Artikel

Analysis And Design of Decision Support System in Major Assignment at Buddhi High School Using AHP and SAW Methods

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A B S T R A C T

Education is one of the important factors to fulfill the needs because education can develop various potential in a person. High school is a process of student development. The selection of major in BuddhiHigh School still takes a long time and the result are less accurate because of human error factors, and other factors that influence students such as parents' wishes or follow them, friends. To solve those problems a Decision Support System using the AHP and SAW methods is needed. The AHP and SAW Method require the decision-maker to determine the weight for each attribute. The rating of each attribute must have passed the normalization process of the previous matrix. The result from this system will help students to decide major that suitable with their interest and talents, and also help the school to decide major that suitable according to the appropriate criteria. Calculation with the AHP method has a consistency of 93.96%.

INTRODUCTION

Based on the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 24 of 2016 concerning Core Competencies and Basic Competencies of Learning in the 2013 Curriculum. In the 2013 Senior High School curriculum structure, there are many subjects, subjects are divided into 2, compulsory subjects, and elective subjects. In subjects of choice, students can choose subjects that are of interest and according to their learning abilities. Also, it provides opportunities to develop the potential of students by their talents, interests, and academic potential[1]. The majors in the 2013 Curriculum for High Schools (SMA) are no longer done in class XI, but rather starting in class X. This policy is said by many to be a challenge in its application, both for the school and the students. This is because most students have not fully understood and explored subjects at the high school level so they have not been able to ascertain the desired majors. Also, high school students sometimes choose majors that are not by their abilities, talents, interests and academic achievements. This

might be due to the confusion of students when given majors.

Many of them just follow their friends who choose one of the majors or even submit their choices to their parents. Determination of majors based on these factors will certainly cause students to feel sorry for choosing a course and cause a decline in the quality and academic achievement of students due to the majors not by their talents, interests and academic potential [2] [12].

At Buddhi High School Tangerang has two majors that is Science and Social Sciences. The process of determining this department is based on the report card grades, the results of tests in academic potential, the value of the National Examination on junior high, and student interest.

The current selection process for majors has a drawback, including requiring quite a long time and also the results obtained are less accurate because there could be a lot of errors due to the unavailability of special applications to support these calculations. By using the AHP and SAW methods where the AHP method will be used as a weighting criterion and the SAW method is used as an alternative ranking.

I. LITERATURES REVIEW

In Budi Nugrohojournal, said that the Method (WP) Weighted Product can be implemented in the Decision Support System for Student Majors in Senior High School 1 Grobogan. It can be used to support the student majors process in Grobogan 1 High School based on the best alternative of student achievement scores[3].

In Firliana journal, said that student evaluations using profile matching methods with academic and non-academic criteria can give major recommendations by calculating

the value of student competency Gaps and majors standards according to the criteria weights of each department and paying attention to Core Factors and Secondary Factors. The highest total value from the sum of academic and non-academic criteria is the recommended major. With the application of the department's recommendations can help the Madrasas in evaluating the potential of students[4].

In the journal Supriadi, the author concluded with the existence of a decision support system, the selection of majors in Merangin SMAN 8 students can be done easily and effectively because the department obtained by students in accordance with the interests and abilities of students, and can reduce errors in the selection of majors in students[5].

In the Daniawan journal, that evaluating lecturers' performance in teaching using the AHP and SAW methods can provide a level of consistency 96.75% from the 10 assessment indicators of 28 lecturers teaching 47 courses. By combining these two methods will be able to provide more accurate results and it is very unlikely the lecturers will have the same rating ranking[6].

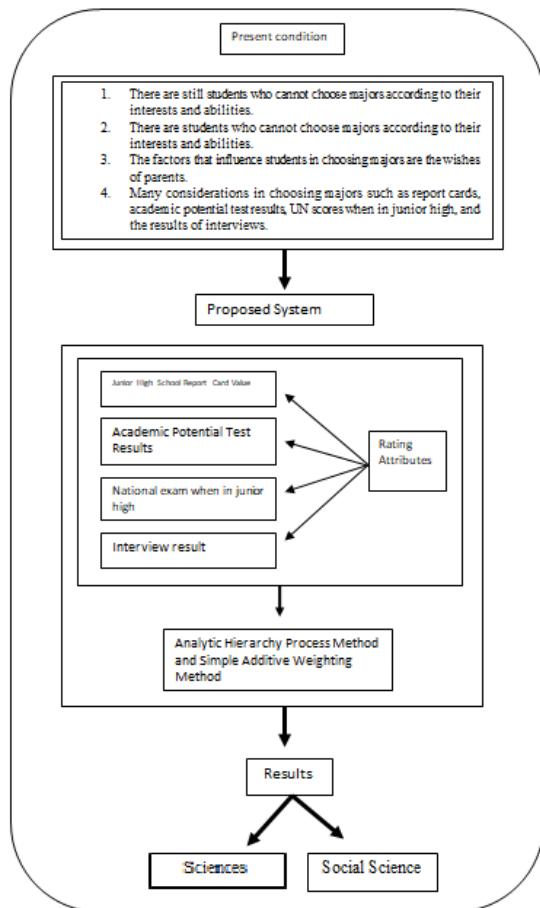## II. FRAMEWORK

The framework as follows:

Figure 1 Framework

III. METHODS

Systems Development Life Cycle (SDLC)

According to Bassil, the SDLC Waterfall Model is a sequential software development process where the process is from top to bottom (such as a waterfall) through the stages that must be carried out for successful software development[7].

a. Analysis Phase

This stage is an analysis of system requirements. The data needed for this analysis phase is obtained from the results of the interview process, questionnaire, and literature study.

a. Design Phase

This stage will process the results of the system requirements analysis into a form of software design, as well as problem-solving (problem-solving) for a device solution.

b. Implementation phase

This stage is the process of changing all system requirements and software design, as well as problem-solving into an educational environment. Where the education environment uses the PHP programming language and MySql database.

c. Testing phase

This stage is the process of testing the system, to find out whether the system is running well by the system and software design

d. Maintenance phase

This stage is a process to correct the errors that occur when the system has been applied.

Analytic Hierarchy Process (AHP)

According to PawelTadeusz and Kazibudzki, Analytic Hierarchy Process (AHP) is a multi-criteria decision making with the support of methodologies that have been recognized and accepted as priorities which in theory can provide different answers to decision-making problems and rank alternative solutions[8].

Following are the steps in AHP according to Saaty :
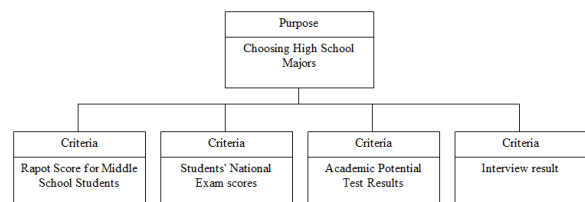
1. Create a hierarchical structure.

Figure 2 Hierarchical structure

2. Define a pairwise comparison, where there is a scale of comparison:

Table 1 Comparison scale

Preference Level	Score
Absolute Very Important	9
Very Important	7
Very important	5
Quite important	3
Equally Important	1
Values between 2 adjacent considerations	2,4,6,8

Source :Satty [9]

3. Normalize data

$$r_{ij} = \sqrt{(ai1)(ai2)\dots\dots(aij)}$$

$$r = \begin{pmatrix} r1 \\ r2 \\ . \\ . \\ . \\ rn \end{pmatrix}$$

According to Marimin, in the AHP method, an iteration is performed at least 3 times, provided that the eigenvalue has not changed to 4 digits behind the comma[10].

4. Calculate Vector Priority and Row Matrix

$$P.V = \frac{r_{ij}}{\sum r_{ij}}$$

5. Calculate Vector Consistency

$$C.V = \frac{Row\ Matrix}{P.V}$$

6. Calculate the eigenvector value

$$\lambda maks = \frac{\sum C.V}{n}$$

7. Estimate Consistency of Index

$$C.I = \frac{(\lambda maks - n)}{(n-1)}$$

8. Calculate the Consistency Ratio (C.R) based on the R.I table

$$C.R = \frac{C.I}{R.I}$$

Table 2 Random index

n	1	2	3	4	5	6	7	8
RI	0	0	0,58	0,9	1,12	1,24	1,32	1,41

n	9	10	11	12	13	14	15
RI	1,45	1,49	1,51	1,48	1,56	1,57	1,59

Source: satty[9]

9. Test the consistency of the hierarchy. If it does not meet with CR <0.1 then the assessment must be repeated[9].

Simple Additive Weighting (SAW)

According to Eniyati, the SAW Method is often also known as the weighted sum method. The basic concept of the SAW method is to find a weighted sum of the performance ratings for each alternative on all attributes. The SAW method requires the decision matrix normalization process (X) to a scale that can be compared with all available alternative ratings[11].

Following are the steps in SAW:

1. Normalize
2. Finding the Maximum and Minimum Value

$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{Max_i\ X_{ij}} \\ \dfrac{Min_i\ X_{ij}}{X_{ij}} \end{cases}$$

3. Calculating the Preference Value

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

In this study only used 4 assessment criteria, and 15 student data used to rank.

IV. RESULT

Analytic Hierarchy Process

The weighting questionnaire was filled out by the vice principal Curriculum on a comparative scale

Table 3 Comparison scale value

	Junior High School Report Card Value	Junior High School National Examination Score	Academic Potential Value	Student Interview Results
Junior High School Report Card Value	1.0000	3.0000	5.0000	7.0000
Junior High School National Examination Score	0.3333	1.0000	3.0000	5.0000
Academic Potential Value	0.2000	0.3333	1.0000	3.0000
Student Interview Results	0.1429	0.2000	0.3333	1.0000
Total	1.6762	4.5333	9.3333	16.0000

1. A pairwise comparison matrix will be processed to determine the ranking of the criteria, namely by determining the eigenvalue. The procedure for obtaining eigenvalues is:
   a. Squaring the matrix
   b. Count the number of values from each row, then normalize.

1st iteration:

Table 4 1st iteration

$$
\begin{vmatrix} 1.0000 & 3.0000 & 5.0000 & 7.0000 \\ 0.3333 & 1.0000 & 3.0000 & 5.0000 \\ 0.2000 & 0.3333 & 1.0000 & 3.0000 \\ 0.1429 & 0.2000 & 0.3333 & 1.0000 \end{vmatrix} x \begin{vmatrix} 1.0000 & 3.0000 & 5.0000 & 7.0000 \\ 0.3333 & 1.0000 & 3.0000 & 5.0000 \\ 0.2000 & 0.3333 & 1.0000 & 3.0000 \\ 0.1429 & 0.2000 & 0.3333 & 1.0000 \end{vmatrix}
$$

$$
= \begin{vmatrix} 4.0000 & 9.0667 & 21.3333 & 44.0000 \\ 1.9810 & 4.0000 & 9.3333 & 21.3333 \\ 0.9397 & 1.8667 & 4.0000 & 9.0667 \\ 0.4190 & 0.9397 & 1.9810 & 4.0000 \end{vmatrix}
$$

Add up the values for each matrix line and calculate the normalized return value:

Table 5 Normalization Result 1

				LINE AMOUNT	NORMALIZATION RESULTS
4.0000	9.0667	21.3333	44.0000	78.4000	0.5670
1.9810	4.0000	9.3333	21.3333	36.6476	0.2651
0.9397	1.8667	4.0000	9.0667	15.8730	0.1148
0.4190	0.9397	1.9810	4.0000	7.3397	0.0531
			Total	138.2603	1.0000

2nd iteration:

Table 6 2nd iteration

$$
\begin{vmatrix} 4.0000 & 9.0667 & 21.3333 & 44.0000 \\ 1.9810 & 4.0000 & 9.3333 & 21.3333 \\ 0.9397 & 1.8667 & 4.0000 & 9.0667 \\ 0.4190 & 0.9397 & 1.9810 & 4.0000 \end{vmatrix} x \begin{vmatrix} 4.0000 & 9.0667 & 21.3333 & 44.0000 \\ 1.9810 & 4.0000 & 9.3333 & 21.3333 \\ 0.9397 & 1.8667 & 4.0000 & 9.0667 \\ 0.4190 & 0.9397 & 1.9810 & 4.0000 \end{vmatrix}
$$

$$
= \begin{vmatrix} 72.4453 & 153.7016 & 342.4508 & 738.8444 \\ 33.5577 & 71.4294 & 159.1873 & 342.4508 \\ 15.0146 & 19.7452 & 71.4294 & 153.7016 \\ 7.0753 & 15.0146 & 33.5577 & 72.4453 \end{vmatrix}
$$

Add up the values for each matrix line and calculate the normalized return value:

Table 7 Normalization Result 2

				LINE AMOUNT	NORMALIZATION RESULTS
72.4453	153.7016	342.2508	738.8444	1307.4421	0.5679
33.5577	71.4294	159.1873	342.4508	606.6252	0.2635
15.0146	19.7452	71.4294	153.7016	259.8908	0.1129
7.0753	15.0146	33.5577	72.4453	128.0929	0.0556
			Total	2302.0510	1.0000

Calculate the difference in eigenvalue before and after the present eigenvalue

0.5670 - 0.5679 = -0.0009
0.2651 - 0.2635 = 0.0016
0.1148 - 0.1129 = 0.0019
0.0531 - 0.0556 = -0.0025

3rd iteration:

Table 8 3rd iteration

$$
\begin{vmatrix} 72.4453 & 153.7016 & 342.4508 & 738.8444 \\ 33.5577 & 71.4294 & 159.1873 & 342.4508 \\ 15.0146 & 19.7452 & 71.4294 & 153.7016 \\ 7.0753 & 15.0146 & 33.5577 & 72.4453 \end{vmatrix} x \begin{vmatrix} 72.4453 & 153.7016 & 342.4508 & 738.8444 \\ 33.5577 & 71.4294 & 159.1873 & 342.4508 \\ 15.0146 & 19.7452 & 71.4294 & 153.7016 \\ 7.0753 & 15.0146 & 33.5577 & 72.4453 \end{vmatrix}
$$

$$
= \begin{vmatrix} 20775.5066 & 39968.9816 & 98531.2487 & 212322.0627 \\ 9641.1812 & 18544.9747 & 45725.0154 & 98531.2487 \\ 3910.3111 & 7436.3109 & 18544.9747 & 39968.9816 \\ 2032.8566 & 3910.3111 & 9641.1812 & 20775.5066 \end{vmatrix}
$$

Add up the values for each matrix line and calculate the normalized return value:

Table 9 Normalization Result 3

				LINE AMOUNT	NORMALIZATION RESULTS
20775.5066	39968.9816	98531.2487	212322.0627	371597.7996	0.5715
9641.1812	18544.9747	45725.0154	98531.2487	172442.4201	0.2652
3910.3111	7436.3109	18544.9747	39968.9816	69860.5783	0.1074
2032.8566	3910.3111	9641.1812	20775.5066	36359.8555	0.0559

Total | | 1.0000 |

Calculate the difference in eigenvalue before and after the present eigenvalue

0.5679 – 0.5715 = -0.0036
0.2635 – 0.2652 = -0.0017
0.1129 – 0.1074 = 0.0055
0.0556 – 0.0559 = -0.0003

2. Calculate Priority Vectors

Table 10 Priority Vectors

$$
\text{Kriteria} \begin{vmatrix} 1.0000 & 3.0000 & 5.0000 & 7.0000 \\ 0.3333 & 1.0000 & 3.0000 & 5.0000 \\ 0.2000 & 0.3333 & 1.0000 & 3.0000 \\ 0.1429 & 0.2000 & 0.3333 & 1.0000 \end{vmatrix} \times \begin{vmatrix} 0.5715 \\ 0.2652 \\ 0.1074 \\ 0.0559 \end{vmatrix}
$$

$$
= \begin{vmatrix} 2.2956 \\ 1.0576 \\ 0.4779 \\ 0.2264 \end{vmatrix}
$$

3. Calculate Vector Consistency

$$
Vector\text{Consistency} = \frac{2.2956}{0.5715} \frac{1.0576}{0.2652} \frac{0.4779}{0.1074} \frac{0.2264}{0.0559}
$$

Vector Consistency = 4.0171 3.9879 4.4480 4.0490

4. Calculate the eigenvector value

$$
\lambda maks = \frac{4.0171 + 3.9879 + 4.480 + 4.0490}{4.0000}
$$

$$
\lambda maks = \frac{16.5020}{4.0000}
$$

$$
\lambda maks = 4.1255
$$

5. Estimate Consistency of Index

$$
C.I = \frac{(4.1255 - 4.0000)}{(4.0000 - 1.0000)}
$$

$$
C.I = \frac{0,1255}{3.0000}
$$

$$
C.I = 0,0418
$$

6. Calculate Consistency Ratio (C.R)

$$
C.R = \frac{0,0418}{0,9000}
$$

$$
C.R = 0,0465
$$

7. Test consistency of the hierarchy
$Consistency\ hierarchy = 0,0465 < 0,1$

Simple Additive Weighting

Table 11 Student scores

No	Name	C1	C2	C3	C4
1	A1	69.33	84.63	74.24	100
2	A2	58.62	59.00	60.25	100
3	A3	78.33	78.00	80.00	100
4	A4	63.67	65.75	68.00	100
5	A5	76.00	78.25	75.00	100
6	A6	77.34	65.00	75.60	100
7	A7	67.78	70.88	72.31	100
8	A8	80.00	77.25	83.41	100
9	A9	62.45	60.00	67.23	100
10	A10	53.45	58.32	60.23	100
11	A11	55.65	54.51	52.00	100
12	A12	54.55	55.80	53.30	100
13	A13	52.35	54.98	55.44	100
14	A14	55.45	54.00	55.74	100
15	A15	53.23	55.67	57.65	100

Table 12 Matrix Normalization Results

	Normalization			
Alternative	C1	C2	C3	C4
Weight Normalization	0.5715	0.2652	0.1074	0.0559
Alternative 1	0.4952	0.2652	0.0956	0.0559
Alternative 2	0.4187	0.1849	0.0776	0.0559
Alternative 3	0.5595	0.2444	0.1030	0.0559
Alternative 4	0.4548	0.2060	0.0876	0.0559
Alternative 5	0.5429	0.2452	0.0966	0.0559
Alternative 6	0.5525	0.2037	0.0974	0.0559
Alternative 7	0.4842	0.2221	0.0931	0.0559
Alternative 8	0.5715	0.2421	0.1074	0.0559
Alternative 9	0.4461	0.1880	0.0914	0.0559
Alternative 10	0.3818	0.1827	0.0819	0.0559
Alternative 11	0.3975	0.1708	0.0670	0.0559
Alternative 12	0.3897	0.1749	0.0687	0.0559
Alternative 13	0.3739	0.1723	0.0714	0.0559
Alternative 14	0.3961	0.1692	0.0718	0.0559
Alternative 15	0.3802	0.1744	0.0743	0.0559

Table 13 Vector Preferences and Ranking

Alternative	Scores	Rank
Alternative 1	0.9120	4
Alternative 2	0.7371	9
Alternative 3	0.9629	2
Alternative 4	0.8043	7
Alternative 5	0.9406	3
Alternative 6	0.9094	5
Alternative 7	0.8553	6
Alternative 8	0.9769	1
Alternative 9	0.7815	8
Alternative 10	0.7024	12
Alternative 11	0.6950	11
Alternative 12	0.6929	10
Alternative 13	0.6775	15
Alternative 14	0.6970	13
Alternative 15	0.6890	14

The minimum value to enter the science department is 0.7. Where the standard value is determined by the school, and if the prevalence value is less than 0.7, it will go into the Social Sciences major.

This journal used 15 alternatives (students) out of a total of 120 students. From the tested data, 10 students entered the science department, and 5 students entered the social science department.
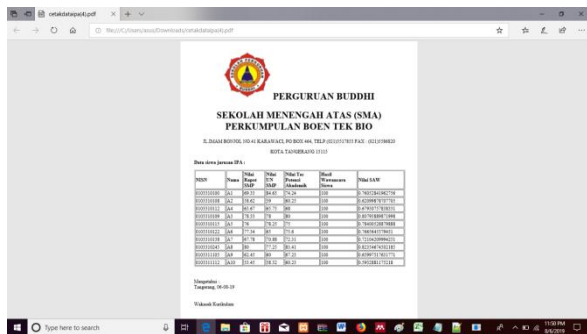

Figure 3 student major report in Sciences

Figure 4 student major report in social studies

V. DISCUSSION

Combination of AHP and SAW Methods

The advantages of the AHP method according to Daniawan, is to have a hierarchical structure so that the problem is more structured, there is a measurement scale to determine the value of the comparison of interests, has a careful calculation and has a measure of consistency in filling out the questionnaire filled out by respondents. Meanwhile, the disadvantage of the AHP method is that the calculation is more complicated, the method is mathematical without statistical testing so there is no confidence limit of the correctness of the model formed and to make improvements to the decision must start again from the initial stage[6].

The advantage of the SAW method is that it has an easy to understand the calculation, a matrix normalization calculation by the attribute value (between benefit and cost value). The disadvantage of the SAW method is that the calculations are performed using crisp or fuzzy numbers, used in local weighting.

From the consideration of the advantages and disadvantages of each method, the AHP and SAW methods were combined as a method for the decision support system for majors atBuddhi High School.

AHP method is used in calculating the weighting criteria and the SAW method is used in calculating alternative weighting.

VI. CONCLUSION

a. With this Decision Support System for determining majors, the school will get direction in determining student majors according to their interests and talents.

b. With the existence of a Decision Support System for determining majors, this can help schools determine the direction of their students according to the criteria used.

c. The results of the Consistency Ratio AHP method produce a value of 0.0603577. Where the value shows 93.96% that means consistent.

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BIOGRAPHY

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