Journal of General Education and Humanities
Vol. 1, No. 2, May 2022, pp. 83~94, https://doi.org/10.58421/gehu.v1i2.18
ISSN 2963-7147

Application of Additive Ratio Assessment (ARAS) Method for the Selection of Youth Red Cross Chairperson at SMA Negeri 1 Lebakwangi Kuningan

Bayu Pangestu[1], Kosim[1], Asep Kosasih[1]
[1]Sekolah Tinggi Ilmu Komputer Poltek Cirebon, Indonesia

Article Info

Keywords:

ARAS
decision support system
multi-criteria decision-making
assessment criteria

ABSTRACT

This study aims to build a decision support system that can choose the chairman of the Youth Red Cross using the Additive Ratio Assessment (ARAS) method and to overcome the problems faced by the selection committee for the chairman of the Youth Red Cross at SMA Negeri 1 Lebakwangi Kuningan, West Java. The ARAS (Additive Ratio Assessment) method is a multi-criteria decision-making method based on ranking using the utility degree by comparing each alternative's overall index value to the optimal alternative's overall index value. The results of the research obtained are the existence of a decision support system for the election of the candidate for the chairman of the Youth Red Cross, assisting the election committee in assessing and selecting candidates for the PMR board according to the criteria. The design of a decision support system for selecting the chairman of the Youth Red Cross at SMA Negeri 1 Lebakwangi is implemented using a web-based programming language, for the predetermined assessment criteria and sub-criteria can be stored systemized, thus enabling relatively faster processing. By using this decision support system application that has been designed, the assessment and selection of candidates for the chairman of the Youth Red Cross become more accurate and more accessible because it uses computerized media so that the selection of candidates for chairman can be more neat and systematic.

Corresponding Author:

Bayu Pangestu
Sekolah Tinggi Ilmu Komputer Poltek Cirebon, Indonesia
Email: elpangestu44684@gmail.com

1. INTRODUCTION

Technology continues to develop along with human needs in carrying out daily life. Slowly but surely, technology has become essential in supporting various areas of the life of all levels of society, starting from the upper, middle, and lower layers of society. The use of computers as a tool is no longer in doubt, both as a medium for receiving, processing, and storing data. The development of information technology has made it

possible to make decisions with the development of software and the ability to process and combine several techniques in making decisions from various alternative solutions [1].

The decision support system is designed to support all stages of decision making, starting from identifying problems, selecting relevant data, and determining the approach used in the decision-making process, for example, providing results or decisions taken so they can be accounted for. A Decision Support System (DSS) is used as a tool for decision-makers to expand their capabilities of decision-makers, but not to replace the judgment of decision-makers [2]–[4].

SMA Negeri 1 Lebakwangi is one of the favorite high schools in Kuningan Regency, West Java. Admission of new students at this school is very selective, so many of the best students graduate from this school. This school is active in all activities, both extracurricular and extracurricular activities. One of the extracurricular activities at SMA Negeri 1 Lebakwangi is the Youth Red Cross (PMR) organization. The Youth Red Cross (PMR) is an organization assisted by PMI (Indonesian Red Cross), which aims to prepare youth to be formed as future volunteers.

Since its establishment, the Youth Red Cross (PMR) of SMA Negeri 1 Lebakwangi has begun to play an active role in the social and humanitarian field. Based on the results of observations and research carried out by the author at SMA Negeri 1 Lebakwangi, humanitarian and social activities that the Youth Red Cross has carried out (PMR), such as first aid for students who are sick or faint during the flag ceremony, raising funds for misfortunes and natural disasters, are ready in every school event and outside of school and blood donation. In forming an organization, it is necessary to form core management consisting of a chairperson, secretary, and treasurer. The selection of core management candidates is based on assessment factors. The assessment factors include managerial ability, knowledge, responsibility, communication, cooperation, and discipline.

At the time of the election of the candidates for the core board of the Youth Red Cross (PMR), it was still through direct voting, namely a tiny piece of paper that would be distributed to all members, then members voted by writing down the back number for the candidate for the core board. Then the committee counted the number of ballots. In the calculation process, there was often a problem. Namely, PMR members did not make the back numbers of the three candidates: the chairman, secretary, and treasurer. So many ballots were forfeited for this incident. This impacts the committee in deciding the final results of the prospective candidates to be selected and the inaccurate data produced. In this election, ballots are valid to be counted if the members write down the three back numbers of the candidates for the core board consisting of the chairman, secretary, and treasurer. Therefore, to select candidates for the maximum core management, it is necessary to have a decision support system to assist the committee in determining whom the core administrators are elected according to predetermined criteria.

The use of computer-based systems will increase the effectiveness of decision-making [5]–[10], but it can also increase efficiency [11]–[14]. The appropriate system for the above case is a decision support system (DSS). One of DSS's objectives is to increase decision-making effectiveness in semi-structured or unstructured problems [15]–[19]. One of the decision-making system methods, Additive Ratio Assessment (ARAS), establishes a

process to identify and provide estimates of overall system interactions. The reason for choosing ARAS is because ARAS is a form of a decision model suitable for multi-criteria and multi-substitution problems.

This research is essential to do because there are several benefits. The benefits of this research for educational institutions are expected to be a learning material and reference for friends who will conduct further research on topics related to the research title above. In addition, the results of this study are expected to be useful for SMA Negeri 1 Lebakwangi Kuningan, West Java, especially for the PMR board selection committee as input in making decisions on the selection of PMR board candidates.

2. METHOD

The research method that the author uses in this research is using descriptive analysis method. The descriptive analysis method is a research method that seeks to describe, describe, or explain the subject or object (institution, society, and so on) in research based on data obtained naturally or as it is from the subject or object under study [20].

The steps of the descriptive method generally consist of identifying the problems to be solved in the research, limiting the problems so as not to deviate from the discussion in the research, determining the objectives and benefits of the research, and conducting a literature study that is relevant to the problems in the research, making a framework for thinking in research, designing methods applied in research, collecting and analyzing data using relevant techniques in research, and making reports on research that has been carried out. This study's descriptive analysis method aims to accurately describe, describe, or explain the selection of prospective PMR administrators at SMA Negeri 1 Lebakwangi, Kuningan Regency, West Java.

In order to collect the data needed in this study using the techniques of Observation, Interview, and Literature Study. Observation is the basis of all science, and scientists can only work based on data, namely facts about the world of reality obtained through observation [21]. In observational studies, the status of the phenomenon is determined by not asking questions but by observing. In this case, the author made direct observations at SMA Negeri 1 Lebakwangi, Kuningan Regency, to obtain information for research materials.

The second technique is the interview. An interview is a meeting between two people to exchange information and ideas through question and answer so that meaning can be constructed in a particular topic [21]. In this case, the researcher interviewed the Deputy Head of Student Affairs of SMA Negeri 1 Lebakwangi to obtain the data needed in the study.

While the third technique is literature study, the literature study is collecting several books and magazines relating to the problem and research objectives. The book is considered a source of data to be processed by historians, literature, and language experts [22]. The author uses several references to support the theory concerned with the object of this research, in the form of books, journals, and sources from the internet.

3. RESULTS AND DISCUSSION

Additive Ratio Assessment (ARAS) is a method used for ranking criteria, and conceptually the ARAS method is used with other methods that use the concept of ranking, where the ranking process must be processed using the ARAS method. The steps in the ranking process using the ARAS method are as follows [23]:

a. Formation of Decision-Making Matrix

$$X = \begin{bmatrix} X_{01} & X_{0j} & \cdots & X_{0n} \\ X_{11} & X_{ij} & \ldots & X_{in} \\ \vdots & \vdots & \ddots & \vdots \\ Xn1 & Xmj & \ldots & X_{mn} \end{bmatrix}, i = 0, i = 0, m; \ldots j = 1, n \quad (1)$$

Where :

m = Number of alternatives

n = number of criteria

X_{ij} = Performance value of alternative i against criterion j

X_{0j} = Optimum value of criterion j

If the optimal value of the criterion (X_{0j}) is not known, then:

$X_{0j} = \frac{max}{1} . X_{ij}$ if $\frac{max}{1} . X_{ij}$ is Benefit (2)

$X_{0j} = \frac{min}{1} . X_{ij}$ if $\frac{min}{1} . X_{ij}$ is Cost (3)

b. Normalization of the decision matrix for all criteria

If the Benefit (max) criteria are then normalized as follows:

$$X_{ij}* = \frac{X_{ij}}{\sum_{i}^{m}=0 . X_{ij}} \quad (4)$$

Where $X_{ij}*$ is the normalized value.

If the criteria are Non-benefits, then Normalization is carried out following:

$$X_{ij} * = \frac{1}{X_{ij}} \quad (5)$$

$$R = \frac{X_{ij}}{\sum_{i}^{m}=0 . X_{ij}} \quad (6)$$

Where :

R = Matrix Normalization

c. Determine the weight of the matrix that has been normalized

$$D = \left[d_{ij}\right] m \, x \, n = R_{ij} . W_j \quad (7)$$

Where:

D = matrix weight

Rij = Normalized value

Wj = criterion weight

d. Determine the value of the optimization function (Si)

$$S_i = \sum_{j}^{n} = 1 \; . \; d_{ij} \quad (8)$$

Where S_i is the value of the alternative optimality function i. The most significant value is the best value, and the most negligible value is the worst. By considering the process of proportional relationship with the value and weight of the criteria known to affect the final result.

e. Determine the highest ranking alternative

$$K_i = \frac{S_i}{S_0} \quad (9)$$

Where :

K_i = Highest rank level

Where S_i and S_0 are the values of the optimality criteria obtained from the equation is clear, Hu is calculated that the value of Ui is in the interval and is the desired equation first, the relative complexity of the feasible alternatives can be determined according to the value of the utility function.

3.1. Normalization

Normalization is a technique by taking a bottom-up approach that is used to help identify relationships. Meanwhile, according to Connolly and Begg, Normalization is a technique that produces a collection of relations with the desired property by providing a data requirement for the company [24]. The objectives of Normalization are as follows:

a. To get rid of duplicate data
b. To reduce complexity
c. To make it easier to modify data

In carrying out Normalization, several processes are needed, including the following:

a. The data is described in tabular form, then analyzed based on specific requirements to several levels.
b. If the table being tested does not meet specific requirements, then the table needs to be broken down into several more straightforward tables to meet the optimal data.

The objectives of Normalization are as follows:

a. To remove duplicate data.
b. To reduce complexity.
c. To facilitate data modification.

Normalization has the following forms, namely:

a. The form is not normal (unformalized form)
   This form is a form of recorded data, and there is no need to follow a particular format; the data may be incomplete or duplicated.
b. First normal form (1NF or first normal form)
   The first normal form has the characteristic that each data is formed in a flat file (base file), and the data is formed in one record after another. There are no repeating or multiple-valued attribute sets.
c. Second normal form (2NF or second normal form)
   The second normal form has the condition that the data form has met the criteria for the first normal form; the non-key attribute must be functionally dependent on the primary key or primary key, so for the second normal form, the field keys must have been determined. The field key must be unique and can represent other attributes that are members of it.

d. Third normal form (3NF or three normal forms)
To be in the third normal form, the relation must be in the second normal form, and the non-primary attributes must not have a transition relationship; in other words, each unlocking attribute must depend on the primary key as a whole.

3.2. Normalization Test

Normalization is the process of grouping data elements into tables that show entities and their relationships.

1. Abnormal Shape
Write down all the data to be recorded; the double part does not need to be written. It is shown in Table 1 below:

Table 1. Abnormal Shape

Candidate Code	Class	Criteria Code	Criteria Name	Weight
1920004	XI IPA 1	C1	Discipline	0.35
		C2	Responsibility	0.25
		C3	Organizational Activity	0.20
		C4	Performance	0.15
		C5	Skills	0.05

Table 2. Continued Abnormal Shapes

Name Crips	Crips value	ARAS calculation results	Rank
100% Presence	5	0.929	1
Very responsible	5	0.929	1
Often active in participating in organizational activities	4	0.929	1
1st Rank in Class	4	0.929	1
Have Innovation in Carrying Out Activities	5	0.929	1

2. First Normal Form (1NF)
A table is said to be 1NF if and only if each attribute of the data has only a single value in one row.

Table 3. First Normal Form (1NF)

Candidate Code	Class	Criteria Code	Criteria Name	Weight
1920004	XI IPA 1	C1	Discipline	0.35
1920004	XI IPA 1	C2	Responsibility	0.25
1920004	XI IPA 1	C3	Organizational Activity	0.20
1920004	XI IPA 1	C4	Performance	0.15
1920004	XI IPA 1	C5	Skills	0.05

Table 4. Continued Abnormal Shapes

Name Crips	Crips value	ARAS calculation results	Rank
100% Presence	5	0.929	1
Very responsible	5	0.929	1
Often active in participating in organizational activities	4	0.929	1
1st Rank in Class	4	0.929	1
Have Innovation in Carrying Out Activities	5	0.929	1

3. Second Normal Form (2NF)
   The 2NF requirement is that there is no partial "functional dependency" on the primary key in a table. The point is that at this 2NF normalization stage, the table must be broken down based on the primary key. So that the 2NF normalization form of these tables is as shown in Table 5 below:

Table 5. Second Normal Form (2NF)

Candidate Code	Class	Criteria Code	Criteria Name	Weight
1920004	XI IPA 1	C1	Discipline	0.35
1920004	XI IPA 1	C2	Responsibility	0.25
1920004	XI IPA 1	C3	Organizational Activity	0.20
1920004	XI IPA 1	C4	Performance	0.15
1920004	XI IPA 1	C5	Skills	0.05

Table 6. Continued Abnormal Shapes

Name Crips	Crips value	ARAS calculation results	Rank
100% Presence	5	0.929	1
Very responsible	5	0.929	1
Often active in participating in organizational activities	4	0.929	1
1st Rank in Class	4	0.929	1
Have Innovation in Carrying Out Activities	5	0.929	1

3.3. Testing Analysis Results

1. To compare each candidate's data in the alternative table, a table of criteria such as discipline, responsibility, organizational activity, achievements, and skills is needed. The criteria weight the selection committee will determine data for prospective management with the sum of all criteria weights equal to 100 or 1. The criteria weight table is as follows:

Table 7. Sub-criteria Data / Crips

Criteria Code	Criteria Name	Attribute	Weight
C01	Discipline	Benefit	0.30
C02	Responsibility	Benefit	0.25
C03	Organizational Activity	Benefit	0.20
C04	Performance	Benefit	0.15
C05	Skills	Benefit	0.05

2. To describe the criteria, sub-criteria were formed. The sub-criteria of the existing criteria can be seen in the following table:

Table 8. Candidate Data

Criteria Name	Sub-criteria	Score
Discipline	Number of late or absent more than five times	1
Discipline	The number of late or no-shows is only four times	2
Discipline	The number of late or no-shows is only three times	3
Discipline	The number of late or no-shows is only one time	4
Discipline	100% Presence	5
Responsibility	Very Irresponsible	1
Responsibility	Not responsible	2
Responsibility	Responsible Enough	3
Responsibility	Responsible	4
Responsibility	Very responsible	5
Organizational Activity	Very never active in participating in organizational activities	1
Organizational Activity	Never been active in participating in organizational activities	2
Organizational Activity	Sometimes active in following organizational activities	3
Organizational Activity	Often active in participating in organizational activities	4
Organizational Activity	Always active in participating in organizational activities	5
Performance	Never Achieved	1
Performance	Top 10 Rank in Class	2
Performance	Top 3 in Class	3
Performance	1st Rank in Class	4
Performance	Academic Competition Representing School	5
Skills	Not doing activities	1
Skills	Not Performing Procedure	2
Skills	Inappropriate in carrying out activities in the procedure	3
Skills	Carry out procedures following the specified	4
Skills	Have Innovation in Carrying Out Activities	5

3. From the table of criteria and sub-criteria, it is used to find the comparative value of each candidate for management in the following table:

Table 9. Candidate Data

Candidate Code	Candidate's name	Class
1920001	Budi Firmasyah	XI IPS 1
1920002	Eka Dwimantara	XI IPA 2
1920003	Dimas Nugraha	XI IPS 2
1920004	Angga Hernandi	XI IPA 1
1920005	Heru Cahyanto	XI IPA 3

4. From the data criteria that have been determined, the next step is to determine the suitability rating, as shown in the table below:

Table 10. Match Rating

Candidate Code	Criteria				
	C01	C02	C03	C04	C05
1920001	5	3	5	3	4
1920002	4	4	4	3	4
1920003	5	4	5	4	4
1920004	5	5	4	4	5
1920005	5	3	5	5	5
Max	5	5	5	5	5
Min	4	3	4	3	4

In Table 7, Table 8, Table 9, and Table 10, it can be explained that the initial data include Criteria, Weights, and Alternatives (Prospective Management). Alternatives are obtained from the candidate's name for the board of directors. In contrast, the criteria are obtained from the value data that the prospective administrator has carried out. The weight data is obtained from the criteria data whose weight value has been determined by the authors and administrators. Max Min value is obtained from Benefit and Cost, where if Benefit, the highest value will be taken, and if Cost, the lowest value will be taken from each alternative value (prospective management).

5. Define the decision matrix

$$X = \begin{bmatrix} 5 & 5 & 5 & 5 & 5 \\ 5 & 3 & 5 & 3 & 4 \\ 4 & 4 & 4 & 3 & 4 \\ 5 & 4 & 5 & 4 & 4 \\ 5 & 5 & 4 & 4 & 5 \\ 5 & 3 & 5 & 5 & 5 \\ 29 & 24 & 28 & 24 & 27 \end{bmatrix}$$

6. Normalize the decision matrix for all criteria:

$$R_{ij} = \frac{\text{Criteria Score}}{\text{Total Score All Criteria}} = \text{Results (Benefits)}$$

so that the normalization matrix is obtained, which can be seen in the following table

Table 11. Matrix Normalization

	C01	C02	C03	C04	C05
A000	0.17241	0.20833	0.17857	0.20833	0.18519
1920001	0.17241	0.125	0.17857	0.125	0.14815
1920002	0.13793	0.16667	0.14286	0.125	0.14815
1920003	0.17241	0.16667	0.17857	0.16667	0.14815
1920004	0.17241	0.20833	0.14286	0.16667	0.18519
1920005	0.17241	0.125	0.17857	0.20833	0.18519

7. Weighted Normalization

The following process is to perform weighted Normalization of all criteria. This can be done by multiplying the decision matrix normalized to the weight of the criteria.

$$D = R_{\text{ij}} . W_{\text{j}}$$

So that the weighted normalization data is obtained as follows

Table 12. Weighted Normalization

c	C01	C02	C03	C04	C05
Weight	35	25	20	15	5
A000	0.06034	0.05208	0.03571	0.03125	0.00926
1920001	0.06034	0.03125	0.03571	0.01875	0.00741
1920002	0.04828	0.04167	0.02857	0.01875	0.00741
1920003	0.06034	0.04167	0.03571	0.025	0.00741
1920004	0.06034	0.05208	0.02857	0.025	0.00926
1920005	0.06034	0.03125	0.03571	0.03125	0.00926

8. Determining Optimization Value

The next step is to determine the optimum value and the degree of utility, the value of the optimization function (Si), by adding all the criteria values from the weighted normalization results.

Table 13. Optimization Value

c	C01	C02	C03	C04	C05
Weight	35	25	20	15	5
A000	0.06034	0.05208	0.03571	0.03125	0.00926
1920001	0.06034	0.03125	0.03571	0.01875	0.00741
1920002	0.04828	0.04167	0.02857	0.01875	0.00741
1920003	0.06034	0.04167	0.03571	0.025	0.00741
1920004	0.06034	0.05208	0.02857	0.025	0.00926
1920005	0.06034	0.03125	0.03571	0.03125	0.00926

9. Ranking

Determining the highest ranking value of each alternative (K_i) by dividing the overall value of each alternative (S_i) against the overall value of the optimal alternative S0 from A_0. So that the ranking is obtained as presented in the following table:

Table 14. Ranking

	Total	K . score	Rank
A000	0.18865	1	
1920001	0.15347	0.81349	4
1920002	0.14467	0.76687	5
1920003	0.17013	0.90184	2
1920004	0.17526	0.92901	1
1920005	0.16782	0.88957	3

Based on the final result of the calculation using the ARAS method, the final calculation result is in the form of ranking. From the ranking results, first place is the alternative with candidate code 1920004.

Based on the results above, using the ARAS method is very helpful in determining the selection of the chairman of the Youth Red Cross by involving many profile variables from candidates. With this technique, the number of variables that will be used will not be a problem recruiting very potent leaders in various aspects.

4. CONCLUSION

Based on the research that has been carried out by the author, which is described in this final project regarding the applications that have been done, it can be concluded that a decision support system for the selection of candidates for PMR management assists the election committee in assessing and selecting candidates for PMR management according to the criteria. In addition, the design of a decision support system for selecting PMR management at SMA Negeri 1 Lebakwangi is implemented using a web-based programming language, for the predetermined assessment criteria and sub-criteria can be stored and systemized, thus enabling relatively faster processing. By using this decision support system application that has been designed, the assessment and selection of candidates for PMR management become more accurate and more manageable because it uses computerized media so that the selection of candidates for management can be more neat and systematic.

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