

Decision Support System Using the TOPSIS Method in New Teacher Selection

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Submitted: Jun 12, 2024 | **Accepted:** July 1, 2024 | **Published:** July 16, 2024

Abstract: Every school needs teachers who have good competence to educate students to become outstanding students. Getting teachers who have good competence is certainly not an easy thing, it must be a very strict selection process. This research aims to help determine teachers who are eligible to be accepted at IT Al Munadi Private Elementary School Medan by using the TOPSIS method. The selection consists of 5 criteria, namely education, microteaching, teaching experience, tahsin and memorization of the Koran. The TOPSIS method is widely used for Multi Attribute Decision Making (MADM) decision making. The TOPSIS method is used as a ranking to see teachers who have competencies that are worthy of acceptance. Based on the results of the TOPSIS calculation where there are 6 alternatives that have been determined, the results obtained are G6 in the first place with a preference value of 2.82, 2nd place with a preference value of 2.48, 3rd place with a preference value of 2.09, 4th place with a preference value of 1.72, 5th place with a preference value of 1.67, while the 6th place is G1 with a preference value of 1.00. It is hoped that the decision support system using TOPSIS can help schools in determining teachers who have good competence so as to produce outstanding students.

Keywords: DSS, TOPSIS, Teacher Selection, Students, MADM

INTRODUCTION

Technology is currently developing very rapidly in helping every level of society in various fields. In agriculture, technology can be used to water plants automatically, measure soil moisture and water PH and be used to determine the freshness of fruit using IoT (Sandi & Yulia, 2023), (2023) (Wulandari et al., 2024)(Rodiah et al., 2020). Likewise, in the field of education, technology is widely used to help the process of running education, especially during the Covid-19 pandemic. During the covid-19 pandemic, the technology used was the use of elearning to help the learning process at home (Wijaya et al., 2020). With elearning, both teachers and students can interact with long distances without having to meet face to face. After the pandemic, elearning is also still used in the world of education both in schools and universities (Maulana et al., 2023), (Abdullah, 2023). In addition to elearning, there are several technologies used in education such as the development of learning media using video and the selection system for outstanding teachers and principals (Sa'adati et al., 2018).

Education is the main milestone in the formation of a cultured, productive and just society. In the midst of the dynamics of the times that continue to develop, the role of teachers is becoming increasingly vital in ensuring the continuity and quality of education (Sugiarto & Farid, 2023)(Nisa et al., 2023). Teachers are not only teachers in the classroom, but also the main movers in forming character, critical thinking, and the skills needed to face the challenges of the modern world. They not only convey knowledge, but also become role models who inspire students to grow and develop. The existence of teachers provides a strong foundation for an effective teaching and learning process. Teachers must be able to understand the individual needs of each student and provide appropriate guidance to maximize their potential. Apart from that, teachers also act as a link between the nationally or locally designed curriculum and the needs and realities in the classroom (Alamsyah et al., 2022; Anggreini & Priyojadmiko, 2022; Astini, 2022).

Teachers have an important role in improving the quality of students' education as the nation's next generation. Teachers must have good competencies such as teaching abilities, insight and the ability to carry out tasks well to improve the quality of student education (Wardana & Sumijan, 2021). SD IT Al Munadi continues to make efforts

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so that the quality of education continues to improve, especially in increasing teacher competency. Every year SD IT Al Munadi continues to recruit teachers but they do not meet the expected competencies. The assessment process for recruiting new teachers is still carried out manually using an assessment form without using a system. The problem is the difficulty in assessing who deserves to be accepted as a teacher with the expected competencies.

To facilitate the process of evaluating teachers who deserve to be accepted, a computerized system is needed to help carry out the assessment process based on predetermined criteria. Decision support systems are a branch of science that lies between information systems and intelligent systems. Decision support systems are designed for all stages of decision making, starting from identifying problems, selecting appropriate data, defining the approach used in the decision making process (Dasmita, 2022; Fatimah et al., 2024; Samsir et al., 2020). The method used in assessing new teachers is the TOPSIS method. TOPSIS suggests that the optimal alternative from a set of alternatives should present the shortest geometric distance from the positive ideal solution. This method uses criteria values that correspond to weights, compares alternative properties of positive and negative ideals, and mathematical matrix equations.

There are several previous researchers who have conducted research related to teacher performance assessment using the TOPSIS method. The TOPSIS method can help with a more optimal decision making process to resolve assessment problems. In this problem, the data taken is teacher data and criteria weights as a reference in carrying out assessments. Based on research conducted, the TOPSIS method can help researchers as a tool for making appropriate decisions in assessing teacher performance (Effendi, 2021).

In the next research, the TOPSIS method was used to determine appropriate sanctions for students at school. The aim of this research is to provide recommendations for appropriate sanctions for students who commit violations. There are 8 criteria used in this research, namely arriving late, fake permission slips, dirtying school facilities, behaving immorally, being rude to teachers, carrying sharp weapons, intimidating friends, getting involved in brawls, stealing in the school environment and having tattoos. The TOPSIS method can help the school to provide sanctions that are appropriate to the violations committed (Khultsum & Taufik, 2023).

The TOPSIS method can also be used to assess teacher performance. This research was conducted at SMK Negeri 1 Lhokseumawe to determine the quality of teaching and learning, so qualified teachers are needed. In this research, the TOPSIS method is used to provide solutions/policies in teacher assessments carried out by students based on predetermined criteria. There are 5 criteria that are assessed, namely student satisfaction with the delivery of material, student understanding, student achievement, arrival time and mastery of the material. The TOPSIS method can be used as a recommendation to school principals in looking at teacher performance in learning (Rahman et al., 2022)

Selecting the best teacher is a very important thing to do in education because it can determine the quality of teaching and learning. The TOPSIS method at the UPTD SD Negeri 16 Bandar Rahmad school for selecting the best teachers uses 5 criteria, namely based on teacher absences, pedagogical competence, personnel competence, social competence and professional competence. After processing using the TOPSIS method, 3 rankings of the best teachers were produced at the UPTD school SD Negeri 16 Bandar Rahmad (Efendi et al., 2023).

In another study, the TOPSIS method was used to determine the best teachers in an online learning system. In this research, there are 7 criteria used, namely RPP, suitability of RPP, online learning instruments, work discipline, teacher and student interaction, teacher presence and teacher attitude. This method provides recommendations for the best teachers based on predetermined criteria so that it can speed up the process of selecting the best teachers in the learning system (Hamdani et al., 2021).

The process of determining which teachers are worthy of being accepted at SD IT Al Munadi is still assessed manually so the acceptance process takes a long time. The TOPSIS method is used to provide recommendations to decision makers in determining teachers who are worthy of being accepted at SD IT Al Munadi. The criteria used in this research.

METHOD

The TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method is a multi-criteria selection technique used to select the best alternative from a group of alternatives based on certain criteria. TOPSIS is able to provide problem solving with structured and unstructured conditions (Hts et al., 2023). The TOPSIS method is used to find positive and negative ideal solutions based on the shortest and longest distances and maximize the value of the criteria. The method used in this research uses the TOPSIS method. There are 7 steps to the TOPSIS method in determining teachers who are worthy of being accepted at SD IT Al Munadi Medan. The following is a figure of the steps in the TOPSIS method:

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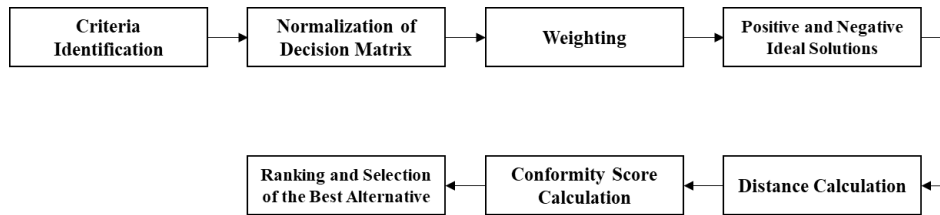


Fig 1. TOPSIS Method

Criteria Identification

Determine the evaluation criteria that are relevant and important for decision making. These criteria must be measurable and comparable among all alternatives.

Normalization of Decision Matrix

Transform the decision matrix (alternatives vs. criteria) into a comparable form by normalization. Normalization is done to eliminate the effects of different units of measurement or different scales between criteria.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \tag{1}$$

Weighting

Assign a relative weight to each criterion, indicating its level of importance in decision-making. This weight reflects the decision maker's relative preference for each criterion.

$$y_{ij} = w_i r_{ij} \tag{2}$$

Positive and Negative Ideal Solutions

Determine the positive ideal solution (largest for profit criteria) and the negative ideal solution (smallest for cost criteria).

$$A^+ = (y_1^+, y_1^+, \dots, y_n^+); \tag{3}$$

$$A^- = (y_1^-, y_1^-, \dots, y_n^-); \tag{4}$$

Distance Calculation

Calculate the distance between each alternative and the positive and negative ideal solutions using a distance metric, such as Euclidean distance or Manhattan distance.

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_i^+ - y_{ij})^2} \tag{5}$$

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_i^-)^2} \tag{6}$$

Conformity Score Calculation

Calculate the similarity score for each alternative using the TOPSIS formula. The similarity score is the ratio between the alternative distance to the negative ideal solution divided by the total alternative distance to the negative and positive ideal solutions.

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \tag{7}$$

Ranking and Selection of the Best Alternative

The alternative with the highest suitability score is considered the best alternative or top preference.

RESULT

The needs of the system are obtained through an interview process with the Head of Al Munadi IT Elementary School, the main criteria such as Education, Teaching Experience, Tahsin, Memorization of the Quran and Microteaching. All criteria are given a score of 1-5 where 1 is the lowest score and 5 is the highest score.

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Table 1. TOPSIS Value Description

Description	Value
Very Important	5
Slightly More Important	4
Essential	3
Less Important	2
Very Unimportant	1

In table 1 above, the highest score is 5 with a description of very important while the lowest is 1 with a description of very unimportant.

Table 2. Criteria

Criteria	Code
Education	C1
Microteaching	C2
Teaching Experience	C3
Tahsin	C4
Quran memorization	C5

In table 2 above, the criteria are converted into code form to simplify the calculation process. Education is coded C1, Microteaching is coded C2, Teaching Experience is coded C3, Tahsin is coded C4 and Memorization of the Quran is coded C5.

Table 3. Alternatives

Alternatives	Code
Indi Rahmadani	G1
Daud Ridho	G2
Yuanda Riski	G3
Nurhalimah	G4
Aisyah	G5
Nabilah Marwa	G6

There are 6 alternatives to be assessed which are then ranked so that they are eligible to become new teachers at SD IT Al Munadi. Each alternative is then given a code from G1 to G6.

TOPSIS Method Calculation

The first step in selecting new teachers using TOPSIS assigns criteria values to each alternative. The value is given based on the test results. Criteria values can be seen in table 4 below:

Table 4. Criteria Value

Alternatives	Criteria				
	C1	C2	C3	C4	C5
G1	4	5	3	3	5
G2	3	4	2	2	4
G3	4	5	2	3	4
G4	4	3	3	1	5
G5	3	5	3	2	5
G6	4	3	2	1	3

Table 4 is the matrix value of the criteria from each alternative. Furthermore, based on the matrix value of the criteria, the normalized matrix value can be calculated:

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$$R_{11} = 4 / \sqrt{4^2 + 3^2 + 4^2 + 4^2 + 3^2 + 4^2} = 0,44$$

$$R_{12} = 3 / \sqrt{4^2 + 3^2 + 4^2 + 4^2 + 3^2 + 4^2} = 0,33$$

$$R_{13} = 4 / \sqrt{4^2 + 3^2 + 4^2 + 4^2 + 3^2 + 4^2} = 0,44$$

$$R_{14} = 4 / \sqrt{4^2 + 3^2 + 4^2 + 4^2 + 3^2 + 4^2} = 0,44$$

$$R_{15} = 3 / \sqrt{4^2 + 3^2 + 4^2 + 4^2 + 3^2 + 4^2} = 0,33$$

$$R_{16} = 4 / \sqrt{4^2 + 3^2 + 4^2 + 4^2 + 3^2 + 4^2} = 0,44$$

$$R_{21} = 5 / \sqrt{5^2 + 4^2 + 5^2 + 3^2 + 5^2 + 3^2} = 0,48$$

$$R_{22} = 4 / \sqrt{5^2 + 4^2 + 5^2 + 3^2 + 5^2 + 3^2} = 0,38$$

$$R_{23} = 5 / \sqrt{5^2 + 4^2 + 5^2 + 3^2 + 5^2 + 3^2} = 0,48$$

$$R_{24} = 3 / \sqrt{5^2 + 4^2 + 5^2 + 3^2 + 5^2 + 3^2} = 0,29$$

$$R_{25} = 5 / \sqrt{5^2 + 4^2 + 5^2 + 3^2 + 5^2 + 3^2} = 0,48$$

$$R_{26} = 3 / \sqrt{5^2 + 4^2 + 5^2 + 3^2 + 5^2 + 3^2} = 0,29$$

$$R_{31} = 3 / \sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 2^2} = 0,48$$

$$R_{32} = 2 / \sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 2^2} = 0,32$$

$$R_{33} = 2 / \sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 2^2} = 0,32$$

$$R_{34} = 3 / \sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 2^2} = 0,48$$

$$R_{35} = 3 / \sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 2^2} = 0,48$$

$$R_{36} = 2 / \sqrt{3^2 + 2^2 + 2^2 + 3^2 + 3^2 + 2^2} = 0,32$$

$$R_{41} = 3 / \sqrt{3^2 + 2^2 + 3^2 + 1^2 + 2^2 + 1^2} = 0,57$$

$$R_{42} = 2 / \sqrt{3^2 + 2^2 + 3^2 + 1^2 + 2^2 + 1^2} = 0,38$$

$$R_{43} = 3 / \sqrt{3^2 + 2^2 + 3^2 + 1^2 + 2^2 + 1^2} = 0,57$$

$$R_{44} = 1 / \sqrt{3^2 + 2^2 + 3^2 + 1^2 + 2^2 + 1^2} = 0,19$$

$$R_{45} = 2 / \sqrt{3^2 + 2^2 + 3^2 + 1^2 + 2^2 + 1^2} = 0,38$$

$$R_{46} = 1 / \sqrt{3^2 + 2^2 + 3^2 + 1^2 + 2^2 + 1^2} = 0,19$$

$$R_{51} = 5 / \sqrt{5^2 + 4^2 + 4^2 + 5^2 + 5^2 + 3^2} = 0,46$$

$$R_{52} = 4 / \sqrt{5^2 + 4^2 + 4^2 + 5^2 + 5^2 + 3^2} = 0,46$$

$$R_{53} = 4 / \sqrt{5^2 + 4^2 + 4^2 + 5^2 + 5^2 + 3^2} = 0,46$$

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$$R_{54} = 5 / \sqrt{5^2 + 4^2 + 4^2 + 5^2 + 5^2 + 3^2} = 0,46$$

$$R_{55} = 5 / \sqrt{5^2 + 4^2 + 4^2 + 5^2 + 5^2 + 3^2} = 0,46$$

$$R_{55} = 3 / \sqrt{5^2 + 4^2 + 4^2 + 5^2 + 5^2 + 3^2} = 0,28$$

The results of the normalized matrix calculation above can be seen in table 5.

Table 5. Normalized and weighted matrix

Divisor		9,06	10,44	6,24	5,29	10,77
No	Alternatives	Criteria				
		C1	C2	C3	C4	C5
1	G1	0,44	0,48	0,48	0,57	0,46
2	G2	0,33	0,38	0,32	0,38	0,37
3	G3	0,44	0,48	0,32	0,57	0,37
4	G4	0,44	0,29	0,48	0,19	0,46
5	G5	0,33	0,48	0,48	0,38	0,46
6	G6	0,44	0,29	0,32	0,19	0,28

The next step is to calculate the weighted normalized matrix (Y)

$$Y = \begin{bmatrix} 1,77 & 2,39 & 1,44 & 1,70 & 2,32 \\ 1,33 & 1,92 & 0,96 & 1,13 & 1,86 \\ 1,77 & 2,39 & 0,96 & 1,70 & 1,86 \\ 1,77 & 1,44 & 1,44 & 0,57 & 2,32 \\ 1,33 & 2,39 & 1,44 & 1,13 & 2,32 \\ 1,77 & 1,44 & 0,96 & 0,57 & 1,39 \end{bmatrix}$$

The next step is to determine the positive solution value (A+) and negative solution value (A-) that will be used in calculating the distance between each alternative.

$$Y_1^+ = \max \{1,77; 1,33; 1,77; 1,77; 1,33; 1,77\} = 1,77$$

$$Y_2^+ = \max \{2,39; 1,92; 2,39; 1,44; 2,39; 1,44\} = 2,39$$

$$Y_3^+ = \max \{1,44; 0,96; 0,96; 1,44; 1,44; 0,96\} = 1,44$$

$$Y_4^+ = \max \{1,70; 1,13; 1,70; 0,57; 1,13; 0,57\} = 1,70$$

$$Y_5^+ = \max \{2,32; 1,86; 1,86; 2,32; 2,32; 1,39\} = 2,32$$

$$Y_1^- = \min \{1,77; 1,33; 1,77; 1,77; 1,33; 1,77\} = 1,33$$

$$Y_2^- = \min \{2,39; 1,92; 2,39; 1,44; 2,39; 1,44\} = 1,44$$

$$Y_3^- = \min \{1,44; 0,96; 0,96; 1,44; 1,44; 0,96\} = 0,96$$

$$Y_4^- = \min \{1,70; 1,13; 1,70; 0,57; 1,13; 0,57\} = 0,57$$

$$Y_5^- = \min \{2,32; 1,86; 1,86; 2,32; 2,32; 1,39\} = 1,39$$

The distance between the weighted values of each alternative to the positive ideal solution:

$$D_1^+ = (1,77-1,77)^2 + (2,39-2,39)^2 + (1,44-1,44)^2 + (1,70-1,70)^2 + (2,32-2,32)^2 = 0$$

$$D_2^+ = (1,77-1,33)^2 + (2,39-1,92)^2 + (1,44-0,96)^2 + (1,70-1,13)^2 + (2,32-1,86)^2 = 1,09$$

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$$D_3^+ = (1,77-1,77)^2 + (2,39-2,39)^2 + (1,44-0,96)^2 + (1,70-1,70)^2 + (2,32-1,86)^2 = 0,67$$

$$D_4^+ = (1,77-1,77)^2 + (2,39-1,44)^2 + (1,44-1,44)^2 + (1,70-0,57)^2 + (2,32-2,32)^2 = 1,48$$

$$D_5^+ = (1,77-1,33)^2 + (2,39-2,39)^2 + (1,44-1,44)^2 + (1,70-1,13)^2 + (2,32-2,32)^2 = 0,72$$

$$D_6^+ = (1,77-1,77)^2 + (2,39-1,44)^2 + (1,44-0,96)^2 + (1,70-0,57)^2 + (2,32-1,39)^2 = 1,82$$

The distance between the weighted values of each alternative to the negative ideal solution:

$$D_1^+ = (1,77-1,33)^2 + (2,39-1,44)^2 + (1,44-0,96)^2 + (1,70-0,57)^2 + (2,32-1,39)^2 = 1,87$$

$$D_2^+ = (1,33-1,33)^2 + (1,92-1,44)^2 + (0,96-0,96)^2 + (1,13-0,57)^2 + (1,86-1,39)^2 = 0,88$$

$$D_3^+ = (1,77-1,33)^2 + (2,39-1,44)^2 + (0,96-0,96)^2 + (1,70-0,57)^2 + (1,86-1,39)^2 = 1,62$$

$$D_4^+ = (1,77-1,33)^2 + (1,44-1,44)^2 + (1,44-0,96)^2 + (0,57-0,57)^2 + (2,32-1,39)^2 = 1,13$$

$$D_5^+ = (1,33-1,33)^2 + (2,39-1,44)^2 + (1,44-0,96)^2 + (1,13-0,57)^2 + (2,32-1,39)^2 = 1,53$$

$$D_6^+ = (1,77-1,33)^2 + (1,44-1,44)^2 + (0,96-0,96)^2 + (0,57-0,57)^2 + (1,39-1,39)^2 = 0,44$$

The results of the calculation of finding positive and negative ideal solution values can be seen in table 6.

Table 6. Positive Ideal Solution and Negative Ideal Solution

Alternavites	D_i^+	D_i^-
G1	0,00	1,87
G2	1,09	0,88
G3	0,67	1,62
G4	1,48	1,13
G5	0,72	1,53
G6	1,82	0,44

The next step is to find the preference result for alternatives (V_i)

$$G_1 = \frac{1,87}{1,87 + 0} = 1$$

$$G_2 = \frac{0,88}{0,88 + 1,09} = 2,09$$

$$G_3 = \frac{1,62}{1,62 + 0,67} = 1,67$$

$$G_4 = \frac{1,33}{1,33 + 1,48} = 2,48$$

$$G_5 = \frac{1,53}{1,53 + 0,72} = 1,72$$

$$G_6 = \frac{0,44}{0,44 + 1,82} = 2,82$$

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The results of the preference value can be seen in table 7 below:

Table 7. Preference value

Alternatives	Preference	Ranking
G1	1,00	6
G2	2,09	3
G3	1,67	5
G4	2,48	2
G5	1,72	4
G6	2,82	1

The alternative that has the closest distance to the positive ideal solution and the farthest distance from the negative ideal solution will be considered the most desirable alternative or the one with the highest preference value. Conversely, the alternative that has the farthest distance from the positive ideal solution and the closest distance from the negative ideal solution will be considered the least desirable alternative or has the lowest preference value.

DISCUSSIONS

Based on the TOPSIS calculation results where there are 6 alternatives that have been determined, the result is that G6 with the name Nabilah Marwa is in first place with a preference value of 2.82, 2nd place is G4 with the name Nurhalimah with a preference value of 2.48, 3rd place is G2 with the name Daud Ridho with a preference value of 2.09, 4th place is Aisyah G5 with a preference value of 1.72, 5th place is G3 with the name Yuanda Riski with a preference value of 1.67, while 6th place is G1 with the name Indi Rahmadani with a preference value 1.00. The ranking can be seen in the table below:

Alternatives	Preference	Ranking
Nabilah Marwa	2.82	1
Nurhalimah	2,48	2
Daud Ridho	2,09	3
Aisyah	1,72	4
Yuanda Riski	1,67	5
Indi Rahmadani	1,00	6

So, using the TOPSIS method, the one who deserves to be accepted as a teacher is Nabila Marwa. It is hoped that the decision support system using TOPSIS can help schools find teachers who have good competence.

CONCLUSION

The TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) is a multi criteria decision making technique used to evaluate alternatives based on their relative distance from a positive ideal solution and a negative ideal solution. TOPSIS calculates the preference value of the alternatives evaluated by considering the proximity to the positive ideal solution and the proximity to the negative ideal solution. Thus, the preferences of the TOPSIS method will include a relative ranking or assessment of each alternative based on the proximity of positive and negative ideal solutions. Alternatives that are close to the positive ideal solution and away from the negative ideal solution will have a higher preference value compared to alternatives that are the opposite. Based on the TOPSIS calculation results where there are 6 alternatives that have been determined, the result is that G6 with the name Nabilah Marwa is in first place with a preference score of 2.82 so she is worthy of being accepted as a teacher at SD IT AL Munadi Medan

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