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METEOR STIP MARUNDA

ISSN : 1979–4746
EISSN: 2685–4775

SCIENTIFIC RESEARCH
JOURNAL OF THE MARITIME
SCIENCES COLLEGE

Web-Based Information System Modeling Using the *Waterfall* Method in System Data Management (Siakad) at the Jakarta College of Maritime Studies

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***Submitted**: 14/03/2023* ***Revised**: 20/05/2023* ***Accepted**: 12/06/2023* ***Published**: 30/06/2023*

Abstract

The Maritime Academy (STIP) is adapting to the Fourth Industrial Revolution through the implementation of a web-based Academic Information System (SIAKAD). This system replaces the manual approach to managing data on students, faculty, courses, and final grades. STIP serves as an example of a public university that leverages technology to improve the efficiency and accessibility of academic data. The research method used was the waterfall method, which includes the stages of requirements analysis, system design, implementation, testing, and operation and maintenance. The results of the study demonstrate the effectiveness of SIAKAD in managing academic data, providing speed and convenience in accessing information such as class schedules, attendance records, and grades. The use of the waterfall method—combined with use-case-based design, CSS *(Cascading Style Sheets)* and JavaScript interfaces, and the PHP programming language—makes SIAKAD an effective solution for addressing data processing challenges. This system not only simplifies data retrieval for faculty members but also provides easily accessible information for students at STIP.

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Keywords: Academic Information System, *Web-Based, Waterfall* Method, *Use Case Model*

1. INTRODUCTION

The Industry 4.0 initiative launched by the government has spurred several higher education institutions to improve the quality of services and systems within their respective institutions, one of which is the Maritime College.

The Maritime College (STIP) is a public higher education institution that oversees several study programs, including

the Marine Engineering Program, the Nautical Science Program, and the KALK Program. STIP's vision and mission are to become an international-standard maritime education institution that produces professional maritime personnel.

One of the systems in place is the academic thatpreviously was previously managed manually; it now utilizes a web-based Academic Information System (SIAKAD) to facilitate the management of data ranging from students, faculty, courses, class schedules, faculty and student attendance records, to final course grades.

An academic information system is essential because it simplifies the management of academic information for the school—particularly for faculty and students—as it can be accessed online via electronic devices such as smartphones or computers anytime and anywhere (Pakereng, M. I. 2021). This facilitate the management academic data to be more structured and to accelerate the management data and the provision of academic information. Therefore, research on such a system is certainly needed by every perguruan tinggi in Indonesia.

2. METHOD

2.1. Data Description

1. *Waterfall* Method

The waterfall method is a structured information systems method that emphasizes the sequential development of information systems (Steve McConnell, 2004).

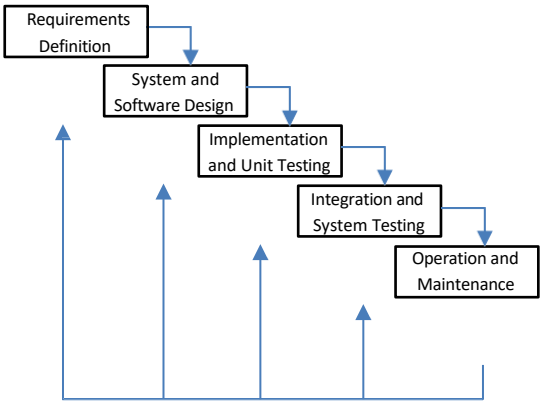


Figure 1. The *Waterfall* Method

The stages of the *waterfall* method based on Figure 1 is as follows:

a. *Requirements definition*

In this phase, we determine and analyze the requirements of a program. Starting with the objectives, features, and other related requirements of the program Detailed data. Data requirements will be determined through interviews and similar methods.

b. *System and Software Design*

As required by this program, both the software and hardware are developed and discussed step by step. In the context of *software* use—such as program development and other tasks—this is extremely important. Hardware specifications are also becoming more advanced to increase the speed of program development.

c. *Implementation and Unit Testing*

Based on the *requirements* obtained earlier, the next step is to develop the program. The program will be divided into several units. Each unit will undergo individual testing to ensure compliance with the established requirements.

d. *Integration and System Testing*

This process involves integrating the units. Then, system testing will be conducted after the programs have been integrated into a single system. Once the units have been integrated, the testing phase will be carried out.

e. *Operation and Maintenance*

In this phase, the program will be deployed for use. To ensure the system runs smoothly, *maintenance* is performed to fix any programs that encounter *errors* or *bugs*.

2. *Requirements*

The development of *the* SIAKAD *software* requires the *web-based software* and hardware listed in Table 1, which includes:

Table 1. *Software* and *hardware* specifications

No.	HARDWARE	SOFTWARE	LANGUAGE PROGRAMMING
1	Intel Processor Core 2 Duo E8400	Windows 10	HTML
2	RAM4GB with	XAMPP PHP version 7.2	CSS
3	500 GB HDD	Visual Studio Code	PHP
4	19-inch LCD Monitor	Google Chrome or Mozilla Firefox	Laravel Framework

3. Features

   There are 8 features in the SIAKAD system, including:

   a. Data User (Admin/ Faculty/Students)
   b. Class Data
   c. Course Data
   d. Class Schedule Data
   e. Study Plan Data
   f. Attendance Data
   g. Grade Data
   h. Course Reports

2.2. Research Period

This research was conducted over a six-month period, from July 2023 to December 2023.

2.3. Research Location

This research was conducted at the Jakarta Maritime Academy (STIP), with the aim of exploring and collecting data. The research was carried out in the Computer Laboratory throughout the research period.

2.4. Research Methodology

Development approaches and methods are systems used to solve problems, starting with problem identification and ending with the fulfillment of requirements. This approach results in a system that involves several activities. When designing a system to be developed, the prototyping method can be used. This method is particularly well-suited for developing systems that will undergo iterative development, beginning with the collection of user requirements, followed by the creation of a rapid prototype, and then re-evaluation.

2.5. Data Collection Techniques

Data collection techniques in the prototyping method typically focus on gathering feedback and evaluations from users involved in the prototype development phase. The prototyping method includes: identifying the needs and objectives of the product or system to be developed; creating a preliminary prototype design, including key features and functionality; building an initial or rough version of the product or system; gathering feedback from users and conducting tests to evaluate the prototype's performance; refining and updating the prototype based on feedback and test results; repeating the process of creation prototyping, evaluation, and refinement to achieve better results; once the prototype has been verified and approved, the final version of the product or system is implemented.

2.6. Data Analysis Techniques

Data analysis techniques may involve analyzing the procedures of the running system. This section systematically describes the activities occurring within an information system that manages user data, class data, course data, class schedule data, study plan data, attendance data, grade data, and course reports.

2.7. Research Flowchart

The attached Research Flowchart illustrates the steps users take when accessing the course forum information system. Users can access the system to search for course information or share additional information through a series of steps described in the flowchart below.

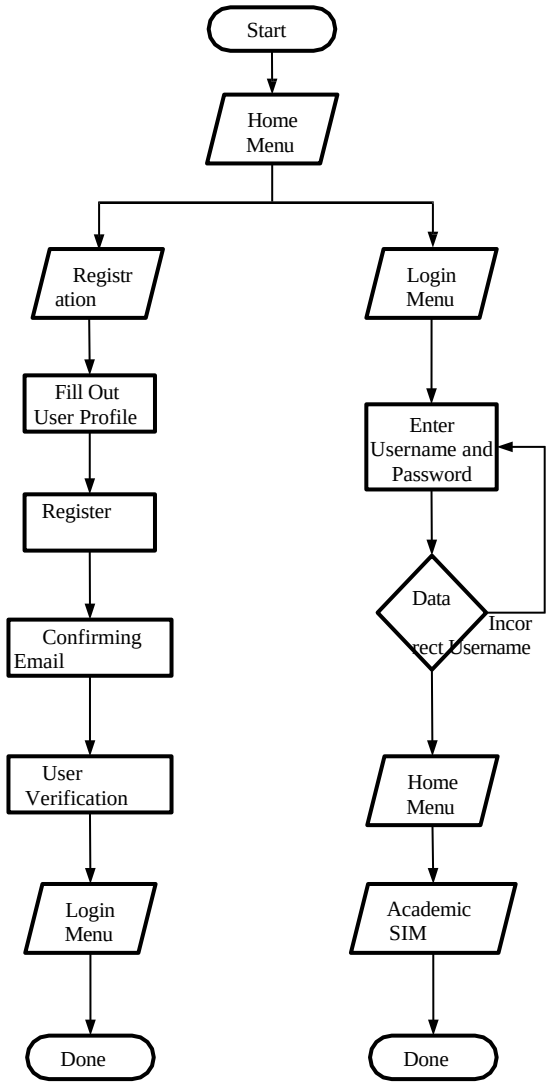


Figure 2. User Information System Access Diagram

3. RESULTS AND DISCUSSION

3.1. System Design

a) Use Case Diagram

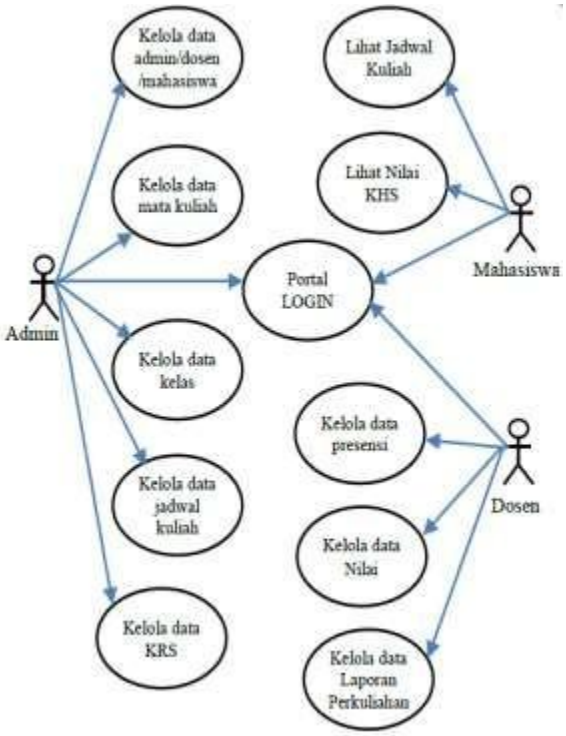


Figure 3. *Use Case Diagram*

To ensure that the modeling meets expectations, this *use case* diagram can be utilized and is highly beneficial. (Sutariyani, Kristono, Mustika I. 2021).

Based on Figure 3, the system requirements in *the use cases* above include:

- Admin

This administrator can log in and is responsible for managing all data in the academic system (SIAKAD), including faculty, student, and class data, as well as course registration (KRS) data, course information, and class schedules.

- Faculty

After logging in to the academic information system (SIAKAD), faculty members can manage student attendance records, student grade data, and course report data.

- Students

Students log in to view their course listings, class schedules, and academic transcripts (KHS). They can print their schedules and grade reports.

b) Entity-Relationship Diagram

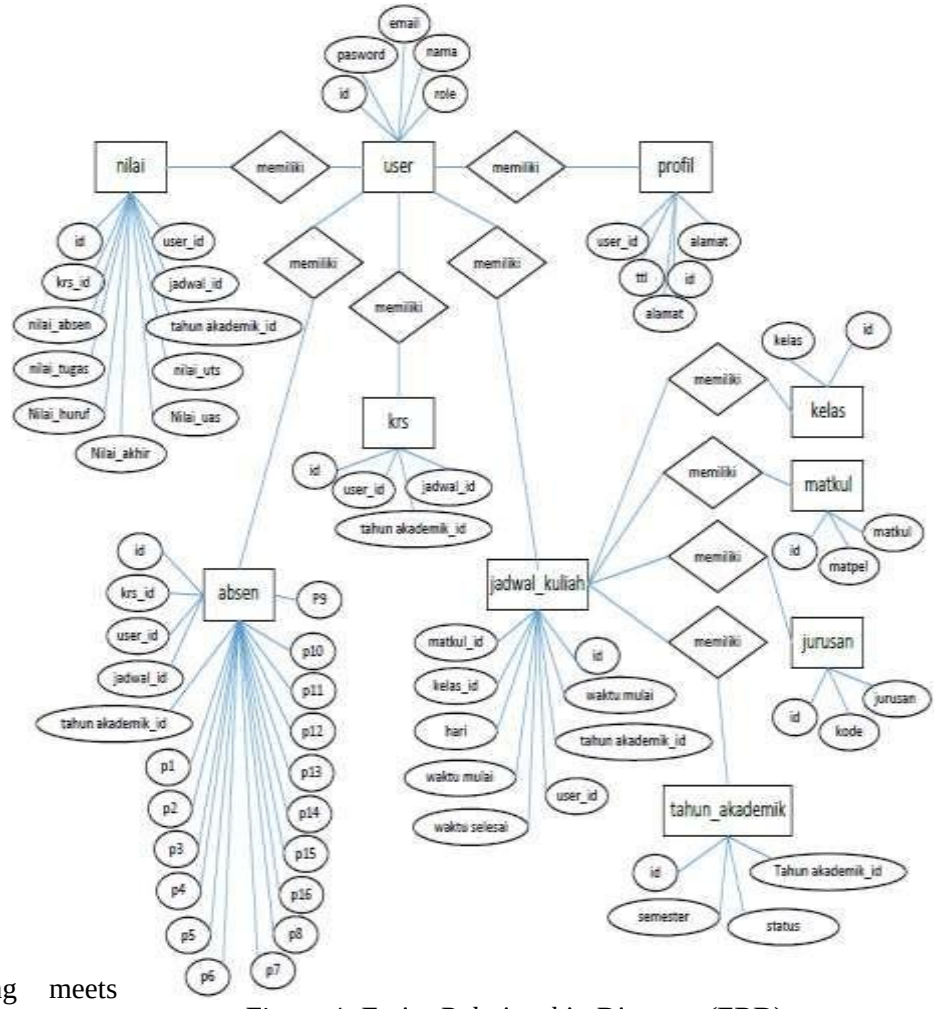


Figure 4. *Entity-Relationship Diagram* (ERD)

An ERD is a model that depicts entities and the relationships between them in an easy-to-read format and serves as a basic modeling tool for databases (Sitorus JH & Yusnaeni W. 2021).

3.2. SIAKAD Application *Interface*

a) *Login* Page

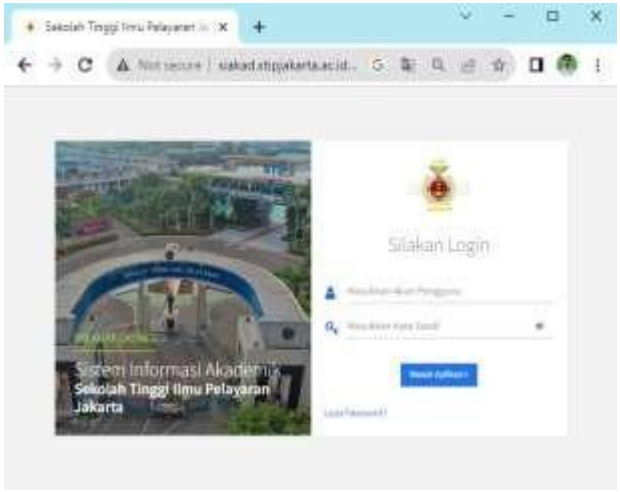


Figure 5. *Login* Page

Figure 5 shows the *login* page. On this page, all *users* can enter their registered username and *password* to proceed to the next step, which is the *dashboard* page.

b) *Dashboard* Page

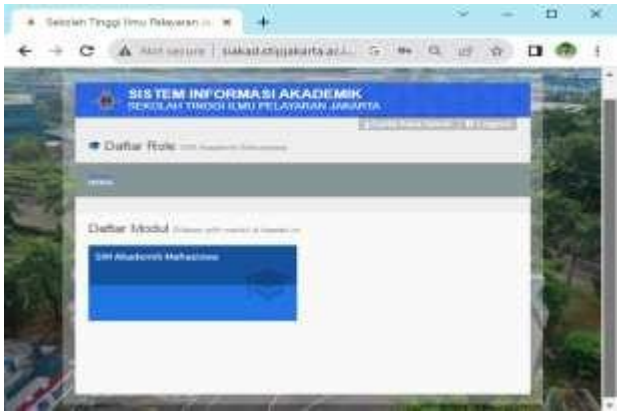


Figure 6. *Dashboard* Page

This page displays the SIAKAD profile for the Maritime Science College, as well as features for enrolling faculty and students and other menus available in the academic information system.

c) *User Data* Page

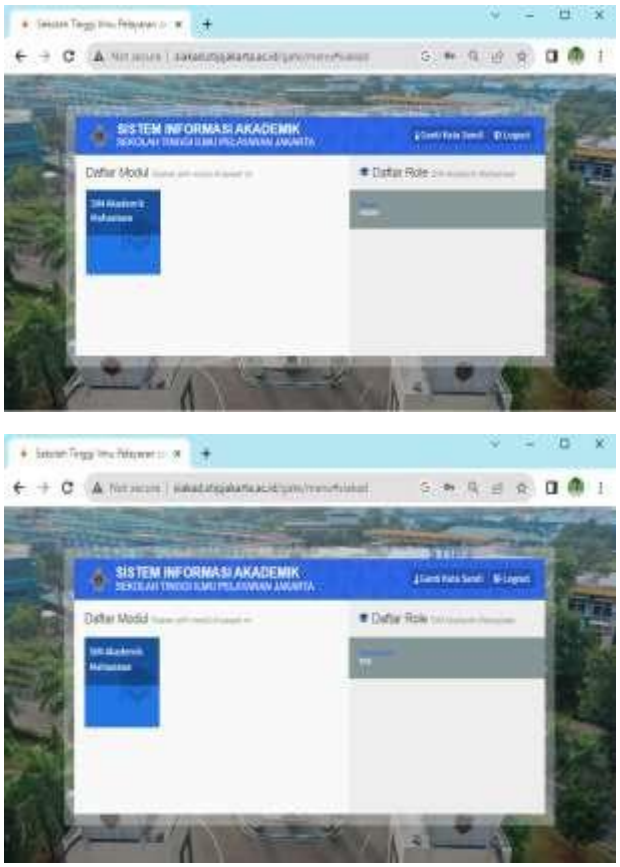


Figure 7. *User Data* Page

This *User Data* page displays *login* information for admins, faculty, or students and includes a feature to change passwords if users wish to do so.

d) Class Schedule Page

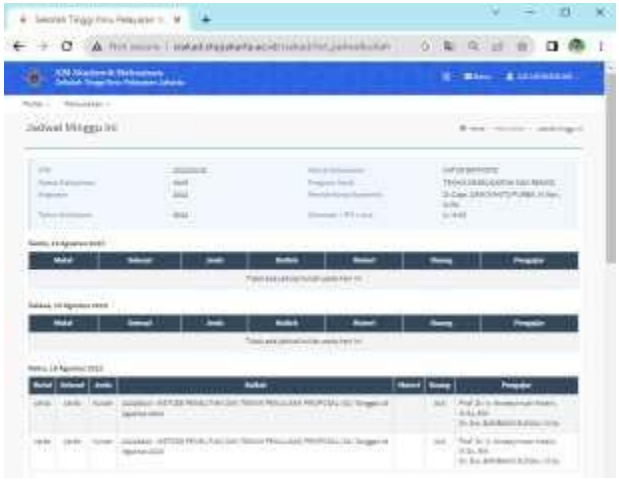


Figure 8. Course Schedule Page

This page displays schedule data for managing the schedules of instructors and students for each class. It is very useful for instructors and students to view their daily class schedules.

e) Study Plan Card (KRS) Page

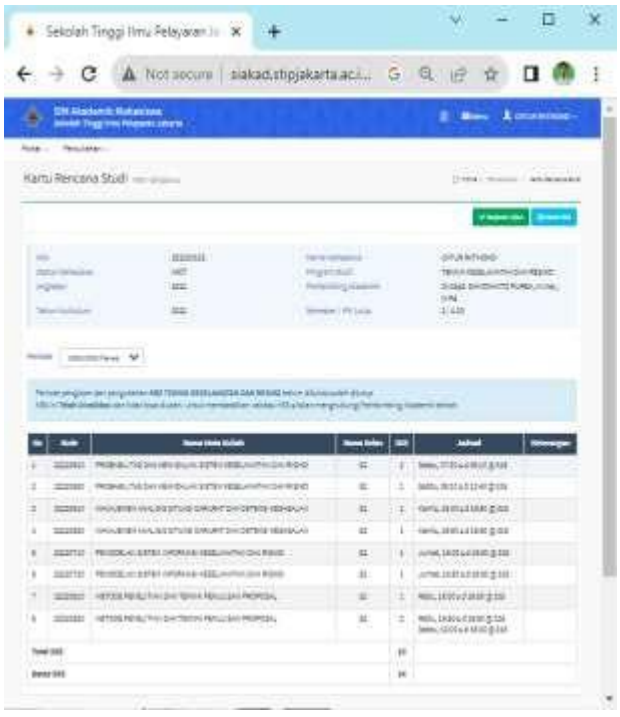


Figure 9. Student KRS Page On , at ,

the page rencana studi shows which courses the student is currently taking

f) Student Attendance Page

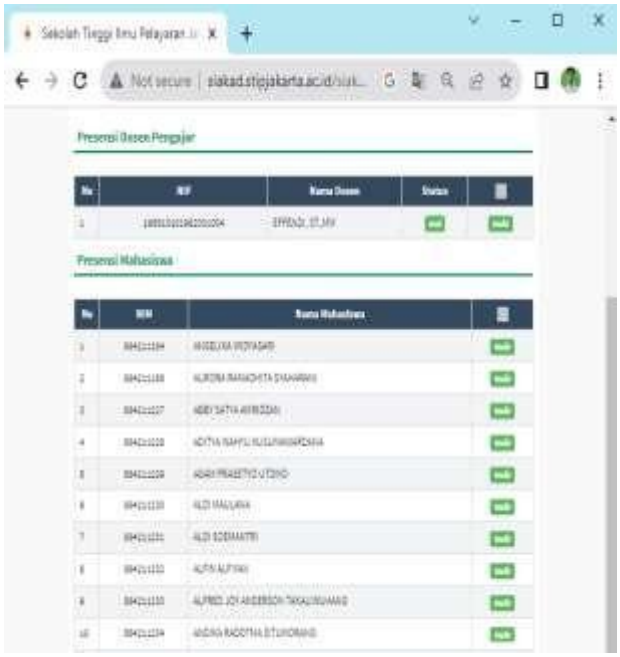


Figure 10. Student Attendance Page at

page attendance students this displays the attendance list for students and instructors. Attendance can be managed by the relevant instructor to determine student attendance.

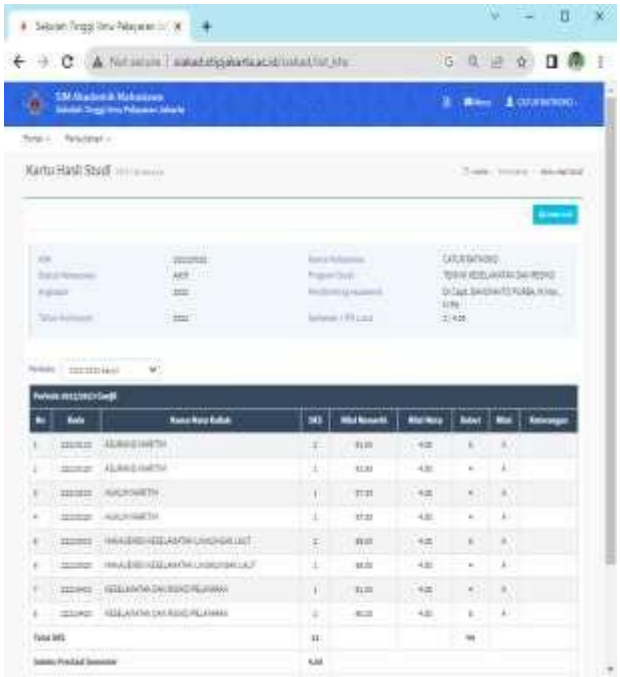


Figure 11. Student Academic Transcript Page

This KHS grade page displays grades and GPA earned by students during both the odd- and even-semester academic periods.

h) Course Report Page



Figure 12. Course Report Page On the Course report page displaying report results lectures per taught by the instructor. These course reports contain the course name, day and date of class, class time, classroom used, planned main topics and actual course material covered, as well as the number of students in attendance at each session, a signature column for the instructor, and an approval column for the program chair. Thus, the course report attachment can serve as evidence for instructors to submit to the BKD Sister database.

3.3. *Black-Box* Testing

Black-box testing is a basic type of testing performed on a system to verify that the system's implemented functions work as intended.

Test Scenarios	Test Cases	Expected Results	Test Results	Conclusion
System Login	Input Email and Password Click "Add	Input system's main menu	Valid	Valid
Add Class Schedule	Data," then enter the class schedule to be the	The class schedule has been successfully added	Valid	Valid
Add the KRS	Click Add data, then enter the KRS data to be Input	KRS has been successfully added	According to	Valid

Fill in Attendance	Click "Fill in Attendance" to record attendance for Students	Attendance has been successfully entered	Valid	Valid
Print Attendance	Click "Print Attendance," then print.	Attendance has been successfully printed.	Correct	Valid
Grades	Click "Print Grades," then enter	Grades have been successfully entered	Correct	Valid
Print Grade	Clickprint Grade	Successfully printed	Valid	Valid
Logout	Click Logout to log out from the system	Log Out fromthe system	Valid	Valid

4. CONCLUSION

The results of *the black-box* testing show that the results align with expectations, and the testing of the system's functionality and external features has been validated. The purpose of this testing is to ensure that the SIAKAD application functions in accordance with the established requirements and delivers the expected results to users. The SIAKAD application can replace the campus academic data management system, which largely still relies on manual academic systems or simply on MS Office. This results in suboptimal performance and a high error rate in data collection due to the large volume of data and a lack of organization. One way to address this challenge is by designing an Academic Information System (SIAKAD). The development of this SIAKAD application aims to simplify academic data management on campus for users, including data on faculty, students, class schedules, attendance, and the generation of final course reports. Furthermore, this Academic Information System—built using the waterfall methodology—will significantly facilitate data access for faculty and users, while also serving as an information channel for students and faculty within the campus community.

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