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Comparison of Copras, Vikor, and Waspas Methods in School Promotion Media Selection

Fatah Ridho Perdana[1*], Gian Athallah[2], Perani Rosyani[3]
Universitas Pamulang
Corresponding Author: Fatah Ridho Perdana fatahridho27@gmail.com

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A B S T R A C T

This Research Aims To Compare The COPRAS, VIKOR, And WASPAS Methods In A Decision Support System For Selecting School Promotion Media. Promotion Is An Important Activity To Improve The Impression And Competitiveness Of Schools. The Selection Of The Right Promotional Media Can Increase The Effectiveness Of The Promotion. The Three Methods Of COPRAS, VIKOR, And WASPAS Are Multicriteria Decision-Making Methods That Can Be Applied To Optimization Cases Such As The Selection Of Promotional Media. The Research Was Conducted By Applying The Three Methods To The Case Of Selecting Promotional Media For SMK Airlangga Using 5 Criteria: Cost, Time, Reach, Completeness, And Flexibility. The Results Show That The COPRAS And WASPAS Methods Produce The Same Ranking Of Alternatives With Billboards As The Best Alternative, While The VIKOR Method Is Different With Brochures As The Best Alternative. It Is Concluded That The WASPAS Method Is The Most Appropriate Because It Has Advantages In Terms Of Ease, Interpretation, And Consideration Of Criteria Weights

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INTRODUCTION

Promotion is an activity to communicate a product to consumers so that they can feel the goodness and benefits of the product. Currently, not only companies that sell products and services, but also educational institutions are increasingly conducting promotions to arouse the interest of potential users of their educational services (Rosita et al., 2020).

In the era of globalization, competition between schools is getting tougher. Therefore, schools need to make various efforts to improve their reputation and competitiveness. One of these initiatives is to conduct school promotion. School promotion is an activity carried out to introduce a school to the wider community. The goal is to increase public interest in sending their children to this school.

In conducting school promotions, it is necessary to choose the right promotional media. To handle these problems, a decision support system is needed that can help the school in choosing the right promotional media and can increase the effectiveness of school promotion.

A decision support system is a system designed to help individuals or organizations make better and more informational decisions (Simanullang & Susilawati, 2023). There are various methods that can be used in selecting school promotion media. In this study, researchers tried to compare several methods between the COPRAS, VIKOR, and WASPAS methods in determining school promotion media. COPRAS is a method used to determine differences between alternatives based on relevant and relevant criteria (Fikri,Fikri, R. M., Lukmana, S. I., & Yulia, P. S. (2019). Rekomendasi Pemilihan Tempat Usaha Makanan dengan Metode COPRAS di Kecamatan Jambangan. E-Proceeding of Engineering, 6(2) et al., 2019). It can identify differences between positive (benefit) and negative (cost) criteria, which are used to evaluate alternatives. The effectiveness and reliability of this method is very important, as it improves usability evaluation (Bagir et al., 2023). VIKOR is a method used to solve problems with conflicting and incompatible criteria. VIKOR is a method used to provide impartial evaluation, perform alternative comparisons, and find solutions that minimize the ideal compromise (Nofriansyah & Defit, 2017). The VIKOR method has a ranking process by having preference values with many alternatives more easily (Prayitno & Hiswara, 2021). WASPAS is an optimized method for interpreting a decision by producing values from highest to lowest with mathematical processes and calculations (Purba et al., 2023). By considering the WASPAS method, it can provide a solution to the best alternative selection of promotional media. The purpose of this research is to compare three methods namely COPRAS, VIKOR and WASPAS in determining the selection of school promotional media. In the end, one of the best methods can be selected to support decisions in the selection of school promotional media.

LITERATURE REVIEW

Promotion is an important element in marketing to increase awareness and a positive image of a product or service. Some previous researchers have conducted studies on school promotion. (Rosita et al., 2020) applied the MOORA method for decision support system of promotional media selection of SMK Airlangga Balikpapan. MOORA method is used in the calculation process of the system with inputs in the form of criteria and alternative promotional media. The criteria used are cost, time, reach, completeness of information, and flexibility. While the alternative promotion media are brochures, posters, billboards, banners, and newspaper advertisements. The results showed that the MOORA method was successfully implemented in this decision support system and produced the best promotional media recommendation output based on its priority ranking. From the calculation results, it is found that brochure media is the highest ranked alternative. System accuracy testing has also been carried out and obtained a calculation accuracy of 100%, which means the system has been correct in applying the MOORA method. In conclusion, the MOORA method is proven to be applied to the decision support system for selecting school promotion media and is able to produce recommendations for the best promotional media according to its priority ranking.

(Fikri et al., 2019) also conducted a similar research by applying the COPRAS method for the recommendation of food business place selection in Jambangan District. Competition in the food business is getting higher, as seen from the number of new food businesses but not matched by the availability of a place to sell. The selection of a place needs many considerations such as rental costs, facilities, and others. The solution built is a Decision Support System (DSS) for rice stall traders using the COPRAS method. with the COPRAS method. The assessment results show that the COPRAS method is able to evaluate alternatives based on positive (benefit) and negative (cost) criteria to rank the best alternatives.

In addition, (Purba et al., 2023) conducted a study by applying the WASPAS method and ROC weighting for the selection of campus ambassadors at Budi Darma University. Campus ambassadors are selected students who act as university promoters. This research aims to assist the university in selecting campus ambassadors appropriately, effectively, and objectively.

The research uses 6 criteria, namely campus insight, GPA, achievement, general knowledge, public speaking, and organizational activity. Alternative data amounted to 10 students and 10 female campus ambassador candidates. Weighting criteria using the ROC method, then ranking alternatives using the WASPAS method.

The results showed that Iman Judi Situmeang received the highest score of 0.9967 as the best male campus ambassador candidate and Siti Humairoh received a score of 0.9999 as the best female campus ambassador candidate. In conclusion, the combination of WASPAS and ROC methods can produce accurate and objective campus ambassador selection decisions in helping the university.

Meanwhile, (Harahap et al., 2022) discusses the application of the VIKOR method to the decision support system for selecting the best monthly promo products at the digital startup company based on the online shop Belanjasegar.com. The selection of promo products is based on five criteria, namely product prices, product discounts, product quality, stock items, and payment types. The VIKOR method is used to get the best alternative from several alternative product choices based on predetermined criteria. The VIKOR method calculation includes determining the best and worst values for each criterion function, normalizing the data into a matrix, calculating the utility measure and regret measure values to get the S and R values of each alternative, then calculating the VIKOR index (Q) for alternative ranking. The calculation results show that the Kuku Balam 10 Kg Rice product from UD. Maju is the product with the smallest VIKOR index value so it deserves to be the best monthly promo product. This system helps companies in choosing promo products that are in accordance with market desires.

Based on the literature study, it can be concluded that the COPRAS, VIKOR, and WASPAS methods are suitable to be applied in selection optimization cases such as the selection of school promotional media. These three methods will be compared to determine the best method for the problem under study.

METHODOLOGY

Research Phase

The research was conducted using several stages, as follows:

a. Sample data collection
b. Data analysis
c. Testing the application of the COPRAS, VIKOR and WASPAS Methods
d. Decision making
e. Preparation of research report

Decision Support System

Decision Support System (DSS), is generally defined as a liberal system that is able to provide both problem solving skills and the ability to communicate semi-structured problems. (Sibagariang & Riandari, 2019).

Complex Propotional Assesment (COPRAS) Method

In 1996, Vilnus Technical University researcher Gediminas created a complex proportional evaluation method, COPRAS (Complex Proportional Assessment). The COPRAS method can be used for multicriteria decision making by maximizing and minimizing the value of criteria. In this method, the types of criteria are benefits or costs that are considered separately (Hezer et al., 2021). Therefore, the alternative ranking results using the COPRAS method allow differences compared to other methods and are more accurate in evaluating and validating the calculation results.

The COPRAS (Complex Proportional Assessment) procedure has various steps that must be performed in this procedure (Fadilla et al., 2022):

a. Phase 1

Create a decision matrix. The decision matrix is a matrix of alternative and attribute values

$$.D = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \\ A_m \end{matrix} \begin{bmatrix} A_{11} & A_{12} & A_{13} & A_{14} & A_{15} \\ A_{21} & A_{22} & A_{23} & A_{24} & A_{25} \\ A_{31} & A_{32} & A_{33} & A_{34} & A_{35} \\ A_{41} & A_{42} & A_{43} & A_{44} & A_{45} \\ A_{51} & A_{52} & A_{53} & A_{54} & A_{55} \\ A_{m1} & A_{m2} & A_{m3} & A_{m4} & A_{m5} \end{bmatrix}$$

b. Phase 2

Normalization of the matrix in decision making. For matrix normalization using the following formula::

$$\text{Xij} = \frac{X_{ij}}{\sum_{1=1}^{m} X_{ij}}$$

To get the normalized matrix, divide each column's value by the total of its column values.

c. Phase 3

After obtaining a weighted normalization matrix, use the following formula to calculate weighted normalization:

$$D^1 = D_{ij} = X_{ij} * W_{ij}$$

Where Wj is the weight of the criteria and Xij is the alternative's normalized value. Every criterion's weight is always equal to the total of its weighted normalized values.

d. Phase 4

The determination of each alternative's top and lowest values on the index. The formula for finding the highest and lowest values for each option is as follows:

$$S_{+i} = \sum_{j=1}^{n} Y_{=+ij}$$

$$S_{-ij} = \sum_{j=1}^{n} Y_{=-ij}$$

Where the weighted normalized values for the benefit and cost characteristics, respectively, are denoted by y_{+ij} and y_{-ij}. The superior option is indicated by a lower S-i value. The level of objective accomplished by each choice is shown by the S+i and S-i values. But the total of the alternatives' "plus" and "minus" (S+1 and S-1, respectively) always equals the total of the weights assigned to the benefit and cost qualities.

e. Phase 5

Identifying important choices by first identifying favorable alternatives S_{+1} and the negative options The relative weight of each option is calculated using S_{-1}.

f. Phase 6

Determine each alternative's relative importance or relative priority (Qi) using the relative significance value.

$$Q_i = S_{+i} + \frac{S_{-i} \min \sum_{i=1}^{m} S_{-1}}{S_{-i} \sum_{i=1}^{m} (\frac{S_{-min}}{S_{-1}})} = S_{+1} + \frac{\sum_{i=1}^{m} S_{-1}}{S_{-1} \sum_{i=1}^{m} (\frac{1}{S_{-1}})} \ (i = 1,2, \dots, m)$$

Where S_{-1} min is the lowest value of S_{-i} and the higher the value of Qi, the higher the alternative's priority. An alternative's relative significance value

indicates the degree of pleasure attained by the realized alternative. The best option among the following choices is the one with the highest significance value (Q_{max}).

g. Phase 7

Calculating quantitative utility (Ui) for each alternative.

$$U_i = \left[\frac{Q_i}{Q_{max}}\right] x\ 100\%$$

Where the greatest relative significance value is denoted by Q_{max}. The range of this utility value is 0% to 100%. Among the five possibilities, the option with the maximum utility value (U_{max}) is the ideal option.

Visektriterijumsko Kompromisno Rangiranje (VIKOR) Method

The Vikor method is one of the multi-criteria decision making methods or better known as Multi Criteria Decision Making (MCDM). MCDM is used to solve problems with conflicting and incompatible criteria. This method focuses on ranking and selecting from a set of conflicting criteria alternatives to be able to make decisions to reach a final decision. (Hezer et al., 2021).

This method makes decisions with a near-ideal solution and each alternative is evaluated based on all predefined criteria. Vikor ranks the alternatives and determines the solution that is closest to the ideal compromise solution. The Vikor method is very useful in situations where the decision maker does not have the ability to make choices at the time of system design. The calculation steps with the Vikor method are as follows (Iqbal Kurniansyah & Sinurat, 2020).

a. Determine the max and min values of each criteria
b. Perform normalization using the following formula:

$$R_{ij} = \left(\frac{X_j^+ - X_{ij}}{X_j^+ - X_j^-}\right)$$

Where R_{ij} and X_{ij} (i=1,2,3,...,m and j=1,2,3,...,n) are elements of the decision matrix (alternative i against criterion j) and X^+_j is the best element of criterion j, X_j is the worst element of criterion j.

c. Calculate normalization multiplied by the weight on each criteria.
d. Calculate the value of S and R using the following formula:

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

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

Where W_j is the weight of each criteria j.

e. Determining the index value

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

Where S-=min Si, S+=max Si and R-=min Ri, R +=max Ri and v = 0,5

f. Hasil perangkingan merupakan hasil pengurutan dari S, R dan Q.
g. The best ranked alternative solution based on the minimum Q value becomes the best ranked with the condition that:

Q(A(2)) - Q(A(1)) ≥ DQ (4)

Where:

A(2) = alternative with the second order in ranking Q
A(1) = the alternative with the best order in ranking Q
DQ = 1 - (m-1), where m is the number of alternatives.
Alternative A(1) must be ranked best in S and R.

Weight Aggregated Sum Product Assesment (WASPAS) Method

In making a decision involves many supporting factors, for that we need a certain method in its processing. One of the methods used is the Weight Aggregated Sum Product Assessment (WASPAS) method. The Weighted Aggregated Sum Product Assessment (WASPAS) method is a combined method consisting of the SAW method and the WP method (Daulay et al., 2021).

a. Determine the Normalization Matrix in Decision Making

$$X = \begin{bmatrix} x_{11} & x_{11} & . & x_{1n} \\ x_{21} & x_{12} & . & x_{2n} \\ . & . & . & . \\ x_{m1} & x_{m1} & . & x_{mn} \end{bmatrix}$$

b. Normalize the matrix X

Benefit Criteria

$Xij = \frac{xij}{maxxij}$

Cost Criteria

$Xij = \frac{minxij}{xij}$

c. Calculating Value Qi

$Qi = 0.5 \sum_{j=1}^{n} x_{ijw} + 0.5 \prod_{j}^{n} = (xij)^{wj}$

RESULTS AND DISCUSSIONS

The decision support system built in this research is implemented using COPRAS, VIKOR, WASPAS methods as calculation methods for determining priority ranking. Criteria, alternatives and criteria weight values are obtained from interview with promotion team of SMK Airlangga Balikpapan as decission maker. The weight value of criteria and its types and the scale of alternative value assessment can be seen in Tables 1 and 2.

Table 1. Weight Value and Criteria Type

Weight	Type	Criteria Name	Criteria
0.35	Cost	Cost	C1
0.15	Benefit	Time	C2
0.25	Benefit	Reach	C3
0.15	Benefit	Completeness	C4
0.10	Benefit	Flexibility	C5

Table 2. Rating Scale

	Not Important	Less Important	Important	Very Important
Value	1	2	3	4

Furthermore, it will carry out the ranking process with the COPRAS, VIKOR, WASPAS methods. In this study, the system was tested using input data as shown in Table 3. In Table 3, alternatives are coded with the provisions of numbers 1 representing Brochures, 2 representing Posters, 3 representing Billboards, 4 representing Banners, and 5 representing Newspaper advertisements.

Table 3. Input Data

Alternative	Criteria				
	C1	C2	C3	C4	C5
A1	4	3	3	3	3
A2	4	3	3	2	2
A3	1	2	2	1	2
A4	3	3	2	3	2
A5	4	3	2	1	2

COPRAS Method Implementation

a. Creating a Decision Matrix

The decision matrix based on alternative normalization results is

$$D = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{matrix} \begin{bmatrix} 4 & 3 & 3 & 3 & 3 \\ 4 & 3 & 3 & 2 & 2 \\ 1 & 2 & 2 & 1 & 2 \\ 3 & 3 & 2 & 3 & 2 \\ 4 & 3 & 2 & 1 & 2 \end{bmatrix}$$

b. Normalization of Matrix X

To normalize a matrix, add the values of all of its columns. Next, divide every possible value in each column by the total number of outcomes in each column to obtain the matrix X_{ij}.

1. Criteria (C1)

C1 = 4+4+1+3+4 = 16

A_{11} = 4/16 = 0.25

A_{21} = 4/16 = 0.25

A_{31} = 1/16 = 0.0625

A_{41} = 3/16 = 0.1875

A_{51} = 4/16 = 0.25

Calculate up to Criteria (Cn)

From the above calculations, the Xij Matrix is obtained, which is as follows:

$$Xij = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{matrix} \begin{bmatrix} 0.25 & 0.214286 & 0.25 & 0.3 & 0.272727 \\ 0.25 & 0.214286 & 0.25 & 0.2 & 0.181818 \\ 0.0625 & 0.142857 & 0.16667 & 0.1 & 0.181818 \\ 0.1875 & 0.214286 & 0.16667 & 0.3 & 0.181818 \\ 0.25 & 0.214286 & 0.16667 & 0.1 & 0.181818 \end{bmatrix}$$

c. Determining the Normalized Weighted Decision Matrix

The next step after getting the Xij matrix is to find the normalized weighted decision matrix (D_{ij}) by using the equation $D' = d_{ij} = X_{ij} \times W$ to multiply the value

of each choice by the weight of the criteria that have been specified in the Table above Criteria Data:

Weighted decision matrix of criteria 1 (C1)

A1 = 0.25 * 0.35 = 0.0875
A2 = 0.25 * 0.35 = 0.0875
A3 = 0.0625 * 0.35 = 0.021875
A4 = 0.1875 * 0.35 = 0.065625
A5 = 0.25 * 0.35 = 0.0875

From the above calculations, the Dij Matrix is obtained, which is as follows:

$$Dij = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \\ \\ \end{matrix} \begin{bmatrix} 0.0875 & 0.032143 & 0.0625 & 0.045 & 0.027273 \\ 0.0875 & 0.032143 & 0.0625 & 0.03 & 0.018182 \\ 0.021875 & 0.021429 & 0.041667 & 0.015 & 0.018182 \\ 0.065625 & 0.032143 & 0.041667 & 0.045 & 0.018182 \\ 0.0875 & 0.032143 & 0.041667 & 0.015 & 0.018182 \\ Cost/Min & Ben/Max & Max & Max & Max \end{bmatrix}$$

d. Maximizing and Minimizing Index for each alternative

Add the values of each criterion based on its kind, as indicated in the above table, after obtaining Dij's value. Standards Information Type cost denotes S-1 (minimum) while type benefit is S+1 (maximum).

S_{+i} = (C2 + C3 + C4 + C5)
A1 = (0.032143 + 0.0625 + 0.045 + 0.027273) = 0.166916
A2 = (0.032143 + 0.0625 + 0.03 + 0.018182) = 0.142825
A3 = (0.021429 + 0.041667 + 0.015 + 0.018182) = 0.096277
A4 = (0.032143 + 0.041667 + 0.045 + 0. 018182) = 0.136991
A5 = (0.032143 + 0.041667 + 0.015 + 0. 018182) = 0.106991

S_{-i} = C5
A1 = 0.0875
A2 = 0.0875
A3 = 0.21875
A4 = 0.065625
A5 = 0.0875
Total from S-i or Cost/Min = 0.35

e. Calculation of Relative Weight on Each Alternative

Table 3. Calculation of Relative Weight

Alternative	1/S-i	S-i * Total 1/S-i
A1	1/0,0875 = 11,428571	0.0875 * 95.238095 = 8.333333
A2	1/0,0875 = 11,428571	0.0875 * 95.238095 = 8.333333
A3	1/0,021875 = 45,714286	0.021875 * 95.238095 = 2.083333
A4	1/0,065625 = 15, 428571	0.065625 * 95.238095 = 6.25
A5	1/0,0875 = 11,428571	0.0875 * 95.238095 = 8.333333
Total	95,238095	

f. Determining Relative Priority (Qi)

Based on the calculation table above, the next step is to determine the relative significance or relative priority of Qi with the equation:

$$Q1 = 0.166916 + \left(\frac{0.35}{8.333333}\right) = 0.208916$$

$$Q2 = 0.142825 + \left(\frac{0.35}{8.333333}\right) = 0.184825$$

$$Q3 = 0.096277 + \left(\frac{0.35}{2.083333}\right) = 0.264277$$

$$Q4 = 0.136991 + \left(\frac{0.35}{6.25}\right) = 0.192991$$

$$Q5 = 0.148991 + \left(\frac{0.35}{8.333333}\right) = 0.148991$$

g. Calculation of utility Ui for each Alternative

The last step is to calculate the utility for each alternative, the utility value ranges from 0% to 100%.

$$U1 = \left(\frac{0.208916}{0.264277}\right) * 100\% = 79\%$$

$$U2 = \left(\frac{0.184825}{0.264277}\right) * 100\% = 70\%$$

$$U3 = \left(\frac{0.264277}{0.264277}\right) * 100\% = 100\%$$

$$U4 = \left(\frac{0.192991}{0.264277}\right) * 100\% = 73\%$$

$$U5 = \left(\frac{0.148991}{0.264277}\right) * 100\% = 56\%$$

h. Ranking Results of COPRAS method

Table 4. Ranking Results

Alternative Code	Alternative	Qi Result	Rank
A1	Brochure	79%	2
A2	Poster	70%	4
A3	Billboards	100%	1
A4	Banners	73%	3
A5	Newspaper Ads	56%	5

VIKOR Method Implementation

a. Determining the max and min values of each criterion

Table 5. Determining th eMax and Min

	C1	C2	C3	C4	C5
X+	4	3	3	3	3
X-	1	2	2	1	2

b. Performing data normalization

1. For criteria C1

$A1 = \left(\frac{4-4}{4-1}\right) = 0$

$A2 = \left(\frac{4-4}{4-1}\right) = 0$

$A3 = \left(\frac{4-1}{4-1}\right) = 1$

$A4 = \left(\frac{4-3}{4-1}\right) = 0{,}333333$

$A5 = \left(\frac{4-4}{4-1}\right) = 0$

From the normalization calculation of the sample above, the Matrix is obtained, which is as follows:

Table 6. Matrix is Obtained

Alternative	**Criteria**				
	C1	**C2**	**C3**	**C4**	**C5**
A1	0	0	0	0	0
A2	0	0	0	0.5	1
A3	1	1	1	1	1
A4	0.333333	0	1	0	1
A5	0	0	1	1	1

c. Calculating normalization multiplied by the weight on each criteria

Table 7. Normalization Multiplied

Alternative	**Criteria**				
	C1	**C2**	**C3**	**C4**	**C5**
A1	0 * 0.35	0 * 15	0 * 0.25	0 * 0.15	0 * 0.10
A2	0 * 0.35	0 * 0.15	0 * 0.25	0.5 * 0.15	1 * 0.10
A3	1 * 0.35	1 * 0.15	1 * 0.25	1 * 0.15	1 * 0.10
A4	0.333333 * 0.35	0 * 0.15	1 * 0.25	0 * 0.15	1 * 0.10
A5	0 * 0.35	0 * 0.15	1 * 0.25	1 * 0.15	1 * 0.10

d. From the above calculations, the Matrix is obtained, which is as follows:

Table 8. Matrix is Obtained

Alternative	**Criteria**				
	C1	**C2**	**C3**	**C4**	**C5**
A1	0	0	0	0	0
A2	0	0	0	0.075	0.1
A3	0.35	0.15	0.25	0.15	0.1
A4	0.116667	0	0.25	0	0.1
A5	0	0	0.25	0.15	0.1

Calculating S and R Values
To calculate the S_n value
A1 = 0 + 0 + 0 + 0 + 0 = 0
A2 = 0 + 0 + 0 + 0.075 + 0.1 = 0.175
A3 = 0.35 + 0.15 + 0.25 + 0.25 + 0.15 = 1
A4 = 0.116667 + 0 + 0.25 + 0 + 0.1 = 0.4666667
A5 = 0 + 0 + 0.25 + 0.15 + 0.1 = 0.5
To calculate the R_n value
A1 = 0 A4 = 0.25
A2 = 0.1 A5 = 0.25
A3 = 0.35
e. Calculating the Vicor Index
Description:
S- = 0 R- = 0
S+ = 1 R+ = 0.35

Q(A1)= $Q_i = \left[\frac{0-0}{1-0}\right] * 0.5 + \left[\frac{0-0}{0.35-0}\right] * (1-0.5) = 0$

Q(A2)= $Q_i = \left[\frac{0.175-0}{1-0}\right] * 0.5 + \left[\frac{0.1-0}{0.35-0}\right] * (1-0.5) = 0.230357$

Q(A3)= $Q_i = \left[\frac{1-0}{1-0}\right] * 0.5 + \left[\frac{0.35-0}{0.35-0}\right] * (1-0.5) = 1$

Q(A4)= $Q_i = \left[\frac{0.466667-0}{1-0}\right] * 0.5 + \left[\frac{0.25-0}{0.35-0}\right] * (1-0.5) = 0.590476$

Q(A5)= $Q_i = \left[\frac{0.5-0}{1-0}\right] * 0.5 + \left[\frac{0.25-0}{0.35-0}\right] * (1-0.5) = 0.607143$

f. VIKOR method ranking results

Table 9. VIKOR Method Ranking Results

Alternative Code	Alternative	Qi Result	Rank
A1	Brochure	0	1
A2	Poster	0.230357	2
A3	Billboards	1	5
A4	Banners	0.590476	3
A5	Newspaper Ads	0.607143	4

WASPAS Method Implementation
a. Creating a decision matrix

$$X = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ A_4 \\ A_5 \end{matrix} \begin{bmatrix} 4 & 3 & 3 & 3 & 3 \\ 4 & 3 & 3 & 2 & 2 \\ 1 & 2 & 2 & 1 & 2 \\ 3 & 3 & 2 & 3 & 2 \\ 4 & 3 & 2 & 1 & 2 \end{bmatrix}$$

b. Calculating the Normalized Matrix
Cost (C1) = 4+4+1+3+4 = 1
A1 = 1 /4 = 0.25
A2 = 1 /4 = 0.25
A3 = 1/1 = 1

A4 = 1/3 = 0.333333
A5 = 1 /4 = 0.25
Benefit (C2) = 3+3+2+3+3 = 3
A1 = 3/3 = 1
A2 = 3/3 = 1
A3 = 2/3 = 0.666667
A4 = 3/3 = 1
A5 = 3/3 = 1

From the results of the above calculations, it can be seen in the following matrix:

$$X = \begin{bmatrix} 0.25 & 1 & 1 & 1 & 1 \\ 0.25 & 1 & 1 & 0.666667 & 0.666667 \\ 1 & 0.666667 & 0.666667 & 0.333333 & 0.666667 \\ 0.333333 & 1 & 0.666667 & 1 & 0.666667 \\ 0.25 & 1 & 0.666667 & 0.333333 & 0.666667 \end{bmatrix}$$

c. Calculating Preference (Qi)

Q1 $= (0.5 * \sum(0.25 * 0.35) + (1 * 0.15) + (1 * 0.25) + (1 * 0.15) + (1 * 0.10)) + (0.5 * \pi ((0.25)^{0.35} + (1)^{0.15} + (1)^{0.25} + (1)^{0.15} + (1)^{0.10})$

$= 0.36875 + 2.307786$

$= 2.676536$

From the results of the above calculations, it can be seen in the following matrix:

Table 10. Results of the Above Calculations

Qi	Qi Result
Q1	2.676536
Q2	2.586506
Q3	2.694231
Q4	2.596931
Q5	2.424668

d. WASPAS Method ranking results

Table 11. WASPAS Method Ranking Results

Alternative Code	Alternative	Qi Result	Rank
A1	Brochure	2.676536	2
A2	Poster	2.586506	4
A3	Billboards	2.694231	1
A4	Banners	2.596931	3
A5	Newspaper Ads	2.424668	5

Table 12. Comparison Results between the COPRAS, VIKOR, and WASPAS Methods

Alternative Code	Alternative	COPRAS	VIKOR	WASPAS
A1	Brochure	2	1	2
A2	Poster	4	2	4
A3	Billboards	1	5	1
A4	Banners	3	3	3
A5	Newspaper Ads	5	4	5

Based on the table above, the COPRAS and WASPAS methods obtain the same rank on the alternatives, while the VIKOR method is different, namely rank 1 on brochures, rank 2 on posters, rank 3 on banners, rank 4 on newspaper advertisements, and rank 5 on billboards.

CONCLUSIONS AND RECOMMENDATIONS

The COPRAS, VIKOR, and WASPAS methods are multicriteria methods that can be used for school promotion media selection. The three methods have their own advantages and disadvantages.

The COPRAS method is a method that uses the concept of pairwise comparison to determine the best alternative. This method has advantages in terms of ease of use and interpretation of results. However, this method has the disadvantage of not considering the relative weight of each criteria.

The VIKOR method is a method that uses the concept of multiple preferences to determine the best alternative. This method has the advantage of considering the relative weight of each criteria. However, this method has disadvantages in terms of calculation complexity and interpretation of results.

The WASPAS method is a method that combines the concepts of pairwise comparison and multiple preferences to determine the best alternative. This method has advantages in terms of ease of use, interpretation of results, and considering the relative weight of each criteria.

Based on the comparison of the three methods, it can be concluded that the WASPAS method is the most appropriate method for selecting school promotional media. This is because the WASPAS method has advantages over the other two methods, namely ease of use, interpretation of results, and considering the relative weight of each criteria.

FURTHER STUDY

This research compares three methods COPRAS, VIKOR, and WASPAS for the case of school promotion media selection. Some suggestions for further research are:

1. Apply other optimization methods such as TOPSIS, MOORA, or Fuzzy AHP for promotional media selection and compare the results.
2. Conduct a study with a larger number of criteria and alternatives.
3. Considering the uncertainty aspect by applying fuzzy logic to the method used.

4. Conducting a user perception survey of the selected promotional media to validate the decisions taken.

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