected to change significantly during development. Another advantage of the V-Model is its ability to minimize errors, as each stage is carefully controlled and validated before progressing to the next [13].

2.4. Report Cards

A report card is a medium used to formally convey students' learning outcomes within the education system. As a tool for evaluation and feedback, it provides information on academic achievement, attendance, and other aspects of student development deemed important by the school. With the advancement of technology, report cards now exist in two main forms: physical report cards and electronic report cards.

2.4.1. Physical Report Cards

A physical report card is a printed document formally used by schools to report student achievements for each academic period, such as a semester or the end of the school year. This document contains academic grades, attendance records, as well as qualitative evaluations from teachers regarding students' behavior and development. Physical report cards are typically delivered directly to parents or guardians in the form of a booklet or printed sheets [14].

2.4.2. Electronic Report Cards

Electronic report cards are an innovation in student learning outcome reporting based on digital technology. The e-Report application serves as a tool for teachers and educational institutions to record and report students' academic achievements to parents or guardians [9]. Through online applications or platforms, teachers can input student grades automatically and more efficiently. This information can be accessed anytime by students and parents using devices such as computers or smartphones. Moreover, electronic report card systems allow for continuous monitoring of student progress without having to wait for the printed report card at the end of the semester.

2.5. Website

A website refers to a collection of web pages within the internet network [10]. As a medium for delivering information, websites have a wide range of functions, including in the field of education. A website serves as a centralized platform for storing and accessing data. In the context of electronic report cards, the data stored on the website can be accessed at any time by authorized users. This provides flexibility for students and parents to monitor learning progress directly without having to wait for printed report cards [15].

2.6. Database

A database is a collection of interconnected data that can be accessed easily [11]. In the field of education, particularly in the development of electronic report card applications, databases play a vital role as storage for information related to students, grades, and other records associated with learning outcomes. Databases simplify the process of data retrieval, academic information management, and structured, efficient storage, making them a crucial component of modern information systems.

2.7. Use Case Diagram

A Use Case Diagram is one of the system modeling tools that forms part of the Unified Modeling Language (UML). It is used to illustrate the interactions between users and the system. The use of a Use Case Diagram provides an effective representation for explaining the system's context, clearly showing the boundaries of the system [14].

2.8. Entity Relationship Diagram

An Entity-Relationship Diagram (ERD) is a diagram used to describe the logical structure of a database within a system under design. An ERD provides a visual representation of the entities (main objects) in the database, their attributes, and the relationships among those entities. ERDs are typically used during the system design phase to ensure that every required entity in the database has been accurately identified and that the relationships between entities are properly designed [16].

3. Research Methodology

3.1. Problem Analysis

The problem analysis in this study is divided into three stages: analysis of the current process in the field, analysis of the proposed method, and analysis of the proposed system.

3.1.1. Analysis of the Current Process in the Field

The management and reporting of student learning outcomes at SMAS Dr. Wahidin Sudirohusodo Medan are still carried out in a semi-computerized manner, using spreadsheets and paper-based documents. The process involves teachers collecting grades, manual recap and verification, report preparation by homeroom teachers, and distribution of printed reports. However, this process faces several major challenges, such as reliance on time-consuming manual methods that are prone to errors, as well as limited access to student grade data for parents. Based on these issues, a technology-based information system with a V-Model approach is needed to automate the grade management process, improve efficiency and accuracy, and provide integrated and secure reporting of student learning outcomes. This system is expected to serve as an effective solution to support the school's needs and facilitate communication with parents.

3.1.2. Analysis of the Proposed Method

The analysis of the proposed method outlines the stages of the V-Model applied in the system development for this research, as follows:

1. Requirement Analysis & Acceptance Testing
 - a. Identify system requirements from the school, teachers, parents, and students.
 - b. Core features: management of student data, grades, and electronic report cards.
 - c. Parents can access data in real time through the web.
 - d. Technology used: PHP & Bootstrap.
 - e. Objective: to facilitate access to information and improve the quality of reporting.
2. System Design & System Testing
 - a. Design the system structure and user interface using Balsamiq Mockup.
 - b. Database design is carried out using Class Diagrams.
 - c. System testing is conducted to ensure alignment between the design and requirements.
3. Architecture Design & Integration Testing
 - a. Design the system architecture using XAMPP, PHP, HTML, CSS, and JavaScript.
 - b. Map modules such as students, grades, and electronic report cards.
 - c. Integration testing is conducted to ensure that modules function correctly when connected.
4. Module Design & Unit Testing
 - a. The system is divided into smaller modules, including: School Data, Departments, Classes, Academic Year, Students, KKTP, Subjects, Homeroom Teachers, and Report Cards.
 - b. Each module is tested individually (unit testing).
 - c. The design is supported by Balsamiq Mockup.
5. Coding
 - a. Implementation of the code using HTML, CSS, PHP, and JavaScript.
 - b. The code is written according to the design of each module.
 - c. Post-coding unit testing is performed to ensure all features function as intended.

3.1.3. Analysis of the Proposed System

This analysis is carried out using a Use Case Diagram, as shown in Figure 3 below.

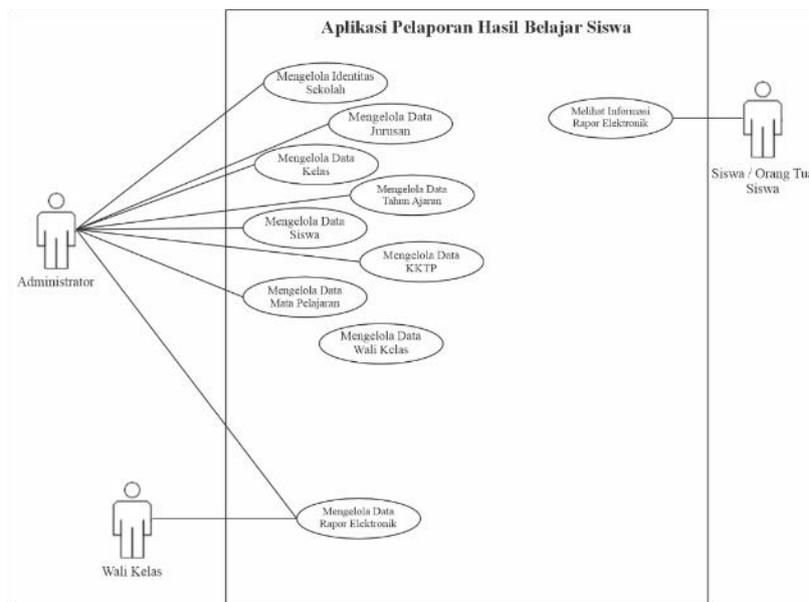


Fig. 2: Use Case Diagram of the Proposed System

3.2. System Design

System design discusses the planning and design process that forms the foundation for developing the application or research system. It is a crucial stage to ensure that the designed system can meet user needs and the objectives that have been set. In this study, the system design is divided into two parts: interface design and database design.

3.2.1. Interface Design

The interface design was created using Balsamiq Mockup 3. Figure 4 shows one of the interface prototypes of the student learning outcome reporting application developed with the V-Model method at SMAS Dr. Wahidin Sudirohusodo.

4. Results And Discussion

The result of this research is the development of a student learning outcome reporting application using the V-Model method at SMAS Dr. Wahidin Sudirohusodo. The following section presents the application interface, starting with the student/parent user. Student/parent users can only view the reporting information of student learning outcomes in the form of an electronic report card, as shown in Figure 6.

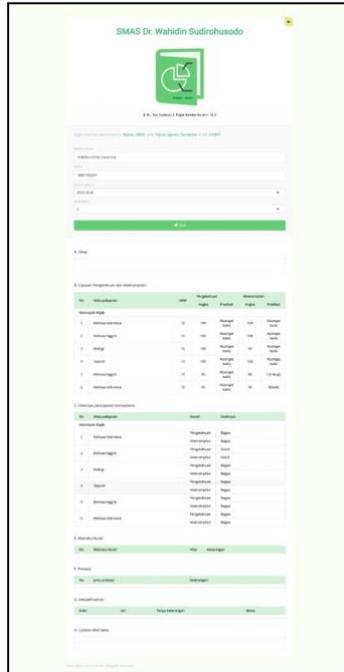


Fig. 5: Electronic Report Card Information Display Page

Furthermore, Figure 7 shows the report output (printout) of student grades directly generated from the developed system/application.

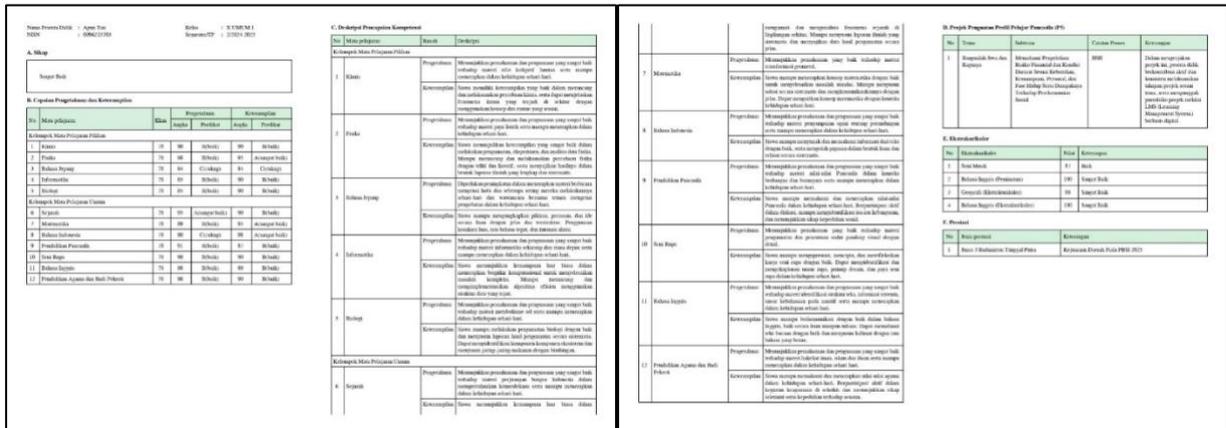


Fig. 6: Report Output (Printout) of Student Grades

Based on the results of module testing shown in Table 1, it can be observed that all modules functioned properly with outputs as expected.

Table 1: Results of Module Design & Unit Testing

No	Module	Testing Result
1	School Identity Management Module	Functioning Well
2	Department Data Management Module	Functioning Well
3	Class Data Management Module	Functioning Well
4	Academic Year Data Management Module	Functioning Well
5	Student Data Management Module	Functioning Well
6	KKTP Data Management Module	Functioning Well
7	Subject Data Management Module	Functioning Well
8	Homeroom Teacher Data Management Module	Functioning Well
9	Electronic Report Card Module	Functioning Well

5. Conclusion And Recommendations

5.1. Conclusion

The conclusions derived from this research are as follows:

1. The research results show that the developed web-based application is capable of presenting student learning outcome reports in the form of electronic report cards efficiently, and can be accessed by the school community anytime and anywhere.
2. The use of the V-Model method through development and testing phases ensured that the final product—a website—met user expectations, as module testing results indicated that all modules functioned properly with outputs as expected.

5.2. Recommendations

Several recommendations are provided for future research and development, including:

1. Future development of the application should include formative assessment features (daily or monthly evaluations) to provide a more comprehensive overview of student progress.
2. The application should be developed to accommodate different types of curricula beyond the National Curriculum, so it can also be used by schools adopting international curricula.
3. A feature for uploading or importing data from external databases (e.g., Excel or CSV files) should be developed to make data processing more efficient and accurate.

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