ADesign and Construction of Interactive Sign Language Learning Media for the Deaf and Hearing Impaired Based on Web at Slb Negeri 2 Padang

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Abstract - **Education is a fundamental right for everyone, including deaf students. For them, sign language is more than just a communication tool—it is the key to understanding lessons and engaging with their surroundings. However, traditional learning methods, such as textbooks and face-to-face instruction, often lack accessibility and effectiveness for students with hearing impairments.This study aims to design and develop an Interactive Web-Based Sign Language Learning Platform for SLB Negeri 2 Padang. The development process follows the Waterfall model, consisting of requirement analysis, system design, implementation, testing, and maintenance. This system facilitates self-directed learning through for students with hearing impairments through interactive features such as sign language videos, quizzes, and an automated evaluation system. Additionally, it provides access for teachers, parents, and school administrators to monitor students' learning progress more effectively.The findings indicate that this web-based interactive learning platform significantly enhances accessibility to sign language education, offering a more engaging and flexible learning experience for students with hearing impairments. This initiative is expected to make the learning process at SLB Negeri 2 Padang more inclusive, innovative, and effective.**

Keywords— Interactive learning media, sign language, deaf students, inclusive education, educational technology

I. INTRODUCTION

Education is a fundamental right for all individuals, including students with disabilities. Among them, those with hearing impairments rely heavily on sign language for communication and learning. Despite ongoing efforts to provide inclusive education, existing teaching methods often present challenges in terms of accessibility and engagement. Traditional approaches, such as printed guidebooks and face-to-face instruction, offer limited flexibility, restricting students' ability to review materials independently. Furthermore, the lack of interactive learning methods can reduce motivation and hinder knowledge retention.

Advancements in information technology have introduced web-based learning as a promising tool to enhance accessibility and effectiveness in education, particularly for students with disabilities. Interactive learning platforms enable the integration of multimedia content such as sign language videos, quizzes, and progress tracking, providing an engaging and flexible learning environment. Teachers can also utilize these platforms to structure lessons more effectively and monitor student progress in real time.

SLB Negeri 2 Padang, one of the special education institutions in Padang City, is committed to providing inclusive education for students with disabilities. Based on data from the 2024–2025 school year study groups, there are 15 deaf students spread across all classes from grade I to grade V. The student data is presented in the following table to provide a clearer picture of the number and distribution of students.

Deaf students at SLB Negeri 2 Padang are accompanied by experienced and dedicated teachers during the learning process. Sign language learning still uses conventional approaches, such as guidebooks and direct classroom teaching. Although this method has advantages in terms of face-to-face interaction between teachers and students, there are several limitations that must be considered. One of them is the limited access to learning materials outside the classroom. Because the learning media is not flexible, students have difficulty repeating the material independently. In addition, students may not be interested in learning if there is no variation in learning methods (Firdaus, Purbaningrum, & Murtadlo, 2021).

Web-based learning has become an effective tool to improve the quality of education, especially for people with disabilities, along with advances in information technology. Interactive learning media allows the use of various features, such as quizzes, instructional videos, and tracking student progress. By using this media, students can access learning materials anytime and anywhere, which increases the flexibility and effectiveness of the learning process. In addition, teachers can use this media as a tool to deliver material in a more interesting and structured way (Learning & Language, 2024).

This study aims to develop an interactive web-based learning platform tailored to the needs of students with hearing impairments at SLB Negeri 2 Padang. The platform is expected to enhance learning accessibility and engagement while serving as a valuable resource for teachers in creating an inclusive and structured learning environment. Additionally, this initiative is anticipated to contribute to the broader landscape of educational technology in Indonesia, particularly in supporting students with disabilities to achieve equitable learning opportunities.

II. LITERATUR REVIEW

A. Instructional Media

Learning media are tools or means used to deliver learning materials to students so that they can more easily understand and master the material being taught. Learning media can be in the form of physical tools, technology, or digital platforms designed to support interactions between teachers and students during the learning process. The use of appropriate learning media not only makes it easier to deliver information but can also increase students' interest and motivation in learning (Aryani, Patmawati, & Santika, 2023).

B. Sign language

Sign language is a visual communication system used by deaf people to convey information, interact, and express themselves. This language relies on hand gestures, facial expressions, and body language as the main means of communication. According to research, sign language has an important role in supporting the communication needs of deaf people, especially in everyday life and formal education (Aryani et al., 2023).

C. PHP

PHP (Hypertext Preprocessor) is a server-side programming language specifically designed for web application development. PHP is one of the most widely used programming languages due to its simplicity, flexibility, and compatibility with various operating systems such as Windows, Linux, and macOS. PHP works by generating dynamic web pages based on user requests, allowing applications to respond to input in real-time (Sinlae, Maulana, Setiyansyah, & Ihsan, 2024).

D. MySQL

MySQL is one of the most popular and widely used open-source DBMS worldwide, especially for web applications. MySQL is known for its high performance, reliability, and ease of use, making it the first choice for many web developers. MySQL supports a wide range of applications, from small websites to complex enterprise applications.

III. METHODS

A. System Design Method

The Waterfall method is one of the most traditional and widely used software development models. This method is linear and sequential, where each stage in software development must be completed before the next stage begins. This method follows a waterfall-like flow, where the process flows down from one phase to the next without any iteration back to the previous phase.
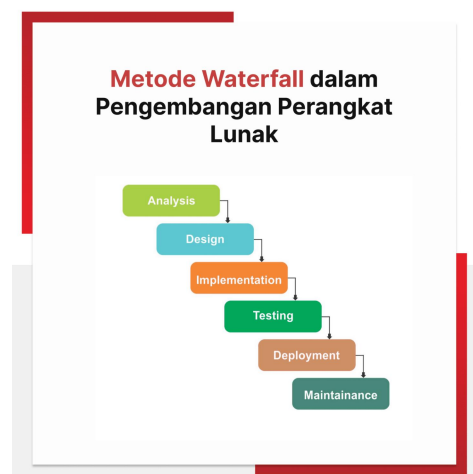

Figure 1. Waterfall Method

1) Analysis: The first stage is to collect and analyze user needs to ensure that the system developed meets the expectations and needs of end users, in this case deaf students.

2) System Design: After the needs are identified, system design is carried out to create an architecture that supports the required functionality. This includes the design of the user interface, database structure, and navigation flow within the website.

3) Implementation: At this stage, the agreed design is implemented into program code using a programming language such as PHP. All planned features are implemented in the source code.

4) Testing: After the implementation is complete, the system is tested to ensure that all functions work as expected. Testing includes unit, integration, and system testing.

5) Implementation and Maintenance: After passing the test, the system is implemented and started to be used by users. The maintenance stage includes bug fixes and system improvements based on user feedback.

B. UML (Unified Modeling Language)

1) Context Diagram: Context Diagram is a diagram that includes a process and shows the scope of the system. The image below is a Context Diagram of a web-based interactive sign language learning media application with external entities involved, namely (a) Admin; (b) Teacher; (c) Student; (d) Parent; and (e) Principal
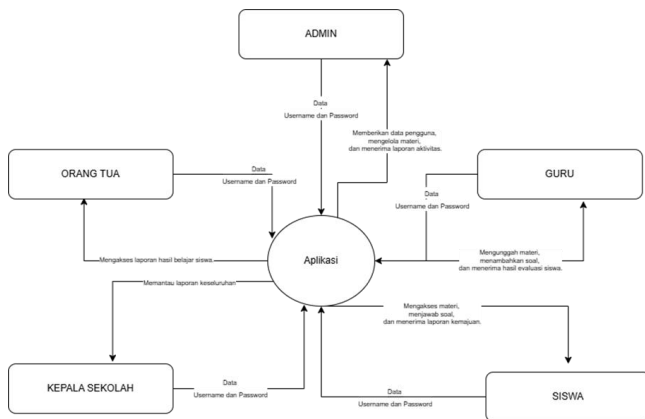
Figure 2. Context Case Diagram

2) Use Case Diagram: In system analysis, task case diagrams are important visual tools that illustrate how users or actors interact with a software system (Bustamin, Hamdani, & Hadi, 2023). Task case diagrams help understand and document user requirements and important system functions. The five main components of a web-based sign language learning system are shown in the following Use Case Diagram:
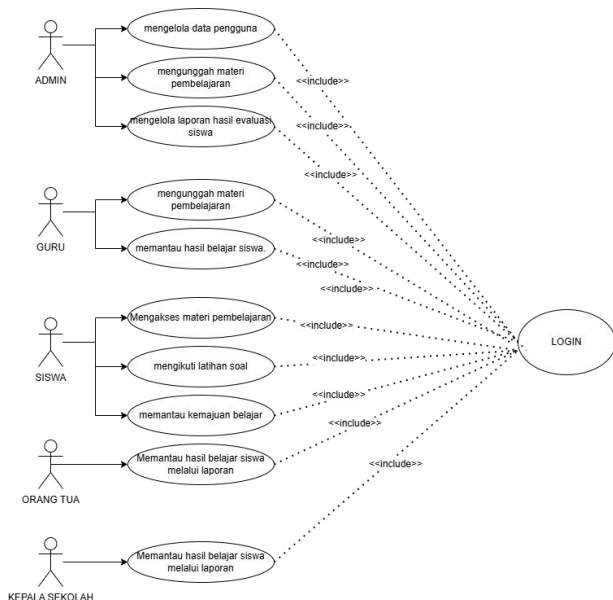

Figure 3. Use case diagram

3) Class Diagram: One of the main components of the Unified Modeling Language (UML) is the Class Diagram, which is used to show the structure of a software system. All classes in the system, including attributes, methods (operations), and relationships between classes, are modeled by this diagram. In the Sign Language Interactive Learning Media system, several main classes play a role, as shown in the class diagram above:
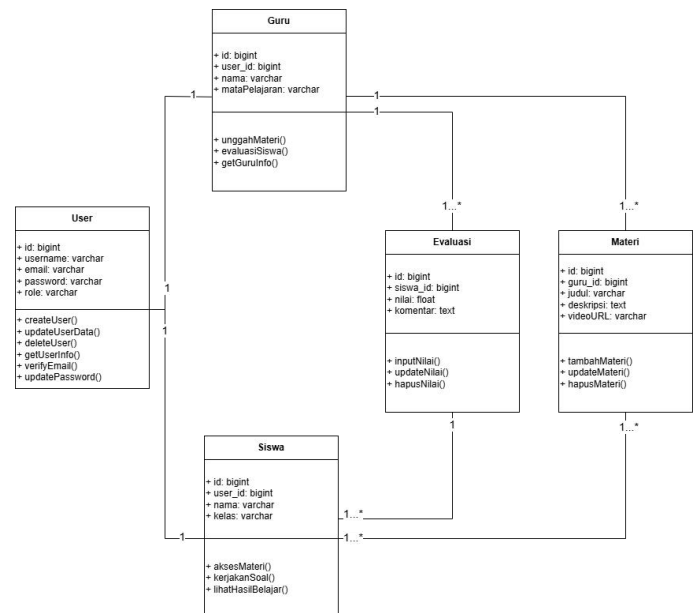
Figure 4. Class Diagram

4) Activity Diagram: One type of Unified Modeling Language (UML) diagram is the Activity Diagram, which is used to model business processes and system operations. This diagram shows the sequence of activities that occur in a process and the relationships between these activities. The following is an activity diagram of the input application.
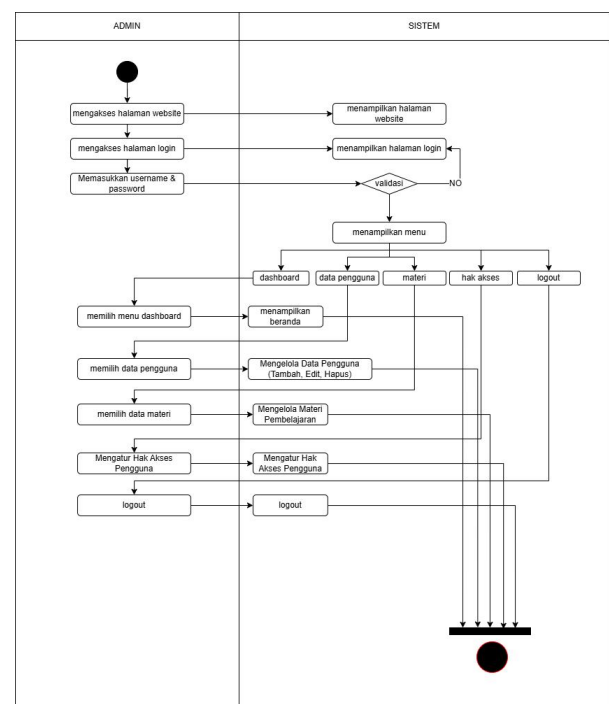

Figure 5. Activity Diagram Admin

Figure 5 shows that the process begins with the login step. The main page of the system will appear after a successful login, which contains the main menu such as Dashboard, User Data, Materials, Access Rights, and Logout. The administrator

has an important role in managing the system, including adding, editing, and deleting user data, as well as managing learning materials that will be used by teachers and students. The administrator is also responsible for setting user access rights so that each role in the system has the appropriate permissions. After all work is completed, the manager can log out to exit the system.
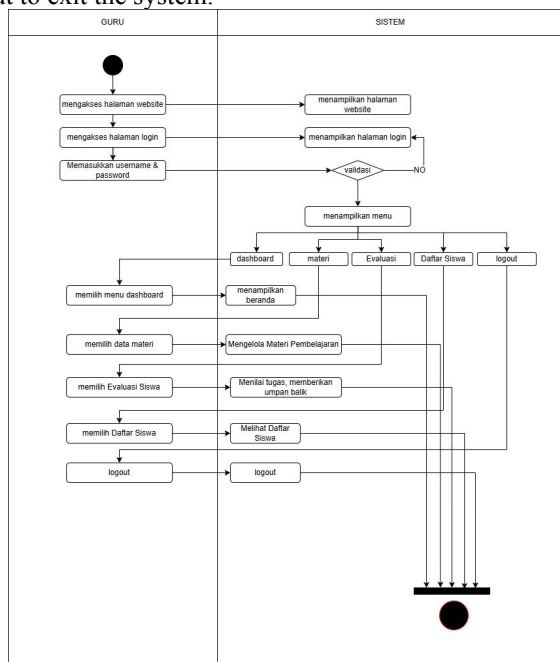

Figure 6. Activity Diagram teacher

In Figure 6 leads to the main page, which displays the main menu such as Dashboard, Material, Evaluation, and Student List, where teachers have the main task in the system, including managing learning materials, where they can add and update teaching materials for students. In addition, teachers can also assess assignments submitted by students and provide feedback to help their academic progress.
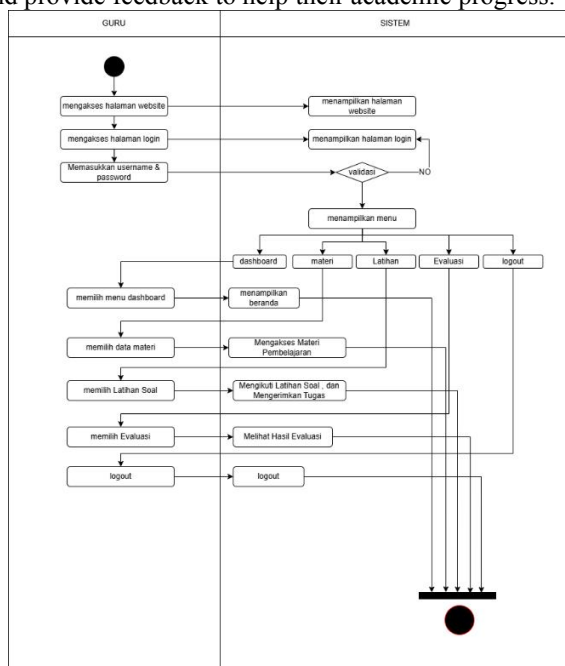
Figure 7. Activity Diagram Siswa

In Figure 7 according to the student diagram activity, after logging in, students will be taken to the main page, which contains the main menus such as Dashboard, Report, Consultation, and Logout. They can use the system to view their learning outcome reports, which show their academic progress and the grades they have obtained. Students also have the opportunity to contact teachers during the consultation session if they encounter problems in learning. Students can exit the system to end the session after completing the assignment.
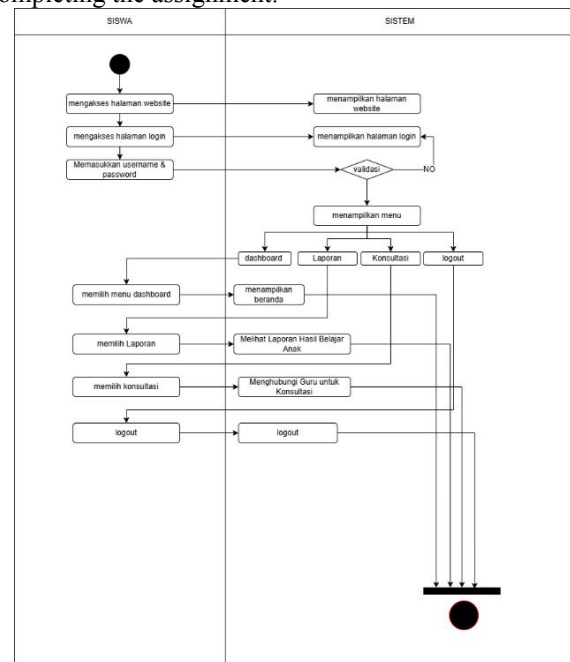

Figure 8. Activity Diagram principal

Figure 8 shows that the principal can access the Dashboard, Report, Report II, and Logout after logging in. The principal has important access to view teacher performance reports, which are used as a tool to evaluate how well teachers are performing. They can also view student progress reports, which show students' academic performance and their level of achievement during the learning process. The principal can choose to log out of the system after all tasks are completed.

IV. RESULT AND DISCUSSION

1) Landing Page

The landing page is the initial page that appears when users access the Learning Media application. This page serves as an introduction with basic information about the platform, as well as navigation buttons to the Login and Registration pages.
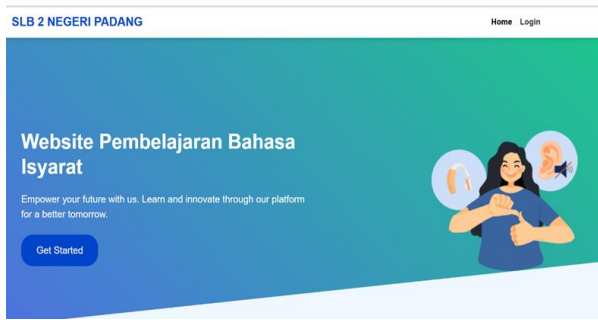
Figure 9. Landing Page

2) Login Page

The login page is a page used to verify users who have access to the system. Users can enter their email and password to log in.
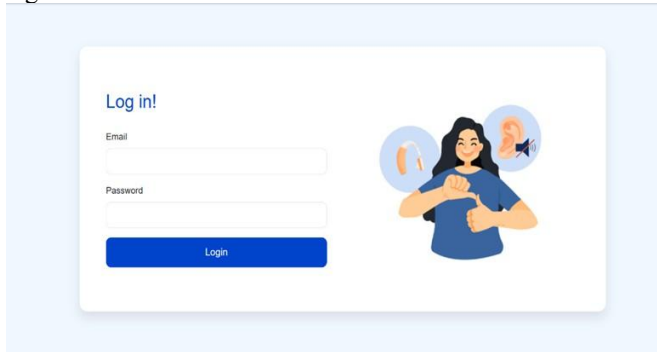

Figure 10. Login Page

3) Admin Dashboard Page

The admin dashboard page is the main page that appears after the admin successfully logs into the system. This page displays statistics on the number of users, the number of materials, and activity reports in the system.
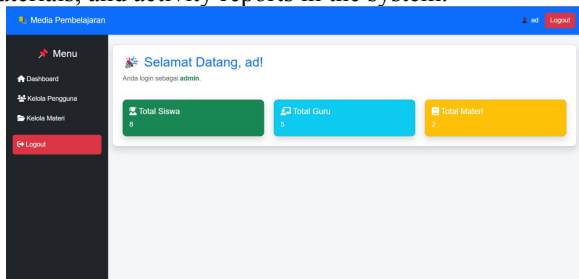

Figure 11. Admin Dashboard Page

4) Admin Manage User Page

The Manage User page is a page that allows the admin to view, add, edit, and delete user data in the system. This page displays a list of users along with information such as name, email, and role in the application.
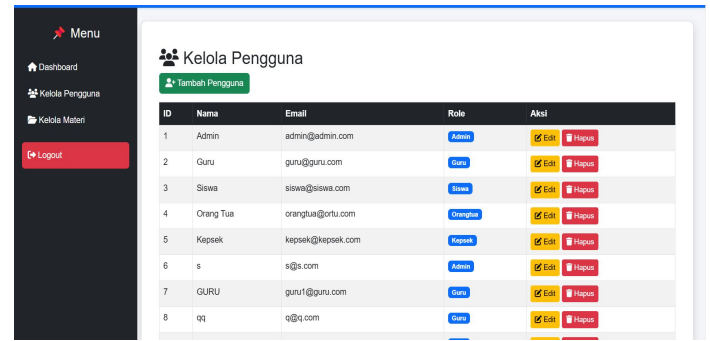

Figure 12. Admin Manage User Page

5) Admin Add User Page

The Add User page allows the admin to add new users to the system. The admin can enter the name, email, password, and select the user's role before saving it to the database.
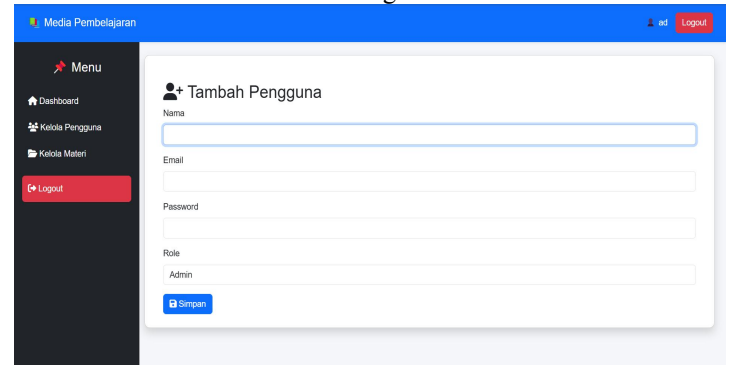

Figure 13. Admin Add User Page

6) Admin Manage Material Page

The Manage Material page allows the admin to view, add, edit, and delete learning materials in the system. This page displays a list of materials along with information such as title, category, and upload date.
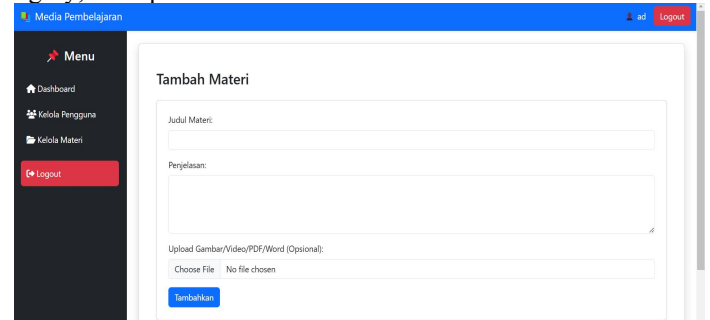

Figure 14. Admin Manage Material Page

7) Teacher Dashboard Page

The Teacher Dashboard page is the main page that appears after the teacher successfully logs into the system. This page displays statistics on the number of students, materials that have been created, and quick access to the material management and student evaluation features
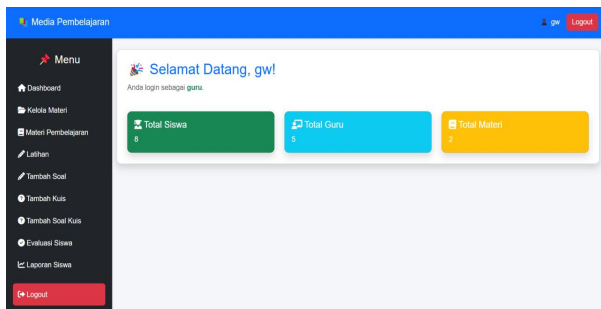
Figure 15. Teacher Dashboard Page

8) Teacher Manage Materials Page

The Manage Teacher Materials page allows teachers to view, add, edit, and delete learning materials that they have created in the system. This page displays a list of materials along with the title, category, and upload date.
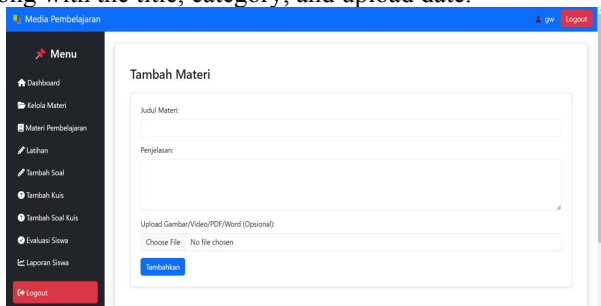

Figure 16. Teacher Manage Materials Page

9) Teacher View Materials Page

The View Teacher Materials page allows teachers to view a list of learning materials available in the system. Teachers can see the title of the material, category, and upload date
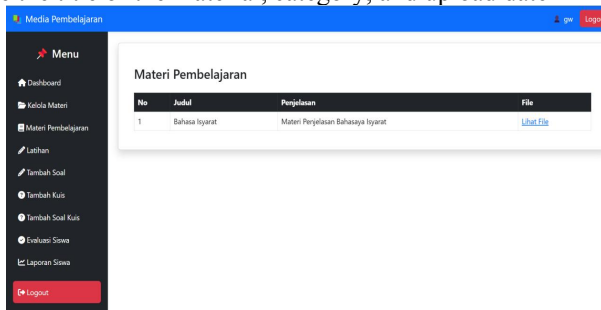

Figure 17. Teacher View Materials Page

10) Teacher Manage Exercises View

The Manage Teacher Exercises view allows teachers to view, add, edit, and delete practice questions that they have created in the system. This page displays a list of exercises along with the title, category, and upload date
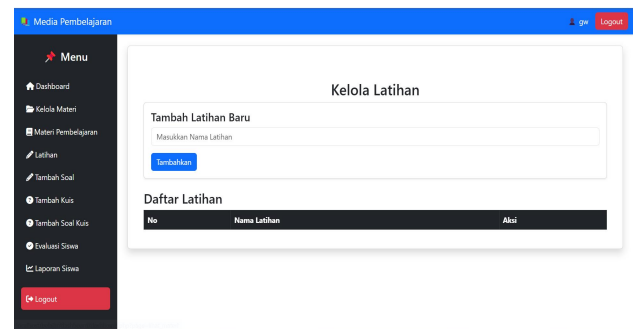

Figure 18. Teacher Manage Exercises View

11) Teacher Manage Add Quiz Page View

This view displays the Add Quiz page allowing teachers to create new quizzes that can be worked on by students. Teachers can enter the quiz title, category, and duration of the work before saving it to the database
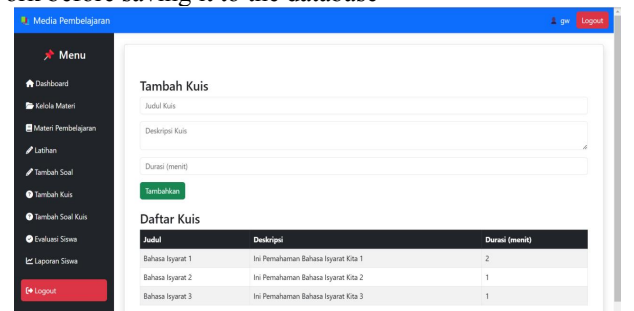

Figure 19. Teacher Manage Add Quiz Page View

12) Teacher View Student Learning Outcome Report

The Student Learning Outcomes Report page allows teachers to see student development based on the results of the quizzes and exercises they have worked on. Teachers can see students' names, grades, and completion dates
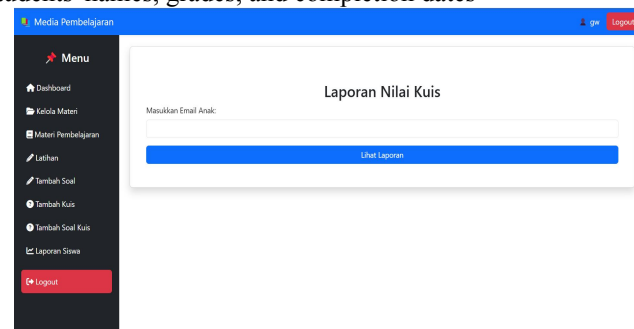

Figure 20. Teacher View Student Learning Outcome Report

13) Student Dashboard Page

The Student Dashboard page is the main page that appears after students successfully log in to the system. This page displays statistics on the number of materials, the number of exercises available, and quick access to learning features
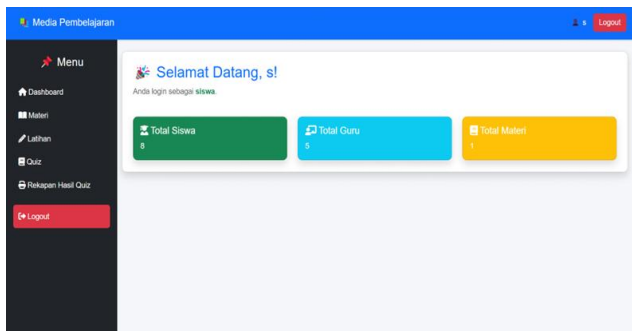
Figure 21. Student Dashboard Page

14) Student Check Material Page

The Student Check Material page allows students to see a list of learning materials available in the system. Students can see the title of the material, category, and upload date, and access the materials directly
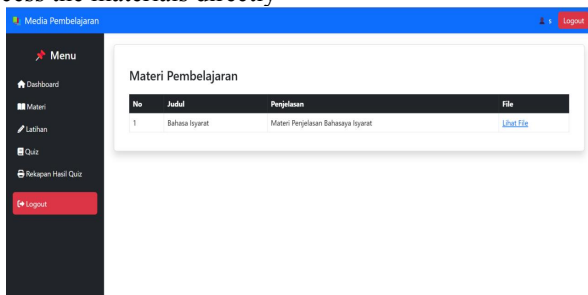

Figure 22. Student Check Material Page

15) Student Doing Exercises Page

The Student Doing Exercises page allows students to access and answer practice questions that have been created by the teacher. Students can select answers and submit their results for review
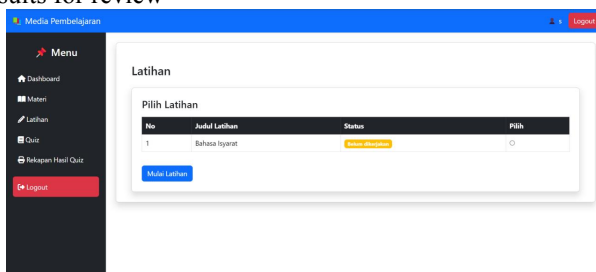

Figure 23. Student Doing Exercises Page

16) Student Doing Quizzes Page

The Student Doing Quizzes page allows students to access and answer quizzes that have been created by the teacher. Students can select answers and submit their results for review
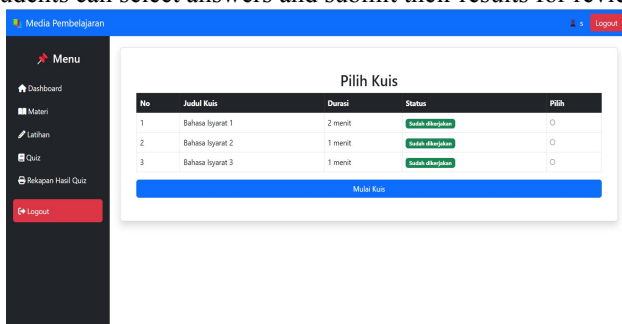

Figure 24. Student Doing Quizzes Page

17) Student Learning Outcome Summary Page

The Student Learning Outcome Summary page allows students to see their learning outcomes based on the scores for the quizzes and exercises that have been completed. This page displays the date of completion, type of exam, and final score
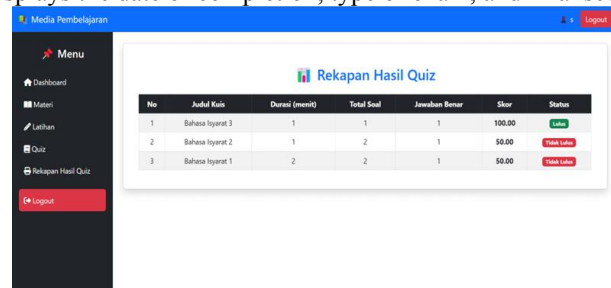

Figure 25. Student Learning Outcome Summary Page

18) Parents View Student Learning Results Page

The Parents View Student Learning Results page allows parents to monitor their child's academic progress based on the results of the quizzes and exercises that have been completed. This page displays the student's name, date of completion, type of exam, and final score
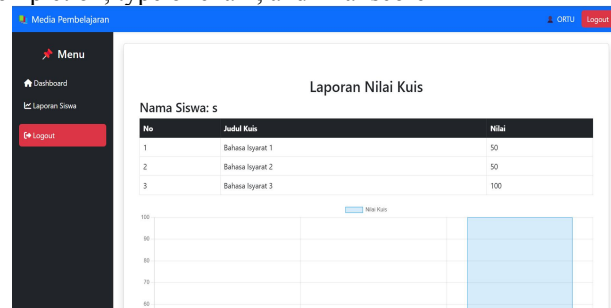

Figure 26. Parents View Student Learning Results Page

19) Principal View All Students Report Results Page

The Principal View All Students Report Results page allows the principal to monitor the academic progress of all students based on the results of the quizzes and exercises that have been completed. This page displays the student's name, class, date of completion, type of exam, and final score
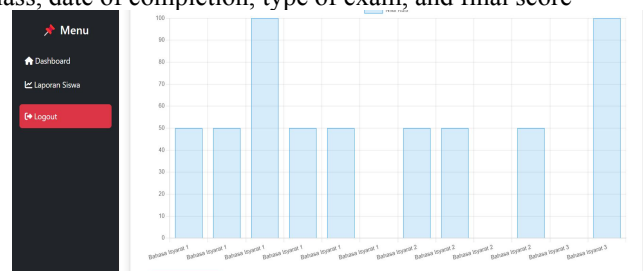
Figure 27. Principal View All Students Report Results Page

V. CONCLUSIONS AND SUGGESTIONS

A. Conclusions

Based on the application design and implementation of the Learning Media Application, the conclusion is that this study has succeeded in producing a Learning Media application that allows users to view lodging data and foreign citizen data at a lodging, making it easier for immigration officers to monitor foreign citizens who are staying. This application has been

enriched with various features such as lodging registration, lodging verification, inputting foreign citizen data, tracking foreign citizens, and reports on foreign citizen movement activities at lodging, as well as a feature to download foreign citizen reports that can be used by immigration officers and lodging officers.

B. Suggestions

The suggestions that can be given for further development are as follows:

1) Development of Additional Features

It is expected that in further development, the system can be improved to be more complex and integrated, with the addition of several additional features such as discussion forums, rating of materials, and direct consultation features between teachers and students.

2) Performance and Security Optimization

In order for the application to run faster and more securely, it is necessary to optimize the code and database, as well as implement data encryption mechanisms and two-factor authentication to improve user security.

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