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Decision Support System for Selecting Outstanding Students Using a Combination of AHP and SAW Methods

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ABSTRACT

The process of selecting outstanding students at MA Badrul Islam Gulung is still done conventionally, mainly by considering report card grades as the key factor, which could lead to subjectivity and be less effective in decision making. This study aims to develop a decision support system for selecting outstanding students using a combination of the Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods. AHP is used to determine the priority weight of each criterion, while SAW is used to rank students based on preference scores. Data was collected through observation, interviews, questionnaires, and literature studies, involving 10 respondents and 5 student alternatives as research subjects. This study uses six assessment criteria: academic grades, non-academic achievements, behavior, discipline, activeness, and memorization of the Qur'an. The research results show that the combination of the AHP and SAW methods can produce a more objective, transparent, and systematic evaluation process. Based on the calculations, alternative A3, named Oktaviana, scored the highest at 0.991 and was chosen as the outstanding student because she had excellent and consistent scores across almost all assessment criteria, especially in academic performance, behavior, and Qur'an memorization. Thus, the decision support system that was developed can help the school determine outstanding students more accurately and efficiently.

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Introduction

Education is an important need in shaping the future. That's why educational institutions strive to improve the quality of students through achievements. Every student has a different level of achievement, especially in academics (Rahmawati & Mardiyati, 2023) (Puspita et al., 2025). However, students who have good grades aren't necessarily considered high-achieving students, so a proper assessment process according to their abilities is needed (Ignatius Joko Dewanto et al., 2023). High-achieving students become an indicator of a school's success in producing competent and competitive

graduates, which is measured through the learning outcomes that students achieve (Octaviansyah Pasaribu et al., 2023)(Fathoni et al., 2021).

However, the process of selecting outstanding students in many schools still faces various obstacles. Assessments are often done manually and involve a degree of subjectivity, so the results are less accurate and take longer (Kusuma et al., 2021)(Ratsanjani et al., 2024). Another problem that often comes up is the lack of transparency in the evaluation process, which creates a sense of unfairness and can end up causing social jealousy among students (Hidayat et al., 2024) (Wardana et al., 2023). Also, the lack of a structured and easily accessible system can slow down decision-making, especially when it involves many parties in the evaluation process (Faqih & Cahyani, 2023).

As technology develops, the need for decision support systems (DSS) is increasing to help make decisions in a systematic and objective way based on various criteria (Purnomo et al., 2026) (Nawandi et al., 2023). Methods that are often used in DSS are AHP and SAW (Suprapto et al., 2024). AHP is used to determine the priority weights of criteria through pairwise comparisons, while SAW is used to rank alternatives based on the results of normalization and weighting of criteria (Baowolo et al., 2025)(Rahman, 2025), Meanwhile, SAW is used to rank alternatives based on the results of normalization and criteria weighting (Mohamad Yudana Hutomo dan Kemal Ade Sekarwati, 2022). Combining these two methods can improve accuracy and objectivity in decision-making.

Previous research on decision support systems for selecting outstanding students has often been carried out using AHP and SAW methods. Research by I. Kurnia and A. Muhtarom used criteria such as habituation, vocabulary, reading, grammar, and speaking. The results showed that combining AHP and SAW could produce structured priority weights for criteria and determine the best students objectively with a consistency level of 0.083 (Kurnia & Muhtarom, 2021). Research at SMKS Darul Kamilin uses academic criteria, discipline, extracurricular activity involvement, attitude and behavior, as well as non-academic achievements, and results in assessments that are more objective, structured, and consistent (Reza et al., 2023). Other research used criteria like student attendance, student behavior, neatness of clothing, participation in extracurricular activities, subject grades, and level of violations, with a system accuracy of 88% (Nugraha & Halim Mursyidin, 2024). Meanwhile, a study at MA Sabilurrasyad NW Barabali used national exam scores, school exam scores, student achievements, final semester report card grades, and student interests as criteria. The AHP method was used to weight the criteria and SAW for ranking, resulting in a more effective and accurate selection process (Wulandari et al., 2023).

The novelty of this research lies not only in the inclusion of the Quran memorization criterion but also in the development of a decision support framework that integrates AHP and SAW to accommodate school-specific assessment characteristics. Unlike previous studies that generally employ generic evaluation criteria, this study designs an assessment model tailored to the educational objectives of MA Badrul Islam Gulung by integrating academic, non-academic, behavioral, disciplinary, participation, and religious competencies into a single evaluation framework.

Based on observations, the selection of outstanding students at MA Badrul Islam Gulung is still done in a conventional way, relying mostly on report card grades as the main factor, so the assessment is not very comprehensive and can be subjective. Therefore, a decision support system (DSS) that uses the AHP method for weighting criteria and SAW for ranking students is needed. This system is expected to help MA Badrul Islam Gulung select outstanding students more objectively, accurately, fairly, and transparently.

Method

This research was carried out through several stages, starting from problem identification, data collection, data analysis, to presenting the analysis results and making decisions. In addition, this study also applies research stages as a process in a decision support system for selecting outstanding students using the AHP and SAW methods, as shown in the following figures 1 and 2:

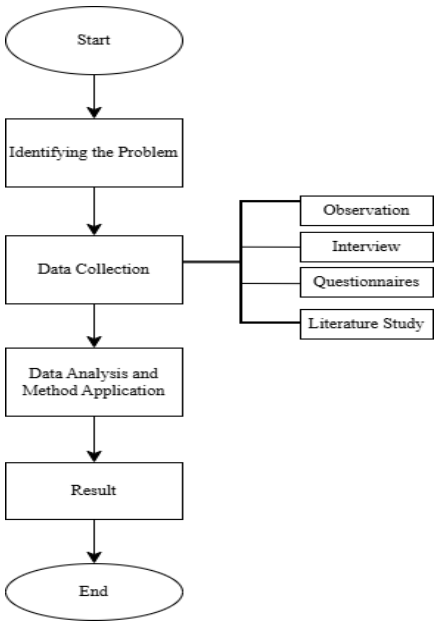

Figure 1. Research Steps

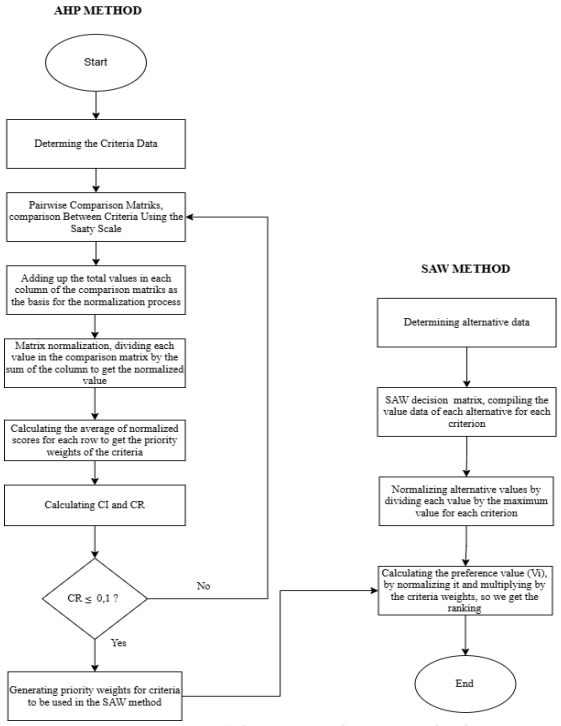

Figure 2. Stages of the AHP and SAW Methods

Figure 2 shows the relationship between the AHP and SAW methods in determining criteria weights and the final ranking of outstanding students. The combination of these two methods is used to produce a more accurate and objective assessment.

Problem Identification

The problem identification stage is carried out to understand the obstacles in the process of selecting outstanding students at MA Badrul Islam Gulung. The evaluation process, which is still done

manually, is considered less effective and has the potential to be subjective, so a decision support system using the AHP and SAW methods is needed.

Data Collection

Data collection is carried out to obtain relevant information and support the assessment process. This study involves 10 respondents from the school concerned, and uses 5 student alternatives as the assessment objects in selecting outstanding students. This process consists of:

a. Observation

The research involves direct observation of students' activities in class, such as their activeness in participating in lessons, discipline, and interactions with teachers and peers, to get a comprehensive picture of students' behavior and achievements.

b. Interview

Interviews are conducted with teachers, homeroom teachers, or other school staff to get in-depth information about a student's achievements, attitude, and contributions at school.

c. Questionnaire

The questionnaire is given to teachers, or other relevant parties with structured questions to systematically collect data about the criteria for high-achieving students.

d. Literature Review

The literature review is done by studying written sources such as journals and related documents to strengthen the theory and support the analysis in this research.

Data Analysis and Method Application

The collected data was analyzed using the AHP and SAW methods to determine the criteria weights and rank the students based on the assessment results. The combination of these two methods is expected to provide fairer and more transparent results.

Application of the AHP Method

The AHP method is a problem-solving approach in decision support systems developed by Thomas L. Saaty (Sari et al., 2025). AHP is used to help make multi-criteria decisions systematically by taking into account logic, experience, knowledge, and emotions (Ayu Kusuma Ningtyas & Agus Diartono, n.d.). The weight of each element is determined using a pairwise comparison matrix based on Saaty's scale to produce decision recommendations (Irmayana et al., n.d.).

The steps for using the AHP method are as follows: (a)Determining the criteria data, (b) Pairwise comparison matrix, comparing between criteria using a scale. And the formula is as follows:

$$Sj = \sum_{i=1}^{n} aij \quad (1)$$

Description:

Sj = the total value in the j-th column of the pairwise comparison matrix.

aij = = the matrix value in the i-th row and j-th column.

n = the number of criteria.

Add up the total values in each column of the comparison matrix as a basis for the normalization process. Normalize the matrix by dividing each value in the comparison matrix by the column total to get the normalized values. Calculate the average of the normalized values in each row to get the priority weights of the criteria Calculate the consistency index (CI) and consistency ratio (CR)

The steps to calculate CI and CR are as follows:

a. Calculate the maximum eigenvalue (λ max)

The maximum eigenvalue is obtained from the division between the sum of the product of the matrix and the priority weights by the priority weights of each criterion. The formula is as follows:

$$\lambda max = \frac{\sum_{i=1}^{n} \frac{Awi}{Wi}}{n} \quad (2)$$

b. Calculating the Consistency Index (CI)

After obtaining the value of λmax, the next step is to calculate the Consistency Index using the formula:

$$CI = \frac{\lambda max - n}{n - 1} \quad (3)$$

c. Calculating the Consistency Ratio (CR)

The Consistency Ratio is calculated using the formula:

$$CR = \frac{CI}{RI} \quad (4)$$

Description:

λ max	= Maximum eigenvalue
Awi	= Result of multiplying the matrix with priority weights
Wi	= Priority weights
N	= Number of criteria
CR	= Consistency Ratio
CI	= Consistency Index
RI	= Random Index.

The Random Index (RI) value in the AHP method based on the number of criteria is 1–2 (0.00), 3 (0.58), 4 (0.90), 5 (1.12), 6 (1.24), 7 (1.32), 8 (1.41), 9 (1.45), and 10 (1.49). This study uses 6 criteria, so the RI used is 1.24. Generate the priority weights of criteria to be used in the SAW method.

Application of the SAW Method

The Simple Additive Weighting (SAW) method is a multi-criteria decision-making technique widely used in decision support systems. SAW normalizes the value of each criterion, multiplies it by the criterion weight, and then sums it up to get the final preference value (Rifasya et al., n.d.). This method helps to choose the best alternative objectively and systematically based on the combination of criteria values and their weights (Tim, n.d.).

Here are the steps of the SAW method: (a) Determine the alternative data, (b) SAW decision matrix, organize the value data of each alternative for each criterion. (c) Normalizing the alternative values by dividing each value by the maximum value for each criterion.

$$R_{ij} = \begin{cases} \frac{x_{ij}}{\max x_{ij}} & benefit \\ \frac{\min x_{ij}}{x_{ij}} & cost \end{cases} \quad (5)$$

Description:

Rij	= normalized value.
Xij	= alternative value for each criterion.
Max xij	= largest value for the criterion.
Min xij	= smallest value for the criterion.
Benefit	= benefit criterion, meaning the bigger the value, the better.
Cost	= cost criterion, meaning the smaller the value, the better.

Calculating the preference value (Vi) by normalizing and then multiplying by the weight to get the ranking.

The formula for calculating the preference value (Vi):

$$Vi = \sum_{j=1}^{n} (Wj \; x \; Rij) \quad (6)$$

Description:
Vi = final value of the alternative
Wj = weight for each j-th criterion
Rij = normalized value of the i-th alternative for the j-th criterion
i = alternative
j = criterion.

RESULTS AND DISCUSSION

Analysis Results

At this stage, student performance assessment is carried out by combining the AHP and SAW methods. The criteria for student performance are first collected and given weights according to their priority. Then, the scores of each student are calculated and added up to get the total score. With this approach, student performance results at the school can be displayed comprehensively and objectively.

Decision Results

Presentation of research results and conclusions regarding student performance assessment shows several key findings that need to be considered in the implementation of a decision support system at the school.

a. Alternatives

Alternative data refers to a set of candidates that will be the objects of assessment in this study. In this case, the researcher chose five alternatives to be analyzed, as shown in table 1 below.

Table 1. Alternative Data

No	Alternatives	Name
1	A1	Fitri Handayani
2	A2	Intan Purnama Sari
3	A3	Oktaviana
4	A4	Seri Ani
5	A5	Suci Anisa

b. Criteria

Several criteria have been set as a basis for assessing achievement. The determination of the 6 criteria in this study is based on the results of observations, interviews, and the school's needs in evaluating students' achievements comprehensively, both in academic and non-academic aspects, behavior, discipline, activeness, and students' religious abilities. These assessment criteria can be seen in the following explanation:

Table 2. Criteria Data

Criteria	Description	Type
C1	Academic Score	Benefit
C2	Non-Academic Score	Benefit
C3	Behavior Attitude	Benefit
C4	Discipline	Benefit
C5	Activeness	Benefit
C6	Quran Memorization	Benefit

Table 2 shows six criteria for assessing outstanding students. All the criteria fall into the benefit category because the higher the score, the better the student's performance, so cost criteria are not used in this study.

Application oh the ahp Method

The AHP method is used to determine the weight of each criterion that doesn't yet have a

weight value. The weighting is done through a pairwise comparison matrix based on respondents' evaluations.

Table 3. Decimal Comparison Matrix and Column Total

Criteria	C1	C2	C3	C4	C5	C6
C1	1,00	3,02	2,40	2,17	2,27	1,82
C2	0,33	1,00	3,74	3,35	2,27	1,89
C3	0,42	0,27	1,00	1,95	2,04	1,72
C4	0,46	0,30	0,52	1,00	1,32	2,40
C5	0,44	0,44	0,49	0,76	1,00	2,17
C6	0,55	0,53	0,58	0,42	0,46	1,00
Total	3,20	5,56	8,74	9,64	9,35	11,00

Table 3 shows the decimal comparison matrix and the total of the columns used as the basis for normalization in the AHP method.

Table 4. AHP Matrix Normalization

Criteria	C1	C2	C3	C4	C5	C6	Total
C1	0,31	0,54	0,27	0,23	0,24	0,17	0,29
C2	0,10	0,18	0,43	0,35	0,24	0,17	0,25
C3	0,13	0,05	0,11	0,20	0,22	0,16	0,15
C4	0,14	0,05	0,06	0,10	0,14	0,22	0,12
C5	0,14	0,08	0,06	0,08	0,11	0,20	0,11
C6	0,17	0,10	0,07	0,04	0,05	0,09	0,09

Table 4 shows the results of the AHP matrix normalization, obtained by dividing each criterion comparison value by the total of its column, resulting in the priority weight of each criterion.

Table 5. Criteria Weight Results

Criteria	Bobot	Bobot Persentase
C1	0,29	29%
C2	0,25	25%
C3	0,15	15%
C4	0,12	12%
C5	0,11	11%
C6	0,09	9%

Table 5 presents the priority weights of the criteria obtained using the AHP method. Criterion C1 has the highest weight (0.29), indicating that academic performance is the most influential factor in selecting outstanding students, while C6 has the lowest weight (0.09).

Determining the Consistency Ratio (CR)

The calculation of the Consistency Ratio (CR) is used to test the consistency of respondents' assessments in the pairwise comparison matrix and to ensure that the AHP results can be used in the next stage. After obtaining the priority weights for each criterion, the value of A × W is calculated, which is then used to find the value of λ (lambda). Based on the calculations, the λ values for each criterion are obtained as follows: C1 = 6.97, C2 = 6.93, C3 = 6.46, C4 = 6.30, C5 = 6.39, and C6 = 6.54. Next, the maximum λ value (λmax) of 6.60 is calculated, which is used to compute the Consistency Index (CI), resulting in a CI value of 0.12. This CI value is then compared to the Random Index (RI) of 1.24 for six criteria, producing a Consistency Ratio (CR) of 0.096. Since the CR value is less than 0.1, the pairwise comparison matrix is considered consistent and can be used in the next calculation stage.

Application of the SAW Method

The process of analysis and problem-solving is carried out using the SAW method, which consists of several stages as follows:

a. Calculation of the SAW decision matrix

Table 6. SAW Decision Matrix

Teacher	Student	C1	C2	C3	C4	C5	C6
G1	S1	75,33	74,67	90,00	85,33	79,33	78,67
G2	S2	84,00	76,00	86,67	84,00	83,33	79,33
G3	S3	84,67	75,33	92,00	83,33	80,00	80,00
G4	S4	78,67	73,33	88,00	83,33	82,00	71,33
G5	S5	78,67	68,67	84,67	80,00	80,00	73,33
MAX SCORE		84,67	76	92	85,33	83,33	80

Normalization Calculation

a. Normalization Calculation for Alternative = A1

$$R1.1 = \frac{75,33}{84,67} = 0,89$$
$$R1.2 = \frac{74,67}{76} = 0,98$$
$$R1.3 = \frac{90}{92} = 0,98$$
$$R1.4 = \frac{85,33}{85,33} = 1,00$$
$$R1.5 = \frac{79,33}{83,33} = 0,95$$
$$R1.6 = \frac{78,67}{80} = 0,98$$

Based on the SAW normalization calculations, the values are obtained by dividing each alternative's value by the maximum value for each criterion. The calculation shown is an example for alternative A1, while A2–A5 are calculated in the same way. The normalization results for all alternatives are presented in Table 7.

Table 7. Normalized Matrix R Results

Alternative	Criteria					
	C1	C2	C3	C4	C5	C6
A1	0,89	0,98	0,98	1,00	0,95	0,98
A2	0,99	1,00	0,94	0,98	1,00	0,99
A3	1,00	0,99	1,00	0,98	0,96	1,00
A4	0,93	0,96	0,96	0,98	0,98	0,89
A5	0,93	0,90	0,92	0,94	0,96	0,92

3.5.2 Ranking Process Using Weights

The ranking process is done by using the weights that have been set for each criterion.

W = (0,29. 0,25. 0,15. 0,12. 0,11. 0,09)

Here are the results that were obtained:

V1 = (0,89*0,29) + (0,98*0,25) + (0,98*0,15) + (1,00*0,12) + (0,95*0,11) + (0,98*0,09) = 0,953
V2 = (0,99*0,29) + (1,00*0,25) + (0,94*0,15) + (0,98*0,12) + (1,00*0,11) + (0,99*0,09) = 0,987
V3 = (1,00*0,29) + (0,99*0,25) + (1,00*0,15) + (0,98*012) + (0,96*0,11) + (1,00*0,09) = 0,991
V4 = (0,93*0,29) + (0,96*0,25) + (0,96*0,15) + (0,98*0,12) + (0,98*0,11) + (0,89*0,09) = 0,950
V5 = (0,93*0,29) + (0,90*0,25) + (0,92*0,15) + (0,94*0,12) + (0,96*0,11) + (0,92*0,09) = 0,925

Calculations are carried out to obtain values V1 to V5. The results of each calculation and their rankings are presented in Table 8, which shows the final results along with the ranking order based on the values obtained.

Table 8. Preference Score Results (Vi)

Alternative	Student Name	Result	Rangking
A1	Fitri Handayani	0,953	3
A2	Intan Purnama Sari	0,987	2
A3	Oktaviana	0,991	1
A4	Seri Ani	0,950	4
A5	Suci Anisa	0,925	5

The analysis results show that the SAW method can be used objectively to determine high-achieving students. The table presents the scores of students A1–A5 based on six criteria, namely academic scores (C1), non-academic (C2), behavior (C3), discipline (C4), activeness (C5), and Quran memorization (C6). Based on the preference score calculations, the best student is A3, named Oktaviana, with a score of 0.991, influenced by the highest scores in criteria C1, C3, and C6.

Conclusions

This study demonstrates that integrating AHP and SAW provides an effective decision support system for selecting outstanding students at MA Badrul Islam Gulung, using AHP to determine objective criterion weights and SAW to systematically rank alternatives, with Oktaviana (A3) emerging as the top-ranked student. Its main contribution lies in an assessment framework that unifies academic, non-academic, behavioral, disciplinary, participation, and religious criteria into a single model tailored to Islamic school characteristics. Practically, the system supports a more objective, transparent, and efficient selection process, while theoretically it confirms that AHP-SAW integration is an effective multi-criteria approach adaptable to educational institutions with varying assessment needs.

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