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Decision Support System for the Selection of Prospective Recipients of Poor Student Assistance with Comparison of ROC-WASPAS and ENTROPY-WASPAS

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ABSTRACT

The process of selecting potential recipients of aid for poor students often experiences difficulties because it involves many criteria that must be assessed accurately and objectively. Mistakes in assessment can result in the distribution of aid not being on target, thereby harming those who should receive the aid. This research aims to develop a decision support system that can assist in selecting potential recipients of aid for poor students by comparing two different ranking methods, namely ROC-WASPAS and ENTROPY-WASPAS. The ROC-WASPAS method combines the Rank Order Centroid (ROC) technique to determine criteria weights with the Weighted Aggregated Sum Product Assessment (WASPAS) for ranking alternatives. In contrast, the ENTROPY-WASPAS method uses entropy to determine criteria weights based on the level of data uncertainty, combined with the WASPAS method. The aim of this research is to compare the effectiveness of the two methods in producing accurate and fair rankings for potential aid recipients. The contribution of this research includes the development of a reliable evaluation model and the provision of a system that makes it easier for decision makers to select aid recipients more precisely. Results Comparison between the ROC-WASPAS and Entropy-WASPAS evaluation methods shows that both can produce different rankings for the same alternative. This shows the importance of choosing evaluation methods carefully in decision making, because the final results can be influenced by the approach used. This variation in ratings indicates that each method has a unique approach to assessing performance, and a deep understanding of the method used is necessary to provide a more comprehensive picture.

PENDAHULUAN

Poor student assistance is one of the most important government programs to ensure that students from underprivileged families can continue their education without being hindered by cost issues. This program plays a significant role in supporting the government's efforts to improve access to education for all levels of society. The selection of prospective recipients is based on various criteria such as family income, number of dependents, and academic achievements. Given the many criteria that must be considered and the number of candidates that need to be evaluated, this selection process requires a systematic and objective approach to ensure that aid is channeled to those who really need it.

However, the process of selecting prospective recipients of poor student assistance cannot be separated from various problems. One of the main problems that often arise is subjectivity in assessment and decision-making. This subjectivity can lead to injustice and inaccuracy in the provision of aid, so that help does not always reach the students who need it most. In addition, the large volume of data and the complexity of comparing various criteria make this selection process very challenging and error-prone. To overcome this problem, a solution is needed that can help make decisions more objectively and efficiently. In this case, the Decision Support System (SPK) emerged as a solution that can overcome these problems by providing a structured framework for the evaluation and selection of prospective aid recipients.

A Decision Support System (SPK) is a computer-based information system designed to assist the decision-making process by analyzing data and generating recommendations. SPK is able to handle complex problems by considering a variety of relevant criteria, thus assisting decision-makers in making the best choice based on the available data. In the context of selecting prospective recipients of assistance for poor students, SPK can be used to process data on prospective recipients, assess them based on predetermined criteria, and

provide recommendations on who is most eligible to receive assistance. Thus, SPK can help ensure that the selection process is carried out objectively, transparently, and accurately.

In this study, two methods used to determine the weight of the criteria and alternative evaluation are ROC-WASPAS and Entropy-WASPAS. The ROC (*Rank Order Centroid*) method is used to determine the weight of the criteria based on the order of relative importance of the criteria. This method gives greater weight to the criteria that decision-makers consider more important, so that it can reflect existing priorities. On the other hand, the Entropy method is used to determine the weight of criteria based on the level of uncertainty or randomness in the data. This method gives higher weight to criteria that have greater variation in data, assuming that they have more significant information. Once the criteria weights are determined with each method, the WASPAS (*Weighted Aggregated Sum Product Assessment*) method is used to evaluate and rank the best alternatives. WASPAS is a method that combines weighted addition and weighted multiplication approaches to provide a comprehensive and accurate evaluation.

Previous research has shown various approaches in the use of SPK for the selection of prospective beneficiaries. Some of the research that can be used as a reference in this study is a study by Mhd Bobbi Kurniawan Nasution et al in June 2022 entitled "Decision Support System for Performance Assessment of the Head of Study Program Applying the WASPAS Method with ROC Weighting". The results of this study show that the performance assessment process of the head of the study program becomes more objective and accountable. In this study, the Head of Study Program who received the reward was an A2 alternative with a preference value of 0.958. Samuel Damanik and Dito Putro Utomo in October 2020 conducted a study entitled "Implementation of ROC (Rank Order Centroid) and WASPAS Methods in the Decision Support System for Vendor Cooperation Selection". This study reveals that the A6 alternative on behalf of Swandy Acc was chosen as the cooperation vendor with the highest value of 0.864321. Badrul Anwar et al. in December 2022 in a study entitled "Combination of the Application of the WASPAS Method and Rank Order Centroid (ROC) in the Decision to Select the Best Mobile Phone Camera Technology" concluded that the best mobile phone camera technology is the Samsung Galaxy S22 Ultra which is found in the A5 alternative with the highest score of 3.8354 as the first ranking. Another study by Gogor Christmass Setyawan et al in August 2023 entitled "Application of Entropy and WASPAS Methods in Recommendations for Choosing the Best Graphic Design Laptop" found that the best graphic design laptop is the RAZER BLADE 15 ADVANCED on the A4 alternative with the highest score of 3.79720. Rima Tamara Aldisa in December 2022 compared the ROC-WASPAS and Entropy-WASPAS methods in a study entitled "Comparative Analysis of ROC-WASPAS and Entropy-WASPAS Methods in the Decision to Give Performance Rewards for Hotel Employees". The results showed that the A5 alternative was the best alternative with the highest score of 2,958 in the ROC-WASPAS method and 2,968 in the Entropy-WASPAS method.

This study aims to fill the gap by comparing two different methods in the context of selecting prospective recipients of poor student assistance. By making these comparisons, it is hoped that a more effective and efficient method can be found in helping decision-makers to choose the most deserving potential beneficiaries. The results of this study are expected to make a significant contribution to the development of SPK in the context of education, as well as provide practical recommendations for parties involved in the selection process of prospective recipients of poor student assistance. In addition, this research is also expected to enrich the literature on the use of ROC-WASPAS and Entropy-WASPAS methods in SPK, as well as provide new insights for researchers and practitioners in this field.

METHOD

Poor student assistance is a program designed to help students from underprivileged families to continue their education without being constrained by cost problems. The program considers various criteria such as family income, number of dependents, and academic achievement. The main challenge in the program is to ensure that aid is provided to students who need it most, which requires a fair and objective selection process.

The ROC (*Rank Order Centroid*) method is a weighting technique used to determine the weight of criteria based on the order of relative importance of the criteria. Weights are determined by calculating the average of all possible weights that can be assigned to a criterion based on their position in the order. This method is simple and effective for assigning weights that reflect the relative priority between the criteria.

The Entropy method is used to determine the weight of criteria based on the level of uncertainty or randomness in the data. The greater the variation or uncertainty of the data of a criterion, the higher the weight given. This method measures the entropy of each criterion's data to determine a more objective weight, assuming that the criteria with more varied data have more significant information.

The WASPAS (*Weighted Aggregated Sum Product Assessment*) method is a method that combines a weighted sum approach (*Weighted Sum Model*) and weighted multiplication (*Weighted Product Model*). This method is used to evaluate and rank alternatives based on criteria that have been weighted. WASPAS offers a comprehensive approach by considering the advantages of both methods combined.

This research stage consists of several important steps that are integral to the process of developing a Decision Support System (SPK) for the selection of prospective recipients of poor student assistance. The following is a picture of the research stages carried out by the fund, which can be seen in figure 1.

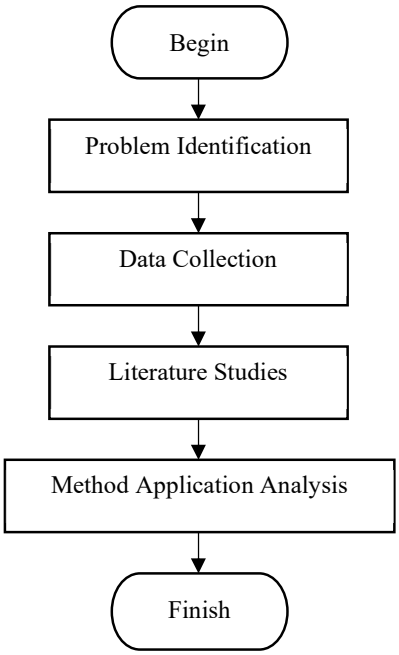

Figure 1. Research Stages

The following is an explanation for each stage of research contained in figure 1:

1. Problem Identification
   The initial stage in research is to identify the problem you want to solve or the area you want to research. This involves determining relevant issues or challenges in the selection of potential recipients of poor student assistance that will be the focus of the research.
2. Data Collection
   Once the problem is identified, the next step is to gather the relevant and necessary data to resolve the issue. This data can be in the form of information about prospective recipients of assistance, selection criteria, and other related factors.
3. Literature Studies
   This stage involves reviewing and analyzing existing literature related to the problem being researched. Literature studies help in understanding the context of the problem, evaluating previous approaches, and identifying knowledge gaps that can be filled by this research.
4. Method Application Analysis
   After having a solid understanding of the problem and relevant data, the research then involves analyzing the application of a particular method or approach in addressing the identified problem. This could include developing or adapting models, algorithms, or other appropriate approaches.
5. Method Comparison

Once the method or approach is implemented, the next step is to compare the effectiveness and efficiency of the different methods used. This can involve comparing the results obtained from different approaches to evaluate which one provides the best solution to the problem at hand.

6. Conclusion and Recommendations
   The last stage is to conclude the results of the research and present recommendations based on the findings. This involves drawing conclusions about what has been learned from the research, the practical implications of the findings, as well as suggestions for future research or practical implementation of the proposed solution.

RESULTS AND DISCUSSION

Alternative Assignments

To determine the recipients of assistance for poor students, several alternative data are needed. In order to produce accurate decisions, the authors compared the ROC-WASPAS and Entropy-WASPAS methods to see the difference in the best alternative results of the two methods. The data needed includes information about students. The following are 10 alternative student data presented in Table 1:

Table 1. Alternative Data

Alternate Code	Alternative Names
CSMA01	Putri
CSMA02	Ayu
CSMA03	Indah
CSMA04	Wahyuni
CSMA05	Herman
CSMA06	Citra
CSMA07	Yunita
CSMA08	Desi
CSMA09	Dina
CSMA10	Vira

Table 1 shows a list of students considered as potential recipients of aid for poor students. Each student is identified by a unique alternate code and student name. The alternative codes are CSMA01 to CSMA10, with the following student names: Putri (CSMA01), Ayu (CSMA02), Indah (CSMA03), Wahyuni (CSMA04), Herman (CSMA05), Citra (CSMA06), Yunita (CSMA07), Desi (CSMA08), Dina (CSMA09), and Vira (CSMA10). This information is used to identify and compare each candidate in the selection process of aid recipients.

Determination of Criteria

To analyze the comparison of ROC-WASPAS and Entropy-WASPAS methods, several criteria are needed as supporting data in problem solving. The following are the 5 criteria presented in Table 2:

Table 2. Criteria Data

Criterion Code	Criterion Name	Types of Criteria
Kode01	Parent/Guardian Income	*Cost*
Kode02	Number of Dependents of Parents/Guardians	*Benefit*
Kode03	Average Score	*Benefit*
Kode04	Housing Conditions	*Cost*
Kode05	Class Rank	*Benefit*
Kode06	School Attendance	*Benefit*

Setiap kriteria diidentifikasi dengan kode yang unik dan deskripsi nama kriteria. Berikut adalah rincian kriteria yang digunakan:

1. Parent/Guardian Income (Code01): This criterion evaluates the amount of monthly income received by the student's parent or guardian, which is a key indicator of the family's economic ability.
2. Number of Parents/Guardians (Code02): This criterion includes the number of family members who are dependents of the student's parents or guardians, providing an overview of the financial burden that must be borne by the family.
3. Average Grade Point Average (Code03): This criterion assesses a student's academic achievement based on the average score obtained over a certain period, as an indicator of the student's academic performance.
4. Condition of Residence (Code04): This criterion examines the condition of the student's residence, including aspects of the feasibility and security of the residence, whether permanent, semi-permanent, or temporary.
5. Class Rank (Code05): This criterion looks at a student's position or ranking in a class, which shows the student's relative achievement compared to his classmates.
6. School Attendance (Code06): This criterion evaluates the level of student attendance at school, reflecting the student's commitment and active participation in teaching and learning activities.

Table 3. Alternative Data and Criterion Values

Alternative Names	Kode01	Kode02	Kode03	Kode04	Kode05	Kode06
Putri	2.000.000	3	90	Cukup Layak	Tinggi	Baik
Ayu	2.500.000	2	95	Layak	Tinggi	Baik
Indah	1.500.000	4	100	Cukup Layak	Sangat Tinggi	Sangat Baik
Wahyuni	1.800.000	3	85	Cukup Layak	Sedang	Cukup
Herman	2.700.000	2	80	Sangat Layak	Sedang	Cukup
Citra	3.000.000	3	95	Layak	Tinggi	Baik
Yunita	1.500.000	1	90	Cukup Layak	Tinggi	Baik
Desi	2.000.000	2	80	Layak	Sedang	Cukup
Dina	1.800.000	3	80	Sangat Layak	Sedang	Cukup
Vira	2.100.000	2	85	Cukup Layak	Sedang	Cukup

Table 3 contains student data and their scores on six selection criteria for poor student aid recipients: parental income, number of dependents, average grades, housing conditions, class ranks, and school attendance. For example, Putri students have a parental income of IDR 2,000,000, 3 dependents, an average score of 90, etc. This data is used for evaluation and comparison of prospective aid recipients.

Table 4. Code04 Weighting Value

Information	Value
Highly Worthy	5
Proper	4
Quite Decent	3
Not Eligible	2
Very Unworthy	1

Table 4 contains weighting for Code04, which is a criterion that assesses the living conditions of students. Each condition is rated from "Very Unworthy" (1) to "Very Worthy" (5). This value determines the relative weight of the housing conditions in the evaluation.

Table 5. Code05 Weighting Value

Information	Value
Very High	5
Tall	4
Keep	3
Low	2
Very Low	1

Table 5 shows the weighting for Code05, which reflects the student's class ranking. Each class rating caption is rated from 1 to 5, from "Very Low" to "Very High". These values are used to give weight to a student's grade rating in the overall assessment.

Table 6. Code06 Weighting Value

Information	Value
Excellent	5
Good	4
Enough	3
Less	2
Very Less	1

Table 6 shows the weighting for Code06, which assesses school attendance. Each attendance level is rated from 1 to 5, from "Very Poor" to "Very Good". These values are crucial to determine the relative weight of student attendance in the final assessment.

Table 7. Match Rating

Alternative Names	Kode01	Kode02	Kode03	Kode04	Kode05	Kode06
Putri	2000000	3	90	3	4	4
Ayu	2500000	2	95	4	4	4
Indah	1500000	4	100	3	5	5
Wahyuni	1800000	3	85	3	3	3
Herman	2700000	2	80	5	3	3
Citra	3000000	3	95	4	4	4
Yunita	1500000	1	90	3	4	4
Desi	2000000	2	80	4	3	3
Dina	1800000	3	80	5	3	3
Vira	2100000	2	85	3	3	3

Table 7 shows the match rating for each student based on the criteria and weighting. This assessment takes into account the student's performance in each aspect assessed, taking into account the weighting that has been set. The results of this match rating will be used in decision-making to determine the most deserving poor student aid recipients.

Application of ROC-WASPAS

Application of ROC Method

The application of the ROC method is implemented to produce the necessary weight values for the next ranking stage as follows:

$$W_1 = \frac{1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6} = \frac{2,4500}{6} = 0,4083$$

$$W_1 = \frac{0+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6} = \frac{1,4500}{6} = 0,2417$$

$$W_1 = \frac{0+0+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6} = \frac{0,9500}{6} = 0,1583$$

$$W_1 = \frac{0+0+0+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}{6} = \frac{0,6167}{6} = 0,1028$$

$$W_1 = \frac{0+0+0+0+\frac{1}{5}+\frac{1}{6}}{6} = \frac{0,3667}{6} = 0,0611$$

$$W_1 = \frac{0+0+0+0+0+\frac{1}{6}}{6} = \frac{0,1667}{6} = 0,0278$$

Table 8 shows the weight values after the weighting calculation is carried out using the ROC method to give weight to each criterion, making it easier to interpret the weight values.

Table 8. Criteria Data by Applying the ROC Method

Criterion Code	Criterion Name	Weight Value	Types of Criteria
Kode01	Parent/Guardian Income	0,4083	*Cost*
Kode02	Number of Dependents of Parents/Guardians	0,2417	*Benefit*
Kode03	Average Score	0,1583	*Benefit*
Kode04	Housing Conditions	0,1028	*Cost*
Kode05	Class Rank	0,0611	*Benefit*
Kode06	School Attendance	0,0278	*Benefit*

Tabel 8 menunjukkan hasil perhitungan bobot kriteria menggunakan metode *Rank Order Centroid* (ROC). Bobot tertinggi ada pada Pendapatan Orang Tua/Wali, yang menunjukkan kepentingan terbesar, sedangkan Kehadiran di Sekolah memiliki bobot terendah, menunjukkan kepentingan terkecil. Kriteria Cost diharapkan memiliki nilai serendah mungkin, sedangkan Benefit diharapkan setinggi mungkin.

Application of the WASPAS Method

The application of the WASPAS method is carried out to produce rankings on each alternative. The calculation is carried out when after the criterion weight value is generated, the calculation steps of the WASPAS method are as follows:

1. Creating a decision matrix

$$X_{ij} = \begin{bmatrix} 2000000 & 3 & 90 & 3 & 4 & 4 \\ 2500000 & 2 & 95 & 4 & 4 & 4 \\ 1500000 & 4 & 100 & 3 & 5 & 5 \\ 1800000 & 3 & 85 & 3 & 3 & 3 \\ 2700000 & 2 & 80 & 5 & 3 & 3 \\ 3000000 & 3 & 95 & 4 & 4 & 4 \\ 1500000 & 1 & 90 & 3 & 4 & 4 \\ 2000000 & 2 & 80 & 4 & 3 & 3 \\ 1800000 & 3 & 80 & 5 & 3 & 3 \\ 2100000 & 2 & 85 & 3 & 3 & 3 \end{bmatrix}$$

Where:

Criteria with the criteria codes Code02, Code03, Code05, and Code06 are the types of *Benefit criteria*.

$Max(X_{ij}) = \{4; \quad 100; \quad 5; \quad 5\}$

Criteria with criterion code Code01, and Code04 are the type of criteria *Cost*.

$Min(X_{ij}) = \{1500000; \quad 3\}$

2. Normalizing

In determining the normalization of the decision matrix for *the benefit* criterion , use equation 8, and if the *cost* criterion, use equation 9 as can be seen below.

Normalization for the Parent/Guardian Income criteria (Code01) with the Cost type.

$$X_{11} = \frac{1500000}{2000000} = 0{,}7500$$
$$X_{21} = \frac{1500000}{2500000} = 0{,}6000$$
$$X_{31} = \frac{1500000}{1500000} = 1{,}0000$$
$$X_{41} = \frac{1500000}{180000} = 0{,}8333$$
$$X_{51} = \frac{1500000}{2700000} = 0{,}5556$$
$$X_{61} = \frac{1500000}{3000000} = 0{,}5000$$
$$X_{71} = \frac{1500000}{1500000} = 1{,}0000$$
$$X_{81} = \frac{1500000}{2000000} = 0{,}7500$$
$$X_{91} = \frac{1500000}{1800000} = 0{,}8333$$

$X_{101} = \frac{1500000}{2100000} = 0{,}7143$

After the matrix normalization calculation is carried out for all criteria, the matrix normalization results are produced as can be seen in table 9 below.

Table 9. Normalization of the Matrix

Alternate Code	Kode01	Kode02	Kode03	Kode04	Kode05	Kode06
CSMA01	0,7500	0,7500	0,9000	1,0000	0,8000	0,8000
CSMA02	0,6000	0,5000	0,9500	0,7500	0,8000	0,8000
CSMA03	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
CSMA04	0,8333	0,7500	0,8500	1,0000	0,6000	0,6000
CSMA05	0,5556	0,5000	0,8000	0,6000	0,6000	0,6000
CSMA06	0,5000	0,7500	0,9500	0,7500	0,8000	0,8000
CSMA07	1,0000	0,2500	0,9000	1,0000	0,8000	0,8000
CSMA08	0,7500	0,5000	0,8000	0,7500	0,6000	0,6000
CSMA09	0,8333	0,7500	0,8000	0,6000	0,6000	0,6000
CSMA10	0,7143	0,5000	0,8500	1,0000	0,6000	0,6000
SUM	7,5365	6,2500	8,8000	8,4500	7,2000	7,2000

1. Calculating Qi value

$$Q_1 = 0{,}5\sum\big((0{,}7500 * 0{,}4083) + (0{,}7500 * 0{,}2417) + (0{,}9000 * 0{,}1583) + (1{,}0000 * 0{,}1028) + (0{,}8000 * 0{,}0611) + (0{,}8000 * 0{,}0278)\big) + 0{,}5\prod\Big((0{,}7500^{0{,}4083}) * (0{,}7500^{0{,}2417}) * (0{,}9000^{0{,}1583}) * (1{,}0000^{0{,}1028}) * (0{,}8000^{0{,}0611}) * (0{,}8000^{0{,}0278})\Big)$$

$$Q_1 = 0{,}5\sum(0{,}3063 + 0{,}1813 + 0{,}1425 + 0{,}1028 + 0{,}0489 + 0{,}0222) + 0{,}5\prod(0{,}8892 * 0{,}9328 * 0{,}9835 * 1{,}0000 * 0{,}9865 * 0{,}9938)$$

$$Q_1 = 0{,}5 * 0{,}8039 + 0{,}5 * 0{,}7997$$

$$Q_1 = 0{,}4019 + 0{,}3999 = 0{,}8018$$

Perform the calculation to find the value of Q2 to Q10, so that the ranking results are obtained as shown in the following table 10.

Table 10. ROC-WASPAS Ranking Results

Alternate Code	Alternative Names	Value	Rank
CSMA01	Putri	0,8018	3
CSMA02	Ayu	0,6563	9
CSMA03	Indah	1,0000	1
CSMA04	Wahyuni	0,8093	2
CSMA05	Herman	0,5858	10
CSMA06	Citra	0,6738	8
CSMA07	Yunita	0,7374	5
CSMA08	Desi	0,6788	7
CSMA09	Dina	0,7605	4
CSMA10	Vira	0,6949	6

Table 10 shows the results of alternative ranking using the ROC-WASPAS method. This table lists ten alternatives with their respective values and ratings. Indah (CSMA03) got the highest score of 1.0000 and was ranked first, followed by Wahyuni (CSMA04) with a score of 0.8093 in second place, and Putri (CSMA01) with a score of 0.8018 in third place. Herman (CSMA05) had the lowest score of 0.5858 and was ranked tenth. These results illustrate the ranking of each alternative based on the value obtained from the ROC-WASPAS method.

Application of Entropy-WASPAS

Application of Entropy Methods

The application of the Entropy method is implemented to produce the weight values required for the next ranking stage as follows:

1. Determination of the initial data of the decision matrix
   The decision matrix can be taken from the decision matrix (X_{ij}) in the application of the WASPAS method above.
2. Initial data normalization
   The results of the normalization value of the decision matrix (X_{ij}) can be seen in table 9 above.
3. Determining the value of the matrix (a_{ij})
   Determine the matrix value for the Parent/Guardian Income criterion (Code01) with the type of (a_{ij})*Cost*.

$a_{11} = \frac{0,7500}{7,5365} = 0,0995$
$a_{21} = \frac{0,6000}{7,5365} = 0,0796$
$a_{31} = \frac{1,0000}{7,5365} = 0,1327$
$a_{41} = \frac{0,8333}{7,5365} = 0,1106$
$a_{51} = \frac{0,5556}{7,5365} = 0,0737$
$a_{61} = \frac{0,5000}{7,5365} = 0,0663$
$a_{71} = \frac{1,0000}{7,5365} = 0,1327$
$a_{81} = \frac{0,75000}{7,5365} = 0,0995$
$a_{91} = \frac{0,8333}{7,5365} = 0,1106$
$a_{101} = \frac{0,7143}{7,5365} = 0,0948$

The process is carried out until the calculation of the Code06 criteria so that the results of matrix value data (a_{ij}) can be seen in the following table 11.

Table 11. Matrix Value Data (a_{ij})

Alternate Code	Kode01	Kode02	Kode03	Kode04	Kode05	Kode06
CSMA01	0,0995	0,1200	0,1023	0,1183	0,1111	0,1111
CSMA02	0,0796	0,0800	0,1080	0,0888	0,1111	0,1111
CSMA03	0,1327	0,1600	0,1136	0,1183	0,1389	0,1389
CSMA04	0,1106	0,1200	0,0966	0,1183	0,0833	0,0833
CSMA05	0,0737	0,0800	0,0909	0,0710	0,0833	0,0833
CSMA06	0,0663	0,1200	0,1080	0,0888	0,1111	0,1111
CSMA07	0,1327	0,0400	0,1023	0,1183	0,1111	0,1111
CSMA08	0,0995	0,0800	0,0909	0,0888	0,0833	0,0833
CSMA09	0,1106	0,1200	0,0909	0,0710	0,0833	0,0833
CSMA10	0,0948	0,0800	0,0966	0,1183	0,0833	0,0833

1. Calculation of Entropy values for each criterion (E_j)
Determine the Entropy value for the Parent/Guardian Income criterion (Code01) with the Cost type.

$a_{11} = [a_{11} \ln a_{11}] = [0,0995 \ln 0,0995] = -0,2296$
$a_{21} = [a_{21} \ln a_{21}] = [0,0796 \ln 0,0796] = -0,2015$
$a_{31} = [a_{31} \ln a_{31}] = [0,1327 \ln 0,1327] = -0,2680$
$a_{41} = [a_{41} \ln a_{41}] = [0,1106 \ln 0,1106] = -0,2435$
$a_{51} = [a_{51} \ln a_{51}] = [0,0737 \ln 0,0737] = -0,1922$
$a_{61} = [a_{61} \ln a_{61}] = [0,0663 \ln 0,0663] = -0,1800$

$a_{71} = [a_{71} \ln a_{71}] = [0{,}1327 \ln 0{,}1327] = -0{,}2680$
$a_{81} = [a_{81} \ln a_{81}] = [0{,}0995 \ln 0{,}0995] = -0{,}2296$
$a_{91} = [a_{91} \ln a_{91}] = [0{,}1106 \ln 0{,}1106] = -0{,}2435$
$a_{101} = [a_{101} \ln a_{11}] = [0{,}0948 \ln 0{,}0948] = -0{,}2233$
$\sum_{i=1}^{n}[a_{ij} \ln(a_{ij})] = -2{,}2792$
$E_1 = \frac{-1}{\ln(7)}(-2{,}2792) = 0{,}9898$

Perform the calculation to get the E2 to E10 values in the same way, then the entropy values for all criteria are generated as can be seen in the following table 12.

Table 12. The Value of Entropy (E_j)

Alternate Code	Kode01	Kode02	Kode03	Kode04	Kode05	Kode06
CSMA01	-0,2296	-0,2544	-0,2332	-0,2526	-0,2441	-0,2441
CSMA02	-0,2015	0,0192	0,0116	0,0140	0,0154	0,0154
CSMA03	-0,2680	0,0128	0,0123	0,0105	0,0154	0,0154
CSMA04	-0,2435	0,0256	0,0129	0,0140	0,0193	0,0193
CSMA05	-0,1922	0,0192	0,0110	0,0140	0,0116	0,0116
CSMA06	-0,1800	0,0128	0,0103	0,0084	0,0116	0,0116
CSMA07	-0,2680	0,0192	0,0123	0,0105	0,0154	0,0154
CSMA08	-0,2296	0,0064	0,0116	0,0140	0,0154	0,0154
CSMA09	-0,2435	0,0128	0,0103	0,0105	0,0116	0,0116
CSMA10	-0,2233	0,0192	0,0103	0,0084	0,0116	0,0116
SUM	-2,2792	-0,1072	-0,1305	-0,1482	-0,1168	-0,1168
E	0,9898	0,0466	0,0567	0,0644	0,0507	0,0507

1. Calculate the dispersion of each criterion
   $D_1 = 1 - 0{,}9898 = 0{,}0102$
   $D_2 = 1 - 0{,}0466 = 0{,}9534$
   $D_3 = 1 - 0{,}0567 = 0{,}9433$
   $D_4 = 1 - 0{,}0644 = 0{,}9356$
   $D_5 = 1 - 0{,}0507 = 0{,}9493$
   $D_6 = 1 - 0{,}0507 = 0{,}9493$
   $\sum D_j = (0{,}0102 + 0{,}9534 + 0{,}9433 + 0{,}9356 + 0{,}9493 + 0{,}9493) = 4{,}7410$
1. Normalization of dispersion values
   $W_1 = \frac{0{,}0102}{4{,}7410} = 0{,}0021$
   $W_2 = \frac{0{,}9534}{4{,}7410} = 0{,}2011$
   $W_3 = \frac{0{,}9433}{4{,}7410} = 0{,}1990$
   $W_4 = \frac{0{,}9356}{4{,}7410} = 0{,}1973$
   $W_5 = \frac{0{,}9493}{4{,}7410} = 0{,}2002$
   $W_6 = \frac{0{,}9493}{4{,}7410} = 0{,}2002$

The results obtained from the calculation of Entropy, namely the weight value for each criterion, can be seen in table 13.

Table 13. Criterion Data by Applying Entropy Method

Criterion Code	Criterion Name	Weight Value	Types of Criteria
Kode01	Parent/Guardian Income	0,0021	*Cost*
Kode02	Number of Dependents of Parents/Guardians	0,2011	*Benefit*
Kode03	Average Score	0,1990	*Benefit*
Kode04	Housing Conditions	0,1973	*Cost*
Kode05	Class Rank	0,2002	*Benefit*
Kode06	School Attendance	0,2002	*Benefit*

Application of the WASPAS Method

The application of the WASPAS method is carried out to produce rankings on each alternative. The calculation is carried out when the weight value has been obtained in each criterion, the calculation steps of the WASPAS method are as follows:

1. The initial decision matrix here is the same decision matrix as the decision matrix Xij in the calculation part of step 1 of WASPAS above.
2. Normalize the decision matrix.(X_{ij})
   The results of the normalization of the decision matrix (X_{ij}) can be seen in table 9 above.
3. Calculating Qi value

$$Q_1 = 0{,}5\sum\big((0{,}7500 * 0{,}0021) + (0{,}7500 * 0{,}2011) + (0{,}9000 * 0{,}1990) + (1{,}0000 * 0{,}1973) + (0{,}8000 * 0{,}2002) + (0{,}8000 * 0{,}2002)\big) + 0{,}5\prod\big((0{,}7500^{0{,}0021}) * (0{,}7500^{0{,}2011}) * (0{,}9000^{0{,}1990}) * (1{,}0000^{0{,}1973}) * (0{,}8000^{0{,}2002}) * (0{,}8000^{0{,}2002})\big)$$

$$Q_1 = 0{,}5\sum(0{,}0016 + 0{,}1508 + 0{,}1791 + 0{,}1973 + 0{,}1602 + 0{,}1602) + 0{,}5\prod(0{,}9994 * 0{,}9438 * 0{,}9793 * 1.0000 * 0{,}9563 * 0{,}9563)$$

$$Q_1 = 0{,}5 * 0{,}8492 + 0{,}5 * 0{,}8447$$

$$Q_1 = 0{,}4246 + 0{,}4223 = 0{,}8469$$

Perform the calculation to find the value of Q2 to Q10, so that the ranking results are obtained as shown in the following table 14.

Table 14. Entropy-WASPAS Ranking Results

Alternate Code	Alternative Names	Value	Rank
CSMA01	Putri	0,8469	2
CSMA02	Ayu	0,7512	5
CSMA03	Indah	1,0000	1
CSMA04	Wahyuni	0,7519	4
CSMA05	Herman	0,6160	10
CSMA06	Citra	0,8076	3
CSMA07	Yunita	0,7134	6
CSMA08	Desi	0,6450	9
CSMA09	Dina	0,6677	8
CSMA10	Vira	0,6974	7

Table 14 entitled "Entropy-WASPAS Ranking Results" displays the results of the evaluation of ten alternatives (CSMA01 to CSMA10) using a combined method of Entropy and WASPAS. The alternatives are Putri, Ayu, Indah, Wahyuni, Herman, Citra, Yunita, Desi, Dina, and Vira. Each alternative is rated and scored, with the highest score being 1.0000 (Beautiful) which puts it in first place, while the lowest score is 0.6160 (Herman) in tenth place. This table makes it easy to analyze the performance of each alternative based on the criteria set.

Comparative Results of ROC-WASPAS and Entropy-WASPAS Methods

The results of the comparison of the application of the ROC-WASPAS and Entropy-WASPAS methods obtained the best alternative as shown in the table which can be seen in the following table 15:

Table 15. Comparative Results of ROC-WASPAS and Entropy-WASPAS

Alternate Code	Alternative Names	ROC-WASPAS		Entropy-WASPAS	
		Value	Rank	Value	Rank
CSMA01	Putri	0,8018	3	0,8469	2
CSMA02	Ayu	0,6563	9	0,7512	5
CSMA03	Indah	1,0000	1	1,0000	1
CSMA04	Wahyuni	0,8093	2	0,7519	4
CSMA05	Herman	0,5858	10	0,6160	10
CSMA06	Citra	0,6738	8	0,8076	3
CSMA07	Yunita	0,7374	5	0,7134	6
CSMA08	Desi	0,6788	7	0,6450	9
CSMA09	Dina	0,7605	4	0,6677	8
CSMA10	Vira	0,6949	6	0,6974	7

Table 15 shows the results of a comparison between two evaluation methods, namely ROC-WASPAS and Entropy-WASPAS, for ten alternatives. Each alternative is assigned a code and a name, with values and ratings assigned based on both methods. The CSMA03 (Beautiful) alternative ranks first in both methods with a perfect value of 1.0000. Meanwhile, CSMA01 (Women) was ranked third with ROC-WASPAS but moved up to second place with Entropy-WASPAS. The CSMA05 (Herman) alternative consistently ranked last on both methods. Some alternatives show a difference in rankings between the methods, such as CSMA02 (Ayu) which ranks ninth in ROC-WASPAS and rises to fifth in Entropy-WASPAS. This table illustrates how two evaluation methods can provide different results in assessing alternative performance.

CONCLUSION

The results of the comparison between the ROC-WASPAS and Entropy-WASPAS evaluation methods show that they can produce different ratings for the same alternative. Although some alternatives, such as CSMA03 (Beautiful), maintain consistent rankings in both methods, there are significant differences in other alternatives, such as CSMA01 (Putri) and CSMA02 (Ayu). This shows that the choice of evaluation method can affect the final result and must be carefully considered in the decision-making process. This variation in ratings indicates that each method has a unique approach to assessing performance, so the combination or in-depth understanding of the methods used can provide a more comprehensive picture.

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