

Decision Support System for Selection of Outstanding Students at Angkasa Maros High School Using the TOPSIS Method

Vivek Sharma¹, Akbar Iskandar^{2*}, Nardo Azalio Bangri³

¹Department of Computer Science and Engineering, Sathyabama Institute of Science and Technology, Chennai, India

²Department of Information Technology Education, Universitas Teknologi Akba Makassar, Makassar, Indonesia

³Department of Informatics, Universitas Teknologi Akba Makassar, Makassar, Indonesia

Abstract

This study aims to develop a Decision Support System (DSS) to aid in the selection of outstanding students at Angkasa Maros High School. The TOPSIS method was selected for its capability to handle diverse criteria, enabling assessments based on academic and non-academic achievements, leadership qualities, and positive attitudes. Data were collected through observational and documentary methods, gathering student achievement data and other relevant factors, which were then inputted into the system to compute relative scores for each student based on predetermined criteria weights. This process resulted in a ranking of students according to their performance against these criteria. The research findings indicated that the DSS achieved an overall percentage score of 90.3% in selecting outstanding students using the TOPSIS method, demonstrating effective system implementation and significant benefits in the student selection process. The study's outcomes are expected to provide objective and accurate recommendations for selecting outstanding students at Angkasa Maros High School, serving as a guide for the school in identifying students with high potential and facilitating more effective and efficient decision-making. Additionally, the research offers valuable insights for Angkasa Maros High School to enhance educational quality, maximize student potential development, and produce graduates capable of competing at national and international levels.

Keywords: Decision support system; Student selection criteria; TOPSIS Method; Effective system implementation

Received: 11 January 2024

Revised: 25 April 2024

Accepted: 7 May 2024

Introduction

In the world of education, selecting outstanding students is a very important element (Syafi'i et al., 2018; Sunarti Rahman, 2021). This process aims to identify and select students who have superior potential and abilities in various fields, both academic and non-academic (Rahman, 2023; Arsara & others, 2023). Thus, selecting outstanding students not only rewards extraordinary individuals but also serves as motivation for other students to continue improving their abilities (Mufasirah & others, 2021; Abduloh et al., 2022). Therefore, selecting outstanding students is an effective way to encourage a healthy competitive culture and improve the overall quality of education (Octaviana, 2021; Syah & Pertiwi, 2024).

The main aim of selecting outstanding students is to ensure that the selected students truly have the ability and potential to be proud of (Adit, 2020; Sugianto, 2010; Prasatya, 2024). They are individuals who demonstrate extraordinary achievements in various aspects, including academics, sports, arts, and other skills. These outstanding students have a very significant role in improving the school's image and helping the school achieve high academic achievements (Thabroni & Riadi, 2022; Studynews.co.id, 2024). Apart from that, they also become role models for other students and motivate the entire school community to try harder to achieve success (Wikipedia, 2023).

However, in the process of selecting outstanding students at Angkasa Maros High School, there are often complex obstacles and challenges. One of the main obstacles is the existence of subjectivity in assessing outstanding students. This subjectivity can arise from the preferences or subjective views of parties involved in the assessment process, such as teachers and school staff (Pettifor & Saklofske, 2011; Brown, 2004; Scott et al., 2014). When assessments are based on a subjective point of view, the decisions taken can be non-objective and unfair (Kusumah, 2015). This is of course detrimental to students who actually have the same or even better abilities but do not get the recognition they deserve.

*Corresponding author.

E-mail address: akbariskandar@akba.ac.id (Akbar Iskandar)



(Dahlan, 2015; Rabudin, 2020; Setiawan, 2023). To overcome this obstacle, it is important for SMA Angkasa Maros to develop a more objective and transparent assessment system. This system must include clear and measurable assessment criteria and involve various parties in the evaluation process to reduce bias. Apart from that, training for teachers and school staff regarding the importance of objectivity in assessment can also be an important step to ensure that the process of selecting outstanding students runs fairly and in line with the expected goals. Thus, it is hoped that the selection of outstanding students can provide maximum benefits for all students and improve the quality of education at Angkasa Maros High School.

Therefore, an organized, unbiased, and effective system is needed to help recruit outstanding students at Angkasa Maros High School. The TOPSIS methodology allows taking better decisions. The TOPSIS method allows decision-makers to evaluate alternatives based on several important criteria. By implementing a decision support system based on the TOPSIS method in the case of selecting outstanding students at Angkasa Maros High School, it is hoped that the selection process can become more transparent, structured, and accurate. This system will help decision-makers, such as teachers, and school staff in making more objective decisions based on the criteria that have been selected. Also, use can also increase efficiency in the process of selecting outstanding students so that the time and resources required can be optimized.

With the existence of a decision support system for selecting outstanding students at Angkasa Maros High School using the TOPSIS method, it is hoped that it can improve the quality of selecting outstanding students, create a fair and objective environment, and encourage students to develop their best potential and achievements.

Method

The method used in this research is the TOPSIS method. The TOPSIS method, or Technique for Order Preference by Similarity to Ideal Solution, is one of the methods used in multi-criteria decision-making. TOPSIS was first introduced by Yoon and Hwang in 1981 as a multi-criteria decision-making technique (Kantinit, 2022; Eliyana et al., 2020; Rahmawati, 2020; Syafnidawaty, 2020). The principle used in TOPSIS is that the alternative chosen must be closest to the positive ideal solution and farthest from the negative ideal solution from a geometric point of view (Ardiansyah, 2017; Darmawan et al., 2021). To measure the relative closeness of an alternative, the geometric distance is calculated using Euclidean distance (Munthe, 2019; Limbong, 2011; Sipayung, 2016). Good solutions are essential for every product, while bad solutions are not so important. The TOPSIS method uses these two distances to measure the closeness between alternative solutions and the best solution and considers how close the alternative is to the best solution (Sundari, 2015). Alternative priorities can then be determined based on the relative distance comparison. This method is widely used to make practical decisions because the concept is easy to understand, computationally effective, and capable of measuring the relative performance of various decision alternatives (Code, 2022; Kompasiana, 2024; Wicaksono, 2023). The steps for completing the TOPSIS method are as follows.

1. The first step is that we have to Create a normalized decision matrix.
2. Next we have to create a weighted normalized decision matrix.
3. After that we determine the positive ideal solution matrix & negative ideal solution matrix.
4. After that we determine the distance between the value of each alternative and the positive ideal solution matrix & negative ideal solution matrix.
5. Then we will determine the preference value for each alternative.

The formula used in the TOPSIS method is:

Table 1. Formula used in the TOPSIS method

Step	Formula	Explanation
Create a decision matrix	$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}$	Normalize the decision matrix with $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$.

Step	Formula	Explanation
Create a weighted normalized decision matrix	$y_{ij} = w_i r_{ij}$	The normalized decision matrix is multiplied by weights, with $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$.
Determine the positive ideal solution matrix and the negative ideal solution matrix. And determine value y_i^+ And y_i^-	$A^+ = (y_1^+, y_2^+, \dots, y_n^+)$ And $A_- = (y_1^-, y_2^-, \dots, y_n^-)$ $y_i^+ = \begin{cases} \max_j y_{ij} & \text{if } j \text{ is a benefit attribute} \\ \min_j y_{ij} & \text{if } j \text{ is a cost attribute} \end{cases}$ $y_i^- = \begin{cases} \min_j y_{ij} & \text{if } j \text{ is a benefit attribute} \\ \max_j y_{ij} & \text{if } j \text{ is a cost attribute} \end{cases}$	Positive and negative ideal solutions. Determine the maximum and minimum values for the profit and cost attributes
Determine the distance between the value of each alternative and the positive and negative ideal solution matrices	$D_i^+ = \sqrt{\sum_{j=1}^n (y_i^+ - y_{ij})^2}$ And $D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_i^-)^2}$	Calculate the distance between the value of each alternative and the positive and negative ideal solutions.
Determine the preference value for each alternative.	$V_i = \frac{D_i^-}{D_i^- + D_i^+}$	Preference value for each alternative.

Brief Explanation:

Normalize the Decision Matrix: The decision matrix is normalized to convert the attribute values to a comparable scale.

Create Weighted Normalized Decision Matrix: The normalized decision matrix is multiplied by the weights of each criterion.

Determine Positive and Negative Ideal Solutions: Positive and negative ideal solutions are identified based on benefit and cost attributes.

Calculate Distance to Ideal Solutions: The distance between each alternative and the positive and negative ideal solutions is calculated.

Preference Value: The preference value for each alternative is calculated based on the distance between the positive and negative ideal solutions.

In this research, the author designed a comprehensive and systematic arrangement of research stages for the selection of outstanding students at Angkasa Maros High School. The stages expected in this research include analysis of student academic and non-academic achievement data, identification of key factors that contribute to student success, development of objective assessment criteria, preparation of student assessment matrices, normalization of assessment matrices, calculation of the distance between each student with an ideal solution matrix, and finally, decision making based on the resulting student rankings. The stages of this research can be seen in Figure 1.

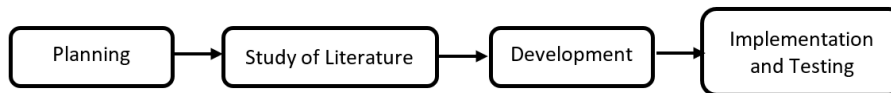


Figure 1. Research stages

In this system, procedures are explained using UML (Unified Modeling Language). UML (Unified Modeling Language) is a standard modeling language used to describe, define, design, and document components in software systems. UML allows developers and analysts to create visual models that cover various aspects of a system, such as structure, behavior, and interactions between components (Booch et al., 1997; Jacobson & Booch, 2021). UML is used to describe systems in the form of use-case diagrams that describe interactions between actors and systems (Booch et al., 1996; Quatrani & Evangelist, 2003). A use case diagram is a visual representation that shows how users (or actors) interact with a system (Bittner & Spence, 2003; Setiyani, 2021). These diagrams depict various system usage scenarios, including the actions users can take and how the system responds. Next, every process that occurs in the system will be explained using an activity diagram that visualizes the workflow and steps taken. The system use case can be seen in Figure 2.

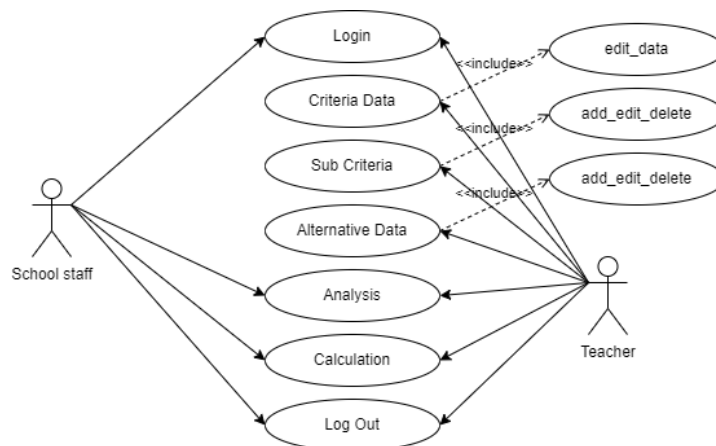


Figure 2. Use case diagram

In designing this system, class diagrams are also used, which are a type of structural diagram in UML that are used to describe the structure and relationships between classes, attributes and methods in a system.(Ali et al., 2007; Berardi et al., 2005; Evans, 1998). This class diagram is static, which means it does not describe the interactions between the classes directly, but provides an overview of how the classes interact in the system.(Dennis et al., 2015; Fowler, 2018). The following is the Class Diagram of the Decision Support System for Selection of Outstanding Students at Angkasa Maros High School, in Figure 3.

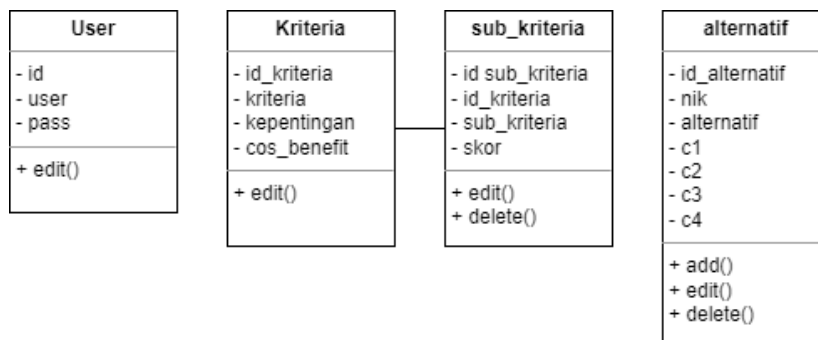


Figure 3. Class diagram

Results and Discussion

Results

The results of research on the Decision Support System for Selection of Outstanding Students at Angkasa Maros High School Using the TOPSIS Method are as follows:

System testing results using the Black Box Texting method. Testing is carried out to observe how the software behaves without requiring an understanding of the code structure used. This trial is carried out after software development is complete, with the aim of verifying that the software functions properly and as expected. The results of the black box test can be seen in Table 2.

Table 2. Results of black box testing

Testing	Test	Which are expected	Conclusion
Login menu	Enter the correct username and password data	Admin is visible in the text, username and pass are listed as well	Success
	Entering incorrect username and password data	Admin data is not visible and is rejected	Success
	Select the login button	The button can function as desired	Success

Testing	Test	Which are expected	Conclusion
Criteria	Fill in the Criteria id	Criteria data have appeared	Success
	Select edits	Data is stored in tables	Success
Sub Criteria	Fill in the sub-criteria ID	Sub-criteria data is displayed	Success
	Select the add button	The input form appears and can be saved	Success
Alternative	Select the edit button	The button can function as desired	Success
	Fill in the ID or code of the alternative	Alternative data is displayed	Success
	Select the add button	The input form appears and can be saved	Success
	Select the edit button	The button can function as desired	Success
Analysis	Select the cancel button	The data is not saved and then returned	Success
	Select the print/view button	View options will be displayed	Success
Calculation	Select the print/view button	View options are displayed	Success



Figure 4. Login page

In Figure 4, the login menu page is the first page that appears after the system is accessed. To access this page, both admin and user must fill in their username and password correctly to be able to enter the system.

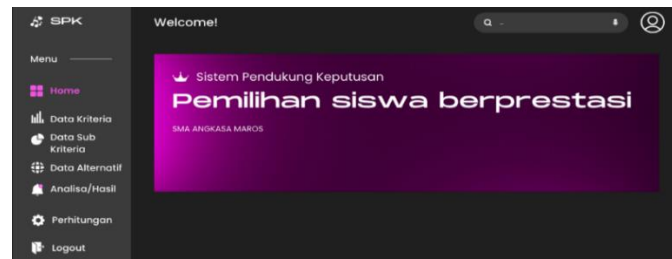


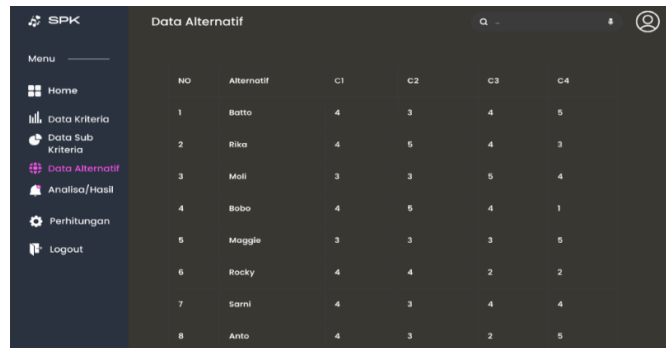
Figure 5. Dashboard page

In Figure 5, the dashboard page is the page that appears after successfully logging in as admin. The user will be directed to the Dashboard page which displays various main menus, including home, criteria data, alternative data, analysis and results.

NO	Kriteria	Bobot	Atribut	Opsi
1	Akademik	5	Benefit	EDIT
2	Non Akademik	3	Benefit	EDIT
3	Kepemimpinan	3	Benefit	EDIT

Figure 6. Criteria page

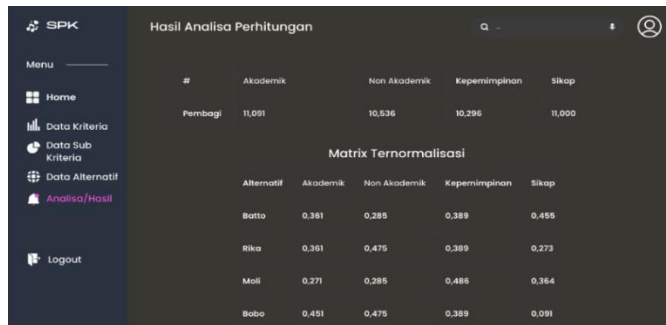
In Figure 6, the criteria page contains criteria description data. This data is needed before starting calculations in the decision support system. Users need to pay attention to the importance of inputting data in accordance with approved specifications.



NO	Alternatif	C1	C2	C3	C4
1	Batto	4	3	4	5
2	Rika	4	5	4	3
3	Moli	3	3	5	4
4	Bobo	4	5	4	1
5	Maggie	3	3	3	5
6	Rocky	4	4	2	2
7	Sami	4	3	4	4
8	Anito	4	3	2	5

Figure 7. Alternative data page

In Figure 7, the alternative data page is where users can use alternative data or student data and use score values in the decision support calculation process.



#	Akademik	Non Akademik	Kepemimpinan	Sikap
Pembagi	11,081	10,536	10,296	11,000

Alternatif	Akademik	Non Akademik	Kepemimpinan	Sikap
Batto	0,361	0,285	0,389	0,455
Rika	0,361	0,475	0,389	0,273
Moli	0,271	0,285	0,486	0,364
Bobo	0,451	0,475	0,389	0,091

Figure 8. Calculation results page

In Figure 8, the calculation, analysis, and assessment results page is a page where users can see the analysis results of each alternative choice. Users can easily draw conclusions from the results.



Alternatif	Hasil Akhir
Bobo	0,867
Rocky	0,567
Rika	0,528
Sami	0,383
Moli	0,380
Batto	0,308

Figure 9. Calculation and ranking results page

In figure 9, the calculation and ranking results page, this page will display the results of the alternative rankings that have been calculated previously. These results are presented in rank order based on highest to lowest scores, providing users with clear and detailed information regarding the most superior alternatives in selecting high-achieving students. In this test, the implementation of the TOPSIS method will be carried out by calculating using alternative candidate (student) data and the criteria for each alternative entered by the user.

Table 3. Alternative data

Alternative Code	Alternative name
A1	Batto
A2	Rika
A3	Moli
A4	Bobo
A5	Maggie

Alternative Code	Alternative name
A6	Rocky
A7	Sarni
A8	Anthony

Table 4. Criteria data

Code	Criteria	Type	Weight
C1	Academic	Benefits	5
C2	Non-Academic	Benefits	3
C3	Leadership	Benefits	3
C4	Attitude	Cost	4

After obtaining all the necessary data, the next step is to weigh the criteria to fill in the values obtained from the alternatives.

Table 5. C1 – C4 weighting

Price	Weight
<50	1
51 - 65	2
66 - 75	3
76 - 85	4
86 - 100	5

The first stage is to create a normalized decision matrix

Table 6. Alternative values for each criterion

Alternative	Criteria				
	C1	C2	C3	C4	C5
Batto	4	5	5	5	4
Rika	4	5	4	4	4
Moli	3	5	4	4	4
Bobo	5	4	4	4	4
Maggie	3	4	5	5	5
Rocky	4	5	4	4	4
Sarni	4	5	4	4	4
Anthony	4	5	5	4	4

Next, we will create a normalized decision matrix first.

$$X = \begin{bmatrix} 4 & 3 & 4 & 5 \\ 4 & 5 & 4 & 3 \\ 3 & 3 & 5 & 4 \\ 5 & 5 & 4 & 1 \\ 3 & 3 & 3 & 5 \\ 4 & 4 & 2 & 2 \\ 4 & 3 & 4 & 4 \\ 4 & 3 & 2 & 5 \end{bmatrix}$$

Calculating the normalized matrix, before looking for the value, we will look for the value with the following formula: r_{ij}

$$|X_n| = \sqrt{\sum_{i=1}^m x_{ij}^2}$$

$$|X_1| = \sqrt{(4)^2 + (4)^2 + (3)^2 + (5)^2 + (3)^2 + (4)^2 + (4)^2 + (4)^2} = 11,091$$

$$|X_2| = \sqrt{(3)^2 + (5)^2 + (3)^2 + (5)^2 + (3)^2 + (4)^2 + (3)^2 + (3)^2} = 10,536$$

$$|X_3| = \sqrt{(4)^2 + (4)^2 + (5)^2 + (4)^2 + (3)^2 + (2)^2 + (4)^2 + (2)^2} = 10,296$$

$$|X_4| = \sqrt{(5)^2 + (3)^2 + (4)^2 + (1)^2 + (5)^2 + (2)^2 + (4)^2 + (5)^2} = 11,000$$

After getting the value of X_n , then complete the formula as follows: r_{ij}

$$\begin{aligned} r_{11} &= \frac{x_{11}}{|x_1|} = \frac{4}{11,091} = 0,361 & r_{12} &= \frac{x_{12}}{|x_2|} = \frac{3}{10,536} = 0,285 \\ r_{21} &= \frac{x_{21}}{|x_1|} = \frac{4}{11,091} = 0,361 & r_{22} &= \frac{x_{22}}{|x_2|} = \frac{5}{10,536} = 0,475 \\ r_{31} &= \frac{x_{31}}{|x_1|} = \frac{3}{11,091} = 0,271 & r_{32} &= \frac{x_{32}}{|x_2|} = \frac{3}{10,536} = 0,285 \\ r_{41} &= \frac{x_{41}}{|x_1|} = \frac{5}{11,091} = 0,451 & r_{42} &= \frac{x_{42}}{|x_2|} = \frac{5}{10,536} = 0,475 \\ r_{51} &= \frac{x_{51}}{|x_1|} = \frac{3}{11,091} = 0,271 & r_{52} &= \frac{x_{52}}{|x_2|} = \frac{3}{10,536} = 0,285 \\ r_{61} &= \frac{x_{61}}{|x_1|} = \frac{4}{11,091} = 0,361 & r_{62} &= \frac{x_{62}}{|x_2|} = \frac{4}{10,536} = 0,380 \\ r_{71} &= \frac{x_{71}}{|x_1|} = \frac{4}{11,091} = 0,361 & r_{72} &= \frac{x_{72}}{|x_2|} = \frac{3}{10,536} = 0,285 \\ r_{81} &= \frac{x_{81}}{|x_1|} = \frac{4}{11,091} = 0,361 & r_{82} &= \frac{x_{82}}{|x_2|} = \frac{3}{10,536} = 0,285 \\ r_{13} &= \frac{x_{13}}{|x_3|} = \frac{4}{10,296} = 0,389 & r_{14} &= \frac{x_{14}}{|x_4|} = \frac{5}{11,000} = 0,455 \\ r_{23} &= \frac{x_{23}}{|x_3|} = \frac{4}{10,296} = 0,389 & r_{24} &= \frac{x_{24}}{|x_4|} = \frac{3}{11,000} = 0,273 \\ r_{33} &= \frac{x_{33}}{|x_3|} = \frac{5}{10,296} = 0,486 & r_{34} &= \frac{x_{34}}{|x_4|} = \frac{4}{11,000} = 0,364 \\ r_{43} &= \frac{x_{43}}{|x_3|} = \frac{4}{10,296} = 0,389 & r_{44} &= \frac{x_{44}}{|x_4|} = \frac{1}{11,000} = 0,091 \\ r_{53} &= \frac{x_{53}}{|x_3|} = \frac{3}{10,296} = 0,291 & r_{54} &= \frac{x_{54}}{|x_4|} = \frac{5}{11,000} = 0,455 \\ r_{63} &= \frac{x_{63}}{|x_3|} = \frac{2}{10,296} = 0,194 & r_{64} &= \frac{x_{64}}{|x_4|} = \frac{2}{11,000} = 0,182 \\ r_{73} &= \frac{x_{73}}{|x_3|} = \frac{4}{10,296} = 0,389 & r_{74} &= \frac{x_{74}}{|x_4|} = \frac{4}{11,000} = 0,364 \\ r_{83} &= \frac{x_{83}}{|x_3|} = \frac{2}{10,296} = 0,194 & r_{84} &= \frac{x_{84}}{|x_4|} = \frac{5}{11,000} = 0,455 \end{aligned}$$

So the normalized decision matrix (R) is obtained as follows:

$$R = \begin{bmatrix} 0,361 & 0,285 & 0,389 & 0,455 \\ 0,361 & 0,475 & 0,389 & 0,273 \\ 0,271 & 0,285 & 0,486 & 0,364 \\ 0,451 & 0,475 & 0,389 & 0,091 \\ 0,271 & 0,285 & 0,291 & 0,455 \\ 0,361 & 0,380 & 0,194 & 0,182 \\ 0,361 & 0,285 & 0,389 & 0,364 \\ 0,361 & 0,285 & 0,194 & 0,455 \end{bmatrix}$$

Calculates the weighted normalized matrix (Y), for the specified weights (W) = [5,3,3,4].

Formula: $y_{ij} = w_i * r_{ij}$

$$\begin{aligned}
y_{11} &= w_1 \times r_{11} = 5 \times 0,361 = 1,803 & y_{12} &= w_2 \times r_{12} = 3 \times 0,285 = 0,854 \\
y_{21} &= w_1 \times r_{21} = 5 \times 0,361 = 1,803 & y_{22} &= w_2 \times r_{22} = 3 \times 0,475 = 1,424 \\
y_{31} &= w_1 \times r_{31} = 5 \times 0,271 = 1,353 & y_{32} &= w_2 \times r_{32} = 3 \times 0,285 = 0,854 \\
y_{41} &= w_1 \times r_{41} = 5 \times 0,451 = 2,254 & y_{42} &= w_2 \times r_{42} = 3 \times 0,475 = 1,424 \\
y_{51} &= w_1 \times r_{51} = 5 \times 0,271 = 1,353 & y_{52} &= w_2 \times r_{52} = 3 \times 0,285 = 0,854 \\
y_{61} &= w_1 \times r_{61} = 5 \times 0,361 = 1,803 & y_{62} &= w_2 \times r_{62} = 3 \times 0,380 = 1,139 \\
y_{71} &= w_1 \times r_{71} = 5 \times 0,361 = 1,803 & y_{72} &= w_2 \times r_{72} = 3 \times 0,285 = 0,854 \\
y_{81} &= w_1 \times r_{81} = 5 \times 0,361 = 1,803 & y_{82} &= w_2 \times r_{82} = 3 \times 0,285 = 0,854 \\
\\
y_{13} &= w_3 \times r_{13} = 3 \times 0,389 = 1,166 & y_{14} &= w_4 \times r_{14} = 4 \times 0,455 = 1,818 \\
y_{23} &= w_3 \times r_{23} = 3 \times 0,389 = 1,166 & y_{24} &= w_4 \times r_{24} = 4 \times 0,273 = 1,091 \\
y_{33} &= w_3 \times r_{33} = 3 \times 0,486 = 1,457 & y_{34} &= w_4 \times r_{34} = 4 \times 0,364 = 1,455 \\
y_{43} &= w_3 \times r_{43} = 3 \times 0,389 = 1,166 & y_{44} &= w_4 \times r_{44} = 4 \times 0,091 = 0,364 \\
y_{53} &= w_3 \times r_{53} = 3 \times 0,291 = 0,874 & y_{54} &= w_4 \times r_{54} = 4 \times 0,455 = 1,818 \\
y_{63} &= w_3 \times r_{63} = 3 \times 0,194 = 0,583 & y_{64} &= w_4 \times r_{64} = 4 \times 0,182 = 0,727 \\
y_{73} &= w_3 \times r_{73} = 3 \times 0,389 = 1,166 & y_{74} &= w_4 \times r_{74} = 4 \times 0,364 = 1,455 \\
y_{83} &= w_3 \times r_{83} = 3 \times 0,194 = 0,583 & y_{84} &= w_4 \times r_{84} = 4 \times 0,455 = 1,818
\end{aligned}$$

Multiplying the preference weights with the normalized matrix, the matrix (Y) is obtained as follows:

$$Y = \begin{bmatrix} 1,803 & 0,854 & 1,166 & 1,818 \\ 1,803 & 1,424 & 1,166 & 1,091 \\ 1,353 & 0,854 & 1,457 & 1,455 \\ 2,254 & 1,424 & 1,166 & 0,364 \\ 1,353 & 0,854 & 0,874 & 1,818 \\ 1,803 & 1,139 & 0,583 & 0,727 \\ 1,803 & 0,854 & 1,166 & 1,455 \\ 1,803 & 0,854 & 0,583 & 1,818 \end{bmatrix}$$

Next, determine the Positive Ideal Solution (A+) and Negative Ideal Matrix (A-).

A+ = MAX value from the results of the weighted criteria values (MAX=largest value) Positive = Max on benefits, Min on costs

A- = MIN value from the results of the weighted criteria values (MIN=smallest value) Negative = Min on benefits, Max on costs

By using the formula: A+ = max (y1+, y2+, ..., yn+) and A- = min (y1-, y2-, ..., yn-)

y_i	Ideal Solution	Y +	Y -
y_1	1,803; 1,803; 1,353; 2,254; 1,353; 1,803; 1,803; 1,803	max = 2,254	min = 1,353
y_2	0,854; 1,424; 0,854; 1,424; 0,854; 1,139; 0,854; 0,854	max = 1,424	min = 0,854
y_3	1,166; 1,166; 1,457; 1,166; 0,874; 0,583; 1,166; 0,583	max = 1,457	min = 0,583
y_4	1,818; 1,091; 1,455; 0,364; 1,818; 0,727; 1,455; 1,818	min = 0,364	max = 1,818

After determining the positive and negative values, the results will be as follows:

A +	2,254	1,424	1,457	0,364
A -	1,353	0,854	0,583	1,818

Next, calculate the distance between the positive ideal solution (D+) and the negative ideal solution (D-). Formula to calculate it:

a. The distance between alternative AI and the ideal solution is positive

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_i^+ - y_{ij})^2}$$

$$D1^+ = \sqrt{(2,254 - 1,803)^2 + (1,424 - 0,854)^2 + (1,457 - 1,166)^2 + (0,364 - 1,818)^2} = 1,652$$

$$D2^+ = \sqrt{(2,254 - 1,803)^2 + (1,424 - 1,424)^2 + (1,457 - 1,166)^2 + (0,364 - 1,091)^2} = 0,904$$

$$D3^+ = \sqrt{(2,254 - 1,353)^2 + (0,854 - 0,854)^2 + (1,457 - 1,457)^2 + (0,364 - 1,455)^2} = 1,526$$

$$D4^+ = \sqrt{(2,254 - 2,254)^2 + (1,424 - 1,424)^2 + (1,457 - 1,166)^2 + (0,364 - 0,364)^2} = 0,291$$

$$D5^+ = \sqrt{(2,254 - 1,353)^2 + (1,424 - 0,854)^2 + (1,457 - 0,874)^2 + (0,364 - 1,818)^2} = 1,895$$

$$D6^+ = \sqrt{(2,254 - 1,803)^2 + (1,424 - 1,139)^2 + (1,457 - 0,583)^2 + (0,364 - 0,727)^2} = 1,087$$

$$D7^+ = \sqrt{(2,254 - 1,803)^2 + (1,424 - 0,854)^2 + (1,457 - 1,166)^2 + (0,364 - 1,455)^2} = 1,343$$

$$D8^+ = \sqrt{(2,254 - 1,803)^2 + (1,424 - 0,854)^2 + (1,457 - 0,583)^2 + (0,364 - 1,818)^2} = 1,846$$

b. The distance between alternative Ai and the ideal solution is negative

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_i^-)^2}$$

$$D1^- = \sqrt{(1,353 - 1,803)^2 + (0,854 - 0,854)^2 + (0,583 - 1,166)^2 + (1,818 - 1,818)^2} = 0,737$$

$$D2^- = \sqrt{(1,353 - 1,803)^2 + (0,854 - 1,424)^2 + (0,853 - 1,166)^2 + (1,818 - 1,091)^2} = 1,182$$

$$D3^- = \sqrt{(1,353 - 1,353)^2 + (0,854 - 0,854)^2 + (0,853 - 1,457)^2 + (1,818 - 1,455)^2} = 0,947$$

$$D4^- = \sqrt{(1,353 - 2,254)^2 + (0,854 - 1,424)^2 + (0,853 - 1,166)^2 + (1,818 - 0,364)^2} = 1,895$$

$$D5^- = \sqrt{(1,353 - 1,353)^2 + (0,854 - 0,854)^2 + (0,853 - 0,874)^2 + (1,818 - 1,818)^2} = 0,291$$

$$D6^- = \sqrt{(1,353 - 1,803)^2 + (0,854 - 1,139)^2 + (0,853 - 0,583)^2 + (1,818 - 0,727)^2} = 1,214$$

$$D7^- = \sqrt{(1,353 - 1,803)^2 + (0,854 - 0,854)^2 + (0,853 - 1,166)^2 + (1,818 - 1,455)^2} = 0,822$$

$$D8^- = \sqrt{(1,353 - 1,803)^2 + (0,854 - 0,854)^2 + (0,853 - 0,583)^2 + (1,818 - 1,818)^2} = 0,451$$

The final step is to determine the preference value for each alternative using the following formula:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+}$$

$$V_1 = \frac{0,737}{0,737 + 1,652} = 0,308$$

$$V_2 = \frac{1,182}{1,182 + 0,904} = 0,567$$

$$V_3 = \frac{0,947}{0,947 + 1,526} = 0,383$$

$$V_4 = \frac{1,895}{1,895 + 0,291} = 0,867$$

$$V_5 = \frac{0,291}{0,291 + 1,895} = 0,133$$

$$V_6 = \frac{1,214}{1,214 + 1,087} = 0,528$$

$$V_7 = \frac{0,822}{0,822 + 1,343} = 0,380$$

$$V_8 = \frac{0,451}{0,451 + 1,846} = 0,196$$

From the results of calculating the preference value for each alternative above, below is the ranking of the vector values (V) from largest to smallest:

Rank 1 = V4 = 0.867

Rank 2 = V2 = 0.567

Rank 3 = V6 = 0.528

Rank 4 = V3 = 0.383

Rank 5 = V7 = 0.380

Rank 6 = V1 = 0.308

Rank 7 = V8 = 0.196

Rank 8 = V5 = 0.133

From the preference values above, the rankings of 8 students were obtained, for the students who were entitled to be used as Outstanding Students based on the 4th alternative ranking, namely: Bobo.

Testing the respondent assessment system. The following is the respondent's assessment regarding the decision support system (DSS) for selecting outstanding students at Angkasa Maros High School using the TOPSIS method with 6 selected questions: academic achievement, non-academic achievement, leadership, and attitude. Each criterion is weighted according to its importance. This question table includes 30 respondents.

Table 7. Respondents' questions

Question	Mark				
	SS	S	N	T.S	STS
Easy to use?	23	5	2	0	0
Speed up the selection process?	18	9	3	0	0
Display quality and features?	20	7	3	0	0
Complete explanation on the web?	24	4	4	0	0
Help select outstanding students?	16	10	4	0	0
Exploring and measuring student creativity?	12	12	6	0	0
Total value	113	47	20	0	0

From the final percentage value of the questionnaire in Table 6, it can be concluded that the decision support system for selecting outstanding students at Angkasa Maros High School using the TOPSIS method has a total percentage value of 90.3%. This shows that the system is implemented and provides significant benefits in the selection process for outstanding students.

Discussion

This discussion section aims to evaluate the results of research that has been carried out and relate them to relevant literature as well as the basic concepts underlying the use of the TOPSIS method in the Decision Support System (DSS) to select outstanding students at Angkasa Maros High School. Based on the results obtained from system testing, the following is an analysis and interpretation of the findings of this research. This research shows that the use of the TOPSIS method in DSS provides reliable and objective results in selecting outstanding students. The selection process involves several important steps such as determining student alternatives, establishing relevant criteria, and assigning weight to each criterion. The end result is a preference score that allows ranking students based on their level of success in meeting established criteria. For example, a student with the name "Bobo" obtained the highest score of 0.867 and was ranked first as an outstanding student.

This finding is very important because it shows that the TOPSIS method is able to handle various criteria effectively and produce accurate rankings. In the context of Angkasa Maros High School, the results of this research provide practical solutions to simplify the decision-making process in selecting outstanding students. With this DSS, schools can identify students with superior potential more efficiently and objectively, which in the end can improve the quality of education and optimize the development of student potential. This research is consistent with previous studies such as research Agung & Ricky (2016) which states that the TOPSIS method is effective in making multi-criteria decisions. On research Fitriana et al. (2015) And Lesmana, (2021) said that the use of the TOPSIS method was considered effective. Next on research Sikumbang & Muhammad (2021) TOPSIS method in the decision support system for selecting outstanding students, the test results use the Topsis alternative method with 66 alternatives and 3 criteria, namely normative value, adaptive value, and productive value. The results obtained support the existing literature, which shows that TOPSIS can provide appropriate solutions in situations where multiple factors must be considered simultaneously.

From a theoretical point of view, this research confirms the validity and reliability of the TOPSIS method in an educational context. In terms of application, this DSS can be used as a reliable tool for schools in the selection process for outstanding students. Apart from that, the results of this research can be a reference for the development of similar DSS in other educational institutions that have similar needs. This research has clear relevance in the educational context, particularly in terms of better and more efficient decision-making in selecting high-achieving students. However, the limitation of this research lies in the scope of the data used, which only covers Angkasa Maros High School. For broader generalizations, further studies are needed involving other schools. Thus, this research not only provides a practical contribution to Angkasa Maros High School in selecting outstanding students but also adds to the literature on the application of the TOPSIS method in the field of education.

Conclusions and Suggestions

Conclusions

Based on the analysis of the decision support system for selecting outstanding students using the TOPSIS method, it can be concluded that this system provides reliable results in the process of selecting outstanding students:

1. Selection of outstanding students using the TOPSIS method involves steps such as determining student alternatives, relevant criteria, and criteria weights. The process involves analyzing student scores, matrix weighting, and preference calculations. This system produces information about outstanding students based on the assessment results obtained.
2. The Decision Support System for Selection of Outstanding Students at Angkasa Maros High School using the TOPSIS Method can function well because it is able to facilitate and support decision making for the selection of outstanding students at Angkasa Maros High School by obtaining a valid level of accuracy for testing alternative criteria. The results of the TOPSIS method show that the 4th alternative, namely the student with the name "Bobo," obtained a score of 0.867 and was ranked first as the selected outstanding student.

Suggestions

Suggestions from this research are:

1. In the future, you can Update and develop the system regularly: To maintain the effectiveness of the system, it is important to carry out regular updates and development. Update assessment criteria, add relevant features, and adapt to evolving school needs and student assessment standards.
2. Can provide training and technical support: Provide training to school staff on the use of the system and ensure they properly understand how to manage and utilize it. Also, provide adequate technical support so that users can resolve technical issues that may arise during use of the system.

By implementing these suggestions, it is hoped that the system for selecting outstanding students at Angkasa High School can run more effectively, improve the quality of selecting outstanding students, and support educational success at the school.

References

- Abduloh, S. P., Suntoko, M. P., Purbangkara, T., Abikusna, A., & others. (2022). *Peningkatan dan pengembangan prestasi belajar peserta didik*. uwa's inspirasi indonesia.
- Adit, A. (2020). Kemendikbud: Ini Kiat Jadi Pelajar Berprestasi. *Edukasi Kompas.Com*. <https://edukasi.kompas.com/read/2020/10/25/081237071/kemendikbud-ini-kiat-jadi-pelajar-berprestasi>
- Agung, H., & Ricky, R. (2016). Aplikasi Sistem Pendukung Keputusan Untuk Pemilihan Siswa Teladan Menggunakan Metode Topsis. *Jurnal Ilmiah FIFO*, 8(2), 112–126. <https://doi.org/https://doi.org/10.22441/fifo.v8i2.1306>
- Ali, N. H., Shukur, Z., & Idris, S. (2007). A design of an assessment system for UML class diagram. *2007 International Conference on Computational Science and Its Applications (ICCSA 2007)*, 539–546. <https://doi.org/https://doi.org/10.1109/ICCSA.2007.2>
- Ardiansyah, H. (2017). Sistem Penunjang Keputusan Pemilihan Guru Terbaik dengan Metode TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) Studi Kasus: SDN Bendungan Hilir 01 Pagi Jakarta Pusat. *J. Inform. Univ. Pamulang*, 2(2), 89. <https://doi.org/https://doi.org/10.32493/informatika.v2i2.1510>
- Arsara, C. T., & others. (2023). *Manajemen Peserta Didik Dalam Peningkatan Prestasi Non Akademik di SMA Negeri 1 Ingin Jaya*. UIN Ar-Raniry Banda Aceh.
- Berardi, D., Calvanese, D., & De Giacomo, G. (2005). Reasoning on UML class diagrams. *Artificial Intelligence*, 168(1–2), 70–118. <https://doi.org/https://doi.org/10.1016/j.artint.2005.05.003>
- Bittner, K., & Spence, I. (2003). *Use case modeling*. Addison-Wesley Professional.
- Booch, G., Jacobson, I., Rumbaugh, J., & others. (1996). The unified modeling language. *Unix Review*, 14(13), 5.
- Booch, G., Rumbaugh, J., & Jacobsen, I. (1997). UML: unified modeling language. *Versão*.
- Brown, G. T. L. (2004). Teachers' conceptions of assessment: Implications for policy and professional development. *Assessment in Education: Principles, Policy & Practice*, 11(3), 301–318. <https://doi.org/https://doi.org/10.1080/0969594042000304609>
- Code, R. S. (2022). *Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)*. <https://rumahsourcecode.com/metode/topsis>
- Dahlan, A. (2015). Prinsip-Prinsip Penilaian Pendidikan. *Eureka Pendidikan*. <https://eurekapendidikan.com/prinsip-prinsip-penilaian-pendidikan/>
- Darmawan, F. R., Amalia, E. L., & Rosiani, U. D. (2021). Penerapan Metode Topsis pada Sistem Pendukung Keputusan untuk Kota yang Menerapkan Pembatasan Sosial Berskala Besar yang di Sebabkan Wabah Corona. *Jurnal Sistem Dan Teknologi Informasi (Justin)*, 9(2), 250. <https://doi.org/10.26418/justin.v9i2.43896>
- Dennis, A., Wixom, B., & Tegarden, D. (2015). *Systems analysis and design: An object-oriented approach with UML*. John Wiley & sons.
- Eliyana, I., Sari, P., & Pertiwi, W. (2020). *Pemanfaatan Metode Topsis Dalam Mendukung Keputusan Memilih Sekolah Menengah Atas atau Jurusan Terbaik*. 11(03).
- Evans, A. S. (1998). Reasoning with UML class diagrams. *Proceedings. 2nd IEEE Workshop on Industrial Strength Formal Specification Techniques*, 102–113.
- Fitriana, A. N., Harliana, H., & Handaru, H. (2015). Sistem pendukung keputusan untuk menentukan prestasi akademik siswa dengan metode TOPSIS. *Creative Information Technology Journal*, 2(2), 153–164. <https://doi.org/https://doi.org/10.24076/citec.2015v2i2.45>
- Fowler, M. (2018). *UML distilled: a brief guide to the standard object modeling language*. Addison-Wesley Professional.

- Jacobson, L., & Booch, J. R. G. (2021). *The unified modeling language reference manual*.
- Kantinit. (2022). Metode TOPSIS: Pengertian, Cara Kerja dan Penerapannya. *Kantinit.Com*. <https://kantinit.com/kecerdasan-buatan/metode-topsis-pengertian-cara-kerja-dan-penerapannya/>
- Kompasiana. (2024). Metode Topsis dalam Membantu Pengambilan Keputusan. *Kompasiana.Com*. <https://www.kompasiana.com/nimasliankusuma0701/6674d81034777c0e22162673/metode-topsis-dalam-membantu-pengambilan-keputusan>
- Kusumah, W. (2015). Guru Harus Mampu Memberikan Penilaian Obyektif kepada Siswa. *Kompasiana.Com*. <https://www.kompasiana.com/wijayalabs/550e99e5813311892cbc67ce/guru-harus-mampu-memberikan-penilaian-obyektif-kepada-siswa>
- Lesmana, A. Y. (2021). Penggunaan Metode TOPSIS untuk Sistem Pendukung Keputusan Pemilihan Siswa Berprestasi di MAN 1 Metro. *Jurnal Teknologi Terkini*, 1(2).
- Limbong, T. (2011). *Sistem Pendukung Keputusan TOPSIS*. https://www.academia.edu/4124656/Sistem_Pendukung_Keputusan_TOPSIS
- Mufasirah, R., & others. (2021). *Strategi Kepala Sekolah Dalam Peningkatan Prestasi Non Akademik Peserta Didik SMA Negeri 8 Banda Aceh*. UIN Ar-Raniry.
- Munthe, A. (2019). Sistem Pendukung Keputusan dengan Metode TOPSIS. *Academia.Edu*. https://www.academia.edu/39696241/SISTEM_PENDUKUNG_KEPUTUSAN_DENGAN_METODE_TOPSIS
- Oktaviana, D. S. (2021). *Peran Manajemen Kepala Madrasah Dalam Menumbuhkan Motivasi Belajar Siswa Di Mts Manahijul Ulum Plaosan Cluwak Pati*. IAIN KUDUS.
- Pettifor, J. L., & Saklofske, D. H. (2011). Fair and ethical student assessment practices. In *Leading student assessment* (pp. 87–106). Springer. https://doi.org/https://doi.org/10.1007/978-94-007-1727-5_5
- Prasatya, I. (2024). Apa itu Pemilihan Mahasiswa Berprestasi (Pilmapres)? *Studiliv.Com*. <https://studiliv.com/pemilihan-mahasiswa-berprestasi/>
- Quatrani, T., & Evangelist, U. M. L. (2003). Introduction to the Unified modeling language. *A Technical Discussion of UML*, 6(11), 3.
- Rabudin. (2020). Bagaimana Melakukan Penilaian Terhadap Hasil Belajar? *Detik Pendidikan*. <https://www.detikpendidikan.id/2020/12/penilaian-terhadap-hasil-belajar.html>
- Rahman, F. A. (2023). *Manajemen Program Kesiswaan dalam Meningkatkan Prestasi Belajar Siswa di MAN 2 Ponorogo*. IAIN Ponorogo.
- Rahmawati, A. (2020). Metode TOPSIS. *DosenIT.Com*. <https://dosenit.com/tag/metode-topsis>
- Riadi, M. (2022). Prestasi Akademik (Pengertian, Fungsi, Jenis, Ukuran dan Faktor yang Mempengaruhi). *Kajianpustaka.Com*. <https://www.kajianpustaka.com/2021/03/prestasi-akademik.html>
- Scott, S., Webber, C. F., Lupart, J. L., Aitken, N., & Scott, D. E. (2014). Fair and equitable assessment practices for all students. *Assessment in Education: Principles, Policy & Practice*, 21(1), 52–70. <https://doi.org/https://doi.org/10.1080/0969594X.2013.776943>
- Setiawan, I. (2023). Pentingnya Penilaian Objektif Dan Mendalam Dalam Pembelajaran Di Kelas. *Man4pandeglang.Sch.Id*. <https://man4pandeglang.sch.id/blog/pentingnya-penilaian-objektif-dan-mendalam-dalam-pembelajaran-di-kelas/>
- Setiyani, L. (2021). Desain Sistem: Use Case Diagram. *Prosiding Seminar Nasional Inovasi Dan Adopsi Teknologi (INOTEK)*, 1(1), 246–260.
- Sikumbang, E. D., & Muhammad, I. M. (2021). Metode Topsis Dalam Sistem Pendukung Keputusan Pemilihan Siswa Berprestasi. *J-SAKTI (Jurnal Sains Komputer Dan Informatika)*, 5(1), 481–490.
- Sipayung, S. (2016). Sistem Pendukung Keputusan Metode TOPSIS. *Academia.Edu*. https://www.academia.edu/31852759/SISTEM_PENDUKUNG_KEPUTUSAN_Metode_TOPSIS_and_Contoh_Implementasi
- Studynews.co.id. (2024). 12 Pengertian Prestasi Menurut Para Ahli, Macam, Sikap & Artinya. *Studynews.Co.Id*. <https://www.studineews.co.id/12-pengertian-prestasi/>
- Sugianto. (2010). *Pentingnya Motivasi Berprestasi Dalam Mencapai Keberhasilan Akademik*.
- Sunarti Rahman. (2021). Pentingnya Motivasi Belajar Dalam Meningkatkan Hasil Belajar. *Prosiding Seminar Nasional Pendidikan Dasar, November*, 289–302.
- Sundari, S. (2015). Sistem Pendukung Keputusan Dengan Menggunakan Metode Topsis. *STIKOM Tunas Bangsa*.

- https://www.academia.edu/50584140/Sistem_Pendukung_Keputusan_Dengan_Menggunakan_Metode_Topsis
Syafi'i, A., Marfiyanto, T., & Rodiyah, S. K. (2018). Studi Tentang Prestasi Belajar Siswa Dalam Berbagai Aspek Dan Faktor Yang Mempengaruhi. *Jurnal Komunikasi Pendidikan*, 2(2), 115. <https://doi.org/10.32585/jkp.v2i2.114>
- Syafnidawaty. (2020). Metode TOPSIS (Technique For Others Preference by Similarity to Ideal Solution). *Raharja.Ac.Id.* <https://raharja.ac.id/2020/04/02/metode-topsis-technique-for-others-reference-by-similarity-to-ideal-solution/>
- Syah, M. E., & Pertiwi, D. S. (2024). *Psikologi belajar*. Feniks Muda Sejahtera.
- Thabroni, G. (2022). Prestasi Belajar: Pengertian, Fungsi, Indikator & Faktor - serupa.id. *Serupa.Id.* <https://serupa.id/prestasi-belajar-pengertian-fungsi-indikator-faktor/>
- Wicaksono, S. R. (2023). *TOPSIS - Teori dan Implementasi*. <https://doi.org/10.5281/ZENODO.8035225>
- Wikipedia. (2023). Prestasi. *Wikipedia*. <https://id.wikipedia.org/wiki/Prestasi>