Analysis of the ELECTRE Method on the Selection of Student Creativity Program Proposals

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Abstract. Creativity is a potential that is owned by every human being and not received from outside the individual. Human creativity, born together with the birth of the human being. Student Creativity Program is one form of effort carried out by students and lecturers in improving the quality of students’ education in universities so that they can apply, develop, and disseminate knowledge, technology and culture and enrich national culture. This study aims to analyze the selection of proposals that are eligible to be submitted to the Directorate General of Learning and Student Affairs, Ministry of Research Technology, and Higher Education through the url https://simbelmawa.risteldikti.go.id using the ELECTRE (ELimination and Choice Expressing Reality) method by using 8 assessment criteria namely Title (C1), Abstract (C2), Introduction (C3), Objective (C4), Method (C5), Results and Discussion (C6), Conclusions (C7), Bibliography (C8). And the results of the study obtained 10 proposals worth submitting from the 15 proposals selected. The results of this study can answer the formulation of the problem and become a recommendation in the selection of the Student Creativity Program which aims to improve the quality of students and improve the value of accreditation for related institutions, especially in the STIKOM Tunas Bangsa environment.

1. Introduction

Research and community service are two routine tasks for lecturers and students each year. Through these activities lecturers and students are required to be able to produce new findings and find solutions to the problems faced by institutions and society. Creativity is a potential that is owned by every human being and not received from outside the individual. Human creativity, born together with the birth of the human being. In this life creativity is very important, because creativity is a very meaningful ability in the process of human life. The goal is to improve the quality of community life and development performance in various sectors from the regional level to the national level. This is expected to be spirit as well as a sense of responsibility of the lecturers in designing and conducting research and community service [1]. Many branches of computer science can solve complex problems. This is evidenced by several studies in the field of Data Mining [2] [3] - [6] [7], the field of Artificial Neural Networks [8] - [12]. In this case, the researcher uses a Decision Support System with ELECTRE method because it is one of the multicriteria decision making methods based on the outranking concept by using pairwise comparisons of alternatives based on each appropriate criteria [13] [14]. The research was conducted in the STIKOM Tunas Bangsa Pematangsiantar environment in the selection of proposals in the student creativity program activities.

In this research, the ELECTRE method was carried out in the selection of student creativity program proposals in the STIKOM Tunas Bangsa environment where this system was used to assist decisions in semi-structured situations and unstructured situations, where no one knew exactly how the decision should be made. Decision support systems are usually built to support solutions to a problem
2. Methodology

Creativity is a person's ability to create results new works which are creations products. To foster college student creativity, lecturer needs to identify characteristics of the creative personality, recognize creative production, understand the cognitive processes used by creative college student, and ultimately establish an environment that promotes the child's interests[16]. While the Student Creativity Program is one of the programs implemented by the Directorate of Learning and Student Affairs of the Ministry of Research Higher Education Technology (Ditbelmawa Ristekdikti) to improve quality of students (students) in college.

2.1. Decision Support System

Decision support system is an information system at the management level of an organization that combines data and sophisticated analytical models to support decision-making in condition of semistructured and unstructured. Decision support system can be interpreted as a model-based system consisting of procedures in processing the data and the results of the data processing is used to assist managers in making decisions[17].

2.2. ELECTRE Method

ELECTRE (Elimination and Choice Ekspresing Reality) is based on the concept of outranking by paired comparisons between alternatives on the appropriate criteria. An alternative is said to dominate the other alternatives if one or more criteria are met (compared with the criterion of other alternatives)[18].

2.3. The steps taken in solving the problem using the ELECTRE method:

a) Normalization of the decision matrix

In this procedure, each attribute is converted to a Comparable value. Any normalization of \( x_{ij} \) values can be done with the formula:

\[
\tilde{r}_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{n} x_{ij}^2}}  \tag{1}
\]

for \( i = 1,2,3 \ldots, m \) and \( j = 1,2,3 \ldots, n \)

So that the obtained matrix \( R \) results from normalization,

\[
R = \begin{bmatrix}
\tilde{r}_{11} & \tilde{r}_{12} & \tilde{r}_{13} \\
\tilde{r}_{21} & \tilde{r}_{22} & \tilde{r}_{23} \\
\tilde{r}_{m1} & \tilde{r}_{m2} & \tilde{r}_{m3}
\end{bmatrix}
\]

\( R \) is a normalized matrix, where \( m \) denotes an alternative, \( n \) states criteria and \( r_{ij} \) is normalization of the choice measurement of the alternative \( i \) in relation to the \( j \)th criterion.

b) Determine Concordance and Discordance

1) Determine Concordance

The set of alternative collections included in Concordance with complementary are:

\[
C_{kl} = \{ j \mid V_{kj} \geq V_{ij} \}  \tag{2}
\]

2) Determine Discordance

The set of alternative collections included in Discordance with complementary are:
\[ D_{kl} = \{ j \mid V_{kj} < V_{ij} \} \] (3)

c) Calculate the Concordance and Discordance matrices
1) Calculating the Concordance matrix
To determine the value of the elements in the Concordance matrix is to add the weights included in the Concordance set. The set of Concordances obtained mathematically are as follows:
\[ C_{kl} = \sum_{j \in C_{kl}} W_j \] (4)

2) Calculating the Discordance matrix
To determine the value of the elements in a Discordance matrix is to divide the maximum difference in criteria included in the Discordance subset with the maximum difference in value of all existing criteria, mathematically as follows:
\[ d_{kl} = \frac{\max \{|V_{kj} - V_{ij}| \mid j \in D_{kl}\}}{\max \{|V_{kj} - V_{ij}| \mid V_j \}} \] (5)

d) Determine Dominant Concordance and Discordance Matrices
1) Concordance Dominant Matrix
The Concordance Dominant Matrix is created with the help of the Threshold value, which is obtained by comparing each element of the Concordance matrix with the Threshold value with the following formula:
\[ C_{kl} > c \] (6)

With Threshold values, are:
\[ c = \frac{\sum_{k=1}^{m} \sum_{l=1}^{m} C_{kl}}{m(m-1)} \] (7)

Each matrix element F as the dominant matrix of Concordance is determined by:
\[ f_{kl} = \begin{cases} 1 & \text{if } C_{kl} > c \\ 0 & \text{if } C_{kl} \leq c \end{cases} \] (8)

2) Discordance Dominant Matrix
The Dominant Discordance matrix is created with the help of the Threshold value, which is obtained by comparing each element of the Discordance matrix with the Threshold value:
\[ D_{kl} > D \] (9)

Each matrix element G as the dominant matrix of Discordance is determined by:
\[ g_{kl} = \begin{cases} 1 & \text{if } D_{kl} > D \\ 0 & \text{if } D_{kl} \leq D \end{cases} \] (10)

e) Determining Aggregate Dominance Matrix
The matrix E as an Aggregate Dominance Matrix is a matrix in which each element is a multiplication between the matrix elements F and the corresponding matrix elements G, mathematically can be expressed as:
\[ e_{kl} = f_{kl} \times g_{kl} \] (11)

f) Alternative Elimination that is Less Favorable
The E matrix gives a sequence of choices for each alternative, ie if \( e_{kl} = 1 \) then the alternative \( A_k \) is a better alternative than pada1. So, the rows in matrix E which have the least number \( e_{kl} = 1 \) can be eliminated. Thus, the best alternative is an alternative that dominates other alternatives.

3. Result and Discussion
In this research, the author uses criteria totaling 8 criteria, namely Title (C1), Abstract (C2), Introduction (C3), Objective (C4), Method (C5), Results and Discussion (C6), Conclusions (C7) and Bibliography (C8). The author uses the submission of proposals for the 2017 Student Creativity Program sourced from the Institute of Research and Community Service, STIKOM Tunas Bangsa Pematang Siantar. The proposal data was submitted based on the name of the proposal team leader namely Agnes Gracella Simanjuntak (A1), Desi Ratna Sari (A2), Fikrul Ilmi (A3), Mhd. Gading
Sadewo (A4), Habibah Jayanti Damanik (A5), Karmila (A6), Kiki Fatmawati (A7), Melin Widiastuti (A8), Nurhafidah Dalimunthe (A9), Putrama Alkhairi (A10), Riski Sundari (A11), Siti Sundari (A12), Sri Rahayu Ningsih (A13), Tia Imanda Sari (A14) and Wiwiek Katrina (A15). With the following bobo preferences: 
W = {0.05, 0.1, 0.1, 0.05, 0.25, 0.30, 0.1, 0.05}
With a description of the values 1, 2, 3, 5, 6, 7 (1 = Bad; 2 = Very Less; 3 = Less; 5 = Enough; 6 = Good; and 7 = Very Good).

The next steps in processing data using the Electre method are as follows:

1) Normalization of Decision Matrix
The decision matrix given by the author based on the data to be processed is as follows:

| Alternatif | A1 | A2 | A3 | A4 | A5 | A6 | A7 |
|------------|----|----|----|----|----|----|----|
| C1         | 6  | 6  | 5  | 5  | 6  | 5  | 6  |
| C2         | 6  | 6  | 6  | 6  | 6  | 6  | 6  |
| C3         | 6  | 6  | 6  | 6  | 6  | 6  | 6  |
| C4         | 6  | 6  | 5  | 5  | 6  | 5  | 6  |
| C5         | 5  | 6  | 5  | 5  | 6  | 5  | 6  |
| C6         | 6  | 6  | 5  | 5  | 6  | 5  | 6  |
| C7         | 6  | 6  | 5  | 5  | 6  | 5  | 6  |
| C8         | 6  | 6  | 6  | 6  | 6  | 6  | 6  |

Then the Decision Matrix has been normalized using equation (1) with the following results:

| Alternatif | A1 | A2 | A3 | A4 | A5 | A6 | A7 |
|------------|----|----|----|----|----|----|----|
| C1         | 0.01 | 0.02 | 0.03 | 0.06 | 0.06 | 0.06 | 0.06 |
| C2         | 0.01 | 0.02 | 0.03 | 0.06 | 0.06 | 0.06 | 0.06 |
| C3         | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| C4         | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| C5         | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| C6         | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| C7         | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| C8         | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |

2) Concordance and Discordance Matrix
Concordance and Discordance are generated using equations (2) and (3). The set which belongs to Concordance and Discordance is determined by the Concordance and Discordance Matrix using equations (4) and (5) with the following results:

| M.C | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 | A13 | A14 | A15 |
|-----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|
| A1  | -  | 0.4 | 0.45 | 0.3 | 0.9 | 0.6 | 0.5 | 0.65 | 0.5 | 0.55 | 0.6 | 0.45 | 0.45 | 0.5 | 0.55 |
| A2  | -  | 0.6 | 0.6  | 1   | 0.7 | 1   | 1   | 1   | 1   | 0.95 | 0.7  | 0.95 | 0.95 | 0.85 | 1   |
| A3  | 0.95 | 0.85 | -  | 0.85 | 0.9 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| A4  | 1   | 0.8 | 0.85 | -  | 1   | 1   | 0.9 | 0.95 | 0.95 | 0.95 | 1   | 0.95 | 0.85 | 0.85 | 0.85 |
| A5  | 0.95 | 0.5 | 0.45 | 0.55 | -  | 0.65 | 0.6 | 0.95 | 0.55 | 0.65 | 0.65 | 0.55 | 0.5 | 0.5 | 0.6 |
| A6  | 1   | 0.8 | 0.75 | 0.9 | 1   | -   | 0.9 | 0.95 | 0.9 | 0.95 | 1   | 0.85 | 0.85 | 0.85 | 0.95 |
| A7  | 1   | 0.55 | 0.5  | 0.6 | 1   | 0.7 | -   | 1   | 0.9 | 0.95 | 0.7 | 0.95 | 0.85 | 0.55 | 1   |
| A8  | 1   | 0.35 | 0.45 | 0.6 | 1   | 0.7 | 0.65 | -  | 0.6 | 0.7 | 0.7 | 0.35 | 0.55 | 0.55 | 0.65 |
| A9  | 1   | 0.9 | 0.55 | 0.6 | 1   | 0.7 | 0.9 | 0.95 | -  | 0.95 | 0.7 | 0.85 | 0.95 | 0.9 | 0.95 |
| A10 | 0.95 | 0.85 | 0.5 | 0.55 | 1   | 0.65 | 0.95 | 0.95 | 0.85 | -  | 0.65 | 0.95 | 0.95 | 0.95 | 0.95 |
| A11 | 1   | 0.8 | 0.75 | 0.9 | 1   | 1   | 0.9 | 0.95 | 0.9 | 0.95 | 1   | 0.85 | 0.85 | 0.85 | 0.95 |
| A12 | 0.95 | 0.85 | 0.6 | 0.65 | 1   | 0.65 | 0.95 | 0.95 | 0.85 | 0.85 | -  | 0.8 | 0.5 | 0.95 | 0.95 |
| A13 | 1   | 0.95 | 0.6 | 0.6 | 1   | 0.7 | 0.95 | 0.95 | 1   | 1   | 0.7 | 0.9 | 0.9 | 0.9 | 0.9 |
| A14 | 1   | 0.9 | 0.9 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| A15 | 1   | 0.85 | 0.5 | 0.8 | 1   | 0.7 | 0.95 | 0.95 | 0.9 | 0.95 | 0.7 | 0.8 | 0.8 | 0.5 | -  |
3) Determining Threshold Concordance and Discordance, and Aggregate Dominance Matrix E
(Ranking)

The Threshold is obtained from the formula equation (7) for the Concordance Threshold and equation (9) for Threshold Discordance. So as to produce:

\[ \zeta = 0, 80; \delta = 0, 61. \]

With the second Threshold result, you can then look for the Dominant Concordance and Discordance Matrices of equations (8) and (10). Then determine the Aggregate Dominance Matrix with equation (11) which can be used to determine alternative matrices that are less favorable. The final result in the calculation of data processing using the ELECTRE method is:

| Alternatif | Nilai | Ranking |
|------------|-------|---------|
| A4         | 11    | 1       |
| A3         | 10    | 2       |
| A6         | 10    | 3       |
| A11        | 10    | 4       |
| A14        | 9     | 5       |
| A2         | 7     | 6       |
| A15        | 7     | 7       |
| A7         | 5     | 8       |
| A9         | 5     | 9       |
| A12        | 5     | 10      |
| A10        | 3     | 11      |
| A15        | 3     | 12      |
| A8         | 2     | 13      |
| A5         | 1     | 14      |
| A1         | 0     | 15      |

Based on Table 5 above, the student's creativity program proposal that has the right to be submitted is 10 proposals with the highest value in accordance with the provisions of the 2017 PKM guidelines with a maximum of 10 proposals submitted.

4. Conclusion

From the results of this study the authors conclude that the ELECTRE method can be used as one of the systems used for decision making recommendations in selecting the best PKM proposals so that the value given by the LPPM can be determined well. The result of processing the data above the proposal that is entitled to be submitted with the maximum amount is a proposal consisting in the name of Mhd. Gading Sadewo (A4), Fikrul Ilmi RH Zer (A3), Karmila (6), Riski Sundari (A11), Tia Imandasari (A14), Desi Ratna Sari (A2), Sri Rahayu Ningsih (A13), Kiki Fatmawati (A7), Hurhafidah Dalimunthe (A9), and Siti Sundari (A12).

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