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Comparison of the Results of the Edas and Vikor Methods in the Decision Support System for KIP Scholarship Recipients at Malikussaleh University

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Abstract

Many high school graduates do not go on to higher education due to the high cost of education. To address this issue, the government, educational institutions and related parties can work together to find solutions to reduce financial barriers and increase access to higher education. In finding prospective students who are eligible to receive scholarships, the government must be fair and precise in making decisions regarding KIP scholarship recipients. This research uses EDAS and VIKOR methods in the selection of prospective KIP scholarship recipients at Malikussaleh University. This study uses historical data of previous KIP scholarship recipients as test data, where there are 6 criteria used, namely parent status, parent income, number of parent dependents, parent employment, parent home ownership, and parent home area. The application of the EDAS method resulted in Fauzi (230510004) as the first rank with an AS value of 0.850; then Hernita Ceria (230180023) as the second rank with an AS value of 0.791; and Ipadayan (230340033) as the third rank with an AS value of 0.789. In the application of the VIKOR method results, Halimah Murni (230210176) as the first rank with a Q value of 0.000; then Nauval Alzabar (230110077) as the second rank with a Q value of 0.015; and Muhammad Bukhari (230110040) as the third rank with a Q value of 0.024. 4. The results of this study state that the EDAS and VIKOR methods are methods that have different types. The EDAS method ranks alternatives based on their distance from the average solution, resulting in a ranking of alternatives based on how close they are to the optimal solution. While the VIKOR method ranks alternatives and provides the best compromise solution that best matches the applied criteria.

Keywords: *KIP Scholarship, Decision Support System, EDAS, VIKOR.*

1. Introduction

The rapid advancement of information technology has had a major impact on various aspects of life, especially in the fields of education and the economy [1]. Major changes have occurred in the world of education, where people are now competing to get the best education. Everyone strives to be able to continue their education until they get a bachelor's degree, in the hope of getting a better education and improving their economic conditions [2]. Many high school graduates do not continue to university due to the high cost of university education. To address this issue, the government, educational institutions and related parties can work together to find solutions to reduce financial barriers and promote access to higher education. Scholarships, financial aid and affordable financing programs can help financially disadvantaged prospective students to continue their education. In an effort to find prospective students who are eligible to be awarded scholarships to those who really need them, the government is required to be fair in awarding scholarships and making the right decisions in selecting prospective scholarship recipients [3]. To achieve this, the government needs a decision support system. DSS will assist the government in collecting, organizing, and analyzing student data related to the criteria given by the government. Various methods can be used in building a decision-making system. A number of methods have been applied in decision-making systems to create alternatives that meet the criteria set by the company. In research conducted by Agung Deni Wahyudi in the Application of the Evaluation based on Distance from Average Solution (EDAS) Method for Determining the Head of the Osis based on the results of this study, this method is applied when decision making involves consideration of various criteria or diverse factors [4] [5]. EDAS assists decision makers in evaluating alternatives thoroughly by considering the relationship between each alternative and the average value of the selected criteria [6] [7].

2. Literature Review

2.1. KIP Scholarship

Program Indonesia Pintar (PIP) is a program to provide educational assistance to students who meet certain criteria. The program aims to encourage and facilitate children from financially challenged families to have access to higher education and develop their potential [8] [9] [10].

Based on the Minister of Education and Culture Regulation Number 10 of 2020 concerning the Smart Indonesia Program (PIP), PIP is intended for students admitted to higher education, including students who are persons with disabilities. This program gives priority to students who meet the following criteria:

1. KIP (Smart Indonesia Card) holder students, students who have received a Smart Indonesia Card (KIP) from the government as a form of tuition assistance for poor families.
2. Students who come from families with unstable financial conditions or are vulnerable to poverty, students from families with significant levels of economic deprivation or are in vulnerable conditions.
3. Affirmation students, students who come from certain areas with affirmation status, such as Papua, West Papua, 3T areas (underdeveloped, frontier, infected), and Indonesian Migrant Workers (TKI).
4. Students affected by disasters, social conflicts, or facing special situations.

With the existence of Permendikbud Number 10 of 2020, the Smart Indonesia Program (PIP) provides opportunities for students who meet these requirements to receive tuition assistance in order to realize more equitable access to education at the tertiary level [11] [12].

2.2. Decision Support System

Decision Support System (DSS) is an information system that uses computer technology and is knowledge-based which is used in the decision-making process within an agency or company [2] [13]. In general, a decision-making system can be defined as a system designed to provide support to decision makers in semi-structured decision situations at the managerial level [14] [15] [16].

In the process, DSS is given support by various other systems such as artificial intelligence (AI), expert systems (ES), fuzzy logic, and the like [3]. Therefore, the implementation of SPK aims to:

1. Provide assistance in solving problems that arise in a semi-structured manner.
2. Support manager activities in making decisions related to a problem.
3. Improve the effectiveness of decision-making, not just its efficiency level.

2.3. Evaluation Based On Distance From Average Solution Method

The Evaluation based on Distance from Average Solution (EDAS) method is one of the techniques in multicriteria decision support systems used to evaluate alternatives by considering how far they are from the mean or average solution of all alternatives. This method is useful in situations where decision-making involves consideration of multiple criteria or diverse factors. The EDAS method involves analysis based on the calculation of alternative positive distances, alternative negative distances, positive distance weight tables, negative distance weight tables, and normalization of positive distance values and negative distance values [17] [18].

The following are the stages of selection using the EDAS method:

1. Create a decision matrix

$$X = \begin{bmatrix} x_{i1} & \cdots & x_{in} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix}$$

2. Determine the average solution (AV)

$$AV = \left[AV_j\right]_{1\times m}$$

The value of AV_j will be calculated with the following equation.

$$AV_j = \frac{\sum_{i=1}^{n} X_{ij}}{n}$$

3. Determining the positive and negative distances from the average (PDA and NDA)

$$PDA = \left[PDA_{ij}\right]_{n\times m}$$

$$NDA = \left[NDA_{ij}\right]_{n\times m}$$

For the j criterion with benefit type, the equation applies.

$$PDA_{ij} = \frac{\max\left(0, \left(X_{ij} - AV_j\right)\right)}{AV_j}$$

$$NDA_{ij} = \frac{\max\left(0, \left(AV_j - X_{ij}\right)\right)}{AV_j}$$

For the j criterion with cost type, the equation applies.

$$PDA_{ij} = \frac{\max\left(0, \left(AV_j - X_{ij}\right)\right)}{AV_j}$$

$$NDA_{ij} = \frac{\max\left(0, \left(X_{ij} - AV_j\right)\right)}{AV_j}$$

4. Determine the weighted sum of PDA and NDA (SP and SN)

$$SP_i = \sum_{j=1}^{m} w_j \times PDA_{ij}$$

$$SN_i = \sum_{j=1}^{m} w_j \times NDA_{ij}$$

5. Normalization of SP and SN values

$$NSP_i = \frac{SP_i}{\max\left(SP_i\right)}$$

$$NSN_i = \frac{SN_i}{\max(SN_i)}$$

6. Calculating the assessment score value (AS)

$$AS_i = \frac{1}{2}(NSP_i + NSN_i)$$

7. Ranking

The last step is to rank by sorting the AS values from highest to lowest. The highest AS final value indicates the most superior alternative among all existing alternatives.

2.4. Visekriterijumsko Kompromisno Rangiranje Method

The Visekriterijumsko Kompromisno Rangiranje (VIKOR) method is a multicriteria ranking approach based on a specific order of closeness to the ideal solution. The basic principle of VIKOR involves determining the ranking for the samples, taking into account the utility and solution values of each sample as a result of the evaluation [19] [20] [21].

The following are the stages of completing the VIKOR method:

1. Create a decision matrix

$$X = \begin{bmatrix} x_{11} & x_{12} & x_{13} & \cdots & x_{1n} \\ x_{21} & x_{22} & x_{23} & \cdots & x_{2n} \\ x_{31} & x_{32} & x_{33} & \cdots & x_{3n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ x_{n1} & x_{n2} & x_{n3} & x_n & xn_{xn} \end{bmatrix}$$

2. Perform matrix normalization

$$r_{ij} = \left(\frac{x_j^+ - x_{ij}}{x_j^+ - x_j^-}\right)$$

3. Calculating S and R values

$$S_i = \sum_{j=1}^{n} W_j \left(\frac{x_j^+ - x_{ij}}{x_j^+ - x_j^-}\right)$$

Dan

$$R_i = Max\ j \left[W_j \left(\frac{x_j^+ - x_{ij}}{x_j^+ - x_j^-}\right)\right]$$

4. Determining the vicor index

$$Q_i = \left[\frac{S_i - S^-}{S^+ - S^-}\right] V + \left[\frac{R_i - R^-}{R^+ - R^-}\right] (1 - V)$$

5. The result of the calculation is the sequence of S, R, and Q.
6. The best alternative solution based on the minimum Q rating becomes the best rating.

3. Research Methods

Here's a diagram of the stages of this study:

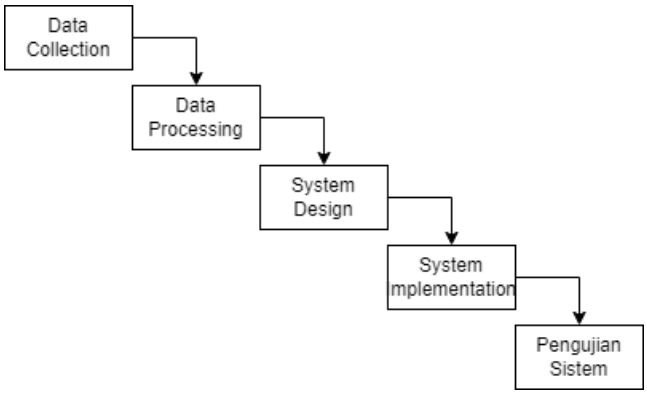

Figure 1. Research Stages

1. Data Collection

   The following are the data collection methods used in this research.

   a. Literary Studies

      In collecting data and information related to the research, a literature analysis was conducted on topics such as decision support systems, KIP scholarships, EDAS method, and VIKOR method. This literature study involves various sources that include research journals and e-books.

   b. Observation

      The author makes direct observations to obtain data from the object of research, namely the receipt of KIP scholarships at Malikussaleh University which can be obtained from the Academic Bureau of Malikussaleh University.

2. Data Processing

   After the data is obtained through observation and literature study, the next stage is data processing. The data that has been obtained will be obtained in accordance with the criteria that have been determined in the acceptance of KIP scholarships.

3. System Design
   The system design in this research uses UML, namely Use Case Diagram, Activity Diagram, Class Diagram, and Sequence Diagram.
4. System Implementation
   System implementation is the stage to realize the system according to the design in the previous stage. The system design that has been made is then coded into the system software with the python programming language and MySQL as a database.
5. System Testing
   This step is useful for knowing whether the system implementation carried out is in accordance with the needs. System testing is done with black box testing.

4. Results and Discussion

1. Criteria
   The criteria used in this study are as follows:

Table 1. Criteria

Code	Criteria	Type
C1	Parental Status	Benefit
C2	Parental Income	Cost
C3	Number of Parental Dependents	Benefit
C4	Parental Occupation	Cost
C5	Parental Home Ownership	Benefit
C6	Size of Parents' House	Cost

In the table the number of criteria used is 6 different types. Parental status, number of dependents, and parental home ownership are of the benefit type because the higher the value of each criterion, the more advisable it is. Meanwhile, the criteria for parents' income, parents' occupation, and the size of the parents' house are of the cost type because the lower the value of each criterion, the more recommended it is.

2. Subcriteria
   The determination of these sub-criteria aims to provide a weight value in the calculation of the EDAS and VIKOR methods. The following are the sub-criteria of each criterion.

Table 2. Parental Status

Subcriteria	Value
Orphan	5
Orphans/Underprivileged	3
Divorced	2
Full Parents	1

Table 3. Parental Income

Subcriteria	Value
Rp. < 500.000	5
Rp. 500.001 – Rp. 1.000.000	4
Rp. 1.000.001 – Rp. 2.000.000	3
Rp. 2.000.001 – Rp. 3.000.000	2
Rp. 3.000.001	1

Table 4 Number of Parental Dependents

Subcriteria	Value
>= 5 Children	5
4 Children	4
3 Children	3
2 Children	2
1 Children	1

Table 5 Parental Occupation

Subcriteria	Value
Not Working	5
Fisherman/Farmer	4
Self-employment/Other	3
Private Employee	2
Civil Servant/Army/Police	1

Table 6 Parental Home Ownership

Subcriteria	Value
Do not have	5
Hitchhiking	4
Monthly Rent	3
Annual Rent	2
Owned	1

Table 7 Size of Parents' House

Subcriteria	Value
< 25 m^2	5
26 - 50 m^2	4
51 - 99 m^2	3
100 - 199 m^2	2
> 200 m^2	1

4.1. Manual Calculation of EDAS Method

1. Create a decision matrix

Table 8 EDAS Decision Matrix

Alternative	C1	C2	C3	C4	C5	C6
A1	3	4	2	3	4	3
A2	1	4	2	3	4	3
A3	1	4	4	3	4	5
A4	1	3	3	3	1	3
A5	1	5	5	3	1	2
.	.	.	.	.	.	.
A300	1	4	4	4	1	5

2. Perform matrix normalization

$$AV_1 = \frac{3+1+1+1+1+1+5+3+1+1+\cdots+1}{300} = 1{,}33$$

$$AV_2 = \frac{4+4+3+5+4+3+3+2+2+\cdots+4}{300} = 3{,}313$$

$$AV_3 = \frac{2+2+4+3+5+5+1+5+1+4+\cdots+4}{300} = 3{,}077$$

$$AV_4 = \frac{3+3+3+3+3+4+3+5+3+3+\cdots+4}{300} = 3{,}297$$

$$AV_5 = \frac{4+4+4+1+1+4+1+1+4+1+\cdots+1}{300} = 1{,}9$$

$$AV_6 = \frac{3+3+5+3+2+4+2+5+3+2+\cdots+5}{300} = 3{,}66$$

3. Determining the positive and negative distances from the average (PDA and NDA)

Table 9 Determining the PDA

Alternative	C1	C2	C3	C4	C5	C6
A1	1,256	0	0	0,09	1,105	0,18
A2	0	0	0	0,09	1,105	0,18
A3	0	0	0,3	0,09	1,105	0
A4	0	0,094	0	0,09	0	0,18
A5	0	0	0,625	0,09	0	0,454
.	.	.	.	.	.	.
A300	0	0	0,3	0	0	0

Table 10 Determining the NDA

Alternative	C1	C2	C3	C4	C5	C6
A1	0	0,207	0,35	0	0	0
A2	0,248	0,207	0,35	0	0	0
A3	0,248	0,207	0	0	0	0,366
A4	0,248	0	0,025	0	0,474	0
A5	0,248	0,509	0	0	0,474	0
.	.	.	.	.	.	.
A300	0,248	0,207	0	0,213	0,474	0,366

4. Determine the weighted sum of PDA and NDA (SP and SN)

Table 11 SP and SN Values

Alternative	SP	SN
A1	0,464	0,122
A2	0,087	0,196
A3	0,140	0,141
A4	0,044	0,108
A5	0,157	0,230
.	.	.
A300	0,060	0,201

5. Normalization of SP and SN values

Table 12 Normalization of SP and SN

Alternative	NSP	NSN
A1	0,525	0,666
A2	0,099	0,463
A3	0,159	0,614
A4	0,05	0,704
A5	0,178	0,37
.	.	.
A300	0,068	0,449

6. Calculating the assessment score value (AS)

Table 13 AS Value

Alternative	AS
A1	0,596
A2	0,281
A3	0,387
A4	0,377
A5	0,274
.	.
A300	0,259

7. Ranking

Table 14 EDAS Ranking

Alternative	Name	AS Value	Rank
A256	Fauzi	0,850	1
A105	Hernita Ceria	0,791	2
A206	Ipadayan	0,789	3
A7	M Rayyan	0,776	4
A274	Ahmad Fairuzi	0,733	5
.	.	.	.
A177	Sultan Muhammad Zaid Aslam	0,012	300

4.2. Manual Calculation of VIKOR Method

1. Create a decision matrix

Table 15 VIKOR Decision Matrix

Alternative	C1	C2	C3	C4	C5	C6
A1	3	4	2	3	4	3
A2	1	4	2	3	4	3
A3	1	4	4	3	4	5
A4	1	3	3	3	1	3
A5	1	5	5	3	1	2
.	.	.	.	.	.	.
A300	1	4	4	4	1	5

2. Perform matrix normalization

Table 16 Normalization Matrix

Alternative	C1	C2	C3	C4	C5	C6
A1	0,5	0,25	0,75	0,667	0,25	0,5
A2	1	0,25	0,75	0,667	0,25	0,5
A3	1	0,25	0,25	0,667	0,25	0
A4	1	0,5	0,5	0,667	1	0,5
A5	1	0	0	0,667	1	0,75
.	.	.	.	.	.	.
A300	1	0,25	0,25	0,333	1	0

3. Weight normalization matrix

Table 17 Weight Normalization Matrix

Alternative	C1	C2	C3	C4	C5	C6
A1	0,15	0,063	0,15	0,1	0,015	0,02
A2	0,3	0,063	0,15	0,1	0,015	0,02
A3	0,3	0,063	0,05	0,1	0,015	0
A4	0,3	0,125	0,1	0,1	0,06	0,02
A5	0,3	0	0	0,1	0,06	0,03
.	.	.	.	.	.	.
A300	0,3	0,063	0,05	0,05	0,06	0

4. Determine the value of S and R

Table 18 Determining S and R

Alternative	S	R
A1	0,498	0,15
A2	0,648	0,3
A3	0,528	0,3
A4	0,705	0,3
A5	0,49	0,3
.	.	.
A300	0,523	0,3

5. Calculating the VIKOR index value (Q)

Table 19 VIKOR Index Value

Alternative	Q
A1	0,163
A2	0,792
A3	0,689
A4	0,841
A5	0,656
.	.
A300	0,685

6. Ranking

Table 20 VIKOR Ranking

Alternative	Name	Q Value	Rank
A144	Halimah Murni	0,000	1
A15	Nauval Alzabar	0,015	2
A8	Muhammad Bukhari	0,024	3
A163	Nanda Musriana	0,064	4
A130	Zahrotul Daimi	0,084	5
.	.	.	.
A54	Gilang Ramadhan	1,000	300

5. Conclusions

The conclusions that can be drawn from this research are:

1. The design of information systems to compare the EDAS method and the VIKOR method on the decision support system for KIP scholarship recipients at Malikussaleh University can be represented in the form of use case diagrams and activity diagrams. The results of this system design can be implemented as an information system that uses python as a programming language for EDAS and VIKOR methods and MySQL as a database.
2. In the application of the EDAS method, Fauzi (230510004) as the first rank with an AS value of 0.850; then Hernita Ceria (230180023) as the second rank with an AS value of 0.791; and Ipadayan (230340033) as the third rank with an AS value of 0.789.
3. In the application of VIKOR method results, Halimah Murni (230210176) as the first rank with Q value 0.000; then Nauval Alzabar (230110077) as the second rank with Q value 0.015; and Muhammad Bukhari (230110040) as the third rank with Q value 0.024.
4. The comparison results of the EDAS and VIKOR methods are that these two methods have different types. The EDAS method ranks alternatives based on their distance from the average solution, resulting in a ranking of alternatives based on how close they are to the optimal solution. While the VIKOR method ranks alternatives and provides the best compromise solution that best matches the criteria applied.

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