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APPLICATION OF THE ANALYTIC HIERARCHY PROCESS METHOD FOR STUDY ASSISTANCE ALLOCATION IN YALIMO REGENCY, PAPUA

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ABSTRACT

The Yalimo Regency Student Association in Indonesia and the local government require a valid and organized student database to support the distribution of study assistance. The existing recipient selection process was still conducted manually, causing long processing time, inefficient data search, and potential inconsistency in decision making. This study developed a decision support system for selecting study assistance recipients in Yalimo Regency using the Analytic Hierarchy Process (AHP). The system development process followed the System Development Life Cycle (SDLC), while AHP was applied to prioritize student alternatives based on four criteria: Grade Point Average (GPA), number of siblings, parents' income, and organizational position. The data processed in the system include student identity, semester, level of study, university, faculty, district of origin, and active academic status. The application was implemented as a web-based system using PHP and MySQL on the XAMPP environment. The system provides login access, student data management, master data management, criteria and alternative input, pairwise comparison processing, and final ranking reports. Black-box testing showed that the main system functions ran according to the expected requirements. The resulting system helps the Yalimo Regency Student Association and the Yalimo Regency Government organize student data and support a more structured, transparent, and efficient study assistance allocation process.

***Keywords**: Decision support system, AHP, SDLC, study assistance, Yalimo students.*

INTRODUCTION

Information systems increasingly support administrative and decision-making activities in organizations and government institutions. By integrating data within a structured environment, they facilitate storage, retrieval, processing, and management more systematically than manual procedures. In public services, accurate and traceable records are important because administrative decisions may affect access to institutional support, public assistance, and educational opportunities. A decision support system (DSS) complements rather than replaces human judgment by providing analytical support for semi-structured problems involving multiple criteria and alternatives (Arnott & Pervan, 2005; Mukharir & Wardoyo, 2021; Sprague, 1980). DSS frameworks have also been used to organize data processing, evaluation, and managerial decision-making in institutional settings (Di Matteo et al., 2021).

The Yalimo Regency Student Association, or Himpunan Mahasiswa Kabupaten Yalimo (HMKY), together with the Yalimo Regency Government, requires reliable student information and a systematic mechanism for allocating study assistance. Previously, student records and recipient selection were handled manually. Data were not consistently integrated in one database, verification required substantial administrative effort, and the absence of systematic criterion calculation could produce inconsistent assessments. Comparable educational selection problems show that manual evaluation may increase subjectivity, reduce efficiency, and complicate candidate comparison across multiple criteria (Halim & Firdaus, 2025; Yusuf Novianto, 2023). These conditions motivate a web-based DSS that integrates student data management with transparent recipient prioritization.

Study assistance allocation is inherently a multi-criteria decision problem because eligibility cannot be determined from a single factor. Academic achievement, family economic circumstances, the number of dependents, and organizational involvement may each influence the priority assigned to a prospective recipient. MCDM methods are appropriate for this type of problem because they provide a systematic framework for evaluating alternatives against several criteria simultaneously (Setiadi et al., 2022; Taherdoost & Madanchian, 2023). Among the available approaches, the Analytic Hierarchy Process (AHP) decomposes a complex decision into a hierarchy consisting of the decision goal, evaluation criteria, and alternatives. It also provides a formal mechanism for translating subjective judgments into measurable priorities within a multi-criteria framework (Saaty, 2008; Tavana et al., 2023).

AHP is applicable to study assistance selection because decision makers can evaluate the relative importance of criteria and alternatives through pairwise comparison. The resulting judgments are converted into priority weights, while consistency measurement provides a check on their logical coherence (Saaty, 2008; Tavana et al., 2023). AHP and hybrid MCDM approaches have been applied to educational decision-support problems, including scholarship selection, elective-course selection, exemplary-student assessment, graduate admission, distance-learning evaluation, and university department evaluation (Bafail et al., 2022; Bekesiene et al., 2021; Halim & Firdaus, 2025; Nurhidayarnis et al., 2024; Setiadi et al., 2022; Wongvilaisakul et al., 2023; Yulianti et al., 2023).

Previous studies on scholarships and educational assistance have employed methods such as Simple Additive Weighting (SAW), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), AHP, and hybrid AHP-based approaches. Their findings demonstrate how academic, economic, and administrative considerations can be incorporated into a structured candidate-ranking procedure (Halim & Firdaus, 2025; Uyun & Riadi, 2011; Yusuf Novianto, 2023). Unlike approaches that concentrate primarily on the ranking calculation, this study integrates AHP-based prioritization with a student information database specifically developed for Yalimo Regency, Papua. The proposed web application combines student data administration, criterion processing, pairwise comparison, and final ranking within a single environment. Accordingly, the contribution lies in linking administrative student-data management with a transparent AHP-based decision-support mechanism for study assistance allocation.

This study aims to develop a web-based decision support system for allocating study assistance to students from Yalimo Regency using the Analytic Hierarchy Process. The system is intended to assist HMKY and the Yalimo Regency Government in managing student information, evaluating selection criteria, calculating priority rankings, and generating decision reports. The study addresses three questions: how the web-based system can be developed for Yalimo Regency; how AHP can prioritize student alternatives using relevant criteria; and how the resulting system can support a more structured, transparent, and efficient decision-making process.

RESEARCH METHOD

This research adopted an applied system-development approach to construct a web-based decision support application for study assistance allocation in Yalimo Regency, Papua. The application combines student information management with an Analytic Hierarchy Process module for establishing recipient priorities. AHP was employed because the selection problem involves multiple criteria that must be organized hierarchically, compared pairwise, converted into priority weights, and evaluated for judgment consistency (Tavana et al., 2023). Previous applications in higher education demonstrate that AHP and its variants can facilitate systematic evaluation and ranking in areas such as graduate admission and academic department assessment (Bafail et al., 2022; Wongvilaisakul et al., 2023). Its use in scholarship and academic recommendation contexts further demonstrates its ability to convert qualitative assessments into quantitative priority values that can be processed consistently (Setiadi et al., 2022; Yusuf Novianto, 2023).

The study focused on administrative and decision-support activities for selecting study assistance recipients involving the Yalimo Regency Student Association and the Yalimo Regency Government, Papua. Research activities were conducted from February to July 2022. The intended users were association administrators and local government officers, and the principal output was a web-based AHP decision support system. The research location, period, object, users, and output are summarized in Table 1.

Table 1. Research Location and Scope

Component	Description
Research location	Yalimo Regency Student Association and the Yalimo Regency Government, Papua, Indonesia
Research period	February to July 2022
Research object	Administrative and decision-making process for selecting study assistance recipients
System users	Association administrators and local government officers
Main output	Web-based AHP decision support system for study assistance allocation

Information required for system development was obtained through interviews, observation, literature study, and documentation. Interviews identified user requirements, the existing selection procedure, and decision criteria. Observation examined how student information and recipient selection were handled under the manual procedure. The literature study established the conceptual basis for DSS, AHP, system development, and testing, while documentation was used to examine student records and administrative information required by the application. The four techniques are summarized in Table 2.

Table 2. Data Collection Techniques

Technique	Purpose
Interview	Determining user requirements, existing selection procedures, and decision criteria
Observation	Examining the manual procedure for student data and assistance-recipient selection
Literature study	Establishing the theoretical basis for DSS, AHP, system development, and testing
Documentation	Examining student records and administrative information required by the system

The research workflow begins with identification of system requirements, followed by student data collection and validation. Validated data are stored in the database before criteria and alternatives are entered into the decision module. The process then proceeds to AHP pairwise comparison, consistency checking, and generation of the final ranking report, as illustrated in Figure 1.

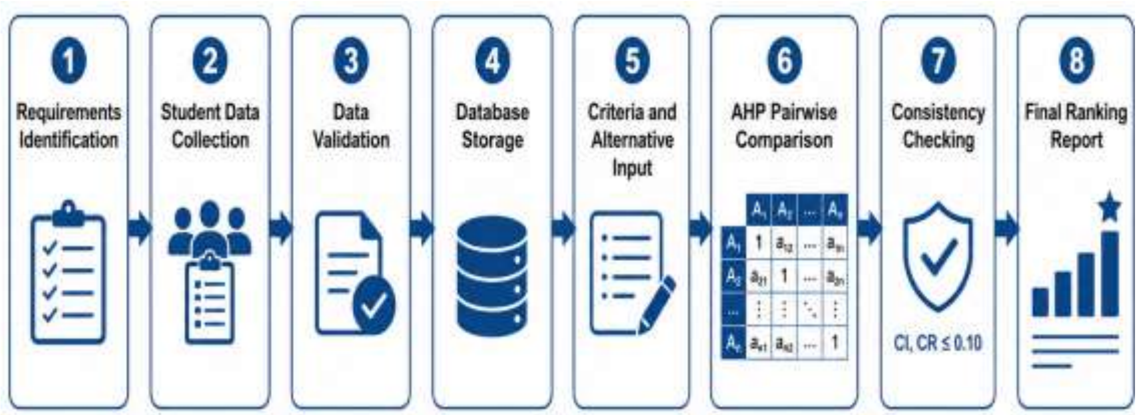

Figure 1. Proposed Research Model for AHP-Based Study Assistance Decision Support System

System construction followed the System Development Life Cycle through five stages: requirements analysis, system design, implementation, testing, and evaluation. Requirements analysis identified limitations in the manual procedure together with user and system needs. System design translated these requirements into workflow, database structure, interface design, and the AHP module. Implementation converted the design into a web application using PHP and MySQL in the XAMPP environment. Black-box testing examined functional behavior, and evaluation reviewed whether the implemented system met identified user requirements.

Table 3. System Development Stages

Stage	Activity
Requirements analysis	Determining problems, user requirements, decision criteria, and required system functions
System design	Translating requirements into workflow, database structure, user interface, and AHP design
Implementation	Implementing the web application using PHP and MySQL
Testing	Examining system behavior through black-box testing
Evaluation	Assessing whether the implemented system meets user requirements

The AHP decision structure contains three hierarchical levels. The first level defines the goal of determining priority study assistance recipients. The second level contains four evaluation criteria: GPA, number of siblings, parents' income, and organizational position. The third level contains the student alternatives registered in the system. This hierarchy is presented in Figure 2.

The four criteria represent different dimensions of recipient eligibility. GPA reflects academic achievement, number of siblings represents a family-related consideration, parents' income describes economic circumstances, and organizational position reflects student involvement and responsibility. Accordingly, assistance priority is not determined by academic performance alone, but also incorporates family, economic, and organizational considerations summarized in Table 4.

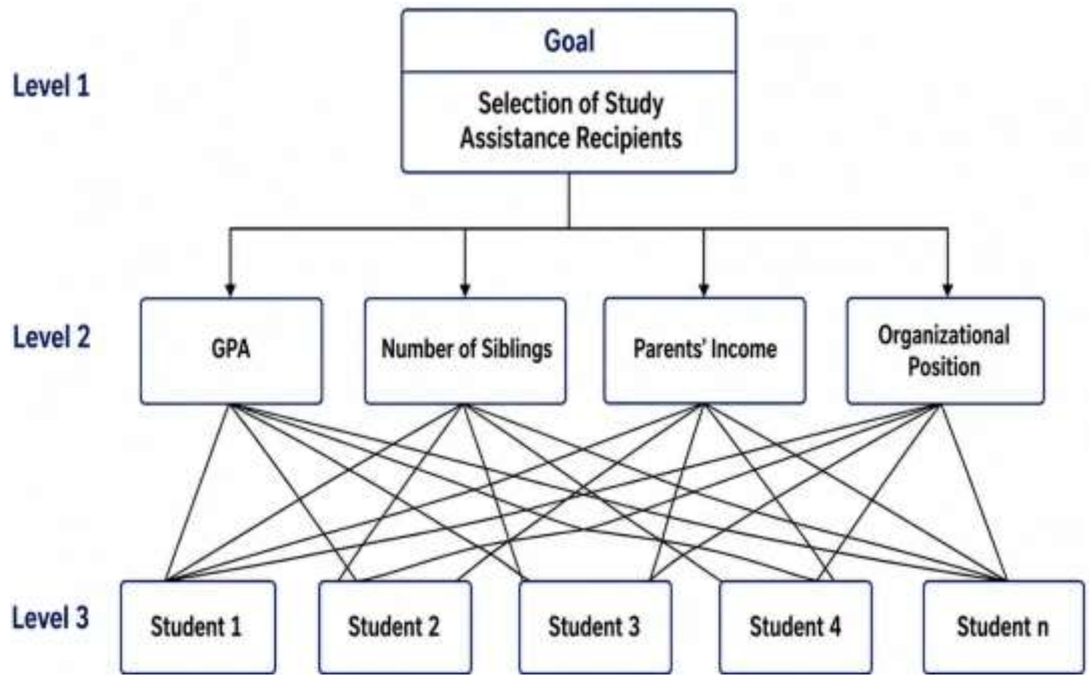

Figure 2. AHP Hierarchy for Study Assistance Recipient Selection

Table 4. Decision Criteria Used in the AHP Model

Criterion	Description	Decision Meaning
GPA	Academic achievement represented by the student's Grade Point Average	A higher GPA indicates stronger academic eligibility
Number of siblings	Number of siblings or family dependents associated with the student	More dependents may indicate greater assistance need
Parents' income	Economic condition represented by parents' or family income	Lower income may increase assistance priority
Organizational position	Student participation and responsibility within an organization	Greater responsibility may contribute to priority consideration

AHP processing begins by expressing the relative importance of the criteria in a pairwise comparison matrix. For n criteria, the matrix can be represented as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}$$

In this matrix, a_{ij} denotes the relative importance assigned to criterion i when it is evaluated against criterion j. The matrix satisfies the reciprocal rule:

$$a_{ji} = \frac{1}{a_{ij}}, \quad a_{ii} = 1$$

A value of one on the main diagonal indicates that a criterion has equal importance when compared with itself. For two different criteria, a preference assigned in one direction determines the reciprocal value in the opposite direction. Thus, if criterion i is judged more important than criterion j, the reciprocal value is assigned when criterion j is compared with criterion i. Through this reciprocal mechanism, comparative judgments can be represented systematically as numerical values that express the relative importance of the decision criteria (Mukharir & Wardoyo, 2021).

After the pairwise comparison matrix is completed, each element is normalized relative to the sum of its corresponding column:

$$n_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}$$

The priority weight for each criterion is then obtained from the mean of the normalized values in its row:

$$w_i = \frac{\sum_{j=1}^{n} n_{ij}}{n}$$

The resulting criterion weights form the priority vector:

$$W = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}$$

For the four criteria used in this study, the priority vector is represented as follows:

$$W = \begin{bmatrix} w_{GPA} \\ w_{Siblings} \\ w_{Income} \\ w_{Organisation} \end{bmatrix}$$

The same pairwise-comparison and normalization procedure is performed for student alternatives under each criterion. Consequently, each student obtains a local priority for GPA, number of siblings, parents' income, and organizational position.

Because AHP relies on comparative judgments, their consistency must also be examined. The evaluation begins by multiplying the pairwise comparison matrix by the priority vector:

$$AW = A \times W$$

Each component of the weighted-sum vector is then divided by the corresponding priority weight to obtain the consistency vector:

$$\lambda_i = \frac{(AW)_i}{w_i}$$

The maximum eigenvalue is obtained by averaging the resulting consistency-vector values:

$$\lambda_{\boldsymbol{max}} = \frac{\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \lambda_{\boldsymbol{i}}}{\boldsymbol{n}}$$

The Consistency Index (CI) is subsequently determined using:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

The Consistency Ratio (CR) compares the resulting CI with the corresponding Random Index:

$$CR = \frac{CI}{RI}$$

Here, RI denotes the random index value. Pairwise judgments are considered acceptable when the following condition is satisfied:

$$CR \leq 0.10$$

A consistency ratio above 0.10 indicates that the pairwise judgments should be reviewed because their internal consistency may be insufficient. The AHP calculation stages are summarized in Table 5.

Table 5. AHP Calculation Stages

Stage	Process	Output
Hierarchy construction	Organizing the decision goal, criteria, and alternatives	AHP hierarchy
Pairwise comparison	Expressing relative importance through pairwise judgments	Comparison matrix
Normalization	Transforming values relative to their column totals	Normalized matrix
Priority weighting	Deriving weights from the normalized comparison matrix	Priority vector
Consistency testing	Computing CI and CR to examine judgment consistency	Consistency ratio
Final ranking	Integrating criterion weights with alternative priorities	Student ranking

After criterion weights and local priorities are obtained, the overall priority of each student is determined by integrating these components. The general final-score formula is:

$$S_i = \sum_{j=1}^{m} w_j x_{ij}$$

In this expression, S_i is the final priority score of student i, w_j is the weight assigned to criterion j, and x_{ij} is the local priority of student i for criterion j. Because the model contains four criteria, the formula can be expanded as follows:

$$S_i = \left(w_{GPA} \times x_{i,GPA}\right) + \left(w_{Siblings} \times x_{i,Siblings}\right) + \left(w_{Income} \times x_{i,Income}\right) + \left(w_{Organization} \times x_{i,Organization}\right)$$

Student alternatives are ordered according to their S_i values, with a higher score corresponding to a higher priority position. The ranking therefore combines criterion importance and alternative performance into a weighted recommendation for study assistance allocation. Similar educational applications show that integrating criterion weighting and alternative prioritization can support systematic decision making (Setiadi et al., 2022; Yusuf Novianto, 2023).

The developed application organizes its functionality into nine principal modules. Users enter through login and proceed to the dashboard, followed by student data management, master data management, criteria and alternatives, pairwise comparison, AHP calculation, final ranking, and report generation. Their operational sequence is illustrated in Figure 3.

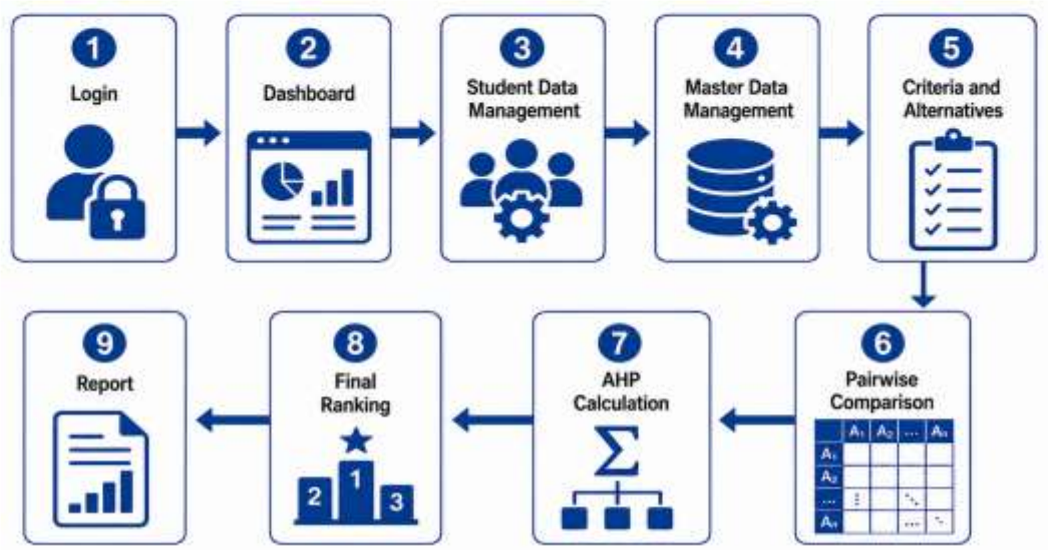

Figure 3. Main Modules of the Developed System

Functional verification was performed using black-box testing. Each scenario examined whether an implemented function generated the expected response for the required input. The evaluated functions covered login, student data input and update, master data management, criteria and alternative input, pairwise comparison processing, and final ranking display. The test scenarios are summarized in Table 6.

Table 6. Black-Box Testing Scenario

Tested Function	Expected Result
Login	Valid credentials are authenticated and provide access to the dashboard
Student data input	Submitted student information is recorded in the database
Student data update	Existing student records are modified according to submitted changes
Master data management	District, university, and faculty reference data can be maintained
Criteria input	Decision criteria required for AHP processing are recorded
Alternative input	Student candidates are registered as decision alternatives
Pairwise comparison	Comparison values for criteria and alternatives are processed
Final ranking	Student alternatives are presented according to calculated priority order

RESULTS AND DISCUSSION

Results

The development process produced a web-based decision support application for study assistance allocation in Yalimo Regency, Papua. Its functionality addresses two main purposes: structured student-data management and AHP-based prioritization of prospective recipients. Administrators can maintain student information in an integrated database, while the decision-support component processes criteria, alternatives, pairwise comparisons, and priority rankings. Implemented functions include login, dashboard navigation, student and master-data management, criteria and alternative input, pairwise comparison, AHP calculation, ranking, and reporting.

System Implementation Results

The implementation outcome is demonstrated through the primary user interfaces of the application. To keep the presentation compact while retaining evidence of the implemented functions, the interface screenshots are combined into one composite illustration. Figure 4 therefore contains four components: (a) the login interface for user authentication, (b) the dashboard and student-data management interface, (c) the criteria and pairwise-comparison interface used for AHP processing, and (d) the final-ranking and decision-report interface used to present the calculated priority order of student alternatives.

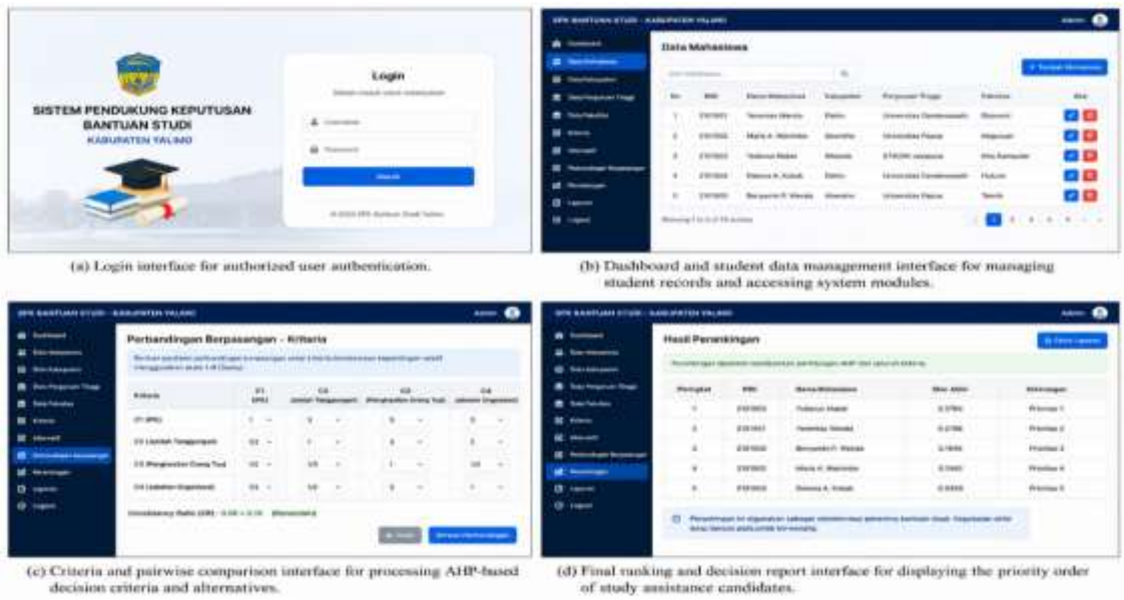

Figure 4. Main User Interfaces of the AHP-Based Study Assistance Decision Support System

Figure 4(a) shows the authentication component through which users provide a username and password before entering the application. Authentication restricts access to student records and decision information to authorized users, particularly HMKY administrators and relevant officers of the Yalimo Regency Government.

Figure 4(b) presents the application's central navigation environment. Through the dashboard, users can access student records, district information, university and faculty reference data, criteria, alternatives, pairwise comparisons, and ranking reports. The student-management component supports creation, modification, storage, and deletion of records. Information maintained through this module includes student identity, district of origin, university, faculty, student registration number, gender, address, semester, study level, and academic status. The interface therefore connects administrative data management with the other functions required in the decision-support workflow.

Figure 4(c) provides access to the decision parameters required for AHP processing. Users can configure GPA, number of siblings, parents' income, and organizational position, register student alternatives, and enter pairwise judgments. These inputs are processed by the AHP module to obtain criterion weights and local priority values for the alternatives.

Figure 4(d) presents the result of the AHP computation as an ordered list of student alternatives. Each candidate's position is determined from the final priority score calculated by the system. The generated ranking is intended to support recipient selection and should therefore be interpreted as a decision recommendation rather than an automatic administrative determination. Final authorization remains with HMKY administrators and the Yalimo Regency Government, which may apply additional verification before confirming recipients.

The operational functions implemented in the application are grouped into nine modules covering user authentication, system navigation, administrative data management, AHP processing, and presentation of decision outputs, as summarized in Table 7.

Table 7. Main Functional Modules of the Developed System

Module	Main Function
Login	Authenticates users before access to protected functions is granted
Dashboard	Provides centralized navigation to the system functions
Student data	Maintains student identity, academic, and administrative information
Master data	Maintains district, university, and faculty reference records
Criteria	Stores evaluation criteria required by the AHP model
Alternatives	Registers student candidates included in the decision process
Pairwise comparison	Records and processes pairwise judgments for criteria and alternatives
Final ranking	Presents the calculated priority order of assistance candidates
Report	Provides decision results for administrative review

AHP Decision Processing Results

AHP processing begins after the decision criteria and student alternatives have been specified. The four criteria represent different assessment dimensions: GPA reflects academic achievement, number of siblings represents family dependents, parents' income describes economic circumstances, and organizational position reflects student involvement and responsibility.

Pairwise judgments entered through the application are processed to determine criterion weights and the local priorities of student alternatives under each criterion. These values are then combined into a final score for every candidate, and the alternatives are ordered according to the resulting scores, with the highest score receiving the highest priority position.

The AHP module therefore provides an explicit and traceable evaluation procedure rather than relying solely on unstructured judgment. Candidate assessment uses predefined criteria and calculated priority values, supporting a study-assistance allocation process that is more structured, transparent, and accountable.

Functional Testing Results

Black-box testing examined the operational behavior of the implemented application. Each test evaluated whether a specific function responded according to its predefined requirement after receiving the corresponding input. The evaluated components included login authentication, creation and modification of student records, master-data management, criterion and alternative entry, pairwise-comparison processing, and presentation of the final ranking. The outcomes are reported in Table 8.

Table 8. Black-Box Testing Results

Tested Function	Expected Result	Status
Login	Valid credentials provide access to the application	Passed
Student data input	Submitted student information is stored in the database	Passed
Student data update	Existing student records are updated according to submitted changes	Passed
Master data management	District, university, and faculty reference data can be maintained	Passed
Criteria input	Criteria required for AHP processing are successfully recorded	Passed
Alternative input	Student alternatives can be registered for evaluation	Passed
Pairwise comparison	Comparison values involving criteria and alternatives are processed	Passed
Final ranking	Student alternatives are displayed in calculated priority order	Passed

All eight black-box test scenarios produced results consistent with the specified functional requirements. Authentication, student and master-data operations, criterion and alternative input, pairwise-comparison processing, and final-ranking presentation were executed successfully. These outcomes indicate that the implemented functions operated as intended within the defined test conditions. The results establish functional behavior for the scenarios that were examined, although they should not be interpreted as evidence of usability, user acceptance, or broader operational performance, which were outside the scope of the reported testing.

Discussion

The developed application addresses two limitations of the previous procedure in Yalimo Regency: fragmented student-data administration and assistance selection based on manual processing. Administrators previously had to locate, verify, and compare student information without an integrated database, while the absence of a systematic computational procedure for evaluating criteria created the possibility of inconsistent judgments.

The web-based system reorganizes these activities by maintaining student records and supporting reference data within dedicated modules. Student, district, university, and faculty information can therefore be handled through a common application environment. This arrangement provides a more organized basis for maintaining candidate information, which is important because recipient prioritization depends on the accuracy and completeness of the data entered into the decision process.

The AHP component adds a structured decision mechanism to this administrative foundation. Eligibility is organized into academic achievement, family circumstances, economic condition, and organizational involvement. Pairwise comparisons are transformed into criterion weights and alternative priorities, which are then combined into an ordered recommendation. The rationale underlying the resulting ranking is therefore more explicit than in the previous manual procedure.

The generated ranking should not be interpreted as an autonomous administrative decision. It functions as analytical support for identifying priority candidates according to the AHP model, while final authorization remains with HMKY administrators and the Yalimo Regency Government. Study-assistance allocation may still require administrative verification and contextual considerations outside the computational ranking procedure.

The findings should be interpreted with several limitations. First, the results focus primarily on system implementation and functional verification; the study does not present a complete numerical AHP example using actual student alternatives, including pairwise matrices, normalized matrices, criterion weights, consistency ratios, and final scores. Second, evaluation is restricted to black-box testing, so usability and user acceptance have not been measured. Third, the current implementation is web-based, while an Android or other mobile-accessible version remains a potential extension.

Future research should strengthen both computational and user evaluation. A complete AHP case using actual student data should report pairwise matrices, normalization results, criterion weights, consistency ratios, and final ranking values. Evaluation should also include usability or user-acceptance assessment. Further work may compare AHP with SAW, TOPSIS, or hybrid AHP-TOPSIS to examine which decision model is most appropriate for study-assistance prioritization.

CONCLUSION

This research resulted in a web-based decision support system that integrates student-data administration with AHP-based prioritization for study assistance allocation in Yalimo Regency, Papua. Recipient assessment is organized around four criteria: GPA, number of siblings, parents' income, and organizational position. The application provides authenticated access, dashboard navigation, student and master-data management, criterion and alternative entry, pairwise comparisons, AHP processing, ranking presentation, and decision reporting. Black-box evaluation showed that all tested functions produced the expected operational outcomes within the defined scenarios, indicating that the implemented features were executed successfully under the specified test conditions. The resulting application provides HMKY and the Yalimo Regency Government with an integrated mechanism for organizing student information and generating structured priority recommendations for prospective study-assistance recipients. The ranking remains a decision-support output, while final recipient determination stays with the authorized decision makers. Further research should present complete numerical AHP calculations using actual student alternatives, explicitly report consistency-ratio values, evaluate usability and user acceptance, and examine broader implementation using real student datasets to strengthen both computational evidence and practical acceptance.

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