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Implementation of a Decision Support System in Determining Scholarship Recipients Using the MOORA Method at STMIK Mulia Darma

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Abstrak− The scholarship recipient selection process often faces challenges such as subjectivity, time constraints, and a lack of transparency in decision-making. To address these issues, this study developed a web-based decision support system that implements the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method. This system is designed to assist scholarship administrators in determining recipients objectively and efficiently by considering several criteria, namely GPA, parental income, number of dependents, and non-academic achievements. The research was conducted using a quantitative approach that included the stages of problem identification, data collection, criterion weight determination, data normalization, calculation of Yi preference values, and alternative ranking. The results of the system implementation indicate that the MOORA method can provide accurate rankings based on the combination of criterion weights and the value of each alternative. This system not only accelerates the selection process but also enhances transparency and accountability in decision-making. In conclusion, the application of the MOORA method in the scholarship decision support system contributes significantly to a fair, structured, and accountable selection process.

Keywords: Decision Support System; Scholarships; MOORA; GPA;Parental Income; Number of Dependents; Non-Academic Achievements

1. INTRODUCTION

The selection of scholarship recipients at STMIK Mulia Darma has, to date, been conducted using a manual method based on subjective considerations by the selection committee. This results in a time-consuming process that lacks transparency and is prone to bias, especially when there are many candidates and the criteria used are diverse (e.g., GPA, parents' income, number of dependents), a situation commonly found in private higher education institutions in Indonesia. Therefore, a systematic solution is needed to enhance efficiency, objectivity, and transparency in the scholarship selection process [1]. The expected solution from this research is the development of a MOORA (Multi-Objective Optimization by Ratio Analysis)-based Decision Support System (DSS) capable of ranking candidates based on objective and procedural criteria weights. Thus, the selection process becomes faster, more accountable, and minimizes subjectivity.[2][3].
Previous relevant research referenced in the last five years based on Sinaga's 2025 study developed an SPK for social assistance recipients using a combination of the K-Means (clustering) and MOORA methods, which improved accuracy and reduced subjectivity in the selection of assistance recipients in secondary schools [4]. Furthermore, research conducted by Eska et al. in 2025 designed a decision support system for selecting scholarship recipients at SDN 04 Kampung Batu Dalam using MOORA with criteria such as family income, number of dependents, and report card scores. This system proved to be more efficient and transparent[5]. Furthermore, research by Wati and Fauzi in 2023 applied MOORA in determining the eligibility of students to participate in the MBKM program at STMIK Kaputama, using GPA, diversity scores, and interview scores as criteria. The results showed a feasible and objective ranking. [6]. Further research by Saputra et al. 2023, using MOORA to select scholarship recipients at SD Negeri 9 Pulau Rimau (base case), using criteria such as parental income, family conditions, and report card grades; the system efficiently identified the optimal alternative [7]. Previous research by Kevin in 2021, applying FMADM with the MOORA method for scholarship selection at SMK Muhammadiyah 1 Palembang, accelerated the process of incorporating multiple criteria such as welfare and academic data of prospective students [8].
Based on the literature review above, it is evident that most MOORA implementations are focused on primary or secondary education levels and institutions outside of STMIK. Combinations of clustering methods such as K-Means have begun to emerge (Sinaga, 2025), but have not yet been applied in the context of higher education institutions like STMIK Mulia Darma. Additionally, most systems have not directly integrated STMIK's academic database with web-based systems and remain at the prototype stage. Therefore, there has been no research on the application of MOORA specifically for scholarship selection at STMIK or similar higher education institutions, and the combination of clustering + MOORA in the context of STMIK Mulia Darma has not been explored to categorize potential recipients based on welfare categories before ranking to improve accuracy. The objective of this study is to develop a web-based decision support system that implements the MOORA method (with clustering integration options such as K-Means) to determine scholarship recipients at STMIK Mulia Darma. It formulates the weights of the selection criteria (GPA, parental income, number of dependents, non-academic achievements) agreed upon by stakeholders. Produce objective, transparent, and

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auditable rankings of scholarship candidates. Therefore, the desired outcome is to accelerate the selection process, minimize subjective bias, and increase transparency and accountability in determining recipients.

2. RESEARCH METHODOLOGY

2.1 Research Stages

The following are the stages of the research. Each stage is designed to support the achievement of the research objective, which is to develop a Decision Support System using the MOORA method to determine scholarship recipients objectively.

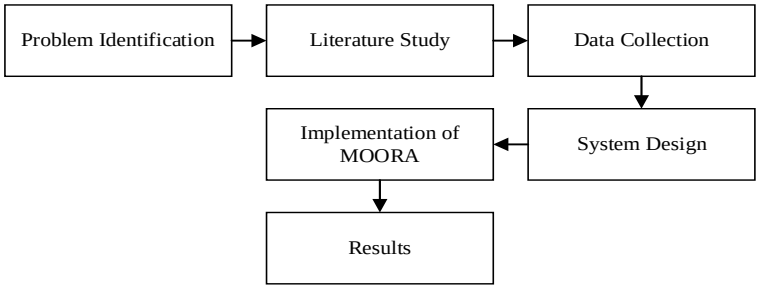

Figure 1. Research stages

1. Problem Identification
Gathering information through observation and interviews regarding the scholarship selection process that has been carried out manually at STMIK Mulia Darma. Formulating research problems and objectives based on issues of subjectivity, inefficiency, and lack of transparency in the selection process.
2. Literature Review
Reviewing theories related to Decision Support Systems (DSS), the MOORA method, and relevant previous studies conducted in the past five years.
3. Data Collection
Primary data: through interviews with scholarship administrators and review of selection documents. Secondary data: scholarship criteria and weightings, including GPA, parental income, and number of dependents.
4. System Design
System flowchart: flowchart of the scholarship selection process based on the system. Database design: designing tables to store student data and criteria. Interface design: creating a web-based DSS prototype.
5. Application of the MOORA Method
Normalization of criteria values using the MOORA formula.
Assigning weights based on importance (GPA, parental income, number of dependents, and non-academic achievements).
Calculating the final score (Yi) and ranking the scholarship candidates.
6. Results
The results of the scholarship recipient selection at STMIK Mulia Darma.

2.2 MOORA Method

MOORA is a multi-criteria decision-making (MCDM) method introduced by Brauers and Zavadskas in 2006. This method compares alternatives based on the ratio of their responses to criteria, using the square root of the sum of the squares of the values for each criterion as the denominator. This approach is easy to implement, computationally efficient, and produces objective and transparent rankings of alternatives [9][10][11].

2.2.1 MOORA Method Steps

The following are the steps of the MOORA method [12][13] :
1. First step: input the Criteria Values and Alternatives.
2. Second step: Convert the Criteria Values into a Decision Matrix.

The decision matrix is a measure of alternative performance. After that, the ratio system is enlarged, where each alternative performance on an attribute is compared with the denominator representing all alternatives for that attribute.

$$X = \begin{bmatrix} X_{11} & X_{1j} & X_{1n} \\ X_{j1} & X_{ij} & X_{jn} \\ X_{m1} & X_{mi} & X_{mn} \end{bmatrix} \quad (1)$$

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1. Step Three: Normalization Matrix
   Normalization aims to unify each member of the matrix so that the members in the matrix have the same value. Normalization in Moora can be calculated using the following equation:

$$X^*\text{ij} = \frac{Xij}{\sqrt{[\sum_{j=1}^{m} X^2 ij]}} \quad (2)$$

2. Step Four: Calculate the Optimization Value

   Multiply the criteria weight by the maximum attribute value minus the product of the criteria weight and the minimum attribute value, if formulated.

$$y_i = \sum_{j=0}^{g} W_j X^*ij - \sum_{j=g+1}^{n} W_j X^*ij \quad (3)$$

3. Step Five: Ranking

   Determine the results of the calculations by ranking the values obtained using the MOORA method.

3. RESULT AND DISCUSSION

The main problem in the scholarship recipient selection process in educational institutions is the lack of a decision support system that can guarantee objectivity and efficiency in assessment. The manual selection process tends to be time-consuming and prone to subjectivity in determining recipients. Therefore, this study aims to develop a decision support system using the MOORA method to make the scholarship recipient selection process more systematic, objective, and fair.

3.1 Alternatives

The following alternatives are listed in the table below:

Table 1. Alternatives

Alternatives	Description
A1	Lusiana
A2	Desi Ratna
A3	Rini Andini
A4	Satrio
A5	Dika

3.2 Criteria

The following criteria are used in the table below:

Table 2. Criteria

Criteria	Description
C1	GPA
C2	Parental Income
C3	Number of Dependents
C4	Non-Academic Achievements

3.3 Criteria Weighting

The weighting for each criterion is shown in the table below:

Table 3. Weighting for each criterion

No	Criteria	Type	weight %
1	GPA	Benefit	35
2	Parental Income	Cost	25
3	Number of Dependents	Benefit	20
4	Non-Academic Achievements	Benefit	20

3.4 Application of the MOORA Method

The following is an example of the application of the MOORA method to determine scholarship recipients based on four criteria: GPA (benefit), parental income (cost), number of dependents (benefit), and non-academic achievements (benefit). There are five alternative students: Lusiana, Innalia, Rini Andini, Satrio, and Dika.

Table 4. Alternatives Original Values

No	Alternatives	C1	C2	C3	C4
1	A1	3.8	Rp .2.000.000	3	4
2	A2	3.5	Rp. 1.500.000	2	2

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3	A3	3.9	Rp. 2.500.000	4	3
4	A4	3.7	Rp. 1.800.000	2	5
5	A5	3.6	Rp. 2.200.000	1	3

Table 5. Normalization Results

No	Alternatives	C1	C2	C3	C4
1	A1	0.4590	0.4409	0.5145	0.5040
2	A2	0.4227	0.3307	0.3430	0.2520
3	A3	0.4710	0.5511	0.6860	0.3780
4	A4	0.4469	0.3968	0.3430	0.6299
5	A5	0.4348	0.4850	0.1715	0.3780

Table 6. Yi Value and Ranking

No	Alternatives	Yi	Ranking
1	A1	0.2541	1
2	A2	0.1843	4
3	A3	0.2399	3
4	A4	0.2518	2
5	A5	0.1408	5

3.5 UI Design

User Interface Design for a Decision Support System The following is the user interface (UI) design for a web-based scholarship recipient decision support system that uses the MOORA method. This system is designed to facilitate users in inputting data, performing automatic calculations, and displaying interactive and informative ranking results.

Figure 2. Main Dashboard

4. CONCLUSION

This study aims to address issues in the scholarship recipient selection process, which has been carried out manually, lacking objectivity, and inefficient. By implementing the MOORA (Multi-Objective Optimization on the Basis of Ratio Analysis) method in a Decision Support System (DSS), this study successfully developed a web-based solution that can assist scholarship administrators in determining candidates systematically and accountably. The system utilizes four primary criteria: GPA, parental income, number of dependents, and non-academic achievements. The first three criteria are quantitative, while non-academic achievements are assessed descriptively and converted into numerical form to be processed using the MOORA method. Through a process of normalization and weighting based on the level of importance of each criterion, the system calculates the final preference value (Yi) of each student alternative. The final result is a ranking of students reflecting their eligibility for the scholarship. In conclusion, the developed system has successfully addressed the main challenges, namely enhancing objectivity, accelerating the selection process, and ensuring fair and transparent outcomes. The system is also flexible and can be adapted to different criteria and weights in accordance with institutional policies in the future.

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