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Implementation Of The *Analytical Hierarchy Process Method For* Admission Of Scholarships At Smk Dharma Patra

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Abstract

Scholarships are assistance in the form of fees given to students or students to help with their education. Likewise at Dharma Patra Vocational School, in this school there is also a scholarship program that is given to students who meet the requirements and criteria as scholarship recipients each semester, one of the criteria is students who get academic achievements such as getting class rankings. The Decision Support System (SPK) for determining scholarship recipients will process criteria data using the Analytcal Hierarchy Process (AHP) method. The assessment consists of several criteria, sub-criteria and alternatives. AHP is a form of decision support model with the main advantage of the equipment is a functional hierarchy. The AHP method is considered appropriate in assisting the decision-making process of determining scholarships because AHP can help determine the priority of several criteria by conducting pairwise comparison analysis of each criterion and sub-criteria. Thus, it is hoped that the results of this study will help the decision-making process to determine scholarship recipients.

Keywords: Scholarship, Decision Support System, Analytical Hierarchy Process

INTRODUCTION

As contained in the Basic Law Number 20 of 2003 concerning the National Education System, Chapter V Article 12 (1.c) which states that every student in each educational unit is entitled to a scholarship for outstanding achievers whose parents cannot afford to pay for their education. Article 31 Paragraph 1 which states that "every citizen has the right to receive teaching". So it has become an obligation for the central and local governments to help provide proper education.

Likewise at Dharma Patra Vocational School, in this school there is also a scholarship program given to students. In this final project, a Decision Support System is implemented that can take into account all the criteria that have been determined. All of these criteria will be used to support decision making to assist, speed up, and simplify the decision-making process. DSS is applied using the *Analytical Hierarchy Process* (AHP) method. AHP is used because AHP is a form of decision support model whose main equipment is a functional hierarchy and the inputs used in this decision are humans who are experts in scholarship issues.

RESEARCH METHODS

1. Decision Support System (DSS)

DSS is an interactive computer-based system, which helps decision makers utilize data and models to solve semi-structured and unstructured problems (Turban, et al, 2005) in the book "Decision Support Systems: Methods & Implementation: 1). DSS is a computer-based system that produces various alternative decisions to assist management in dealing with problems using data and models (Dadan Umar Daihani, 2001:55) in journals (Sri Eniyati, 2011). DSS is a computer-based

system intended to help decision makers utilize certain data and models to solve various problems (Bagas Dista Ariyadi). DSS is an interactive system that supports decision making through alternatives from the results of data processing, information and model designs that help solve unstructured problems (Basuki and Cahyani, 2016) in journals (Yanti Kirana, et al, 2018).

1. Decision Support System Stage (Julius Hermawan, 2002:3) in the journal (Nancy, et al, 2015):
   - The Understanding Phase *(Intelligence Phase),* identifies the information needed and determines the decisions to be taken.
   - The Design Phase *is* the process of creating, testing and validating the model that has been created.
   - The Selection Phase (*Choice Phase)* tests and determines the best decision to solve the problem.
   - Implementation Phase *(Implementation Phase)* , decision-making implements the solution that has been chosen to solve the problem.
2. Characteristics of Decision Support Systems (Danang, 2017):
   - DSS is a computer-based system with an interface between machine, computer and user.
   - DSS is intended to assist decision making in solving a problem at various levels of management and not to replace the human position as a decision maker.
   - DSS is able to provide alternative solutions for unstructured or unstructured problems for individuals or groups and in a variety of decision-making processes and styles.
   - DSS uses data, databases and analysis of decision models.
   - DSS is adaptive, effective, *easy* flexible *to use and* DSS provides access to various formats and types of data sources (*data sources*).

2. *Analytical Hierarchy Process* (AHP)

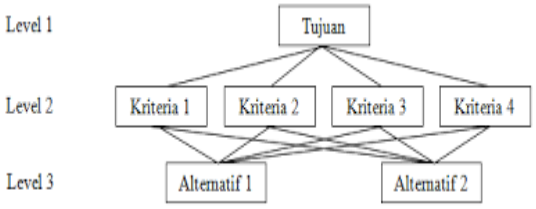
AHP is a functional hierarchy with the main input being human perception. AHP can graphically describe the decision-making process so that it is easier to understand (Kusrini, Dr., M. Kom, 2007) in journals (Norhikmah, et al, 2013). AHP was developed by Thomas L. Saaty, AHP is useful to help decision makers compare criteria (Turban in the journal Hasibuan and Vitas) in journals (Chrismantoro, 2018). A complex problem can be broken down into groups that are organized into a hierarchical form so that the problem looks more structured and systematic and is used to assess actions that are associated with a comparison of the weight of interests between factors (Nining Satriani, et al, 2018). The main purpose of AHP is to rank decision alternatives and choose the best one for the multi-criteria case that combines qualitative and quantitative factors in the overall evaluation of the alternatives (Hanin et al., 2012) .

1. Basic principles of AHP

In using AHP there are 4 basic problems that must be understood. The basic principles of AHP, namely:

a. *Decomposition* (Creating Hierarchy)
   Complex systems can be understood by breaking them down into supporting elements in the form of a hierarchy and combining or synthesizing (Gunawan, 2014; Yusuf 2013).

Figure 1 AHP Structure



b. *Comporative Judgment* (Criteria and Alternative Assessment)

Criteria and alternatives were carried out by pairwise comparisons. A scale of 1-9 which is the best scale representation for expressing opinions (Agus, et al, 2019).

Figure 2. Pairwise Comparison Scale

Intensitas Kepentingan	Keterangan
1	Kedua elemen sama pentingnya
3	Elemen yang satu sedikit lebih penting daripada yang lainnya
5	Elemen yang satu lebih penting daripada yang lainnya
7	Satu elemen jelas lebih mutlak penting daripada elemen lainnya
9	Satu elemen mutlak penting daripada elemen lainnya
2,4,6,8	Nilai-nilai antara dua nilai pertimbangan-pertimbangan yang berdekatan
Kabalikan	Jika aktivitas i mendapat satu angka dibandingkan dengan aktivitas j, maka j memiliki nilai kebalikannya dibandingkan dengan i

If the elements are compared, the number 1 means that it is equally important.

c. *Synthesis of Priority* (Determining Priority)

The relative comparison value of all criteria and alternatives can be adjusted according to the predetermined *judgment to produce weighted and priority values.*

d. *Logical* Consistency

Consistency has two meanings, namely that each of the same objects can be classified according to uniformity and relevance and related to the level of relationship between objects with other objects on certain criteria

2. AHP Completion Steps

The steps in completing the AHP method are as follows:

a. Defining the problem and determining the desired solution, then compiling a hierarchy and the problems encountered by setting goals as targets (Ahmad Kamal, 2017).

b. Determine the priority of elements by creating a pairwise comparison matrix filled with numbers to represent the relative importance between elements.

c. Matrix normalization (Gunawan, 2014; Azwany, 2010) in journals (Nining Satriani, et al)

- Sum the values of each column in the pairwise comparison matrix, with the formula: $\boldsymbol{n} = \sum_{i=0}^{z} \boldsymbol{x_{ij}}$

  where,

  n = the sum of each column
  z = many alternatives
  i = 1,2,3,....,z
  x = value of each cell

- Divide each column value by the total column to obtain the normalized matrix shown in the following equation:

$$\boldsymbol{m} = \frac{\boldsymbol{x_{ij}}}{\boldsymbol{n}}$$

where,

m = result of normalization
x = value of each cell
n = the result of the sum of each column

d. Calculate the priority weight by adding up the values from the rows and dividing the result by the number of elements to get the average value/priority weight shown in the following equation:

$$bp = \frac{\sum_{j=0}^{n} x_{ij}}{n}$$

where,

bp = average yield/priority weight
n = many criteria
j = 1,2,3,....n
x = value of each cell

e. Calculating maximum Eigen

- Multiply each value in the first *cell* by the weight of the first priority, the value in the second *cell column* by the second priority, and so on.
- Add up the results for each row in the matrix.
- The result of the row sum is divided by the corresponding relative priority element.
- Add up the lambda results for each criterion divided by the number of elements, the result is called maz which is shown in the equation below:

$$\lambda maks = \frac{\sum \lambda}{n}$$

where,

maz = eigenmaximum
n = many criteria

f. Calculate the consistency index or *Consistency Index* (CI) which is shown in the following equation **:** $CI = \frac{\lambda maks - n}{n-1}$

where, n = number of elements

g. Calculate the consistency ratio or *Consistency Ratio* (CR) which is shown in the following equation:$CR = \frac{CI}{RI}$

where,

RI = index ratio
CR = consistency ratio

h. Checking hierarchy consistency

If the **CR value is > 0.1 then the** *judgment* data assessment is inconsistent and must be corrected. If the consistent ratio of **CR 0.1** then the data calculation is consistent and correct. RI is a random index value shown in the following table.

Figure 3. Random Index Value

Ukuran Matriks	Nilai RI	Ukuran Matriks	Nilai RI
1,2	0	9	1,45
3	0,58	10	1,49
4	0,90	11	1,51
5	1,12	12	1,48
6	1,24	12	1,56
7	1,32	14	1,57
8	1,41	15	1,59

RESULTS AND DISCUSSION

1. Application of AHP Method

a. Determining Criteria
- Academic achievement (PA)
- Non-academic achievement (PNA)
- Parent's income (POT)
- Personality (KP)

b. Develop a Hierarchy of Scholarship Recipients at Dharma Patra Vocational School

Figure 4. Hierarchical Structure of Scholarship Recipients

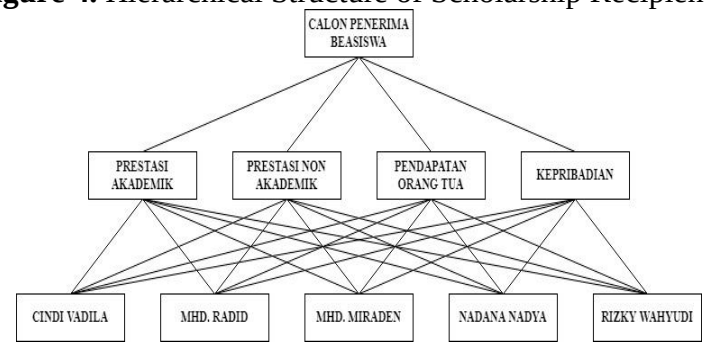


Figure 5. Pairwise Comparison Matrix

Kriteria	PA	PNA	POT	KP
PA	1	5	5	3
PNA	0,2	1	3	1
POT	0,2	0,33	1	5
KP	0,33	1	0,2	1
Jumlah	1,73	7,33	9,2	10

Figure 6. Work Value Matrix

Kriteria	PA	PNA	POT	KP	Jumlah	Prioritas
PA	0,58	0,68	0,54	0,3	2,10	0,53
PNA	0,12	0,14	0,33	0,1	0,68	0,17
POT	0,12	0,05	0,11	0,5	0,77	0,19
KP	0,19	0,14	0,02	0,1	0,45	0,11

Figure 7. The Addition Matrix of Each Row

Kriteria	PA	PNA	POT	KP	Jumlah
PA	0,53	0,85	0,96	0,3	2,67
PNA	0,11	0,17	0,58	0,1	0,96
POT	0,11	0,06	0,19	0,6	0,92
KP	0,18	0,17	0,04	0,1	0,50

Figure 8. Consistency Ratio

Kriteria	JUMLAH PERBARIS	PRIORITAS	HASIL
PA	2,67	0,53	3,20
PNA	0,96	0,17	1,13
POT	0,92	0,19	1,11
KP	0,5	0,11	0,61
JUMLAH			6,05

Figure 9. Consistency Value

$$\lambda maks = \frac{\Sigma\lambda}{n} = \frac{3{,}30 + 1{,}13 + 1{,}11 + 0{,}61}{4} = \frac{6{,}05}{4} = 1{,}51$$

$$CI = \frac{(\lambda maks - n)}{n-1} = \frac{(1{,}51-4)}{4-1} = -0{,}83$$

$$CR = \frac{CI}{CR} = \frac{-0{,}83}{0{,}90} = -0{,}92$$

Figure 10. Result Matrix

PA	PNA	POT	KP
0,53	0,17	0,19	0,11
Rangking 1-5	Prestasi Nasional	> 5 jt	Sangat Baik
0,47	0,51	0,08	0,70
Berprestasi Bidang Akademik	Prestasi Kab/Kota	3 – 5 jt	Baik
0,47	0,22	0,17	0,23
Tidak Ada	Prestasi Sekolah	500.000 – 2 jt	Cukup
0,07	0,22	0,75	0,06
	Tidak Ada		
	0,04		

Figure 11. Value of Scholarship Recipients

Nomor Induk	Nama	NA	PNA	POT	KP
0	RW	Tidak ada	Tingkat sekolah	> 5jt	Cukup
931	CV	Rangking 1-5	Tidak ada	3-5 jt	Sangat Baik
948	MR	Tidak ada	Tidak ada	500.000 – 2 jt	Cukup
947	MM	Rangking 1-5	Tidak Ada	>5 jt	Sangat Baik
952	NN	Tidak ada	Tidak ada	500.000 – 2 jt	Baik

Figure 12. Final Result Value Calculation Table

Nomor Induk	Nama	NA	PNA	POT	KP	Jumlah
0	RW	0,07	0,22	0,08	0,06	0,43
931	CV	0,47	0,04	0,17	0,70	1,38
948	MR	0,07	0,04	0,75	0,06	0,92
947	MM	0,47	0,04	0,08	0,70	1,29
952	NN	0,07	0,04	0,75	0,23	1,09

Figure 13. Rating Decision

Nomor Induk	Nama	NA	PNA	POT	KP	Jumlah
931	CV	0,47	0,04	0,17	0,70	1,38
947	MM	0,47	0,04	0,08	0,70	1,29
952	NN	0,07	0,04	0,75	0,23	1,09
948	MR	0,07	0,04	0,75	0,06	0,92
0	RW	0,07	0,22	0,08	0,06	0,43

2. System planning

Figure 14. Login Page Design

Figure 16. Main Menu Page Design

Figure 19. Student Data Page Design

Figure 20. Student Data View Page Design

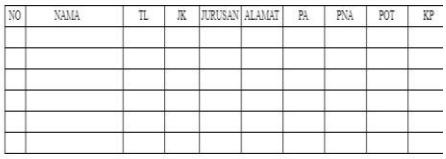


Figure 21. Ranking Results Page Design

STEM PENDUKUNG KEPUTUSAN

SELEKSI PENERIMA BEASISWA

HASIL PERANGKINGAN

RANGKING	NOMOR INDUK	NAMA
1		
2		
3		
4		
5		
6		

CONCLUSION

Based on the results of this study, the authors can conclude that a Decision Support System using the AHP method can be an alternative solution and help facilitate decision makers in determining the right decisions in the process of determining scholarship recipients for students at SMK Dharma Patra.

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