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Development of a Web-Based Student Graduation Information System for Vocational High Schools Using the Waterfall Method

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Abstract

Advances in information technology have driven digital transformation across many sectors, including education. One administrative service that is still largely handled conventionally is the announcement of student graduation results and the distribution of Graduation Certificates (Surat Keterangan Lulus/SKL), which makes the delivery of information relatively inefficient. This study aims to build a web-based Student Graduation Information System for vocational high schools (SMK) that simplifies graduation-data management for school administrators and gives students online access to their graduation information. The system was built using the Waterfall method, covering requirements analysis, design, implementation, testing, and maintenance, and was implemented with the Laravel framework, the PHP programming language, a MySQL database, and a Bootstrap interface. It serves two types of users: administrators, who manage graduation data, and students, who can check their graduation status without logging in by entering their National Student Identification Number (NISN). Students who pass can download their SKL directly in PDF format. The system was evaluated through Black Box Testing and the System Usability Scale (SUS). Testing showed that every system function operated as intended, while the usability evaluation returned an average SUS score of 84.5, placing it in the Excellent (Grade A) category. Overall, the system improves the efficiency of school administration, speeds up the delivery of graduation information, and supports the broader digitalization of educational services.

Keywords: Information System, Student Graduation, Vocational High School, Laravel, Waterfall, Black Box Testing, System Usability Scale.

INTRODUCTION

Progress in information technology has pushed digital transformation into many sectors, education included. Digitalization now extends beyond teaching and learning itself into school administrative services, improving efficiency, accuracy, transparency, and the overall quality of service to every stakeholder involved. Web-based information systems make it possible to manage data in an integrated way, so that administrative processes become faster, more accessible, and less prone to the errors that commonly occur under manual handling [1].

One administrative service that plays a particularly important role in a school setting is the announcement of student graduation results. Graduation marks the final stage of a student's schooling

and is the basis on which they either continue to a higher level of education or enter the workforce. Because of this, graduation information needs to be delivered quickly, accurately, securely, and in a way that every student can access. In practice, however, many vocational high schools (SMK) still announce results through notice boards, printed letters, or in-person delivery at school — approaches that take longer, can create crowding, and make it difficult for students who live outside the area to get timely information [2].

Beyond the announcement itself, distribution of the Graduation Certificate (SKL) is also still largely done the conventional way, with students required to come to the school in person to collect the document. This adds administrative burden as well as transportation costs for students. These conditions point to the need for an information system that can integrate graduation-data management with online delivery of that information to students. Prior work has shown that web-based information systems can indeed raise administrative efficiency, speed up service processes, and simplify data management across a range of educational institutions [3].

Observations at SMK Al Maksum Stabat found that graduation-data management is still handled centrally by administrators and that there is no system in place yet to deliver this information to students online. Student data and graduation status still go through a fairly long administrative process before students receive the information, and students must still come to the school to obtain their SKL. As a result, administrative service becomes less effective, particularly when the number of students being served is large.

Setiawan and Maulana implemented a web-based report-card management and archiving information system using Laravel and the Waterfall method. Their results showed the system improved the efficiency of grade-archive management, made academic data easier to search, and supported school administration more effectively overall. That work, however, focused on report-card archiving and did not address a student graduation information system [4].

The Waterfall method was chosen here because it offers a systematic, sequential set of development stages — requirements analysis, system design, implementation, testing, and maintenance — well suited to a system whose functional requirements can be defined up front, so that each stage can proceed in a structured, well-documented way. Studies on vocational-school information systems support this choice: Irwanto, for instance, applied a Research and Development approach with the Waterfall model to build a school information system at SMK PGRI 1 Kota Serang, evaluating it through both media-expert validation and end-user testing, and reported that both groups rated the system highly feasible, with average scores of 72.5 and 71.96 respectively [5]. Findings such as these indicate that Waterfall remains an effective, well-documented approach for developing web-based school information systems, particularly at the vocational-education level.

The Laravel framework was selected as the development platform because it follows the Model–View–Controller (MVC) architecture, offers solid security features, supports database management through Object Relational Mapping (ORM), and provides a more structured, easier-to-maintain approach to application development. Laravel has already been widely used in academic and educational-administration information systems, with results pointing to improved data-management efficiency and service quality [6].

Building on this background, the present study set out to develop a Web-Based Student Graduation Information System for Vocational High Schools Using the Waterfall Method, one that can help administrators manage graduation data centrally while making it easier for students to obtain their graduation information and download their SKL online. The resulting system is intended to

make school administrative services more effective, speed up information delivery, and support the digital transformation of the education sector [7].

A graduation information system is useful to a school for delivering graduation information to students, and it helps make that delivery faster and more efficient. One reported system, however, ran into errors Framework **Laravel** dipilih sebagai platform pengembangan karena menerapkan arsitektur *Model-View-Controller* (MVC), memiliki fitur keamanan yang baik, mendukung pengelolaan basis data melalui *Object Relational Mapping* (ORM), serta menyediakan mekanisme pengembangan aplikasi when several students checked their graduation status at the same time, which slowed down the information reaching students [8].

Romadhoni et al. designed a web-based new-student registration information system using **Laravel Filament** under the Waterfall model, developed through requirements analysis, design, implementation, testing, and maintenance. Black Box Testing showed every application function worked as required, reducing data-entry errors and improving the efficiency of the administrative process. That study, however, only covered new-student admissions and did not extend to academic administrative services after enrollment [9].

Agstringtyas et al. developed a web-based New Student Admission System (SPMB) using the **Laravel framework** and the Waterfall method, offering online registration, document upload, digital verification, and management of prospective-student data. Their results showed the system improved administrative efficiency, made the selection process more transparent, and reduced data-entry errors. That work, however, focused solely on new-student admissions and did not address graduation announcements or SKL distribution.

Mentari and Haris developed a school profile website using the **Laravel framework** under the Waterfall model, designed to spread school information to the public through digital media. Testing via Black Box Testing and Usability Testing showed the application worked well and was easy to use. That study, however, was oriented purely toward disseminating general school information and did not cover academic administrative services such as graduation announcements [10].

Closer to the present topic, Rizky designed a web-based graduation-announcement system for SMK Negeri 2 Demak, letting students view their results online instead of through a physical notice board [11]. That work, however, was limited to displaying graduation status; it did not extend to integrated management of student and grade data, nor did it provide a facility for downloading the Graduation Certificate (SKL) — both of which the present system incorporates.

RESEARCH METHODOLOGY

4 Research Method

This study used a Research and Development approach with a software-development orientation. Its main goal was to produce a web-based student graduation information system for vocational high schools that helps the school manage graduation data while making it easier for students to obtain their graduation information online.

The software-development method used was Waterfall, one of the sequential development models that moves through requirements analysis, system design, implementation, testing, and maintenance in order. This model was chosen because the system's requirements could already be identified from the outset and because the development process called for structured documentation. Waterfall belongs to the family of **Software Development Life Cycle (SDLC)** methods and is a commonly used

approach based on a sequential analysis–design–coding–testing–support flow [12]. A description of the Waterfall method is given below.

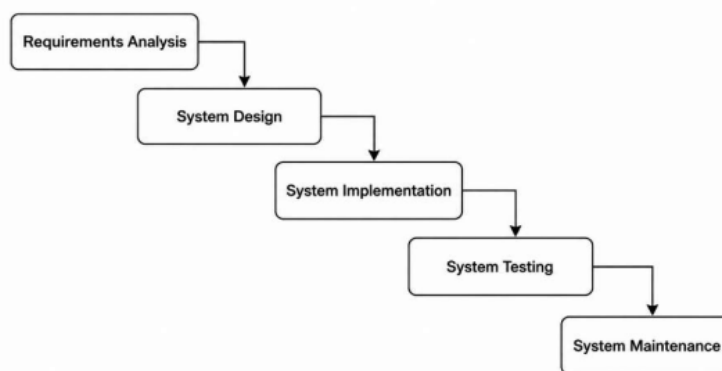


Figure 1. Stages of the Waterfall Method

System Development Stages

1. Requirements Analysis

The requirements-analysis stage identified the problems and user needs relevant to the graduation information system. Requirements were gathered through direct observation of the graduation-administration process together with interviews with school staff. This analysis identified two main user types in the system.

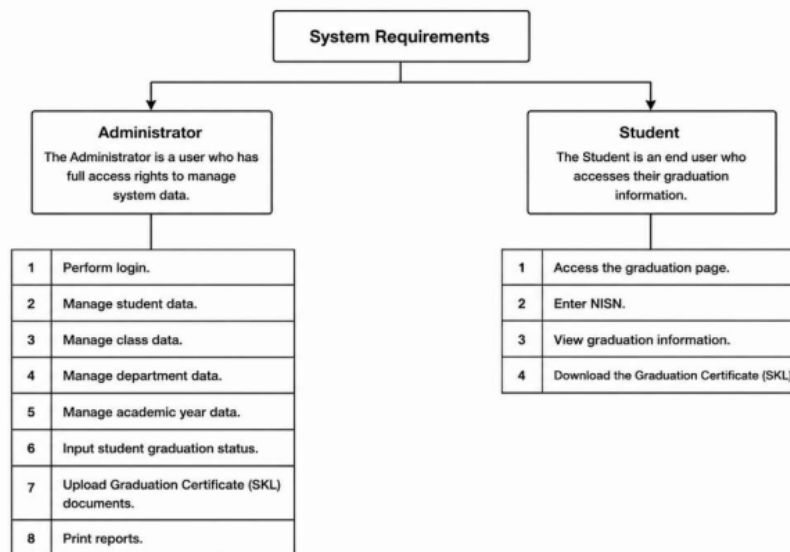


Figure 2. System Requirements Analysis

2. System Design

The design stage built on the requirements analysis and produced a system design using a Unified Modeling Language (UML) approach. The diagrams used included a Use Case Diagram, Activity Diagram, Sequence Diagram, Class Diagram, and Entity Relationship Diagram (ERD).

3. Data-Collection Techniques

Data collection combined observation and interviews. Observation involved directly watching the school's graduation-data process, covering how student records are entered, how graduation status is determined, what obstacles exist in delivering graduation information, and how graduation documents are distributed; the results fed directly into defining the system's requirements. Interviews were held with those involved in graduation administration — the school administrator, the academic operator, and staff who manage student data — to learn about the current system, its administrative problems, the features needed, and what users hoped the new system would offer.

4. Functional Requirements

The system's functional requirements are shown in Table 1.

Table 1. System Functional Requirements

No	User	System Function
1	Admin	Log in to the system
2	Admin	Manage student data
3	Admin	Manage class data
4	Admin	Manage major/program data
5	Admin	Enter graduation status
6	Admin	Upload the Graduation Certificate (SKL)
7	Admin	Print graduation reports
8	Siswa	Enter NISN
9	Siswa	View graduation status
10	Siswa	Download the SKL

5. Non-Functional Requirements

The system's non-functional requirements are shown in Table 2.

Table 2. System Non-Functional Requirements

Component	Specification
Operating System	Windows 10/11
Programming Language	PHP
Framework	Laravel
Database	MySQL
Web Server	Apache
Interface	Bootstrap
Browser	Google Chrome

6. System Testing Method

System testing was carried out to confirm that the finished application met user requirements.

a. Black Box Testing

Black Box Testing was used to check system functions purely by their input and output, without inspecting the underlying code. Testing covered problem identification, data collection, system requirements analysis, system design using UML, implementation with Laravel and MySQL, testing via Black Box Testing and SUS, and finally evaluation and conclusions.

b. System Usability Scale (SUS)

Alongside functional testing, this study used the System Usability Scale (SUS) to gauge how easy the system was to use. SUS consists of 10 questions rated on a 1–5 Likert scale.

Table 3. ⁴Score Interpretation

SUS Score	Category
>80	Excellent
68–80	Good
50–68	Fair
<50	Poor

RESULTS AND DISCUSSION

System Implementation Results

The implementation stage turns the analysis and ²³design work into an application users can actually operate. The Student Graduation Information System was built with the Laravel framework, PHP, and a MySQL database, resulting in a web application reachable by both administrators and students through a browser. It has two user types: administrators, who can manage all graduation-related data, and students, who can view their graduation information by entering their NISN without logging in. Students who have passed can then download their SKL in PDF format.

System Interface Implementation

a. ³Administrator Login Page

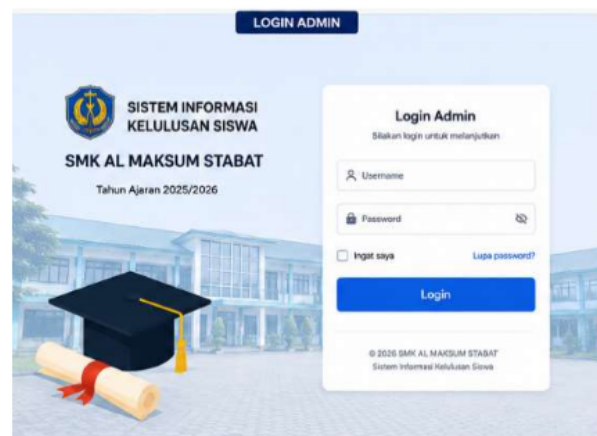


Figure 3. Administrator Login Page

The login page is the authentication gateway administrators must pass through before accessing the system. They enter a registered username and password; correct credentials lead to the dashboard, while incorrect ones trigger an error message.

b. Administrator Dashboard

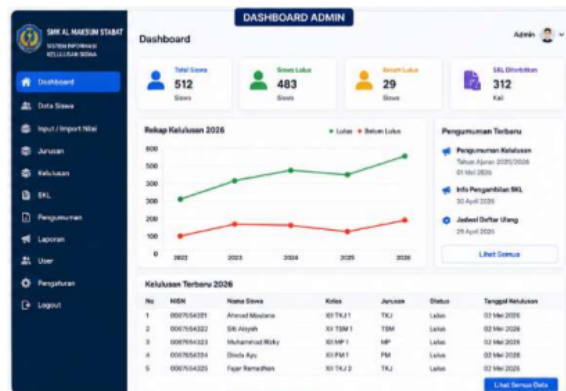


Figure 4. Administrator Dashboard

The administrator dashboard summarizes graduation-related information, showing the number of students, classes, majors, and students who have already been marked as graduated.

c. Student Data Page

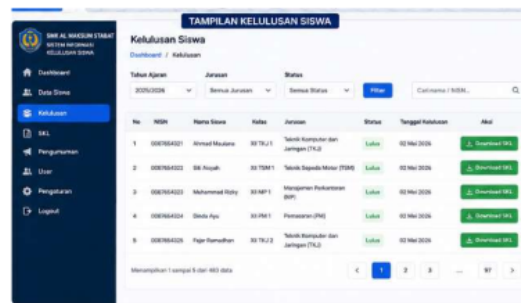


Figure 5. Student Data Page

The student data page is where administrators manage student records — adding new entries, editing or deleting existing ones, and searching by name or NISN.

d. Student Grade Input Page

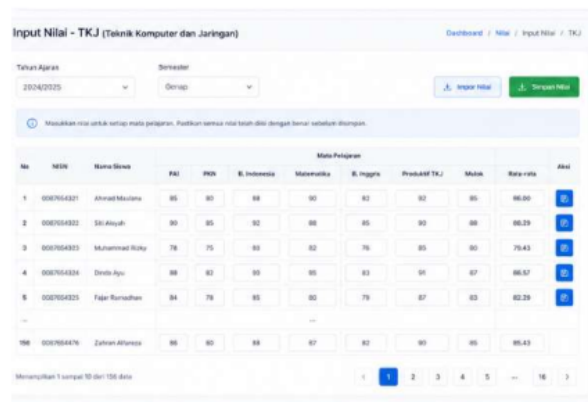


Figure 7. Student Grade Input Page

This page lets administrators manage the student grade data that graduation status is based on, including adding, editing, deleting, and viewing stored grades. Each grade record is linked to a student's identity, keeping data management structured and reducing recording errors.

Administrators enter grades against students already registered in the system. Once saved, the grade data is stored in the database and used as the basis for determining graduation status, making grade management faster, more accurate, and more efficient than manual record-keeping.

e. Graduation Check Page

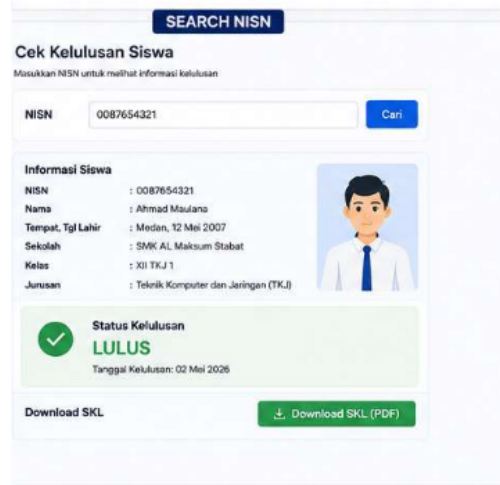


Figure 7. Student Graduation Check Page

The graduation check page is the main page students use. Unlike a typical academic system, students do not need to log in — they simply enter their NISN in a search field, after which the system displays their identity and graduation status.

f. Downloading the Graduation Certificate



Figure 8. SKL Download Menu

The system lets students download their SKL in PDF format, generated automatically from the data administrators have entered. This spares students the need to visit the school in person just to collect their graduation document.

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System Testing**a. Black Box Testing***Table 4. Black Box Testing Results*

Test Scenario	Expected Result	Test Result	Status
Admin login	Dashboard is displayed	Success	Valid
Add student data	Data saved	Success	Valid
Edit student data	Data updated	Success	Valid
Delete student data	Data removed	Success	Valid
Enter graduation data	Status saved	Success	Valid
Upload SKL	File saved	Success	Valid
Search by NISN	Student data displayed	Success	Valid
Download SKL	PDF file downloaded successfully	Success	Valid
Print report	Report printed successfully	Success	Valid

Black Box Testing confirmed that every core function operated in line with the functional requirements set during analysis, covering administrator authentication, student-data management, grade management, graduation-status determination, NISN-based search, SKL download, and report printing.

Every scenario returned a valid status, showing that the system's output matched what was expected in each case, with no functional errors causing process failures during testing. This indicates the implementation meets user needs and is ready to support the school's graduation-administration service.

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b. System Usability Scale (SUS) Testing*Table 5. System Usability Scale (SUS) Testing Results*

Parameter	Value
Number of respondents	50
Average SUS score	84.5
Grade	A
Category	Excellent
Acceptability	Acceptable

Evaluation with the System Usability Scale, based on 50 respondents, produced an average score of 84.5. Under standard SUS interpretation, this falls into the Excellent (Grade A) category with an Acceptable rating, indicating the system is easy to use both in terms of how quickly its features can be learned and how easily tasks can be completed.

This SUS score suggests the interface is well designed, letting users grasp the workflow without special training. The NISN-based graduation-check feature in particular was seen as making it quick and simple for students to get their information. Overall, the system shows a good level of usability and is well suited for use as SMK Al Maksum Stabat's graduation-information service.

c. Analysis of System Implementation

The implementation results show that the graduation information system supports graduation administration more effectively than the manual process it replaces. Student data, grades, graduation status, and SKL documents are all managed within one integrated system, cutting the risk of recording errors and duplicate data. Centralized data management also makes it easier for administrators to update information whenever changes occur.

For students, the system makes it possible to obtain graduation information independently through the NISN-based check page, speeding up information delivery since students no longer need to visit the school in person or wait for a manual announcement. The PDF SKL download feature further supports the digitalization of school administrative services and improves the level of service students receive.

Compared with the work of Halim et al. [8], which focused on web-based delivery of graduation information, this system's advantage lies in integrating student-data management, grades, graduation status, and the SKL document within a single Laravel-based application — an integration that makes it easier for administrators to manage the entire graduation-administration process through one platform.

CONCLUSION

Based on the findings from developing the Web-Based Student Graduation Information System for Vocational High Schools using the Waterfall method, the following conclusions can be drawn.

1. The study successfully developed a web-based Student Graduation Information System using the Laravel framework and a MySQL database, following the Waterfall stages of requirements analysis, system design, implementation, testing, and maintenance. The resulting system supports integrated management of graduation data.
2. The system lets administrators manage student data, class data, major data, academic-year data, student grades, graduation status, and SKL documents centrally. For students, it offers a graduation-check service that requires only a NISN — no login — along with the ability to download the SKL in PDF format.
3. Black Box Testing showed that all of the system's core functions — administrator authentication, data management, NISN-based graduation search, and SKL download — worked in line with the defined functional requirements.
4. A usability evaluation using the System Usability Scale with 50 respondents produced an average score of 84.5, in the Excellent (Grade A) category, indicating the system is easy to use, easy for users to understand, and well suited to serve as SMK Al Maksud Stabat's graduation-information service.
5. Implementing the system has had a positive effect on school administration by speeding up the delivery of graduation information, improving the efficiency of data management, reducing reliance on physical documents, and supporting the digital transformation of educational administrative services.

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