Decision Support System for Selection of Achieving Students Using Method Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) Web Based

Isra Pebrianti[1]*, Syarifah Putri Agustini Alkadri [2], Asrul Abdullah[3]

[1,2,3]Fakultas Teknik Universitas Muhammadiyah Pontianak
israpebrianti1123@gmail.com[1]*, agustini.putri@unmuhpnk.ac.id[2], asrul.abdullah@unmuhpnk.ac.id[3]

Abstract

The selection of outstanding students identifies the best students based on grades and achievements to recommend them for college entrance. This process often encounters challenges due to numerous determining factors, leading to potential biases in decision-making. A Decision Support System (DSS) helps address this by utilizing data and decision models to resolve structured and unstructured problems. This study applies the MOORA (Multi-Objective Optimization on the basis of Ratio Analysis) method, using criteria such as attendance, attitude scores, knowledge and skills component values, extracurricular/organizational involvement, and achievements. The DSS identified 40 outstanding students at SMA Negeri 1 Tayan Hulu, with the highest preference score of 0.0819 achieved by Indah Prasetyaning Tias. Functional testing was conducted using the black-box method with Equivalence Partitioning, and accuracy testing through MAPE showed a calculation accuracy rate of 2.79%.

Keywords: *SPK, MOORA, selection of outstanding students, black-box*

1. Introduction

A student is an individual in an educational institution who develops academic and non-academic potential. Achievement is the result obtained by an individual as a form of effort in academic and non-academic fields.[1] Based on an interview with the principal of SMA Negeri 1 Tayan Hulu, the school has annual targets to improve the quality of education so that graduates are equipped with the skills and expertise needed in the industrial world. One of the programs implemented is giving rewards to outstanding students to facilitate recommendations for participation in university entrance selection based on report cards and achievements. However, the selection of outstanding students at SMA Negeri 1 Tayan Hulu still faces challenges due to the manual data processing, which is slow, complicated, and prone to inaccuracies. Therefore, a decision support system (DSS) is needed to assist in the selection process in a fast, accurate, and objective manner.[2]

A DSS is a methodology to support decision-making by utilizing criteria and weights determined by the decision-makers. The method used in this study is Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA). MOORA can solve complex mathematical calculations and generate final values for alternatives ranked by the highest scores.[3]

Other methods such as Simple Additive Weighting (SAW) and Analytical Hierarchy Process (AHP) have their own advantages but also drawbacks. SAW is suitable for assessment based on preference weights but less accurate if the criteria are dynamic. AHP is excellent in aiding decision-making but suffers from high subjectivity in the modeling process.[4] MOORA addresses the weaknesses of SAW and AHP with simple calculations, high selectivity, and an optimization approach for conflicting attributes. This research aims to apply the MOORA method in selecting outstanding students at SMA Negeri 1 Tayan Hulu to ensure decisions are made quickly, fairly, and accurately.[5]

2. Research Method

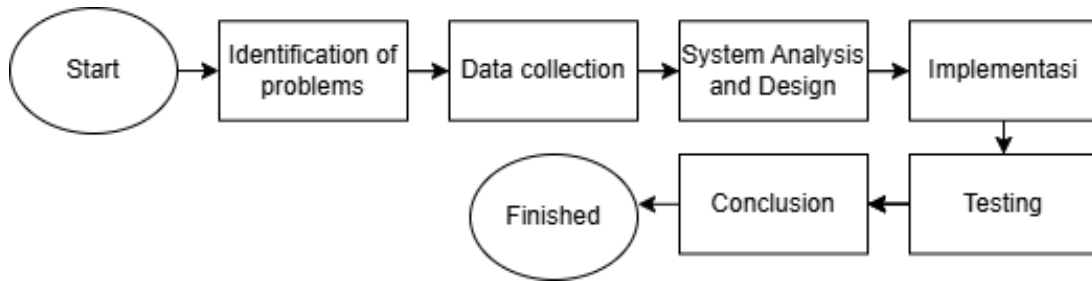The stages of completion in this research can be seen in Figure 1

Fig. 1: Research methodology flow diagram

2.1. Identification of Problems

The problem identification aims to understand issues in selecting outstanding students at SMA Negeri 1 Tayan Hulu. Interviews with the principal revealed challenges in the decision-making process for recommending grade 12 students for university entrance via achievements, due to the absence of an objective method. The research question is: "How to select outstanding students at SMA Negeri 1 Tayan Hulu using the MOORA method?".

2.2. Data Collection

This research uses a descriptive method to describe the current situation or issues based on facts and collected data. To obtain the necessary data for this final report, both primary and secondary data were used.

2.3. System Implementation

The implementation phase involves applying the system design and the MOORA method. The system is developed using PHP with Laravel, Apache web server, and MySQL database. The waterfall model is used for system development, and the system is web-based.

2.4. System Testing

System testing is the final phase to verify if the system works correctly. Black-box testing is used to evaluate functionality, and accuracy is assessed by comparing manual calculations with system recommendations.

3. Result and discussion

The decision support system for selecting outstanding students is developed through several stages to achieve the research objectives. This chapter covers manual calculations using the MOORA method, system implementation, accuracy testing, and black-box testing.

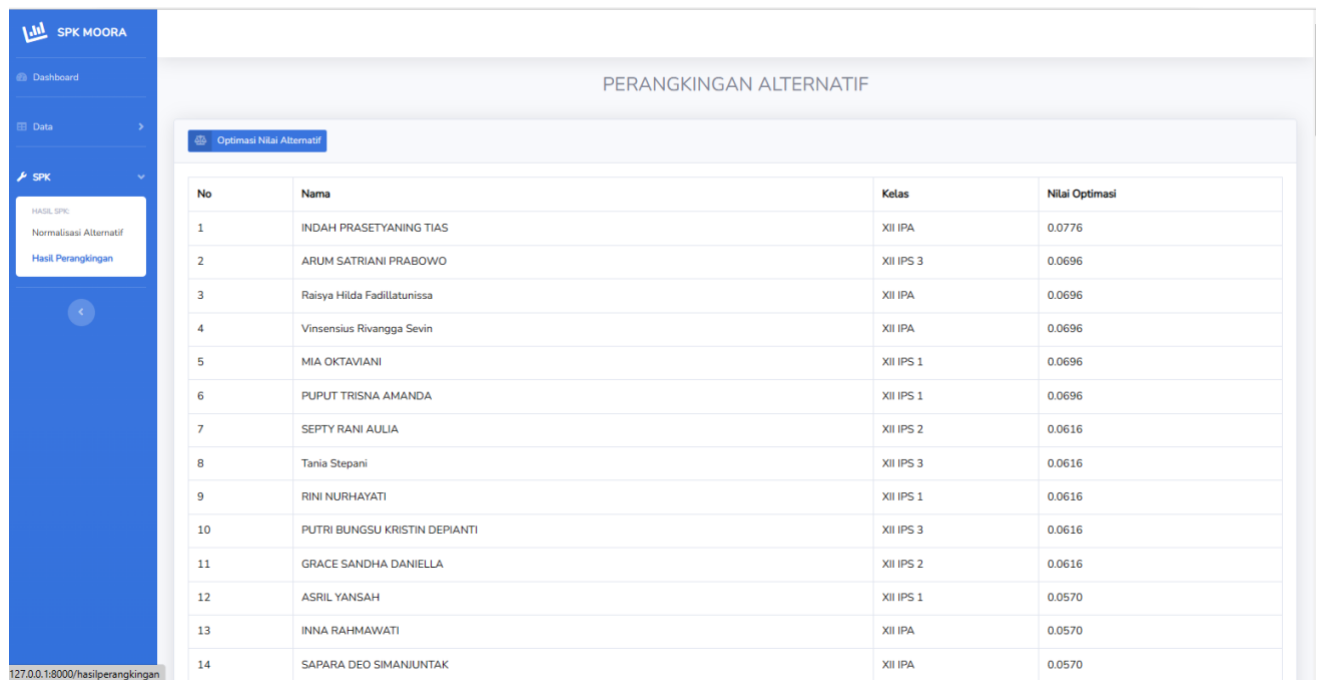### 3.1. MOORA Manual Calculation

The first step in calculating MOORA is to create a decision matrix, by matching each alternative to the criteria. The decision matrix can be seen in table 1.

Table 1: Match Matrix

lternatif	Nama	Kelas	Kriteria					
			C1	C2	C3	C4	C5	C6
A1	Indah Prasetyaning Tias	XII IPA	1	3	3	1	3	1
A2	Puput Trisna Amanda	XII IPS 1	1	3	3	1	2	1
A3	Arum Satriani Prabowo	XII IPS 3	1	3	3	1	2	1
-	-	-	-	-	-	-	-	-
A39	Yanti Ratna Sari	XII IPS 1	2	3	2	1	1	2
A40	Elsa Meliani	XII IPS 2	2	3	2	1	1	2

Table 2: Yi Falue From Optimization Results

Alternatif	Nama	Kelas	Yi(Max - Min)
A1	Indah Prasetyaning Tias	XII IPA	0,0819
A2	Mia Oktaviani	XII IPS 1	0,0738
A3	Puput Trisna Amanda	XII IPS 1	0,0738
-	-	-	-
A39	Yanti Ratna Sari	XII IPS 1	0,0433
A40	Elsa Meliani	XII IPS 2	0,0433

3.2. System Implementation

Fig. 2: Ranking Results Page Display

3.3. Testing

Testing is carried out with the aim of finding an error. Testing is carried out sequentially using black-box testing with the equivalence partitioning method on the decision support system for selecting high achieving students using the Website-based Multi-Objective Optimization on the basis of Ratio Analysis method.

1. Black Box Testi

Table 3: Testing Ranking Results

No	Skenario Pengujian	Hasil Yang Diharapkan	Hasil Pengujian
1	Admin menampilkan halaman Web kemudian admin memilih "Klik Disini!"	Halaman Dashboard Ditampilkan	Berhasil
2	Admin masuk kemenu SPK, admin memilih menu hasil perangkingan	Data hasil perangkingan ditampilkan	Berhasil
3	Admin masuk kemenu SPK, admin memilih menu hasil perangkingan, kemudian klik button "Optimasi Nilai Alternatif"	Data hasil optimasi perangkingan yang baru ditampilkan	Berhasil

2. System Accuracy Level Testing
   System accuracy testing is conducted using the Mean Absolute Percentage Error (MAPE) method to measure the accuracy of the difference between actual and predicted values. MAPE criteria indicate that the smaller the MAPE value, the better the accuracy [6]. The MAPE criteria are shown in Table 4.

Table 4: MAPE Value Criteria

Nilai MAPE	Kriteria
<10	Sangat Baik
10-20	Baik
20-50	Cukup
>50	Buruk

The accuracy test results using the Mean Absolute Percentage Error method can be seen in Table 5.

Table 5: Comparison of Manual and System Calculations

Nama	Kelas	Nilai Aktual $(A_i$	Nilai Prediksi $(F_i)`$	Selisih $(A_i - F_i)/A_i$	Hasil $(A_i - F_i)/A_i * 100\%$
Indah Prasetyaning Tias	XII IPS 2	0,0819	0,0819	0,0000	0,00%
Mia Oktaviani	XII IPS 3	0,0738	0,0739	0,0014	0,14%
Puput Trisna Amanda	XII IPS 1	0,0738	0,0739	0,0014	0,14%
-	-	-	-	-	-
Yanti Ratna Sari	XII IPS 1	0,0433	0,0434	0,0023	0,23%
Elsa Meliani	XII IPS 2	0,0433	0,0434	0,0023	0,23%
Total *MAPE*					**2,79%**

4. Conclusion

The decision support system for selecting outstanding students at SMAN 1 Tayan Hulu has been successfully developed using the MOORA method with PHP, MySQL, and the Laravel framework. The system can provide recommendations based on criteria: attendance (20%), attitude scores (10%), knowledge (25%), skills (25%), extracurricular/organization (10%), and achievements (10%). The selection results indicate that the highest preference score was achieved by Indah Praseting Tias with a score of 0.0819. Black-box testing with the Equivalence Partitioning method confirmed the system functions correctly, and accuracy testing using the Mean Absolute Percentage Error (MAPE) method showed an error rate of 2.79%, categorizing the system as very good.

5. Advice

Suggestions for the development of this research are: adding user features so that the system can be used more widely, including information on student achievement, integrating a combination of other methods in decision making, and allowing data input through Excel file imports to increase efficiency.

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