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Decision Support System for Priority Determination of Prospective Recipients the Smart Indonesian Program Using AHP and SAW Method

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Abstract:

The Smart Indonesia Program (PIP) is the provision of educational money assistance that is expected for children aged 6-21 years who come from underprivileged families. The government makes the necessary instruction strategy for the nine-year compulsory education period. However, the insignificant regional economy often makes them want to work before completing nine years of basic education. Gaga II Public Elementary School in Pakuhaji District is one of the schools where the Smart Indonesia Program (PIP) has been implemented. However, the school understands that it is still difficult to determine which students are eligible for the Smart Indonesia Program (PIP). This problem is due to the absence of weighting criteria that have not been considered, making it difficult to determine the beneficiaries of the Smart Indonesia Program (PIP). The Decision Support System (DSS) was built to assist in determining the weight of each criterion and provide alternative decisions for the recipients of the Smart Indonesia Program (PIP). Then because there is no weighting of criteria at SD Negeri Gaga II, Pakuhaji District, the author uses the Analytical Hierarchy Process (AHP) method using 6 criteria, namely KIP / KKS / PKH / SKTM, Student Active Status, Child Status, Parental Work, Parent's Income , Parental Dependents and the Simple Additive Weighting (SAW) method for positioning systems, this technique was chosen on the grounds that it was considered suitable to choose the best option from various other alternative options, as well as to overcome the multitrend of existing criteria and use 5 alternative student data. Based on the results of calculations using the AHP and SAW methods, Komalasari students (A4) became the priority with the highest score of 0.9409.

Keywords *— Decision Support System, Smart Indonesia Program, AHP, SAW*

I. INTRODUCTION

The Smart Indonesia Program (PIP) is a strategy launched by the Government to try to improve the nature of schooling and reduce dropout rates for underprivileged students. This program is contained in Presidential Regulation of the Republic of Indonesia Number 166 of 2014 concerning the Poverty Alleviation Program and Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 10 of 2020 concerning the Smart Indonesia Program. In 2022, the government will channel 10.2 million students from the target allocation of 17.9 million students, providing assistance to school-age children (aged 6–21 years) in the form of cash data used for education, expanding access, and expanding learning opportunities [1].

Gaga II Public Elementary School, Pakuhaji District, located in Gaga Village, Pakuhaji District, Tangerang Regency, is one of the schools that has implemented the Smart Indonesia Program. Schools are required to register students who have a Smart Indonesia Card (KIP) with the Basic Education Data (DAPODIK) with the aim that they can quickly benefit from PIP. Schools can still register poor students who do not have KIP with DAPODIK by registering students who have Family Welfare Cards (KKS), Family Hope Program (PKH), or Certificate of Inadequacy (SKTM) according to the PIP recipient model. The principal of SD Negeri Gaga II, Pakuhaji District, knows that it is still difficult to determine the needs of students who are eligible to participate in the Smart Indonesia Program (PIP). This is because there is no weighting for each criterion, and the number of students who need to be compared from the existing criteria

Given this problem, a Decision Support System (DSS) is needed that can decide the weight of each criterion and

provide supporting data to help the dynamic cycle remember the steps that have been determined before. Then, because there is no weighting of criteria at SD Negeri Gaga II, Pakuhaji District, the authors use the Analytical Hierarchy Process (AHP) and the Simple Additive Weighting (SAW) method for the ranking process. This method was chosen because it overcomes the multitrend of existing criteria where the trend of benefits is getting bigger the better and the trend of costs is getting smaller the better and can be implemented in a support system decision.

The assessment is carried out by selecting alternatives from the less fortunate student data, after which a ranking process is carried out for each student to determine the optimal alternative. From the results of this study, it is hoped that the Decision Support System can provide additional alternatives to assist the Principal in making decisions.

II. METHODOLOGY

2.1 Research Stages

At the research stage, the initial step was to identify the problems that existed in determining the priority of PIP recipients at SD Negeri Gaga II, Pakuhaji District. The result of this step will be a problem formulation that will later become a benchmark that must be resolved. Furthermore, the researcher collected data obtained from SD Negeri Gaga II Pakuhaji District as the object of research, documents related to PIP, and literature studies to obtain a theory of decision support systems related to the formulation of the problem. Then, after obtaining the data, data and document analysis is carried out using the AHP and SAW methods. In the next stage, decision-making choices will be made using the AHP and SAW methods. Then, from this research, general conclusions can be drawn as a result of the research and will state the answers to the research questions contained in the problem formulation. The stages of the research can be seen in Figure 1.

2.2 Decision Modeling Using AHP and SAW

The Analytical Hierarchy Process (AHP) method is a decision-making technique that is unique compared to other methods. This is because in the weighting of the criteria, the weight of each criterion is determined not at the beginning but using the formula of this method based on the scale of importance (level of importance) sourced from the current table, which can be seen in Table 1 [5].

Step 1: Determine the comparative value of each criterion by looking at the importance table.

Intensity of importance	Definition
1	Equal importance
3	Somewhat more important
5	Much more important
7	Very much more important
9	Absolutely more important
2, 4, 6, 8	Intermediate values

Step 2: Calculating the criterion weight value (Wj)

Step 3: Calculating the value of the consistency index (CI). Find CI in the formula

$$CI = \frac{\lambda\, max - n}{n - 1}$$

Step 4 : Working on the value of the consistency ratio (CR). Find CR in the formula

$$CR = \frac{CI}{RI}$$

The Simple Additive Weighting (SAW) method can be described as a direct weighting technique or a weighted extension to solve problems in the choice network in decision making. This method is to look for presentation ratings (needs scale) on each alternative option on all attributes [5].

Step 1: First, determine the criteria that will be used as a benchmark for dealing with the problem.

Step 2: Alternatives and criteria are matched.

Step 3: Normalize each alternative value for each attribute by calculating the performance rating value using the formula.

$$R_{ij} = \begin{cases} \dfrac{x_{ij}}{Max\,(x_{ij})} \\ \dfrac{Min\,(x_{ij})}{x_{ij}} \end{cases}$$

Step 4: Calculate the preference weight value for each alternative using the formula.

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

RESULTS AND DISCUSSION

3.1 Criteria

In this study, using six criteria obtained from decision makers who have been proven by an identification sheet determining the criteria that has been approved by the Head of SD Negeri Gaga II Pakuhaji District, the existing criteria are divided into two types

of criteria. The first is the type of benefit criteria, namely, the higher the criterion value, the greater the chance of being selected, and the second is the type of cost criteria, namely, the lower the criterion value, the greater the chance of being selected. Codes C1 to C6 are the criteria codes shown in Table 2.

No	Criteria	Code	Criteria Type
1	KIP/KKS/PKH/SKTM	C1	Benefit
2	Student Active Status	C2	Benefit
3	Child Status	C3	Cost
4	Parents' job	C4	Cost
5	Parents Income	C5	Cost
6	Parental Responsibilities	C6	Benefit

3.2 Criteria Value

Next is the criteria value with an interest having an ordered weight value, which can be seen in Table 3.

Code	Criteria	Value	Interest	Bobot
C1	KIP/KKS/PKH/SKTM	No cards	No Major	1
		Have a card	Main	2
C2	Student Active Status	Not active	No Major	1
		Active	Main	2
C3	Child Status	Orphan Piatu	Very Major	1
		Orphan	Main	2
		Piatu	Main Enough	3
		Not Orphan/ orphan	No Major	4
C4	Parents' job	Doesn't work	Very Major	1
		Laborer	Main	2
		Farmer	Main Enough	3
		Employee	No Major	4
C5	Parents Income	No Income	Very Major	1
		=< IDR 699,999	Main	2
		IDR 700,000 – IDR 999,999	Main Enough	3
		IDR 1,000,000 – IDR 1,499,999	Less Major	4
		=> IDR 1,500,000	No Major	5
C6	Parental Responsibilities	1 dependent	No Major	1
		2 – 3 Dependents	Main Enough	2
		4 – 5 Dependents	Main	3
		=> 6 dependents	Very Major	4

3.3 Alternantive

No	Student Name	NISN	Class	Code
1	Alif Setiawan	3144101932	Kelas 1 A	A1
2	Ibnu Hamza	3151586976	Kelas 1 B	A2
3	Intan	3075972366	Kelas 1 C	A3
4	Komalasari	3136559944	Kelas 1 A	A4
5	Siti Umayah	3101038811	Kelas 2 A	A5

3.4 Alternantive Value

Table 6 is a matrix of alternative data values that are already known from each alternative student as a PIP recipient candidate, based on criteria and criteria values.

Code	C1	C2	C3	C4	C5	C6
A1	Got Card	Active	Piatu	Employee	=> Rp1.500.000	1
A2	Got Card	Active	Piatu	Laborer	Rp700.000 – Rp999.999	1
A3	Got Card	Active	No Orphans/Piatu	Laborer	Rp1.000.000 – Rp1.499.999	2
A4	Got Card	Active	No Orphans/Piatu	Farmer	=< Rp699.999	3
A5	Got Card	Active	orphan	Laborer	Rp700.000 – Rp999.999	1

3.5 AHP Method Calculation

Criteria Comparison Matrix

	C1	C2	C3	C4	C5	C6
C1	1	1/3	3	3	3	3
C2	3	1	7	5	5	7
C3	1/3	1/7	1	1/3	1/3	1
C4	1/3	1/5	3	1	1/3	3
C5	1/3	1/5	3	3	1	3
C6	1/3	1/7	1	1/3	1/3	1

Simplified Criteria Comparison Matrix

	C1	C2	C3	C4	C5	C6
C1	1,0000	0,3333	3,0000	3,0000	3,0000	3,0000
C2	3,0000	1,0000	7,0000	5,0000	5,0000	7,0000
C3	0,3333	0,1429	1,0000	0,3333	0,3333	1,0000
C4	0,3333	0,2000	3,0000	1,0000	0,3333	3,0000
C5	0,3333	0,2000	3,0000	3,0000	1,0000	3,0000
C6	0,3333	0,1428	1,0000	0,3333	0,3333	1,0000
Jumlah	**5,3333**	**2,0190**	**18,0000**	**12,6667**	**10,0000**	**18,0000**

Normalization of Criteria and Eigenvector

	C1	C2	C3	C4	C5	C6	*Eigenvector*
C1	0,1875	0,1651	0,1667	0,2368	0,3000	0,1667	**0,2038**
C2	0,5625	0,4953	0,3889	0,3947	0,5000	0,3889	**0,4550**
C3	0,0625	0,0708	0,0556	0,0263	0,0333	0,0556	**0,0507**
C4	0,0625	0,0991	0,1667	0,0789	0,0333	0,1667	**0,1012**
C5	0,0625	0,0991	0,1667	0,2368	0,1000	0,1667	**0,1386**
C6	0,0625	0,0708	0,0556	0,0263	0,0333	0,0556	**0,0507**

The maximum eigen value is obtained by calculating the sum of the number of columns multiplied by the eigenvector.

$\lambda\ Max$ = (5,333 x 0,2038) + (2,0190 x 0,4550) + (18,0000 x 0,0507) + (12,6667 x 0,1012) + (10,0000 x 0,1386) + (18,0000 x 0,0507)

$\lambda\ Max$ = 1,0869 + 0,9188 + 0,9120 + 1,2818 + 1,3862 + 0,9120

$\lambda\ Max$ = 6,4978

3.6 Calculating the Consistency Index (CI)

Calculating the Consistency Index (CI) Value, for n = 6

$$CI = \frac{\lambda max - n}{n-1}$$

$$CI = \frac{(6{,}4978 - 6)}{6 - 1}$$

$$CI = 0{,}0996$$

3.7 Calculating the *Consistency Ratio (CR)*

To calculate the Consistency Ratio (CR), a Random Index (RI) value is needed.

$$CR = \frac{CI}{RI}$$

Jika $n = 6$, then the Random Index (RI) value is: 1,24

$$CR = \frac{0{,}0996}{1{,}24}$$

$$CR = 0{,}0803$$

3.8 Criteria weight results

Criteria	Bobot *(Decimal)*	Bobot (%)
KIP/KKS/PKH/SKTM	0,2038	20,38%
Student Active Status	0,4550	45,50%
Child Status	0,0507	5,07%
Parents' job	0,1012	10,12%
Parents Income	0,1386	13,86%
Parental Responsibilities	0,0507	5,07%

3.9 SAW Method Calculation

Alternative Value Matrix

Code	C1	C2	C3	C4	C5	C6
A1	2	2	3	4	5	1
A2	2	2	3	2	3	1
A3	2	2	4	2	4	2
A4	2	2	4	3	2	2
A5	2	2	2	2	3	1

Alternative Normalization

Code	C1	C2	C3	C4	C5	C6
A1	1	1	0,6667	0,5	0,4	0,5
A2	1	1	0,6667	1	0,6667	0,5
A3	1	1	0,5	1	0,5	1
A4	1	1	0,5	0,6667	1	1
A5	1	1	1	1	0,6667	0,5
Bobot Kriteria	0,2038	0,4550	0,0507	0,1012	0,1386	0,0507

Multiply by Weight

Code	C1	C2	C3	C4	C5	C6	Amount	*Ranking*
A1	0,2038	0,4550	0,0338	0,0506	0,0554	0,0253	0,8240	5
A2	0,2038	0,4550	0,0338	0,1012	0,0924	0,0253	0,9116	3
A3	0,2038	0,4550	0,0253	0,1012	0,0693	0,0507	0,9054	4
A4	0,2038	0,4550	0,0253	0,0675	0,1386	0,0507	0,9409	1
A5	0,2038	0,4550	0,0507	0,1012	0,0924	0,0253	0,9285	2

Based on AHP and SAW calculations, it is obtained that the alternative that is prioritized for PIP recipient candidates with Alternative Code A4 on behalf of Komalasari is the priority with the highest score of 0.9409. The following Table 14 is the result of the study.

Research result

Ranking	Code	Student Name	Value
1	A4	Komalasari	0,9409
2	A5	Siti Umayah	0,9285
3	A2	Ibnu Hamza	0,9116
4	A3	Intan	0,9054
5	A1	Alif Setiawan	0,8240

3.10 Design Application

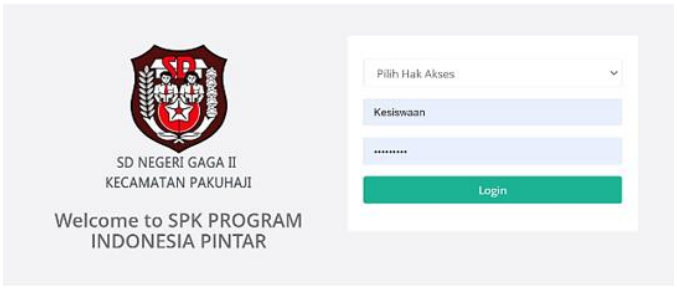

Fig. 1.Login

Fig. 2.Dashboard

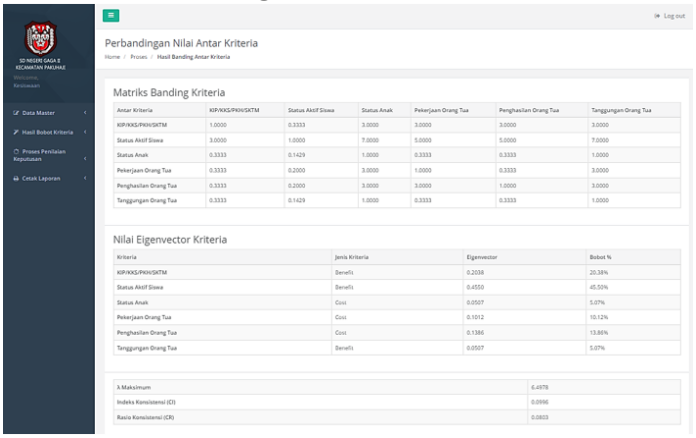

Fig. 3. Criteria Weight Results

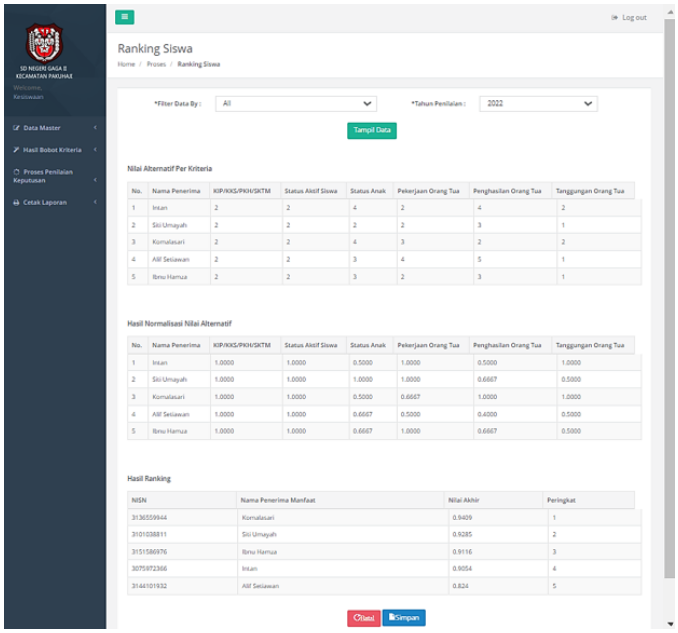

Fig. 4. Ranking

III. CONCLUSIONS

Implementation of a Decision Support System using the analytical hierarchy process (AHP) and Simple Additive Weighting (SAW) methods to determine the priority of prospective PIP recipients at SD Negeri Gaga II Pakuhaji District, making it easier for the Principal to make priority decisions on PIP recipients, and making it easier for students to process data quickly and efficiently.

With SPK using the AHP method, it produces a weight for each criterion so that the results of the assessment are maximized. The results are weighted in priority. Student Active Status 45.50, KIP/KKS/PKH/SKTM 20.38%, Parents' Income 13.86%, Occupation Parents 10.12%, Child Status 5.07%, Dependents of Parents 5.07% Then, with the SPK using the SAW method to determine the best alternative from each existing alternative in the form of a priority ranking of PIP recipients, as in the calculation of the SAW method in Table 14, The results of the research rank sequentially: A4 to 1 value 0.9409, A5 to 2 value 0.9285, A2 to 3 score 0.9116, A3 to 4 value 0.9054, and A1 to 5 value 0.8240. Then an alternative was obtained that was prioritized for PIP recipient candidates, with Alternative Code A4 on behalf of Komalasari as the priority with the highest score of 0.9409.

Even so, the researcher found a shortcoming, namely the condition of the criteria, which was still lacking in detail. In the future, this SPK can be developed by adding more detailed and conditional criteria so as to strengthen the dynamics in deciding the needs of future PIP beneficiaries.

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