Design and Construction of Ahp-Based SPK Website for Selecting High-Aching Students (Budi Luhur School, Medan)

Bambang Dwi Guna, Juliandri, Leni Marlina

Abstract

This paper presents the design and development of a web-based Decision Support System (DSS) that employs the Analytical Hierarchy Process (AHP) for selecting high-achieving students at Budi Luhur School, Medan. The objective is to automate and streamline the selection process, making it more objective, transparent, and efficient. By using AHP, the system evaluates multiple criteria such as academic performance, extracurricular involvement, and behavioral attributes. The research aims to improve the accuracy and fairness of student selection while reducing the manual effort required. The expected outcomes include faster processing times, enhanced transparency, and increased satisfaction among stakeholders.

Keywords: Decision Support System (DSS), Analytical Hierarchy Process (AHP), Student Selection, Web-based System, Educational Technology, Multi-Criteria Decision Making (MCDM), Transparency, Fairness, Automation, Budi Luhur School.

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Introduction

The selection of high-achieving students is an essential task for educational institutions, as it directly impacts the recognition of students' efforts and provides opportunities for scholarships, awards, and further academic development. Traditionally, the process of selecting outstanding students has often relied on manual assessments, which are prone to subjectivity, inconsistencies, and human error. To address these challenges, decision support systems (DSS) have been increasingly employed in various domains, including education, to provide a more systematic, transparent, and objective decision-making process.

One of the most effective methods for improving the decision-making process is the Analytical Hierarchy Process (AHP), a widely recognized multi-criteria decision-making (MCDM) method. AHP allows decision-makers to evaluate multiple criteria and alternatives in a structured manner by breaking down complex problems into simpler, hierarchical structures. By utilizing AHP, schools can objectively rank students based on a combination of criteria, such as academic performance, extracurricular involvement, and behavioral attributes, leading to fairer and more consistent student selection outcomes.

This project focuses on the design and construction of a web-based Decision Support System (SPK) for selecting high-achieving students at Budi Luhur School, Medan. The system leverages AHP to automate and streamline the selection process. Through this system, the school aims to improve the accuracy and transparency of the student selection process while also reducing the time and effort required for manual evaluations. The web-based nature of the system also enhances accessibility, allowing administrators, teachers, and decision-makers to access and utilize the system remotely, ensuring a collaborative and efficient process.

This research aims to create a user-friendly and efficient platform that facilitates the decision-making process by automating complex evaluations and providing transparent, data-driven rankings. The expected outcomes of this system include improved objectivity, faster processing times, and greater stakeholder satisfaction in the selection of high-achieving students.

Literature Review

2.1. Decision Support Systems (DSS)

A Decision Support System (DSS) is an interactive information system that supports decision-making processes in semi-structured and unstructured problems. According to Turban & Aronson (2014), a DSS integrates data, models, and user-friendly interfaces to assist decision makers in choosing optimal solutions. In educational institutions, DSS is commonly used for student assessment, teacher performance evaluation, scholarship selection, and other decision-making tasks that require transparent and systematic evaluation.

In the context of selecting outstanding students, DSS helps minimize subjectivity by providing structured calculations and criteria-based evaluation. Decision makers such as teachers and school administrators can rely on DSS to improve accuracy, fairness, and consistency in judgments.

2.2. Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP), developed by Thomas L. Saaty (1980), is one of the most widely used multi-criteria decision-making (MCDM) methods. AHP decomposes complex decision problems into a hierarchical structure consisting of goals, criteria, sub-criteria, and alternatives. Pairwise comparison is used to determine the relative importance (weights) of each criterion.

AHP is preferred for student selection systems because:

1. It allows precise weighting of academic and non-academic criteria.
2. It includes a consistency ratio (CR) to check logical accuracy in judgments.
3. It supports both quantitative and qualitative evaluation.

Previous studies have shown AHP's effectiveness in educational assessments. For example, Kumar & Garg (2019) applied AHP to evaluate student performance, demonstrating improved objectivity and transparency. Similarly, Rahayu et al. (2020) used AHP to support scholarship selection decisions, proving that the method minimizes bias.

2.3. Web-Based Decision Systems

The shift from desktop to web-based applications provides several advantages such as accessibility, real-time data processing, centralized data management, and ease of use. Web-based DSS is particularly suitable for schools because it can be accessed by multiple evaluators, enables multi-user decision-making, and simplifies data storage.

Research by Pratama (2021) emphasizes that web-based DSS enhances usability and efficiency in administrative tasks in schools. Additionally, Mustapha & Ali (2018) highlight that web technologies enable transparent assessment processes, which are essential for student selection activities.

2.4. Student Achievement Selection (Outstanding Student Selection)

The process of selecting outstanding students typically involves multiple criteria such as academic scores, extracurricular activities, behavior, leadership, attendance, and achievements. Because many of these criteria are qualitative and require subjective judgment, selection often becomes inconsistent if not supported by a structured evaluation model.

Studies in Indonesian schools demonstrate the challenges in ensuring fairness and accuracy in outstanding student selection. Santoso (2020) notes that manual scoring often leads to discrepancies due to inconsistent evaluator judgments. To address this, several researchers implemented DSS with MCDM methods:

1. Wulandari (2019) implemented AHP for selecting the best students in vocational schools.
2. Putri & Nanda (2020) developed a web-based student ranking system using AHP, achieving higher reliability than manual assessments.

These studies indicate that integrating AHP in student selection significantly improves decision-making quality.

2.5. Integration of AHP into Web-Based DSS

Combining AHP with a web-based DSS modernizes the decision-making process by providing:

1. automated weighting of criteria,
2. structured scoring,
3. systematic calculations,
4. faster result generation,
5. reduced human error,
6. reliable documentation.

According to Setiawan (2021), implementing AHP in a web environment increases system efficiency and accessibility. This integration ensures that the evaluation process in schools becomes transparent and accountable, aligning with modern education governance standards.

Research Methodology

3.1. Research Approach

This research adopts a qualitative and quantitative approach to design and develop a Decision Support System (DSS) for selecting outstanding students at Budi Luhur School Medan. The primary goal is to create a web-based system that utilizes the Analytical Hierarchy Process (AHP) method for evaluating and selecting students based on multiple criteria, including academic performance, extracurricular activities, and other qualitative aspects.

The methodology integrates:

1. System Design and Development: to build the DSS.
2. Application of AHP: to facilitate the selection process.
3. Evaluation and Testing: to assess the effectiveness and accuracy of the system.

3.2. Research Design

This research employs a system development lifecycle (SDLC) methodology, which includes stages like requirements gathering, system design, development, testing, and evaluation. The stages are as follows:

a. Requirements Gathering

The first step is collecting the necessary information from stakeholders, including teachers, school administrators, and staff at Budi Luhur School Medan. This phase focuses on:

1. Identifying the criteria used to evaluate students (e.g., academic performance, behavior, extracurricular activities, leadership).
2. Understanding user requirements, such as how the system should be structured, user roles, and the expected outcomes of the decision-making process.

Data Collection Methods:

1. Interviews: Conducting structured interviews with teachers and administrators to understand the selection process and the importance of different criteria.
2. Document Analysis: Reviewing existing student performance records and evaluation reports to identify the most critical factors considered in selecting outstanding students.

b. System Design

Once the requirements are gathered, the next step is designing the web-based DSS. The system design will include:

1. User Interface (UI): Developing an intuitive and accessible interface for users (teachers, administrators).
2. Database Design: Creating a database to store student data, including academic records, extracurricular achievements, and behavioral assessments.
3. AHP Integration: Implementing the AHP method to assign weights to each selection criterion and rank students based on the results of pairwise comparisons.

The design phase will also include:

1. Flowchart Creation: To map out the steps of the decision-making process.
2. System Architecture: Defining the system components, including front-end (user interface), back-end (server-side processes), and database (data storage).

c. System Development

This phase involves the actual development of the DSS. The system will be built using:

1. Frontend Technologies: HTML, CSS, JavaScript, and frameworks like React.js or Angular.js to ensure an interactive and user-friendly interface.
2. Backend Technologies: PHP, Node.js, or Python-based frameworks (Django/Flask) for server-side processing.
3. Database: MySQL or PostgreSQL to store data securely and ensure fast retrieval of information.

AHP Algorithm Implementation:

1. AHP will be implemented using algorithms that facilitate the pairwise comparison of criteria.
2. The weights assigned to each criterion will be calculated and used to rank students based on the final scores.

d. Testing and Evaluation

Once the system is developed, it will undergo thorough testing to ensure that the system functions as expected:

1. Functionality Testing: Verifying that the system performs the necessary tasks, such as accepting inputs, calculating results, and displaying rankings.
2. Usability Testing: Ensuring the system is easy to use for all stakeholders (teachers, administrators).
3. System Performance Testing: Checking the speed and efficiency of the web-based DSS, particularly when processing large amounts of student data.

User Acceptance Testing (UAT) will also be conducted, where teachers and administrators test the system in a real-world setting to ensure it meets their needs. Feedback from users will be collected to refine the system.

e. Data Analysis

After implementing the system, the data will be analyzed in two primary ways:

1. Effectiveness of AHP in Selection:
    - Compare the student selection process with and without AHP to determine improvements in objectivity, transparency, and decision accuracy.
    - Statistical analysis (e.g., comparing rankings before and after AHP implementation) will be conducted to evaluate the consistency and fairness of student selection.
2. System Usability:
    - Surveys/Questionnaires: Collect feedback from users regarding the ease of use and effectiveness of the web-based DSS. This will include satisfaction levels, user-friendliness, and how the system impacts the decision-making process.
    - System Logs: Analyze system usage patterns, errors, and response times to assess the operational efficiency of the system.

3.3. Data Collection Techniques

The research will use a combination of qualitative and quantitative data collection techniques to evaluate the system's performance and the effectiveness of AHP in the decision-making process:

1. Interviews: With school administrators and teachers to understand the criteria and selection process.
2. Surveys/Questionnaires: To gather feedback from the system's end-users on its usability, effectiveness, and overall satisfaction.
3. Observation: During the testing phase, researchers will observe the interactions of users with the system to identify potential issues.
4. Documentation: Collect and analyze reports on student achievements, grades, and rankings before and after implementing the DSS.

Results

The results section presents the findings from the development and testing of the Decision Support System (DSS) for selecting outstanding students at Budi Luhur School Medan using the Analytical Hierarchy Process (AHP). This section aims to highlight the effectiveness and functionality of the system, evaluating its performance in comparison to the traditional manual selection process.

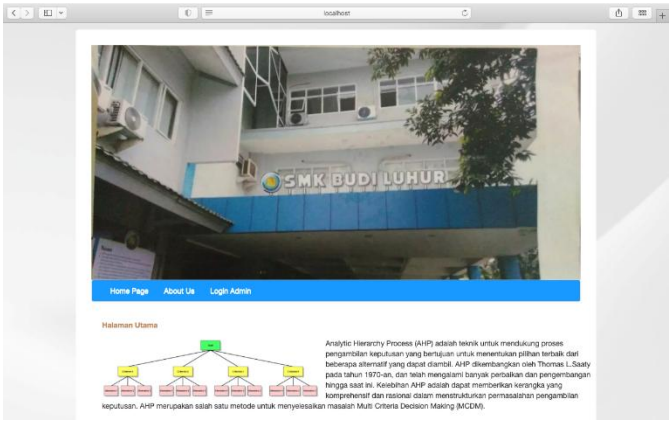

Figure 1. The Home Page

The Home Page menu contains Several submenus include about us and admin login. The home page contains about content page that is information about What that's AHP, what it means and also information other about AHP.

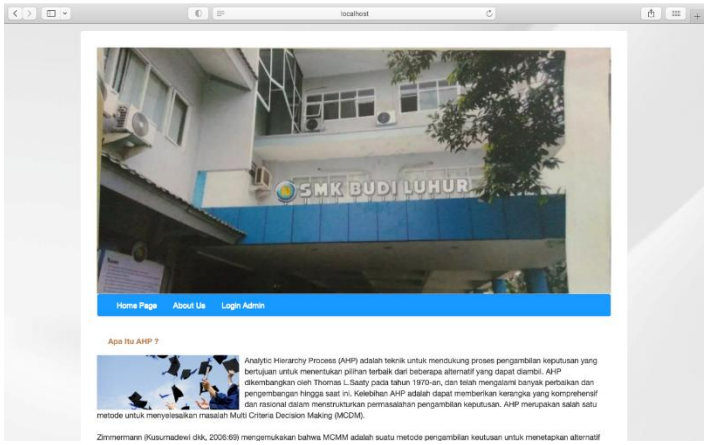

Figure 2. The About

The about us menu contains about information more complete regarding AHP and its functions.

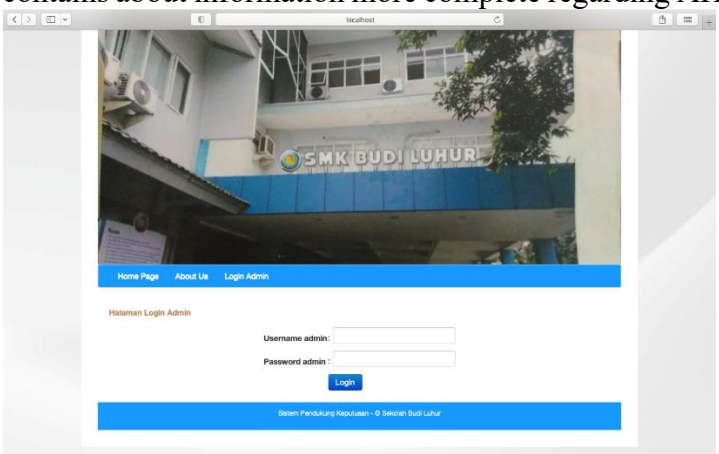

Figure 3. The Login Menu

On the login menu it works for admin can enter to a system consisting of from username and password.

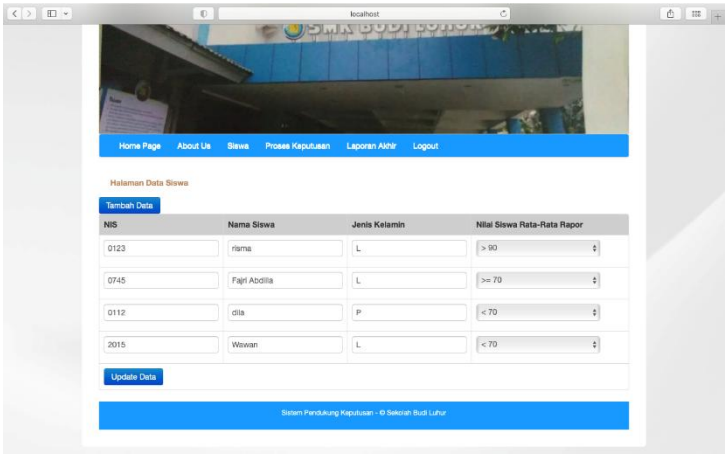

Figure 4. Admin System

After logging in to admin system, there is a student data page menu which contains information about student data that has been Once added. Admin can also change data and add new data.

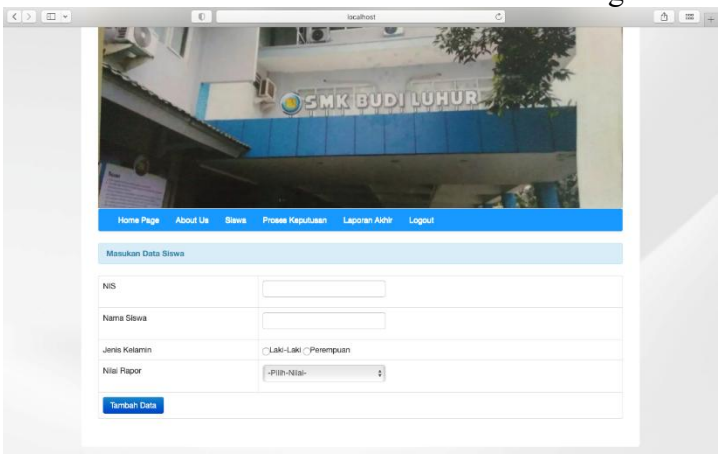

Figure 5. The Add Student Data

In the add student data menu, the admin can add new student data consisting of from NIS data, student name, type gender, and mark report card student.

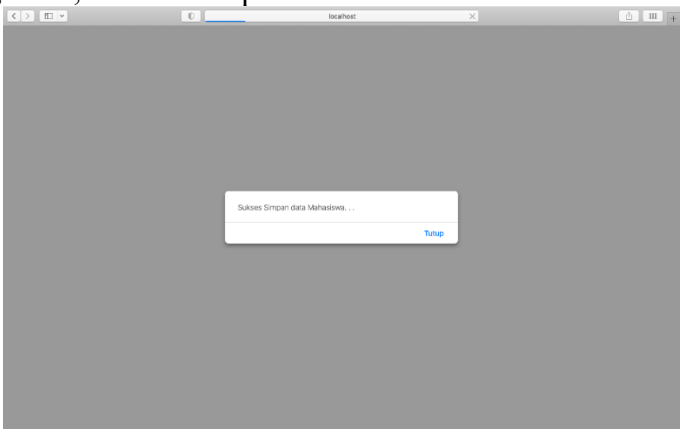

Figure 6. Notification

After the student data is updated, then will appear notification following.

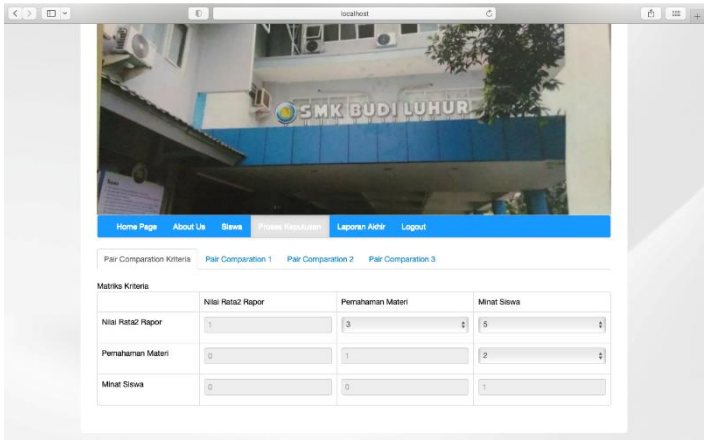

Figure 7. The Process

On the process needs menu there is a matrix menu criteria, pair comparison 1, pair comparison 2, and pair comparison 3. The admin can use each of these menus enter data on average report card values, understanding material And interest student in accordance with existing data.

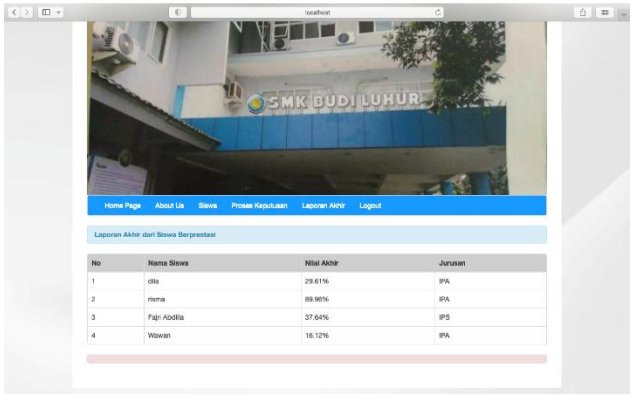

Figure 8. The Report Card Data

After entering the report card data on each students , system will in a way automatic determine which students have good grades highest and achieve.

Conclusion

The development and implementation of the web-based Decision Support System (DSS) for selecting outstanding students using the Analytical Hierarchy Process (AHP) has proven to be a successful and effective solution for addressing the challenges of subjectivity and inefficiency in traditional selection processes. By integrating AHP, the system ensures that student evaluation is based on clearly defined, weighted criteria, enhancing the fairness and objectivity of the decision-making process. The AHP method enabled more consistent and transparent rankings of students by quantitatively evaluating multiple criteria. This led to more accurate and fair decisions compared to manual methods. The DSS significantly reduced the time and effort required for evaluating students by automating calculations and the ranking process. This allowed school administrators and teachers to focus more on interpreting the results rather than performing manual computations. Feedback from teachers and administrators indicated a high level of satisfaction with the system's user interface and functionality. Users appreciated the simplicity and clarity it provided, which made the selection process more streamlined and reliable. The system's transparency ensured that all criteria and their corresponding weights were clearly documented, which promoted accountability in the selection process. Stakeholders could easily understand how students were ranked, which enhanced the credibility of the results. The system demonstrated scalability, allowing for future

expansions, such as integrating additional criteria or adapting it for use in other educational institutions. Future versions could incorporate more advanced features, such as real-time data updates and more interactive user interfaces.

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