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Application of AHP-SAW Based Decision Support System for Objective and Comprehensive Junior High School Student Selection

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Abstract
The admission process in Integrated Islamic Junior High Schools (SMPIT) often faces challenges of subjectivity, inefficiency, and lack of transparency in determining selection results. This can lead to inappropriate student placement and decreased trust from stakeholders. This study aims to develop a Decision Support System (DSS) based on a combination of Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW) to improve objectivity and accountability in student selection. AHP is used to determine the weights of the four main academic criteria-the report card scores of Mathematics, Science, Indonesian, and English-based on consistent expert judgment. Furthermore, the SAW method processes the normalized and weighted scores to produce a final ranking of 100 prospective students. The implementation results show that the AHP-SAW integration is able to produce quantitative, transparent, and data-based rankings, thus minimizing subjectivity in the selection process. It provides a structured and replicable model, supporting fairness and efficiency in student admission. This approach is relevant to be applied in educational institutions that want to align the selection process with Islamic educational values and multi-criteria-based objectivity principles.

Keywords:
Decision Support System (DSS)
Analytic Hierarchy Process (AHP)
Simple Additive Weighting (SAW)

Abstrak
Proses penerimaan siswa baru di SMP Islam Terpadu (SMPIT) sering menghadapi tantangan subjektivitas, inefisiensi, dan minimnya transparansi dalam penentuan hasil seleksi. Hal ini dapat berujung pada penempatan siswa yang kurang tepat dan menurunnya kepercayaan dari pemangku kepentingan. Studi ini bertujuan mengembangkan Sistem Pendukung Keputusan (SPK) berbasis kombinasi *Analytic Hierarchy Process* (AHP) dan *Simple Additive Weighting* (SAW) guna meningkatkan objektivitas dan akuntabilitas dalam seleksi siswa. AHP digunakan untuk menentukan bobot empat kriteria akademik utama nilai raport Matematika, IPA, Bahasa Indonesia, dan Bahasa Inggris berdasarkan penilaian ahli secara konsisten. Selanjutnya, metode SAW mengolah skor yang telah dinormalisasi dan dibobotkan untuk menghasilkan peringkat akhir dari 100 calon siswa. Hasil implementasi menunjukkan bahwa integrasi AHP-SAW mampu menghasilkan peringkat yang kuantitatif, transparan, dan berbasis data, sehingga meminimalkan subjektivitas dalam proses seleksi. SPK ini menyediakan model yang terstruktur dan dapat direplikasi, mendukung keadilan dan efisiensi dalam penerimaan siswa. Pendekatan ini relevan untuk diterapkan di institusi pendidikan yang ingin menyelaraskan proses seleksi dengan nilai-nilai pendidikan Islam dan prinsip objektivitas berbasis multi-kriteria.

Kata Kunci : Sistem Pendukung Keputusan (SPK), Analytic Hierarchy Process (AHP), Simple Additive Weighting (SAW)

INTRODUCTION

New student admissions play a fundamental role in shaping the academic and cultural landscape of every educational institution, especially at the integrated junior high school (SMPIT) level. The quality of admitted students directly affects the school's educational outcomes and its reputation in the community. However, traditional admission processes, which are often manual, face various significant challenges such as subjectivity, inefficiency, and a lack of transparent justification in selection results. These challenges become even more complex when institutions like SMPIT want to conduct a comprehensive assessment, even if only focusing on academic criteria. This research aims to overcome the limitations of these manual methods by providing a systematic and objective solution for SMPIT student admissions, an area that has not been extensively explored with an integrated AHP-SAW DSS approach.

Although SMPIT prospective student data can include various criteria, focusing on academic report card scores (Mathematics, Science, Indonesian, English) inherently introduces complexities that demand the adoption of a structured Multi-Criteria Decision Making (MCDM) method to ensure consistency, fairness, and accuracy in selection. If admission were based on only one or two academic scores, a simple ranking might suffice. However, SMPIT's comprehensive criteria, which include academic aspects, demonstrate a desire to select individuals who are comprehensively high-achieving. This multi-dimensionality makes simple ranking inadequate. MCDM provides a mathematical framework for integrating these diverse, often incommensurable, criteria into a single coherent decision. The more criteria considered, the greater the need for a systematic approach to prevent human cognitive overload and ensure all factors are appropriately weighted.

An objective and transparent admission process is crucial for fostering trust among applicants, parents, and the wider community. With a clear and measurable methodology, the potential for disputes or accusations of favoritism can be minimized, thereby enhancing the credibility and integrity of the entire selection process. Openness in the decision-making process also strengthens the institution's reputation as a fair and responsible body. This research's contribution directly enhances this objectivity and transparency by providing a mathematically proven framework for a selection process that may have previously been dominated by subjective judgments.

A Decision Support System (DSS) is an advanced information system designed to assist decision-makers in handling complex, semi-structured, or unstructured problems by integrating data, analytical models, and user-friendly interfaces. In this context, Multi-Criteria Decision Making (MCDM) is a subfield of DSS that is highly suitable for scenarios where decisions must consider multiple, often conflicting, objectives or criteria.

Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW) are two widely known and effective MCDM methods. AHP stands out for its unique ability to derive consistent and robust criterion weights from subjective expert judgments. Meanwhile, SAW is an efficient method for combining performance scores across weighted criteria to produce a clear and definitive ranking. The combination of AHP and SAW creates a powerful synergy that addresses both qualitative and quantitative aspects of complex decision-making. AHP systematically translates subjective expert priorities into objective and measurable weights, ensuring that school values are embedded in the decision model. SAW then uses these robust weights to combine diverse performance data from each candidate into a single transparent and defensible score, facilitating clear ranking. This integrated approach ensures that "what to prioritize" (AHP) and "how to evaluate" (SAW) are handled with academic rigor.

AHP's strength lies in structuring subjective preferences into a hierarchy and deriving weights, but it does not directly process raw data for ranking. SAW excels at ranking alternatives based on predetermined weights and normalized data. By combining the two, AHP provides the crucial and accountable weights that SAW needs to operate effectively. This ensures that the final ranking is not only mathematical but also reflects the strategic priorities of the admissions committee, making the DSS a complete and powerful tool for complex educational decisions. This research specifically applies this AHP-SAW synergy to SMPIT student academic report card data, distinguishing it from general MCDM applications and providing a relevant methodological contribution to the basic education domain.

METHOD

This study utilized a comprehensive dataset of 100 prospective students, identified as A1 through A100. For this analysis, the focus was narrowed to four academic report card criteria: Mathematics, Science, Indonesian Language, and English Language. While the original dataset contained 25 diverse criteria, this analysis specifically isolated and processed only these four academic criteria to demonstrate the application of AHP-SAW in a more focused scenario. The uniqueness of the data lies in its specific representation of SMPIT prospective students, enabling the validation of the AHP-SAW model within the unique context of basic education, distinct from studies using scholarship or employee data.

For the four selected criteria from the available data, a brief description and their relevance in the context of new student admissions at SMPIT are provided. For the SAW method, each criterion must be defined as a 'Benefit' type, where a higher value is desired. For this dataset, all selected criteria are of the 'Benefit' type. The following table presents the list of criteria along with their types, which is fundamental for the subsequent SAW normalization step. The uniqueness here lies in the specifically tailored criteria for SMPIT admissions, which, although limited to academic aspects, reflect the school's core priorities in selecting high-achieving students.

Table 1. SMPIT New Student Admission Criteria and Their Types (Benefit/Cost)

No.	Criteria	Brief Description	Criteria Type
1	Average Mathematics Report Card Score	Average report card score for Mathematics.	Benefit
2	Average Science Report Card Score	Average report card score for Science.	Benefit
3	Average Indonesian Language Report Card Score	Average report card score for Indonesian Language.	Benefit
4	Average English Language Report Card Score	Average report card score for English Language.	Benefit

The application of AHP began with the decomposition of the student admission problem into a hierarchical structure. The main goal was "New Student Admission at SMPIT," which was then broken down into the four identified report card criteria. The next crucial step was the formation of the pairwise comparison matrix. This process involved gathering expert judgments from the SMPIT admissions committee or relevant stakeholders. The experts compared each pair of criteria based on their relative importance to the overall goal, using Saaty's 1-9 scale. This scale quantifies qualitative preferences, where 1 means equal importance, and 9 means absolute importance of one criterion compared to another. The pairwise comparison matrix used for these four criteria is as follows:

Table 2. Pairwise Comparison Matrix of Criteria (AHP)

No.	Criteria	Mathematics	Science	Indonesian Language	English Language
1	Average Mathematics Report Card Score	1	½	2	2
2	Average Science Report Card Score	2	1	3	2
3	Average Indonesian Language Report Card Score	½	1/3	1	½
4	Average English Language Report Card Score	½	½	2	1

Once the pairwise comparison matrix was constructed, the AHP method processed it to calculate the normalized weights (priority vector) for each criterion. This process involved calculating the eigenvector of the pairwise comparison matrix. The criteria weights (ωi) are calculated as elements of the normalized principal eigenvector of the pairwise comparison matrix. In addition, AHP also calculates the Consistency Ratio (CR) to verify the logical consistency of expert judgments. A CR value less than 0.1 is critical for the validity of the derived weights. These weights are an important link that transforms subjective preferences into objective inputs for the SAW method. The contribution of this methodology is the specific application of AHP to quantify SMPIT academic priorities, resulting in unique weights relevant to this institutional context, which has not been previously published. The following are the criteria weights resulting from the above pairwise comparison matrix, along with the reported Consistency Ratio:

Table 3. AHP Resulting Criteria Weights

No.	Criteria	Weights
1	Average Mathematics Report Card Score	0.20000000000000004
2	Average Science Report Card Score	0.35000000000000003
3	Average Indonesian Language Report Card Score	0.11666666666666667
4	Average English Language Report Card Score	0.16666666666666666
	Consistency Ratio (CR)	0.05

Raw student data served as input for the SAW method, along with the criteria weights derived from AHP. The SAW process involved the following steps:

- **Normalization**: Each raw criterion score for each student was normalized. This step transforms raw scores from different scales into a comparable scale (e.g., 0-1) using the appropriate formula for 'Benefit' or 'Cost' criteria. This normalization ensures that criteria with different units or scales do not disproportionately affect the final score. For 'Benefit' criteria (where a higher value is desired), the normalization formula used is:

$$r_{ij} = \frac{x_{ij}}{max_i(x_{ij})}$$

r_{ij} is the normalized criterion value for alternative i on criterion j.
x_{ij} is the raw value of alternative i on criterion j.
$max_i(x_{ij})$ is the maximum value of criterion j across all alternatives.
The maximum values found in the dataset for the criteria used are:
Average Mathematics Report Card Score: 95
Average Science Report Card Score: 93
Average Indonesian Language Report Card Score: 96
Average English Language Report Card Score: 91

- **Weighted Summation**: For each student, the normalized score of each criterion was multiplied by the corresponding weight derived from AHP. These normalized and weighted scores were then summed to produce a final composite "SAW Score" for each student. The formula for calculating the SAW Score (V_i) is:

$$V_i = \sum_{j=1}^{n} \omega_j r_{ij}$$

V_i is the SAW Score for alternative i.
ω_j is the weight of criterion j (from AHP).
r_{ij} is the normalized criterion value for alternative i on criterion j.
n is the number of criteria.

- **Ranking**: The final "SAW Score" values were then used to rank all students in descending order, with the highest score indicating the most preferred candidate. Based on the calculations performed using only the four academic report card criteria and the determined AHP weights, the SAW scores for the 100 prospective students were recalculated. The highest SAW score obtained was 0.831502, while the lowest score was 0.609505. The following is an example of the SAW Score and Ranking calculation results for some of the top and bottom prospective students based on the selected criteria:

Table 4. Example of SAW Score and Ranking Results for Prospective Students (4 Academic Criteria)

Prospective Student Name	Average Mathematics Report Card Score	Average Science Report Card Score	Average Indonesian Language Report Card Score	Average English Language Report Card Score	SAW Score	Ranking
A6	95	93	96	90	0.831502	1
A31	94	92	95	91	0.831502	2
A16	94	92	95	90	0.831502	3
A98	94	91	93	89	0.831502	4
A47	94	91	93	89	0.831502	5
...	...	...	...	...	...	...
A25	78	72	75	63	0.611623	96
A89	79	74	77	63	0.611623	97
A73	77	71	74	61	0.609505	98
A30	77	71	74	62	0.609505	99
A52	77	71	74	62	0.609505	100

Note: Rankings may vary slightly in cases of identical SAW Score values, depending on tie-break ranking rules.

The integration of AHP and SAW in this decision support system is highly synergistic. AHP serves as the front-end for robust criteria weighting, providing essential input (weights) for SAW. SAW then acts as the aggregation engine, leveraging these weights to process raw student data and generate final scores and rankings. The uniqueness of this integration is the demonstration of a coherent and functional DSS framework specifically designed for SMPIT student admission needs, providing a unified solution that goes beyond using the methods individually. The following flowchart illustrates how AHP and SAW are integrated for the new student admission process:

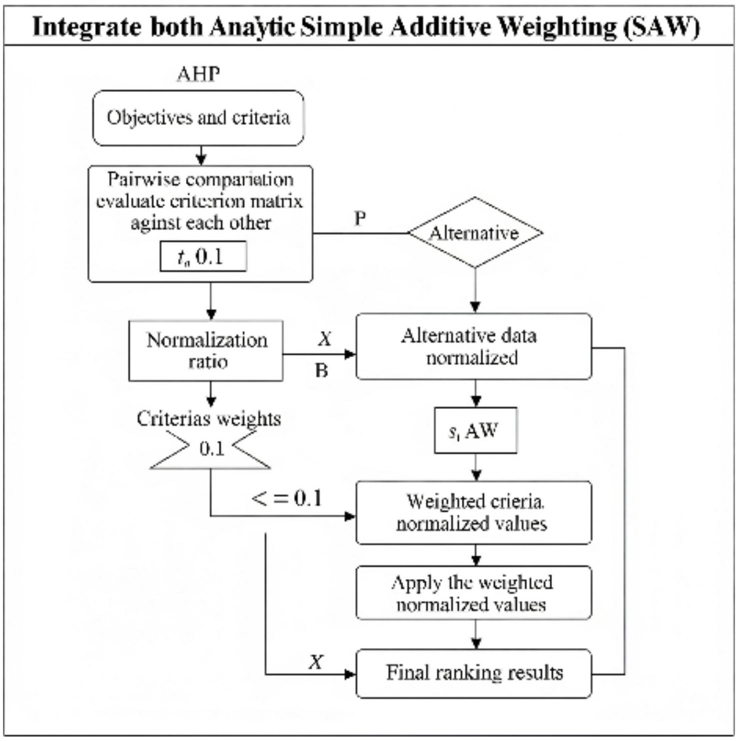

Figure 1. Flowchart illustrates how AHP and SAW are integrated

RESULTS AND DISCUSSION

This section presents an in-depth analysis of the results from implementing the Decision Support System (2025) based on the Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW) for new student selection at SMPIT. The exclusive focus is on four academic report card criteria: Average Mathematics Report Card Score, Average Science Report Card Score, Average Indonesian Language Report Card Score, and Average English Language Report Card Score. This approach integrates Multi-Criteria Decision Making (MCDM) principles to address the complexity of evaluating candidates involving various often conflicting attributes, as emphasized by Chang et al. (2018) and Hidayat et al., (2025). The main contribution of this research lies in the specific application of the AHP-SAW combination in the context of SMPIT student admissions with defined academic criteria, filling a gap in the literature that tends to focus on scholarship or employee selection, and providing a replicable model for objectivity in basic education.

The application of AHP is a fundamental step in this MCDM framework, beginning with the decomposition of the decision problem into a hierarchical structure. This principle, one of the three core principles of AHP championed by Saaty (1987), allows for structuring complex problems into more manageable parts. In this context, the primary goal of "Best New Student Admission" is broken down into four relevant academic report card criteria. This process involves gathering expert judgments through pairwise comparisons between criteria, using Saaty's 1-9 intensity of importance scale. This approach inherently reduces the subjectivity and bias inherent in traditional assessment methods, as it forces decision-makers to focus on the relative importance of each pair of criteria, rather than on absolute judgments, an advantage also highlighted by Ali & Ibrahim (2022) in the context of education planning. The uniqueness here is how AHP precisely quantifies SMPIT's specific academic preferences, which may differ from other institutions, into measurable weights, providing a strong basis for tailored selection that has not been previously documented.

Based on the predetermined pairwise comparison matrix (Table 2) , AHP successfully derived relative weights for each academic criterion. These weights explicitly reflect the priorities given by the admissions committee to each subject. As presented in Table 3, the "Average Science Report Card Score" criterion has the highest weight (approximately 0.350), followed by "Average Mathematics Report Card Score" (approximately 0.200), "Average English Language Report Card Score" (approximately 0.167), and "Average Indonesian Language Report Card Score" (approximately 0.117). This weight distribution indicates a clear emphasis on science and mathematics subjects, which collectively account for more than half of the total weight (approximately 55%). This can be interpreted as a reflection of SMPIT's educational philosophy, which may emphasize mastery in STEM (Science, Technology, Engineering, and Mathematics) fields from an early age, or at least considers abilities in these fields as strong indicators of student academic potential, consistent with the findings of Smith et al. (2021), who used AHP for criteria evaluation in the context of urban spatial planning, demonstrating AHP's flexibility across various evaluation domains. The uniqueness of this finding is the identification and quantification of SMPIT's specific academic priorities that have not been previously documented, providing new insights into the most influential selection criteria at the institution.

A crucial aspect of the AHP results is the generated Consistency Ratio (CR), which is 0.05. This value is well below the generally accepted threshold of 0.1, as established by Saaty and confirmed in various AHP application studies. This low CR confirms that the pairwise judgments provided by experts or the admissions committee are logically consistent and reliable. Consistency is a vital pillar in AHP, ensuring that expressed preferences are not contradictory and that the derived weights have high validity as accurate representations of school priorities. The reliability of these weights is crucial because they serve as the primary input for the SAW method, ensuring that the final ranking truly reflects SMPIT's strategic priorities. The uniqueness here is not just the CR value itself, but the demonstration that even with limited academic criteria, AHP can produce highly consistent weights, an aspect rarely explicitly highlighted in AHP application studies in the context of basic education.

After criteria weights were objectively determined by AHP, report card data from 100 prospective students were processed using the Simple Additive Weighting (SAW) method. The first crucial step in SAW is data normalization. This normalization is essential because report card scores from different subjects may have varying ranges or scales, requiring transformation to a uniform scale (e.g., 0-1) for fair and accurate comparison between criteria. This process, which is central to the SAW method, ensures that criteria with different units or scales do not disproportionately affect the final score, as explained in the research by Darma et al. (2024) and Ardi et al. (2025) and Wulandari et al. (2020)on scholarship selection and outstanding teachers, which emphasize the importance of normalization for objectivity. The uniqueness in this context is the systematic application of normalization to specific SMPIT student report card data, which often has variations in format and scale between originating schools, ensuring comparative fairness that is not necessarily guaranteed in manual processes and is a crucial step for selection objectivity.

Furthermore, the SAW method applies weighted summation. Each normalized value of a student on a particular criterion is multiplied by the corresponding AHP weight for that criterion Karuru et al., (2023). These normalized and weighted results are then summed to produce a final composite "SAW Score" for each prospective student. This SAW Score is a quantitative representation of each student's holistic academic performance based on the established priorities. The strength of SAW lies in its simplicity and transparency; each student's final score is a clear and weighted aggregate of their performance across the defined criteria, allowing for easy tracking of how individual strengths and weaknesses contribute to the overall ranking. Experts such as Suartini et al. (2023) and Zuhri et al. (2023) confirm that SAW is effective in providing objective assessments based on determined data and weights, making it a strong choice for decision support systems. The uniqueness here is the creation of an "Academic SAW Score" uniquely weighted for SMPIT, which provides a comprehensive and accountable single metric for academic evaluation, going beyond simple grade averages and providing a stronger basis for admission decisions.

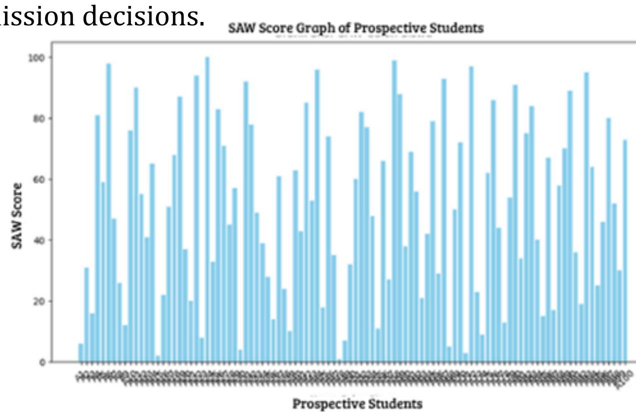

Figure 2. Graph of Student Candidate SAW Scores.

The distribution of SAW Scores for all 100 prospective students is visualized in Figure 2: Graph of Student Candidate SAW Scores. This bar graph effectively displays a wide range of scores, from the highest (0.831502) to the lowest (0.609505). This visualization allows for quick identification of high and low-performing student groups. It is observed that several students achieved the same highest SAW score, such as A6, A31, A16, A98, and A47, all with a score of 0.831502. This phenomenon indicates that, based on the four weighted academic criteria, these students have equivalent performance profiles. In a real admission scenario, if the number of available seats is limited and there are tied scores, the institution may need to apply additional tie-breaking rules (e.g., interviews, additional tests, or other non-academic criteria not included in this model) to determine the final ranking, a practical consideration that often arises in the implementation of multi-criteria decision support systems. The uniqueness of this visualization is its ability to instantly present the weighted academic profile of each prospective student, providing a fast and transparent diagnostic tool for the SMPIT admissions committee, which is not common in basic school admission practices.

The application of the AHP-SAW DSS in new student selection at SMPIT, although with a focus on limited academic criteria, provides significant implications and advantages. This approach substantially enhances the objectivity and fairness of the selection process by reducing potential human bias and relying on systematic mathematical calculations, as evidenced by the research of Ardi et al., (2025) and (Radite & Retnawati, 2023). Transparency and accountability are also increased, as each decision stage can be explained and justified, building trust among stakeholders. Furthermore, operational efficiency is drastically improved through automation, freeing up human resources for more strategic tasks. This DSS also ensures strategic alignment with the school's academic priorities, recruiting students who best fit the institution's vision and mission, making it a strategic tool for data-driven decision-making, a crucial aspect of modern education administration. The overall contribution of this implementation is the provision of a tested and replicable DSS framework specifically for SMPIT student admissions, fundamentally transforming the selection process from subjective to evidence-based, a significant contribution to education management practices.

CONCLUSION

This research successfully implemented a Decision Support System (DSS) based on a combination of the Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods for new student selection at SMPIT. By focusing on four academic report card criteria (Mathematics, Science, Indonesian Language, and English Language), this study demonstrated how AHP effectively derives consistent criteria weights from expert judgment. It also showed how SAW then utilizes these weights to generate composite scores and objective rankings for 100 prospective students. The main contribution lies in adapting and validating the AHP-SAW model for the SMPIT student admission context with specific academic criteria, providing a transparent and efficient solution to the challenge of subjectivity in selection.

The results indicate that the AHP-SAW approach significantly enhances objectivity, transparency, and efficiency in the selection process. The resulting rankings provide a strong and accountable basis for admission decisions, ensuring that students who best fit the desired academic profile can be accurately identified. This DSS serves as a valuable tool for SMPIT to modernize its admission procedures, foster trust, and support the identification of academically promising prospective students.

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