# Decision Support System for Selection of Outstanding Students Using the AHP and SAW Methods

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ABSTRACT

It is very important for outstanding students to be directed and guided to get coaching related to the development of each student's personal potential so that superior and quality students are created. The process of selecting outstanding students can get wrong decisions because the process of selecting outstanding students is based on subjectivity, this allows many selected outstanding students not to reach the desired standard and do not get the best candidates. Therefore, a decision support system was created that can carry out the calculation process for all selections for the selection of outstanding students. This final project will implement the AHP and SAW methods in forming a system. The stages are carried out by comparing feature weights with the AHP method. Then the next stage is to rank using the SAW method to get selected outstanding students. Of the 72 students who were selected from the school, they were then selected to become 20 outstanding students based on the highest-ranking order. Software testing is done by comparing the results of school calculations with system calculations. Based on the results of the tests carried out, an accuracy value of 80% was obtained.

## 1. Introduction

To produce superior and quality students, outstanding students need to get coaching related to the development of each student's personal potential [1]. As a result, this activity is carried out by considering student achievement. However, the method of selecting outstanding students is still manual, so it is less effective and efficient because the process is long. In these problems to make it more effective and efficient a Decision Support System (DSS) is needed. The decision support system can carry out weighting and ranking so that it can help SMA NEGERI 16 PALEMBANG teachers in selecting outstanding students. The Analytical Hierarchy Process (AHP) method can do weighting to determine the selection of choices and alternatives. The purpose of the assessment or weighting is to compare the value or character of the choices based on each existing criterion, so that the level of importance of each criterion can be known in achieving the goals that have been set [7]. The weighted sum method is also known as the Simple Additive Weighting (SAW) method. Is a strategy that can find the total weight of the performance rating on each alternative on all attributes. The results are presented as an alternative series value, from highest to lowest. The Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods were combined in this study to form a decision support system for selecting outstanding students. In relation to this foundation, research is directed at producing programs that can weight and rank outstanding students using the Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW) methods.

## 2. Literature Study

### a. Decision Support System

A Decision Support System (DSS) or Decision Support System (DSS) is a system that can help solve problems in semi-structured and unstructured conditions and communicate effectively. In semi-structured and unstructured situations, where no one is sure how decisions should be made, these systems are used to help people make decisions[4].

### b. Selection of Outstanding Students

To produce superior and quality students, outstanding students need to get coaching related to the development of each student's personal potential[1]. With the current advances in technology, the selection of outstanding students can be applied to software in order to minimize errors made.

### c. Analytic Hierarchy Process (AHP)

Dr. Thomas L. Saaty introduced the AHP method in the early 1970s. At that time, AHP was used to assist governments and businesses in making decisions[4]. This framework simplifies and speeds up the decision-making process with complex issues by organizing these issues into parts or variables in a hierarchical structure, assigning numerical values to the subjective assessment of the importance of each variable, and synthesizing the various considerations. to determine which variables have the greatest impact on the outcome of the situation and prioritize them[2].

The following are the steps carried out in the AHP method :

1. Identify the problem and desired solution.

2. Create a hierarchical structure starting with the main objective.

3. Create a pairwise comparison matrix that describes the relative contribution or influence of each element on the objectives or criteria at the level above it.

4. Defines pairwise comparisons so that the total number of assessors is n x [(n-1)/2], where n is the number of elements being compared.

5. Calculate the eigenvalues and test the consistency, if the consistency value is not equal to 1 then the calculation is repeated.

6. Calculating the eigenvectors of each pairwise comparison matrix which is the weight of each element of each element for determining the priority of elements at the lowest hierarchical level to reach the goal[3].

After doing the steps above, we do the consistency test as follows:

1. Multiply each value in the first column by the relative priority of the first element, the value in the second column by the relative priority of the second element, and so on.

2. Add up each row.

3. The result of the sum of the rows is divided by the corresponding relative priority element.

4. Add up the quotient above with the number of elements present, the result is called λmax.

5. Calculate the Consistency Index with the formula: $Ci = \frac{\lambda\,maks - n}{n - 1}$

6. Calculate the consistency ratio (CR) with the formula: $CR = \frac{Ci}{IR}$

If the consistency ratio (CR) $\leq 0.1$, then the calculation results can be declared correct.

### d. Simple Addictive Weighting (SAW)

The weighted sum method is another name for the SAW method. Finding the weighted sum of the performance ratings for each alternative across all attributes is the basic idea behind the SAW method. After the AHP method, the SAW algorithm uses the normalized matrix formed by the

results of the normalized performance rating values to obtain the eigenvector values and performs the ranking process by multiplying the normalized matrix with preference weight values [6].

SAW steps as follows [10] :

1. Determine the criteria especially Cj which will be the basis for decision making.
2. Determine the weight value of each criterion.
3. Determine how suitable each alternative is for each criterion.
4. After determining the decision matrix based on the criteria (Cj), normalize the matrix using the equation that has been adjusted to take into account the type of attribute in order to obtain a normalized matrix (R).

Provide preference value for each alternative (Vi)

$$R_{ij} \begin{cases} \dfrac{X_{ij}}{Max\ X_{ij}} \\ \dfrac{Min\ X_{ij}}{X_{ij}} \end{cases}$$

$$Vi = \sum_{j=1}^{n} (W_j R_{ij})$$

Information :

$R_{ij}$ = normalized performance rating

Max $X_{ij}$ = maximum value of each row and column

Min $X_{ij}$ = minimum value of each row and column

$X_{ij}$ = rows and columns of the matrix

Vi = Rank for each alternative

Wj = The weight value of each criterion

Rij = Normalized performance values

The ranking process produces the final result, namely the sum of the weight vectors and the normalized matrix R multiplied together, with the largest value being chosen as the best solution.

### e. Rational Unified Process (RUP)

Software development with a disciplined approach in carrying out each task and responsibility within an organization is known as the Rational Unified Process (RUP). RUP itself aims to meet the needs of all interested parties, including time and costs, according to a predetermined plan and guarantee high-quality production [5]. With activities that focus on model development using the Unified Model Language (UML), RUP uses object-oriented design ideas.

### f. Relevance Research

In connection with previous studies on decision support systems web-based lending[9] The standard amount will be determined using the Analytical Hierarchy Process (AHP) method, and customer credit calculation data will be processed using Simple Additive Weighting (SAW) before a final decision is made. Accuracy testing is carried out once the system is built, and 100% accurate. System functionality is excellent as a result of black box testing.

The Analytical Hierarchy Process (AHP) method has become research material decision support system for selecting outstanding lecturers[8] The high presentation value reached 66.3% on the implementation results based on questionnaire data for system suitability, and users have no difficulty in using the system, resulting in value presentation of 71%.

## 3. Methodology

### a. Datasets

Using a dataset obtained from SMA Negeri 16 Palembang. It consists of 72 student data with 4 criteria namely: knowledge value, skill value, extracurricular value, and attitude value.

### b. Software Architecture

in carrying out software development steps with clear stages are needed. The software architecture framework can be seen in Figure 1.



**Fig. I.** Software General Process Flow Diagram

### c. Test Criteria

In this study, the data used in the selection of outstanding students at SMA Negeri 16 Palembang with 4 criteria which included: Knowledge Value, Skill Score, Extracurricular Value, and Attitude Value. The data is processed using a combination of the AHP and SAW methods to produce the best alternative in selecting outstanding students. The next step is to analyze and evaluate the results of combined calculations using the AHP and SAW methods, by comparing the resulting accuracy with manual calculations.

### d. Determine Research Aid

In research decision support system selection of outstanding students using a combination of AHP and SAW methods, a tool is needed assist the research process. The tools used can be seen as following :

*Hardware*

Processor          : Intel(R) Core(TM) i3-4030U CPU @ 1.90GHz   1.90 GHz

RAM               : 6GB

HDD               : 1 TB

*Software*

Operating system  : Windows 10, 64-bit

Text Editor       : Visual Studio Code

## 4. Result and Discussion

Testing was carried out by entering 72 data manually, which would be used in a decision support system to rank the potential of outstanding students. From the 72 student data will be selected to be 20 students with the highest ranking. Then the results of the ranking of the decision support system will be compared with the results of the ranking carried out by SMA Negeri 16 Palembang, to ensure the accuracy of the decision support system.

**Table 1.** Ranking Results Between the System and the School

| No | Name | C1 | C2 | C3 | C4 | School Calculations | System Calculations | Compatibility |
|----|------|-----|-----|----|----|---------------------|---------------------|---------------|
| 1 | STUDENT 1 | 82,93 | 83,79 | B | B | 1 | 1 | T |
| 2 | STUDENT 2 | 86,14 | 86,21 | A | B | 2 | 3 | F |
| 3 | STUDENT 3 | 82,36 | 83,07 | B | B | 3 | 2 | F |
| 4 | STUDENT 4 | 86,79 | 87,00 | A | B | 4 | 4 | T |
| 5 | STUDENT 5 | 81,64 | 82,79 | A | B | 5 | 5 | T |
| 6 | STUDENT 6 | 86,14 | 86,57 | A | B | 6 | 6 | T |
| 7 | STUDENT 7 | 82,86 | 83,86 | B | B | 7 | 7 | T |
| 8 | STUDENT 8 | 86,71 | 86,79 | A | B | 8 | 8 | T |
| 9 | STUDENT 9 | 86,14 | 86,79 | A | B | 9 | 9 | T |
| 10 | STUDENT 10 | 84,21 | 85,14 | B | B | 10 | 10 | T |
| 11 | STUDENT 11 | 84,07 | 84,50 | B | B | 11 | 11 | T |
| 12 | STUDENT 12 | 85,79 | 86,14 | A | B | 12 | 12 | T |
| 13 | STUDENT 13 | 82,93 | 84,21 | A | B | 13 | 13 | T |
| 14 | STUDENT 14 | 84,43 | 85,21 | B | B | 14 | 14 | T |
| 15 | STUDENT 15 | 87,64 | 88,07 | A | B | 15 | 15 | T |
| 16 | STUDENT 16 | 83,64 | 84,79 | A | B | 16 | 17 | F |
| 17 | STUDENT 17 | 83,21 | 83,43 | B | B | 17 | 16 | F |
| 18 | STUDENT 18 | 85,21 | 85,00 | B | B | 18 | 18 | T |
| 19 | STUDENT 19 | 84,79 | 85,64 | A | B | 19 | 19 | T |
| 20 | STUDENT 20 | 85,14 | 85,43 | B | B | 20 | 20 | T |
| 21 | STUDENT 21 | 83,43 | 84,14 | B | B | 21 | 21 | T |
| 22 | STUDENT 22 | 82,79 | 83,79 | A | B | 22 | 22 | F |
| 23 | STUDENT 23 | 86,36 | 87,00 | A | B | 23 | 24 | F |

| 24 | STUDENT 24 | 89,00 | 89,07 | A | B | 24 | 23 | F |
|----|-----------|-------|-------|---|---|----|----|---|
| 25 | STUDENT 25 | 84,86 | 85,50 | A | B | 25 | 25 | F |
| 26 | STUDENT 26 | 84,50 | 84,21 | B | B | 26 | 26 | F |
| 27 | STUDENT 27 | 86,00 | 85,71 | B | B | 27 | 27 | F |
| 28 | STUDENT 28 | 83,21 | 84,36 | B | B | 28 | 29 | F |
| 29 | STUDENT 29 | 82,93 | 83,93 | B | B | 29 | 28 | F |
| 30 | STUDENT 30 | 85,29 | 86,07 | B | B | 30 | 31 | F |
| 31 | STUDENT 31 | 84,50 | 85,29 | A | B | 31 | 30 | F |
| 32 | STUDENT 32 | 83,86 | 84,79 | A | B | 32 | 32 | F |
| 33 | STUDENT 33 | 86,43 | 86,86 | A | B | 33 | 33 | F |
| 34 | STUDENT 34 | 85,36 | 85,21 | A | B | 34 | 34 | F |
| 35 | STUDENT 35 | 84,07 | 84,79 | A | B | 35 | 36 | F |
| 36 | STUDENT 36 | 86,29 | 86,29 | B | B | 36 | 35 | F |
| 37 | STUDENT 37 | 84,14 | 84,14 | A | B | 37 | 37 | F |
| 38 | STUDENT 38 | 85,29 | 84,57 | A | B | 38 | 38 | F |
| 39 | STUDENT 39 | 82,93 | 82,57 | B | B | 39 | 39 | F |
| 40 | STUDENT 40 | 83,57 | 83,43 | B | B | 40 | 42 | F |
| 41 | STUDENT 41 | 86,21 | 85,79 | B | B | 41 | 40 | F |
| 42 | STUDENT 42 | 82,43 | 82,50 | B | B | 42 | 41 | F |
| 43 | STUDENT 43 | 88,07 | 87,50 | A | B | 43 | 45 | F |
| 44 | STUDENT 44 | 85,57 | 85,36 | B | B | 44 | 43 | F |
| 45 | STUDENT 45 | 86,64 | 86,43 | A | B | 45 | 44 | F |
| 46 | STUDENT 46 | 83,86 | 84,29 | A | B | 46 | 46 | F |
| 47 | STUDENT 47 | 87,50 | 87,07 | A | B | 47 | 47 | F |
| 48 | STUDENT 48 | 84,43 | 84,14 | A | B | 48 | 48 | F |
| 49 | STUDENT 49 | 85,43 | 85,21 | B | B | 49 | 49 | F |
| 50 | STUDENT 50 | 84,43 | 84,29 | B | B | 50 | 50 | F |
| 51 | STUDENT 51 | 86,79 | 86,36 | B | B | 51 | 51 | F |
| 52 | STUDENT 52 | 82,57 | 82,43 | A | B | 52 | 52 | F |
| 53 | STUDENT 53 | 86,21 | 86,00 | A | B | 53 | 53 | F |

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| 54 | STUDENT 54 | 87,93 | 87,29 | B | B | 54 | 54 | F |
|----|-----------|-------|-------|---|---|----|----|---|
| 55 | STUDENT 55 | 82,71 | 83,00 | A | B | 55 | 55 | F |
| 56 | STUDENT 56 | 83,64 | 83,14 | A | B | 56 | 57 | F |
| 57 | STUDENT 57 | 83,07 | 82,93 | A | B | 57 | 56 | F |
| 58 | STUDENT 58 | 86,29 | 85,36 | A | B | 58 | 58 | F |
| 59 | STUDENT 59 | 84,00 | 83,93 | A | B | 59 | 59 | F |
| 60 | STUDENT 60 | 85,64 | 85,50 | A | B | 60 | 60 | F |
| 61 | STUDENT 61 | 85,00 | 84,93 | A | B | 61 | 61 | F |
| 62 | STUDENT 62 | 83,43 | 83,21 | A | B | 62 | 62 | F |
| 63 | STUDENT 63 | 83,71 | 84,07 | A | B | 63 | 63 | F |
| 64 | STUDENT 64 | 84,57 | 84,43 | A | B | 64 | 64 | F |
| 65 | STUDENT 65 | 82,14 | 82,36 | B | B | 65 | 65 | F |
| 66 | STUDENT 66 | 84,71 | 84,50 | B | B | 66 | 67 | F |
| 67 | STUDENT 67 | 83,29 | 83,36 | A | B | 67 | 68 | F |
| 68 | STUDENT 68 | 87,00 | 86,86 | A | B | 68 | 66 | F |
| 69 | STUDENT 69 | 85,50 | 85,57 | A | B | 69 | 69 | F |
| 70 | STUDENT 70 | 88,43 | 88,00 | B | B | 70 | 70 | F |
| 71 | STUDENT 71 | 83,64 | 84,00 | B | B | 71 | 71 | F |
| 72 | STUDENT 72 | 87,14 | 86,86 | A | B | 72 | 72 | F |

From the table above it can be seen that the true value is 16, which is said to be true if the ranking condition of the system is equal to the top 20 of the school, which means that the system has succeeded in ranking and is in accordance with the results of the ranking carried out by the school. As for the rest which are false, there are other assessments from the school which result in different ranking results from the system. Therefore, an accuracy value of 80% is obtained based on the results of the accuracy calculation.

From the results that have been done, the decision support system can rank the results according to the school. Where the data tested amounted to 72 data with an accuracy rate of 80%. The number of test data samples can affect the accuracy of the decision support system.

## 5. Conclusion and Recommendation
### a. Conclusion

The following conclusions can be drawn from the results of the research and analysis have been done:

1. Website decision support system that has been built with using the Analytical Hierarchy Process (AHP) and Simple methods Additive Weighting (SAW), the AHP method itself does the testing against the criteria that have been inputted, then the SAW method itself do the ranking to get the best alternative. So that can provide recommendations in the form of rankings that can be used to select outstanding students.

2. Based on the level of accuracy in the results of the Analytical Hierarchy method Process (AHP) and Simple Additive Weighting (SAW) in selection achievement students at SMA Negeri 16 Palembang using 72 student data is 80%.

## b. Recommendation

This research still has room for improvement. Here are a few suggestions for developing this research:

1. This decision support system can be developed again, because This system only uses 4 criteria, so it can be more detailed add to other criteria so that the system is not static.

2. The system is not only developed for the selection of outstanding students, can be developed for others such as a comparison of service providers, building etc.

## References

[1] Anggoro, D. A., & Supriyanti, W. (2019). Aplikasi Sistem Pendukung Keputusan dengan Metode AHP untuk Pemilihan STUDENT Berprestasi di SMAN Kebakkramat. *Jurnal Penelitian Dan Pengabdian Kepada Masyarakat UNSIQ*, *6*(3), 163–171. https://doi.org/10.32699/ppkm.v6i3.777

[2] Anju, D. A., Agustian, F., & Walid, K. I. (2018). Sistem Pendukung Keputusan Pemilihan Jurusan di SMA dengan Analytic Hierarchy Process (AHP). *Multinetics*, *4*(1), 27. https://doi.org/10.32722/vol4.no1.2018.pp27-33

[3] Dzulhaq, M. I., Sidik, A., & Ulhaq, D. A. (2019). Sistem Pendukung Keputusan Untuk Membandingkan Marketplace Terbaik Dengan Menggunakan Metode AHP Dan AHP. *Academic Journal of Computer Science Research*, *1*(1), 13–22. https://doi.org/10.38101/ajcsr.v1i1.233

[4] Fay, D. L. (1967). SISTEM PENDUKUNG KEPUTUSAN PEMILIHAN STUDENT BERPRESTASI DI MTs SA ASSHIDDIQI DENGAN METODE SAW (SIMPLE ADDITIVE WEIGHTING). *Angewandte Chemie International Edition*, *6(11), 951–952.*, *1110651017*, 1–8.

[5] Hutahaean, D. J., Wardani, N. H., & Purnomo, W. (2019). Pengembangan Sistem Informasi Penyewaan Gedung Berbasis Web dengan Metode Rational Unified Process (RUP) (Studi Kasus: Wisma Rata Medan). *Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer*, *3*(Vol. 3, No. 6, Juni), 5789–5798.

[6] Mahendra, G. S., & Ernanda Aryanto, K. Y. (2019). SPK Penentuan Lokasi ATM Menggunakan Metode AHP dan SAW. *Jurnal Nasional Teknologi Dan Sistem Informasi*, *5*(1), 49–56. https://doi.org/10.25077/teknosi.v5i1.2019.49-56

[7] Prasetyo, L. A. (2018). Sistem Pendukung Keputusan MahaSTUDENT Berprestasi Menggunakan Metode Kombinasi Analytical Hierarchy Process (AHP) dan Simple Additive Weigting (SAW). *STRING (Satuan Tulisan Riset Dan Inovasi Teknologi)*, *3*(2), 130. https://doi.org/10.30998/string.v3i2.3039

[8] Puspitasari, W. D., & Ilmi, D. K. (2016). Sistem Pendukung Keputusan Pemilihan Dosen Berprestasi Menggunakan Metode Analytical Hierarchy Process (Ahp). *ANTIVIRUS: Jurnal Ilmiah Teknik Informatika*, *10*(2), 56–68. https://doi.org/10.30957/antivirus.v10i2.163

[9] Riyanto, R. D., & Yunus, M. (2021). Sistem Pendukung Keputusan Pemberian Kredit Berbasis Web Menggunakan Kombinasi Metode Analytical Hierarchy Process (AHP) dan Simple Additive Weighting (SAW). *Jurnal Manajemen Informatika (JAMIKA)*, *11*(2), 102–117. https://doi.org/10.34010/jamika.v11i2.4936

[10]Santoso, R., & Diana, A. (2020). Sistem Penunjang Keputusan Pemilihan Auditor Terbaik Dengan Metode AHP Dan SAW. *Budi Luhur Information Technology*, *17*(1), 9–16. http://journal.budiluhur.ac.id/index.php/bit/article/view/979