Decision Support System of New Student Admission Using Analytical Hierarchy Process and Simple Additive Weighting Methods

Santosa Wijayanto¹, Darmawan Napitupulu¹,2, Krisna Adiyarta¹, Agus Perdana Windarto³

¹ Program Studi Magister Ilmu Komputer, Universitas Budi Luhur, Jakarta, Indonesia
² Research Center for Quality System and Testing Technology, Indonesian Institute of Sciences, Banten, Indonesia
³ STIKOM Tunas Bangsa, Sudirman Street Pematangsiantar, Medan - Indonesia

* santosawijayanto@gmail.com

Abstract. Selection of qualified prospective students is very important for schools to be able to achieve successful learning in school. Problems will arise if the school is wrong in choosing students who are not in accordance with their abilities. The admission selection process for prospective students in Bintaro Informatics Development Vocational School still uses manual method in calculating grades. Determination of the weight of each criterion is also not used optimally, giving rise to difficulties in selecting prospective students based on their talents and abilities. Schools need a decision support system that can help in making decisions to select new students according to their talents and abilities. The system designed using the Simple Additive Weighting (SAW) method is used for ranking, and to determine the weighting using the Analytical Hierarchy Process (AHP) method. The results of the calculation of the two methods can select prospective students who are accepted in school more precisely and accurately in accordance with the abilities and expertise of students.

1. Introduction
Vocational schools are intended to prepare students not only to continue to a higher level of education, but are more intended to prepare students to enter the workforce. Acceptance of new students in vocational schools is a process of selecting prospective students that are appropriate to the talents, interests and abilities of each chosen department.

The selection process for admission to new students at the Bina Informatika Vocational School is based on the criteria that have been established from the school. The weight values used by each of the criteria determined by this school are the same, so that the percentages obtained are based on the total values of all criteria. Problems will arise in choosing prospective students in schools to be less precise and the calculation of the results of the incoming filter values that are obtained become less accurate. The results of ranking calculations will be much different if each criterion is given a weight score to select prospective new students. The value weight given in each of these criteria aims to help the process of entering the screening exam to generate rankings, thus minimizing school errors in selecting prospective students.

Vocational schools emphasize the weight of the ability and expertise of prospective students a little higher than other criteria, with the aim that prospective students are selected according to their chosen
talents and interests. Incompatibility of abilities and expertise can make prospective students unable to attend classrooms so that they can inhibit teaching and learning activities at school. The limited capacity of each department is also a factor to determine the number of students to be accepted, so the school is expected to select prospective students based on the highest score of each entrance screening test.

Based on the problems that arise in the selection process for new students at school, researchers provide solutions by building a decision support system that can help schools in selecting prospective students. Researchers used the Simple Additive Weighting (SAW) method to determine the ranking of the criteria for each prospective student. The process of calculating the SAW method requires the initial weight of each criterion. The author uses the Analytical Hierarchy Process (AHP) method to determine the initial weight of each criterion.

The purpose of this study is the creation of a decision support system for new students in Bintaro Informatics Development Vocational School using the SAW and AHP methods. This information system is designed to make it easier for schools to make selection decisions for prospective new students based on their talents, interests and abilities. According to Kholdani (2017), the AHP method is used to determine the weight value of each attribute, and SAW is used for the best alternative ranking process from several alternatives used [1]. The AHP method is used for calculating criteria and weighting related to academics, including service, research, guidance and teaching, the SAW method is used for calculating weighting and criteria from several questionnaires from colleagues, students, lecturers and supervisors [1]. Based on research on lecturer performance using the AHP and SAW methods, it can be concluded that the research carried out successfully carried out an alternative ranking of the weighting of lecturer performance appraisal [1]. Calculation of several criteria from students, leaders, peers, and lecturers using the SAW method to provide more fair and objective results for each lecturer performance. The SAW results obtained, being the criteria combined with an internal academic calculation include criteria for service, research, guidance and teaching using the AHP method and the results become a final decision [1].

According to Putra (2016), processing the criteria that exist in schools is used to determine the acceptance of a student can make the right decision in determining the acceptance of new students, and will minimize errors in making a decision [5]. The calculation method uses the SAW method for the ranking process, and the AHP method to determine the weight of each criteria determined by the school [5]. Testing the system accordingly and running as expected, this can be shown in the results of the response test and status according to each test well. testing the suitability of the process, functionality, test the suitability of the input with the output, the feasibility testing of the system, along with the algorithm test [5].

According to Iqbal (2017), decision making in selecting new students uses the SAW method to assist in the ranking process based on the results of the assessment of the criteria that have been set. The application of SAW in supporting this decision will provide advice as a material consideration in deciding which students are eligible to enter the school [4]. Decision Support System (DSS) for New Student Admission using the SAW and AHP methods provides results, namely an alternative that will be the highest order if it has a good value on criteria that have the highest importance [4].

According to Handayani (2014), conducting research on selection of majors with Fuzzy Multiple Attribute Decision Making with the SAW method resulted in the conclusion that the more samples used, the level of validity obtained would tend to rise, and the results of this study were an alternative that had value. the best among alternatives that exist [2]. According to Khuntari (2015), the results of the trial research conducted on the selection of majors in higher education by using AHP showed that the department recommendations were adjusted to the students' abilities, interests, and preferences, as well as user preferences of the criteria and subcriteria used [3].

2. Methodology

The AHP and SAW methods, the researcher will use to determine a recommendation to select prospective students in determining the majors based on their interests, talents, and abilities. Figure 1 shows the process of calculating the AHP and SAW methods [6].
2.1. Normalization of paired matrices
Summing each criterion column in the pairwise comparison matrix that will be used to divide each criterion value from the pairwise comparison matrix with the number of each criterion column.

2.2. Calculating Synthesis Weight.
Synthesis weight is obtained from the sum of each row from the result of normalization of pairwise comparison matrix.

\[ \Sigma \text{Column} = k_1 + k_2 + k_3 + k_4 + k_5 + k_6 \]  

2.3. Calculating Eigen values
The calculation of eigenvalues begins by multiplying the pairwise comparison matrix on one line. This result is raised by 1 / the sum of the existing criteria.

\[ \lambda_1 = \left( k_1 \times k_2 \times k_3 \times k_4 \times k_5 \times k_6 \right)^{\frac{1}{6}} \]  

2.4. Calculate Priority Weight
The results of the calculation of the total sum of the eigenvalues of the eigenvalue are used to calculate the priority weight value. Calculations are performed by each criterion by dividing the eigenvalue of each criterion by the total value of the eigen. The priority weight value from the calculation results will be used to calculate preferences in SAW.

2.5. Calculating Value of Interest and Eigen Max
Calculate the importance of each criterion to obtain the maximum eigenvalues. The value of interest is used to check the CI consistency value and the Consistency Ratio CR value.

2.6. CI and CR Consistency Check
The maximum eigenvalue is used to check the consistency value that is to calculate the CI value. The last process in the AHP method is to calculate the CR value of the CI value divided by RI (Index Random Consistency) based on the number of criteria.
2.7. Alternative Normalization
Normalization is based on an equation that matches the type of attribute, so that it obtains a normalized matrix R.

2.8. Calculating Preference Value (V)
Calculations are based on priority weight values and normalized matrix values.

2.9. Alternative Ranking
Ranking results of preference values obtained from each alternative are sorted from highest to lowest value.

3. Results And Discussion
Decision support system used with the SAW method for selection and AHP to determine the initial weight of each criterion. The criteria used for ranking the alternative model of selecting prospective new students in accordance with the department chosen according to school needs as in Table 1 as follows:

| No | Criteria | Description   |
|----|----------|---------------|
| 1  | C1       | National Test |
| 2  | C2       | Academic Test |
| 3  | C3       | Specialization Test |
| 4  | C4       | Psikotes      |
| 5  | C5       | Interview     |
| 6  | C6       | Physical test |

The initial weight of each criterion is determined using the AHP method. The initial step with the criteria comparison matrix in Table 2 below is used to get the eigen values of each row.

| Criteria | C1     | C2     | C3     | C4     | C5     | C6     |
|----------|--------|--------|--------|--------|--------|--------|
| C1       | 1.0000 | 0.3333 | 0.3333 | 0.3333 | 0.2500 | 0.3333 |
| C2       | 3.0000 | 1.0000 | 0.3333 | 1.0000 | 2.0000 | 2.0000 |
| C3       | 3.0000 | 1.0000 | 1.0000 | 1.0000 | 2.0000 | 2.0000 |
| C4       | 3.0000 | 3.0000 | 1.0000 | 1.0000 | 1.0000 | 2.0000 |
| C5       | 4.0000 | 0.5000 | 0.5000 | 1.0000 | 1.0000 | 2.0000 |
| C6       | 3.0000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 1.0000 |

Based on Table 2, the initial weight that will be used in the criteria for new student admission is C1 = 0.0574, C2 = 0.1894, C3 = 0.2274, C4 = 0.2434, C5 = 0.1687, C6 = 0.1137. The process is continued by determining the value of consistency can be done with the following calculations:

a. Look for the Consistency Index value based on the following calculation formula,

\[ CI = \frac{\lambda_{\text{max}} - n}{n - 1} \]

\[ CI = \frac{6.3850 - 6}{5} = 0.0770 \]

b. Looking for Consistency Ratio based on the following calculation formula,

\[ CR = \frac{CI}{RI} \]
Comparative assessment is said to be consistent if the CR is not more than 0.100, so the assessment of the comparative criteria for new student admissions has been consistent and does not require an assessment revision. After getting the initial weight value from each criterion, the next process is to do calculations using the SAW method. The process of determining ranking using the SAW method requires the initial value of each alternative and can be seen in Table 3 as follows:

| Alternative | Criteria of New Student Admission |
|-------------|-----------------------------------|
|             | C1  | C2      | C3      | C4      | C5      | C6      |
| Adhy        | 0.7692 | 1.0000 | 0.8750  | 0.9091  | 0.7692  | 0.8556  |
| Caren       | 0.8974 | 0.9231 | 0.9091  | 1.0000  | 0.8974  | 0.8667  |
| Darren      | 1.0000 | 0.8590 | 1.0000  | 0.8750  | 1.0000  | 0.8000  |
| Elsa        | 0.9872 | 0.9872 | 0.8750  | 0.8409  | 0.9872  | 1.0000  |
| Farisya     | 0.9871 | 1.0000 | 0.9091  | 0.7614  | 0.9743  | 0.7444  |

Calculation of the weight obtained from the calculation of the AHP method multiplied by the value of each criterion, so that the overall results can be seen in Table 4 below. Examples for the acquisition of prospective students named “Adhy” against C1 criteria (National Test) are as follows:

\[(0.7692 \times 0.0573) + (1.0000 \times 0.1905) + (0.8750 \times 0.2208) + (0.9091 \times 0.2487) + (0.7692 \times 0.1700) + (0.8556 \times 0.1127) = 0.8811\]

| Alternative | C1  | C2  | C3  | C4  | C5  | C6  | Σ Rank |
|-------------|-----|-----|-----|-----|-----|-----|--------|
| Adhy        | 0.0442 | 0.1894 | 0.1990 | 0.2213 | 0.1298 | 0.0973 | 0.8808 | 5     |
| Caren       | 0.0515 | 0.1748 | 0.2067 | 0.2434 | 0.1514 | 0.0985 | 0.9264 | 2     |
| Darren      | 0.0574 | 0.1627 | 0.2274 | 0.2130 | 0.1687 | 0.0910 | 0.9201 | 3     |
| Elsa        | 0.0567 | 0.1870 | 0.1990 | 0.2047 | 0.1665 | 0.1137 | 0.9275 | 1     |
| Farisya     | 0.0567 | 0.1894 | 0.2067 | 0.1853 | 0.1644 | 0.0846 | 0.8871 | 4     |

The calculation results from table 4 above can produce the highest rank, first Elsa with a total value of 0.9275, second Caren with a value of 0.9264, third Darren with a value of 0.9201, fourth Farisya with a value of 0.8871 and fifth Adhy with a value of 0.8808.

4. Conclusion

AHP and SAW methods can be used simultaneously to calculate weighting criteria for admission of new students at school. The AHP method is used to determine the initial weight of the calculation of the criteria set by the school. The results of the initial weight gain will be used by the SAW method to find the selected selection of the best students. Decision support systems using the AHP and SAW methods can help the selection process of new students quickly and precisely based on interests, talents and abilities that match the weighting of each criterion.

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