

Utilization of Unified Modeling Language (UML) in the Design of Academic Information Systems based on the OOAD Method

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Abstrak

Sekolah menengah pertama adalah salah satu organisasi yang proses bisnisnya menyangkut kegiatan pembelajaran yang berada di bawah wewenang kepala sekolah. SMP ABC merupakan sebuah sekolah menengah pertama yang selalu berusaha dalam peningkatan kualitas pendidikan salah satunya yaitu peningkatan layanan akademik. Namun proses penyimpanan dan pengolahan data pada SMP ABC ini masih menggunakan Microsoft excel dan Microsoft word sehingga proses pengelolaan data yang masih konvensional dan memungkinkan banyak sekali kesalahan dalam pengolahan data akademik. Sistem informasi akademik adalah salah satu sistem yang dapat membantu menyelesaikan masalah kesalahan dalam pengolahan data serta membuat proses layanan akademik lebih baik dan efektif. Sehingga SMP ABC juga perlu menerapkan sistem informasi akademik tersebut. Hasil dari penelitian ini adalah membuat analisis dan perancangan sistem informasi akademik dengan metode OOAD menggunakan tools UML (Unified Modelling Language) dengan beberapa diagram antara lain use sequence diagram, case diagram, dan ERD untuk memudahkan dalam pengelolaan data akademik serta meningkatkan efisiensi dan efektifitas sehingga pengelolaan data pada SPM ABC dapat terkomputerisasi dengan baik.

Kata kunci: OOAD, UML, Sistem Informasi Akademik,

Abstract

Junior high school is one of the organizations whose business processes involve teaching and learning activities under the principal's responsibility. SMP ABC is a junior high school that continually strives to improve the quality of education, one of which is its academic services. However, the process of storing and processing data at SMP ABC still uses Microsoft word and Microsoft excel. Hence, the data management process is not good and allows a lot of errors in processing academic data. The academic information system is a system that can help solve the problem of errors in data processing and make the educational service process better and more effective. So SMP ABC also needs to implement an academic information system. The results of this study are to analyze and design educational information systems using the OOAD method using UML (Unified Modeling Language) tools with several diagrams, including use case diagrams, sequence diagrams, and ERD, to facilitate academic data management and improve efficiency and effectiveness so that management data on SPM ABC can be computerized appropriately.

Keywords: Academic Information System, OOAD, UML.

1 Introduction

Information technology is widely used in various fields, such as business, administration, education, government, and others. This technology is intended for the effectiveness and efficiency of work [1]. If technology services are not available, business operations will not run well because the role of technology is very important [2]. In education, the use of information technology at this time is a basic need. Likewise, with data processing carried out at schools [3]. Data processing is not easy, so an application is needed to make work more manageable and the data can be more accurate [4]. Many schools and companies have carried out data management using computers. Data

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management using computers can improve performance in managing data in detail and significantly [5].

SMP ABC, one of the schools that do not yet have an information system, is deemed to need a web-based academic information system to provide convenience, especially in terms of processing student data, starting from entering data, changing data, and displaying data, this information system has facilities for reporting grades and student attendance. SMP ABC still uses manual methods in academic processes such as value processing. One problem that often arises in manual systems is that the assessment process carried out by teachers tends to take a long time. Therefore we need a solution that can optimize performance in value processing by using an academic information system with integrated and centralized data storage using a database.

The information system is also an integrated system capable of providing helpful information for its users and knowledge to support operations and management within an organization [6]. While the academic information system is created to facilitate an activity or educational administration activity in the world of education, both schools and universities, all of which are carried out and regulated online [7]. This academic information system makes it easy for students to continue to monitor and know the value of their learning outcomes. It makes it easy for teachers to fill in grades because it can be done anywhere and anytime [8].

In designing this academic information system, UML will be used. UML is a system design model that can facilitate developers in developing the system to be created because of its object-oriented nature [9]. The diagrams used in this design are use case diagrams, ERD, and sequence diagrams. The method used for this research is the OOAD (Object Oriented Analysis and Design) method, which analyzes and designs systems with an object-oriented approach [10].

The use of UML and the OOAD method is used to solve problems in SMP ABC so that later, students will be able to see information related to grades and attendance quickly without needing to come to school. Besides that, parents can monitor steps and attendance through the website, making it easier for the school to input grades. This kind of academic information system is very much needed in the world of education, especially regarding student academics.

2 Literature Review

Previous research on the analysis and design of information systems using UML has been carried out by several previous researchers, such as that conducted by Taufik Rahman in 2019 with the title "Design of Website-Based Academic Information Systems at SMK Bina Medika Jakarta" in the study said that at SMK Bina Medika previously processed attendance data, searched student data, and other matters related to academics done manually. There was no integrated data storage media. This study purposes to design a web-based academic information system using UML modelling so, which is supposed to make it easier for students, teachers and the Bina Medika Vocational High School (SMK) so that it can be more efficient and effective [11].

The following research is by Miranda Ayu Damayanti and Sudaryanto in 2020 with the title "Web-Based Academic Information System at SMA Negeri 13 Semarang". as well as administrative activities, so it takes a long time, and the results are not appropriate. Therefore, the problem in this study is how to construct a website based school academic information system application to support operational activities at the school. In designing the system, the tool used is the Unified Modeling Language (UML) which consists of use sequence diagrams, case diagrams, class diagrams, and activity diagrams [12].

Rubinius Hutapea, Ibnu Sani Wijaya wrote another research regarding the design of a web-based information system, and Roby Setiawan in 2022 with the title "Designing a Web-Based Academic Information System (Case Study: SMP Nommensen Jambi City)". They were Done conventionally, often resulting in errors in inputting academic data. The author will construct a system that will be made using the waterfall method and UML system modelling. Then the system can generate output that can show admin data, students, classes, teachers, subjects, academic years, grades, lesson schedules, and announcements supposed to make it easier to create reports so that administration and teachers can process academic data efficiently and help students obtain accurate and appropriate information [13].

2.1 Information System

An information system is an artificial system generally consisting of a set of computer-based and manual components designed to collect, store, and manage data and provide users with output information [14].

2.2 Academic Information System

The academic information system is a system that serve information services in the form of data in matters relating to educational data [15]. The theoretical information system carries out academic and administrative processes, learning and teaching transactions between teachers and students. It carries out educational administrative operations, including complete documents and fees for registration activities and daily operational activities of academic administration.

2.3 UML

Unified Modeling Language (UML) is a standard specification language used to document, specify and construct software. UML is a methodology for expanding object-oriented systems and is also a tool to support system development [16]. UML Provides standard notation and diagrams that can be used as a communication tool for developers in system analysis and design. Diagrams in UML are established as information in various forms used or generated in the software development process [17]. Based on the perspective in the object-oriented design and analysis process with UML, there are several principal UML diagrams, namely:

1. Use Case Diagrams. Describe the expected functionality of a system and represent its workflow.
2. Activity Diagram. Analysis of the model used to describe a process or activity.
3. Sequence Diagram, represent the objects that exist in the use case and the messages that run in the use case.
4. Class Diagram, Explain several classes and the relationship between classes in the system.

2.4 OOAD

Object Oriented Analysis and Design (OOAD) method for solving problems using models according to real-world concepts. The guidelines for creating an object are based on a combination of behaviour in an entity and a data structure. The OOAD method uses an object-oriented system modelling standard in the form of the Unified Modeling Language (UML) [18].

3 Research Method

3.1 Observation

Observations were made by going directly to the location of SMP ABC by observing the school now with several references, namely analyzing several archival documents related to the school and observing the processing of student data, teacher data, missing student data, and value data. After that, it continued to conduct interviews related to problems at school regarding data processing and business processes from ongoing academics.

3.2 Planning and Analysis

The planning and analysis stages are carried out to obtain all the needs to support the development of the student's academic system. After going through the process of getting all the essentials to build the system, then identifying the functional requirements modeled at the design and design stages. In planning and design, using UML as a means to model visually and the OOAD (Object Oriented Analysis and Design) method, which is a method for analyzing and designing systems with an object-oriented approach.

3.3 Planning and Design

The design and design stages are carried out using UML (Unified Modeling Language) modeling to visually describe To design and create object-oriented software to convey information for the software development process [19]. To further explain the design of the application that was built, three UML diagram models were used, namely:

- a. Use case

The use case is a diagram that describes the typical interaction between the user of a system and a separate procedure through a story of how a system is used, which consists of actors and interactions [20].

b. Entity Relationship Diagram

An entity Relationship Diagram is a conceptual model specifically designed to identify entities that describe data and relationships between data by writing in cardinality [21].

c. Sequence diagram

Sequence diagrams describe the behavior of objects in the use case by describing the lifetime of the thing and the messages sent and received between objects [22].

3.4 Implementation

This stage starts with writing codes using programming languages to develop an academic information system (website) by showing the website interface that has been created.

4 Results and Analysis

4.1 Observation

Observations have been made through observing school conditions, observing archive documents, observing the processing of student data, teachers, student missing data, and value data, and based on the results of observations, obtained information that all student data and teacher data are stored and archived in documents, not yet stored in a system.

In addition, interviews were conducted with school principals, students, and several teachers regarding the problems that occur in schools regarding data processing and business processes from academics that have been running so far. Based on the results of the interview, it can be concluded that academic business processes are still done manually and not yet systemized.

4.2 Planning and Analysis

In this stage, an analysis of the needs of system users will be carried out based on existing business processes, including : (1) The system requires students to log in by entering their username and password, (2) Students can view subject data, lesson schedule data, activity calendar data, grade data, and attendance data, (3) Admins and teachers have full access rights for adding, changing or deleting all data in the system.

Software used in website creation: Sistem informasi windows 10, Web server xampp v.3.2.3, Web browser (Google Chrome, Internet Explore), Microsoft Visio, Sublime Text, Code igniter. The hardware specifications used in website design are Komputer/Laptop, Prosesor Intel Core i5, RAM 2GB.

The system's primary function consists of functional and system information requirements. Functional requirements are all requirements that must be available in the student academic information system at SMP ABC. Meanwhile, for information needs, the system will describe all information requirements that show the data needed to carry out the functionality of the system.

Table 1. System Functionality Requirements

| No | Function Name | Description |
|----|---------------------|---|
| 1 | Login | All actors (Admin, Teachers, and Students) log in by entering their username and password |
| 2 | Adding Class Data | Admins and teachers can add class data which includes class id, class name, and homeroom teacher |
| 3 | View Class Data | Admin and Teacher can view class data which contains class id, class name, and homeroom teacher |
| 4 | Deleting Class Data | Admin and teacher can delete class data |
| 5 | Updating Class Data | Admin and teacher can edit class data if there is data that you want to change |
| 6 | Adding Student Data | Admin and teacher can add student data which includes NIS, student name, class, class, status, place of birth, date of birth, address, gender, cellphone number |
| 7 | View Student Data | Admin and teacher can view student data containing NIS, student name, class, class, status |

| | | |
|----|-----------------------|--|
| 8 | Deleting Student Data | Admin and teacher can delete student data |
| 9 | Updating Student Data | Admin and teacher can edit student data if there is data that you want to change |
| 10 | Printing Student Data | Admin and teacher can print student data forms |
| 11 | Adding Teacher Data | Admin and teacher can add teacher data which includes NIP, name, subject, position, place of birth, date of birth, address, gender, and cellphone number |
| 12 | View Teacher Data | Admins and teachers can view teacher data containing NIP, name, subject, position, place of birth, date of birth, address, gender, and cellphone number |
| 13 | Deleting Teacher Data | Admin and teacher can delete teacher data |
| 14 | Updating Teacher Data | Admin and teacher can edit teacher data if there is data that you want to change |
| 15 | Add Value Data | Admins and teachers can add value data which includes NIS, name, knowledge value, skill value, and attitude |
| 16 | Viewing Value Data | Admins, teachers, and students can view value data containing subjects, teachers, knowledge scores, skill scores, and attitudes |
| 17 | Deleting Value Data | Admin and teacher can delete value data |
| 18 | Updating Value Data | Admin and teacher can edit the value data if there is data that you want to change |
| 19 | Printing Value Data | Admin and teacher can print the value data form |

In addition to functional needs, non-functional needs include:

1. The system can be run in all browsers
2. The application interface is straightforward to understand
3. Responsive web application on various devices
4. Response time when the application is opened no more than 15 seconds

Identification of actors describes the role of actors in using the system. The following is the identification of actors in the ABC SMP student academic system:

Table 2. Actor Identification and Description

| No | Actor Name | Description |
|----|------------|---|
| 1 | Admin | Actors can add, delete, view, and update data in the system and print student, teacher, and grade data. |
| 2 | Teacher | Actors can add, delete, view, and update data in the system and print student, teacher, and grade data. |
| 3 | Student | Actors who can only view specific data are subject data, lesson schedule data, and attendance data. |

4.3 Planning and Design

a. Usecase

The design and design of the academic system are based on the plans' results and analyses described in the previous discussion. The procedure begins with making a use-case diagram of the educational system. Use cases can show what activities can be done by users or actors in the system. In this study, the use case diagram focuses on the needs of what main functions that need to be developed in the system and who (users or actors) use these functions. The requirements related to the part of the use case itself can be seen in Table 1. Meanwhile, the actors in this system are internal admins, teachers, and students. The description of each of these actors has been described in Table 2. Each actor is mapped according to its function needs in the academic system use case diagram. The use case diagram can be seen in Figure 1.

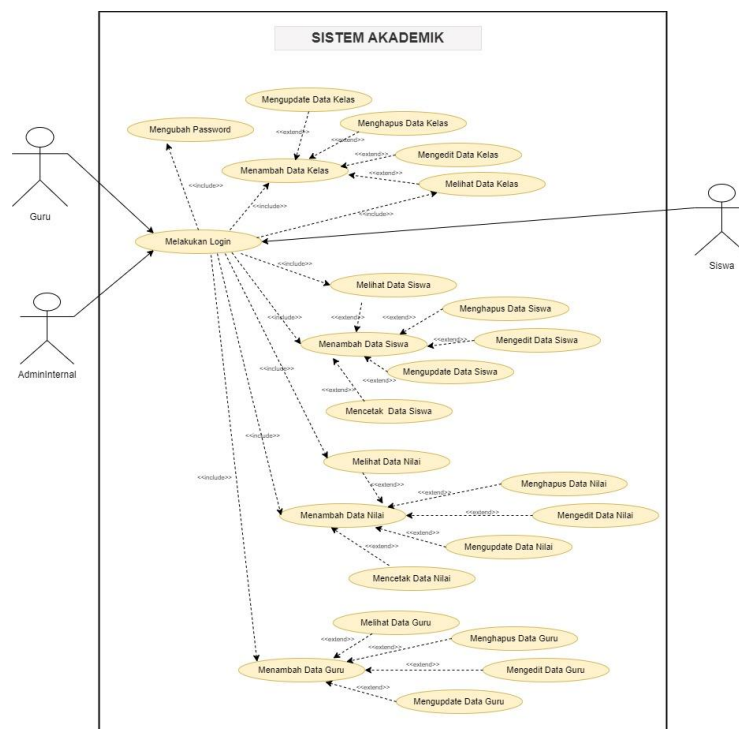


Figure 1. Use Case Diagram

In Figure 1, the use case diagram is made using UML (Unified Modeling Language) modeling. All actors need to log in first before processing data. In the academic system, teachers and internal admins are actors with multiple accesses or roles. At the same time, students can only view student data and student scores and change academic system passwords. Teachers and internal admins have the same function or activity needs in the educational system.

b. Sequence Diagram

After making a use case diagram, the next step is creating a sequence diagram using UML modeling. A sequence diagram is a diagram that is used to describe the execution of a semantic scenario based on a time sequence. In other words, this diagram contains the step-by-step stages that occur in the academic system. The sequence diagram in this study is limited only to the needs of adding value data, updating value data, viewing value data, deleting value data, and printing value data. The sequence diagram can be seen in Figure 2-6.

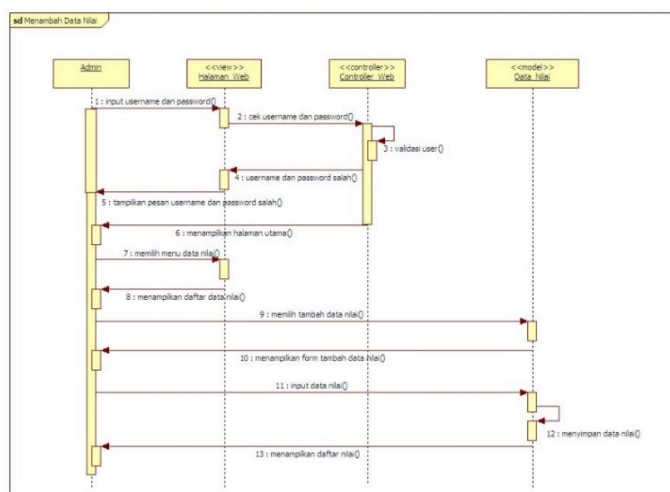


Figure 2. Sequence Diagram of Add Score

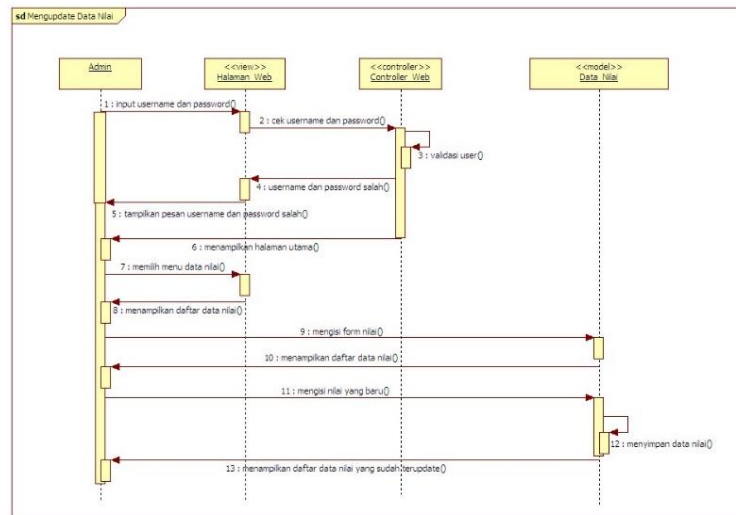


Figure 3. Sequence Diagram of Update Score

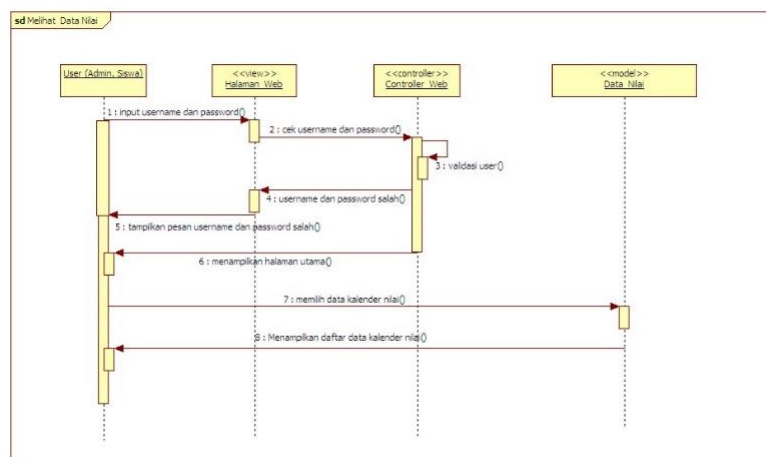


Figure 4. Sequence Diagram of View Data

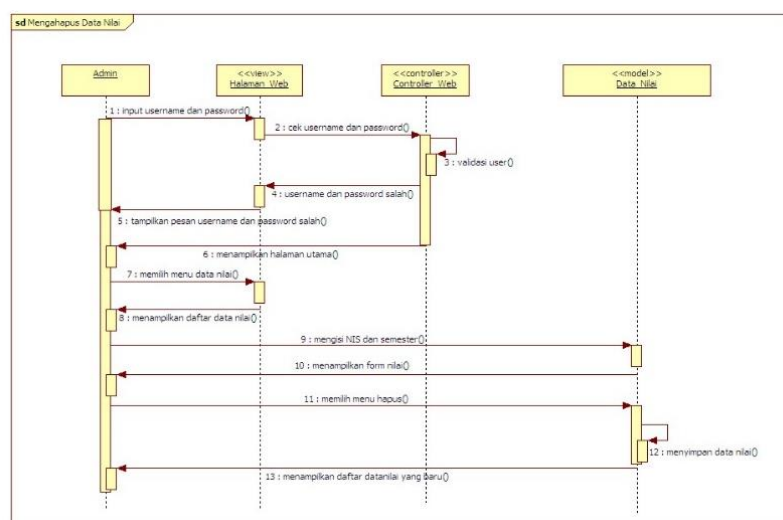


Figure 5. Sequence Diagram of Delete Score

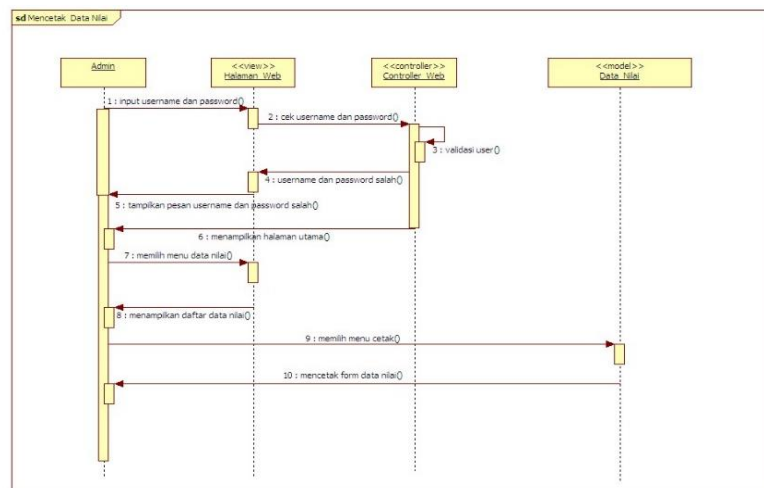


Figure 6. Sequence Diagram of Print Score

c. ERD

ERD design is done to show the relationship between entities in a system. An entity is something in the form of people or data, with information that will be stored, managed, and used by its users. Entities need to be identified and analyzed for their attributes. The academic system design has seven entities, including internal admins, teachers, students, class data, grades data, student data, and teacher data. Each of these entities has attributes, and there is a description of what the entity can carry out activities. Each entity has a relationship with another entity which is indicated by a relationship line. The ERD design can be seen in Figure 7.

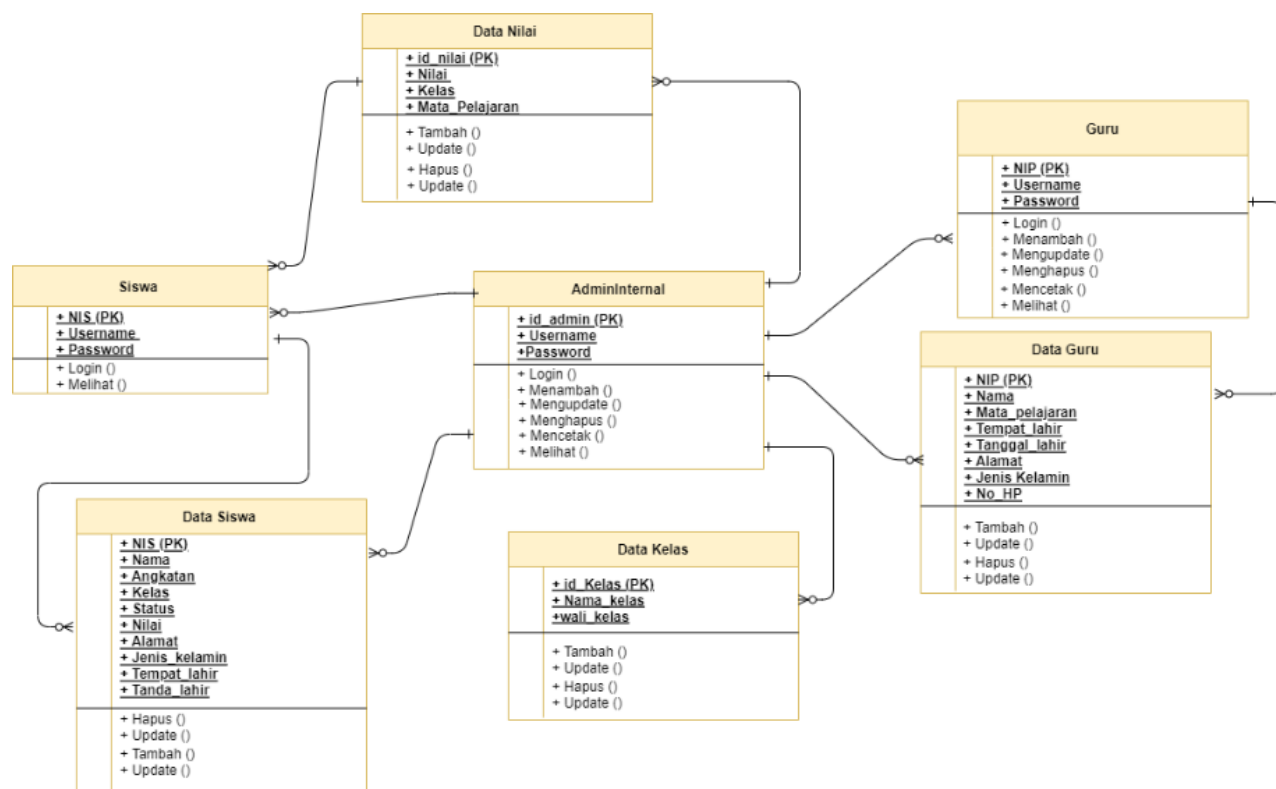


Figure 7. Entity Relation Diagram

4.4 Implementation

This implementation section discusses the design of the academic system's user interface (user interface). The method of the user interface is done by using reference use cases, sequence diagrams, and ERD that have been made. In this study, only a few user interfaces were made, not covering all the functional requirements that have been defined. The user interface created the login page, the add value data page, the value data delete page, the value data change page, and the student score data view. An overview of the user interface can be seen in Figure 8-12.

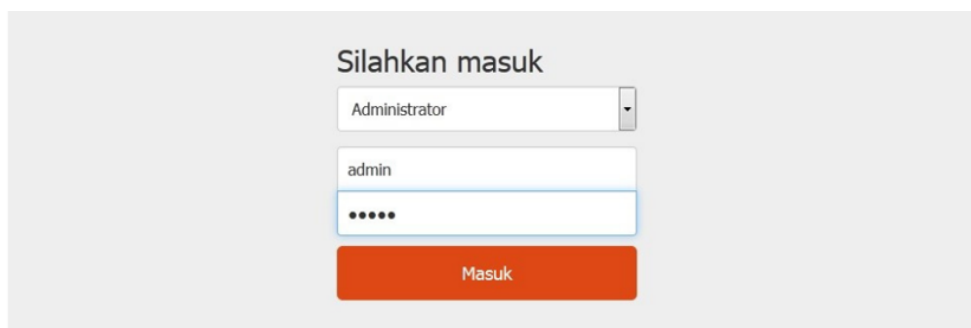


Figure 8. Login Page

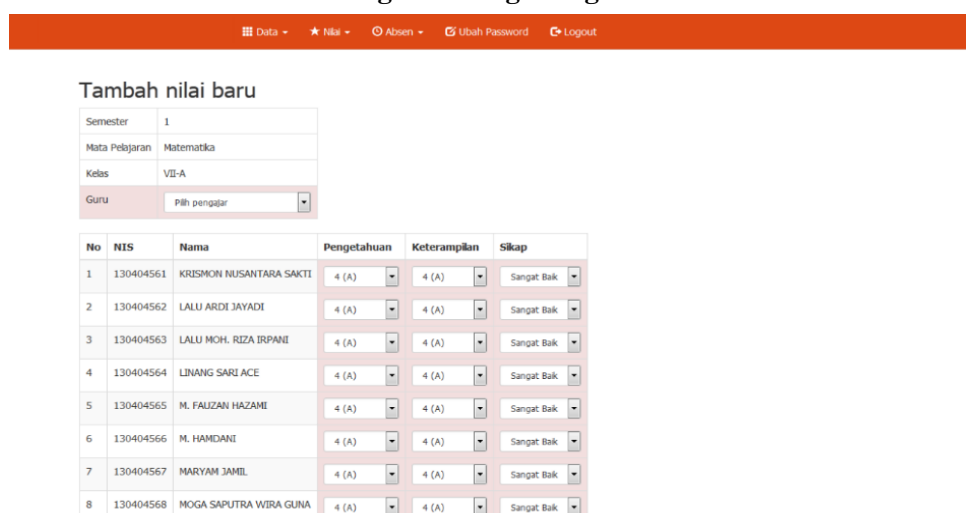


Figure 9. Add Score Page

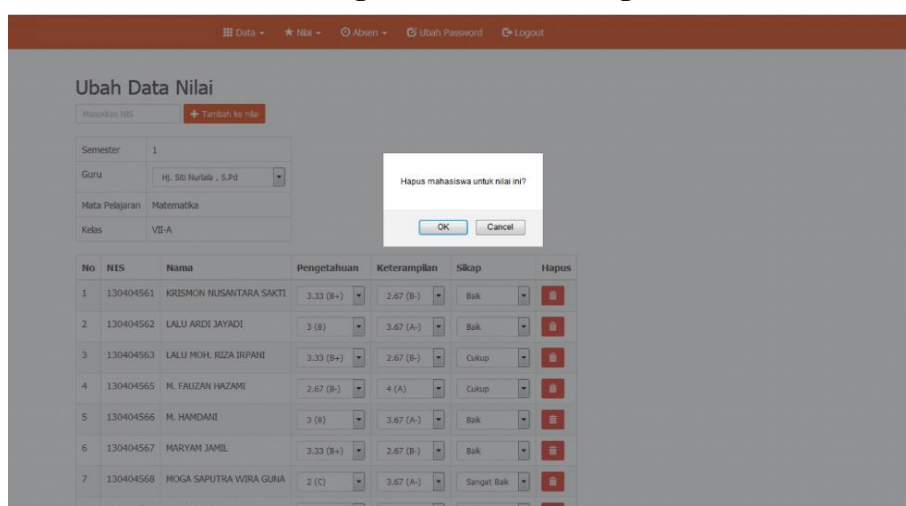


Figure 10. Delete Score Page

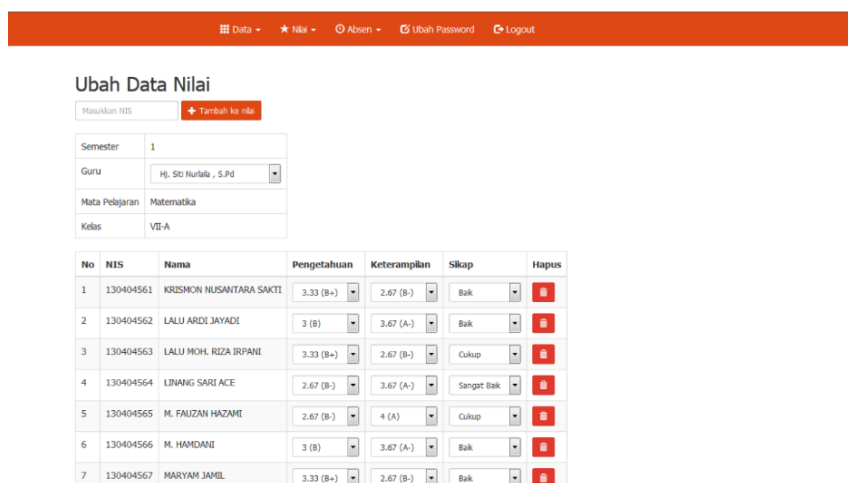


Figure 11. Update Score Page

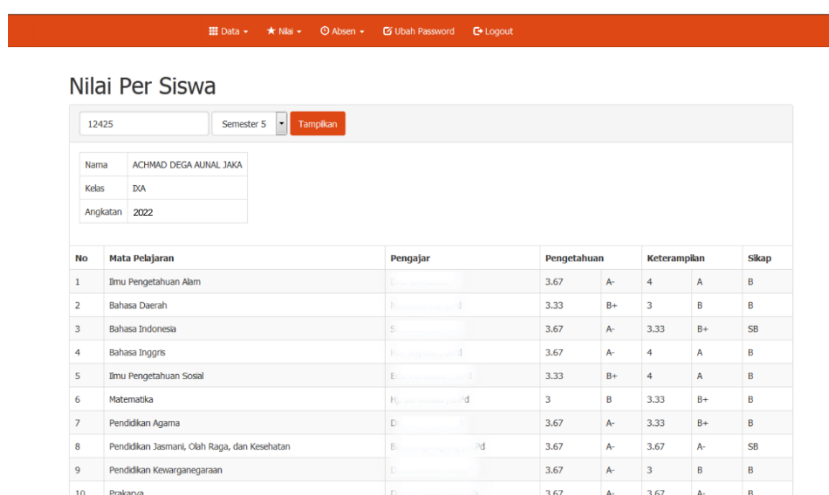


Figure 12. View Score Page

5 Conclusion

The academic system is a system that can support the educational business processes of ABC Junior High School. This academic system can make it easier for teachers to manage data relating to students and schools, such as student data, grade data, and class data. Work and services to students will be more effective and efficient by using the academic system. All data will be stored in a database, where the database is contained in the educational system, which will later be accessible to teachers and students. System integration with the designed database makes the information system more effective, so storing and searching for stored data is not redundant.

In this study, the educational system UML model was designed using the OOAD method tailored to the user's needs. Academic system users are teachers, internal admins, and students. Teachers and internal admins can access the same functions (features), while students can only view student data and student grade data and change passwords. The tasks developed in this study are only limited to the needs of the main functions. UML modeling includes use case diagrams and sequence diagrams. Database design is displayed in the form of an ERD. This research only reached the user interface design stage. Further investigation can validate the user interface design and website development.

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