

# IMPLEMENTATION OF THE TOPSIS METHOD IN DETERMINING THE BEST PHYSICS LEARNING MEDIA AID WITH ROC WEIGHTING

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**Abstract:** *In the era of highly developed, it is very influential in various sectors, including one that is experiencing technological changes that are increasingly sophisticated, so that it can make it easier for students to carry out the learning process using media that has been widely used. physics learning media aids often occur several problems because the learning media is expensive and lacks features in the application of learning media and the explanation is not understood by students can make it difficult for students to use and choose suitable media tools in helping physical learning. In the best physics learning media tools, there are five criteria including user capacity, visual interaction, friendly features, application features and internet data usage. So, in this research, the assistant system was ordered to solve the problems that occurred in the research. The system referred to as a problem solving tool is a Decision Support System (DSS). Based on these problems, a decision support system is needed as a problem-solving technique and is assisted by methods that can produce accurate final scores. The method is the TOPSIS method and the ROC weighting which is very helpful in generating weights from alternative data and criteria so as to get the final results obtained from Alternative M3, the name of the application is Ruang Guru with a value of 0.9998*

**Keywords:** *DSS; TOPSIS; ROC; Physics Learning Media*

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## Introduction

Technology is now increasingly widespread and developing so that it can make it easier to carry out all activities in various fields, one of which is the field of education. The field of education also really needs a media tool that can make it easier for students to carry out learning activities so that they can make students have no difficulties in learning. The tool is in the form of an application that can be used as a learning media tool, where students can utilize a media as a source of knowledge development and can make it easier for students to complete their assignments by using learning media aids in the field of physics (Fikriyah et al., 2015).

Physics learning media is a medium that was created and developed to help students if students have difficulty doing assignments. Physics learning media is also very supportive in expanding student knowledge about subjects related to physics, if the learning media is very clear with various discussions so that students are interested in using/using this learning media as an auxiliary medium in learning physics. These learning media aids can develop an innovation and broad thinking towards students so as to create students who are active and creative. However, in choosing a media tool, problems often occur where the learning media has a paid nature and lacks features in the learning media application and the explanation is not understood by students so that it can make it difficult for students to use and choose suitable media tools in helping the physics student. In determining the best physics learning media aids, there are five criteria including user capacity, visual interaction, friendly features, application features and internet data usage. So in this research a helper system is really needed to solve the problems that occur in the research. The system referred to as an auxiliary tool in solving problems is the Decision Support System (SPK).

Decision Support System is a technique for obtaining a decision and can be designed according to alternative data and predetermined criteria data, SPK is also a computerized system to assist the process of making a decision in accordance with multiple criteria and attributes. (M Mesran, Syefudin, Sarif Surejo, Muhammad Syahrizal, Aang Alim Murtopo, Zaenul Arif, Nugroho Adhi Santoso, Wresti Andriani, Soeb Aripin, Gunawan, 2023). So in this study, the authors apply a TOPSIS method and use ROC weighting where this method can produce weight values and the values obtained according to the data that has been taken and these values are accurate. In SPK there are several methods contained in it, namely PSI, SAW, OCRA, ENTROPY, EDAS, MAUT, WASPAS and many other methods. (Nofriansyah, 2015).

In the research that has been discussed by Shansy Fernandes, et al in 2022 which is related to Position Selection where there are 4 criteria including Work Experience, Education Level, Mastering the Office and Interview. From the application of the TOPSIS method in this study, the final result was Anton's first rank with a value of 0.36429 (Darmansah et al., 2022). Furthermore, the research reviewed by Heruddin, et al, in 2022 regarding the Best Tourism Actors, there are several criteria, namely Number of Visitors/Week, Implementation of the Covid-19 Health Protocol, Limitation of Visit Time, Use of Vaccine Batches for Staff, Facilities and Infrastructure, Cleanliness, Sanctions Covid group. This study uses the OCRA method with ROC weighting so that in this study the highest ranking results will be obtained at A3 on behalf of Sidebuk Debuk Berastagi Baths with a final total of 1.497 (Aldisa & Ginting, 2022). Research that has been peeled off by Rendi Haryono Septy, and Mariza Devega in 2022 relating to Direct Cash Assistance Recipients (BLTA) contains 7 criteria, namely Income, Expenses, Number of Dependents, Number of Family Members of Productive Age, Status of Residence, Size of House, and Land Area. By comparing the 2 methods, namely the TOPSIS method and the SAW method, it will produce the highest rating on behalf of Ramlan at A1 with a value of

0.645(Rendi Haryono Septy & Devega, 2022). Furthermore, the research studied by Abdul Karim, et al tzhun 2021 concerning the Selection of Prospective Employees has several criteria, namely Performance, Discipline, Loyalty, Education, Family Status, Years of Service, and Age. And this study applies the MAUT and OCRA methods and ROC weighting. And has the final result with the highest ranking on behalf of Faris Faturrahman with a value obtained of 0.251(Karim et al., 2021). Furthermore, the research that has been discussed by Haida Defitri in 2022 discusses the Selection of the Best Teachers by applying the TOPSIS and WASPAS methods. Which in this study there are five criteria including Presence, Motivating Ability, Personality, Discipline, and Cooperation so that it can produce the highest ranking value on behalf of the End of Brotherhood with a value of 1(Dafitri et al., 2022).

In previous research that has been reviewed by related research, it can be used as a reference in solving the problems in this study entitled Implementation of the TOPSIS Method in Determining the Best Learning Media Assistance Tool with ROC Weighting so that it can produce the highest ranking obtained from the criteria data and alternatives so that results will be obtained quickly and accurately.

## Research Methodology

### Physics Learning Media

Physics learning media is a medium that really helps students in learning physics which is more relevant and also broad. Physics learning media is in the form of an application in which there are several features in the application where these features can simplify and clarify material related to learning physics. Physics learning media has been widely used by middle school, high school and also students because this media really helps them in completing various assignments and also this media can evaluate students in training students' abilities with physics questions in the application.(Utari, 2019).

### Research Stages

The following are the stages of research carried out to achieve research objectives in decision support systems in determining physics learning media aids, several stages in a study can be explained as follows:

#### 1. Problem Identification

In a study, a reference is really needed to be used as a subject of discussion in order to get problems that can be raised so that these problems can be resolved.

#### 2. Data Collection

In conducting this research, it is very necessary to collect various data needed in evaluating lecturer performance including interviews or searching for various references through Google Scholar and also the library. This data collection can be used as a reference at the time of making this research.

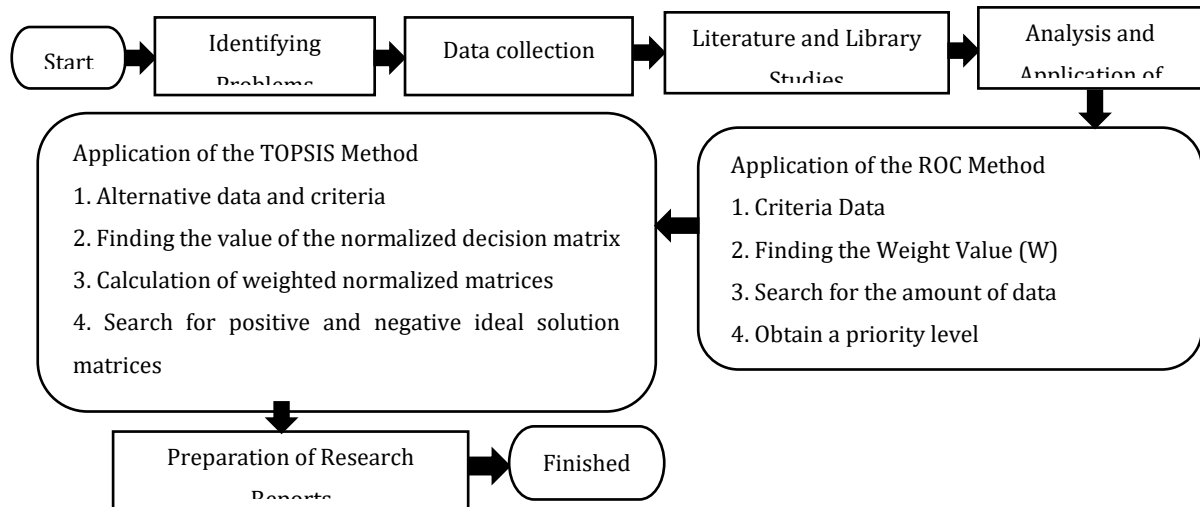
#### 3. Analysis of the application of the method

At this stage of research, the writer can analyze a problem in determining physics learning media aids. Starting from looking for weighting using the ROC method by requiring criterion data and producing a weight, we can perform calculations using the TOPSIS method so as to get accurate final results.

#### 4. Research Report

After the author completes this research, the author can make a research report to see whether the results are as expected after that make conclusions in this research.

The research framework from the above description can be seen as follows:



**Figure 1. Research Framework**

### Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method

TOPSIS is a method that has a function and purpose in getting the final result in a simple form. In the following there are 6 steps in the TOPSIS method as follows (Afriany et al., 2021; Arfyanti, 2021; Ginting et al., 2017; Jasri et al., 2017; Kurniawan et al., 2019; Limbong et al., 2020; Maria Valentine et al., 2022; Windarto, 2017):

1. Create an alternative and criteria that will be calculated using the topsis method
2. Create a normalized decision matrix using the following formula:

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

3. Calculating Weighted Normalization.

$$y_{ij} = w_i r_{ij} \quad (2)$$

4. Make a matrix of positive and negative ideal solutions.

Under the condition :

- a. The lowest criterion value

$$A^- = (y_1^-, y_2^- \dots y_n^-) \quad (3)$$

- b. If the criteria are high

$$A^+ = (y_1^+, y_2^+ \dots y_n^+) \quad (4)$$

5. Calculate the ideal distance.

- a. If the ideal solution is positive,

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_1^+ - y_{ij})^2} \quad (5)$$

- b. If the ideal solution is negative,

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_1^-)^2} \quad (6)$$

## 6. Calculating preferences

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

### Rank Order Centroid (ROC) Method

ROC is a method where this method can produce a weight value in order to obtain accurate final results. The ROC method is also one of the methods that is very easy to understand. In this method, criterion 1 can be compared with criterion 2, and so on. So with this it can be seen in equation 1 (Khalida et al., 2021; Ramadhan et al., 2021; Simorangkir et al., 2021; Waruwu & Mesran, 2021).

$$C_1 > C_2 > C_3 > C_m \quad (1)$$

In determining the weight value (W), it can be seen in equation 2

$$w_m = \frac{1}{m} \sum_{i=1}^m \left( \frac{1}{i} \right) \quad (2)$$

### Result And Discussion

In determining the physics learning media aids, criterion data is needed to get the final results obtained. In the following there are 5 criteria for weight search using the ROC method.

**Table 1. Criteria**

Criteria	Information	Type
C <sub>1</sub>	Storage Capacity	Benefit
C <sub>2</sub>	Visual Interaction	Benefit
C <sub>3</sub>	Friendly Features	Benefit
C <sub>4</sub>	Application Features	Benefit
C <sub>5</sub>	Internet Data Usage	Cost

#### Criteria Description:

Storage Capacity: the ability to accommodate or store an application.

Visual Interaction: communicate among users of an application

Friendly Features: effectiveness in using these features

Application Features: features contained in an application

Use of Internet Data: Data used when opening or using the medicine

In this research, the criterion data does not yet have a weight value, so the authors use the ROC method to produce weight values. In the following, there is a way to find the weight using the formula that has been made in the ROC steps.

$$W_1 = \frac{1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0,457$$

$$W_2 = \frac{0 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0,257$$

$$W_3 = \frac{0 + 0 + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0,157$$

$$W_4 = \frac{0 + 0 + 0 + \frac{1}{4} + \frac{1}{5}}{5} = 0,090$$

$$W_5 = \frac{0+0+0+0+\frac{1}{5}}{5} = 0,040$$

After doing the calculation above, you can get the weight value on the criteria, namely:  $W_1 = 0,457$ ,  $W_2 = 0,257$ ,  $W_3 = 0,157$ ,  $W_4 = 0,090$ ,  $W_5 = 0,040$ . The following in table 2 are the five criteria along with the resulting weights in determining the best physics learning media aids

**Table 2. Criteria Weight**

Criteria	Information	Weight	Type
C <sub>1</sub>	Storage Capacity	0,457	Benefit
C <sub>2</sub>	Visual Interaction	0,257	Benefit
C <sub>3</sub>	Friendly Features	0,157	Benefit
C <sub>4</sub>	Application Features	0,090	Benefit
C <sub>5</sub>	Internet Data Usage	0,040	Cost

In table 3 below is the data from each alternative and criteria.

**Table 3. Alternative Data for Determining Physics Learning Media Aids**

Alternative	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>
CoLearn	1500	Yes	Good	Participants, Explanatory Videos, Discussion Rooms, Training Forums	Low
Qanda	250	Yes	Good	Participants, Discussion Videos, Discussion Rooms, Training Forums	High
Ruang Guru	1500	Yes	Very Good	Participants, Explanatory Videos, Discussion Rooms, Discussion Forums, Values, Question and Answer Forums	Very High
Zenius	1500	Yes	Good	Participants, Explanatory Videos, Discussion Rooms, Discussion Forums, and Grades	High
Pocket Physics	250	No	Enough	Explanation, and Discussion Forum	Low
Socratic by Google	150	No	Good	Explanation, and Discussion Forum	Low

In table 3 there are still linguistic data that need to be weighted so that the alternative data can be processed. The following in table 4 is the weight given to each of these data.

**Table 4. Giving weight values for each linguistic criterion**

Criteria	Information	Weight Value
Application Features	Participant	1
	Explanatory Videos	1
	Discussion Room	1
	Practice Forum	1
	Value	1
	FAQ Forum	1
Visual Interaction	Yes	2
	Nos	1
Friendly Features	Very Good	3
	Good	2
	Enough	1

Internet Data Usage	Very High	3
	High	2
	Low	1

After being given a weight, then based on table 4, the compatibility rating data is obtained between each alternative and the criteria shown in table 5 below.

**Table 5. Match Rating**

Alternative	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>
A1	1500	2	2	4	1
A2	250	2	2	4	2
A3	1500	2	3	6	3
A4	1500	2	2	6	2
A5	250	1	1	2	1
A6	150	1	1	2	1

### Application of the TOPSIS Method

After determining the match rating data based on student scores, the next step is to calculate the TOPSIS:

1. Determine the normalized decision matrix

$$|X_2| = \sqrt{2^2 + 2^2 + 2^2 + 2^2 + 1^2 + 1^2} = 4.2426$$

$$x_{21} = \frac{2}{4.2426} = 0.4714$$

$$x_{22} = \frac{2}{4.2426} = 0.4714$$

$$x_{23} = \frac{2}{4.2426} = 0.4714$$

$$x_{24} = \frac{2}{4.2426} = 0.4714$$

$$x_{25} = \frac{1}{4.2426} = 0.2357$$

$$x_{26} = \frac{1}{4.2426} = 0.2357$$

$$|X_3| = \sqrt{2^2 + 2^2 + 3^2 + 2^2 + 1^2 + 1^2} = 4.7958$$

$$x_{31} = \frac{2}{4.7958} = 0.4170$$

$$x_{32} = \frac{2}{4.7958} = 0.4170$$

$$x_{33} = \frac{3}{4.7958} = 0.6255$$

$$x_{34} = \frac{2}{4.7958} = 0.4170$$

$$x_{35} = \frac{1}{4.7958} = 0.2085$$

$$x_{36} = \frac{1}{4.7958} = 0.2085$$

$$|X4| = \sqrt{4^2 + 4^2 + 6^2 + 6 + 2^2 + 2^2} = 10.5830$$

$$x_{41} = \frac{4}{10.5830} = 0.3779$$

$$x_{42} = \frac{4}{10.5830} = 0.3779$$

$$x_{43} = \frac{6}{10.5830} = 0.5669$$

$$x_{44} = \frac{6}{10.5830} = 0.5669$$

$$x_{45} = \frac{2}{10.5830} = 0.1889$$

$$x_{46} = \frac{2}{10.5830} = 0.1889$$

$$|X5| = \sqrt{1^2 + 2^2 + 3^2 + 2^2 + 1^2 + 1^2} = 4.4721$$

$$x_{51} = \frac{1}{4.4721} = 0.2236$$

$$x_{52} = \frac{2}{4.4721} = 0.4472$$

$$x_{53} = \frac{3}{4.4721} = 0.6708$$

$$x_{54} = \frac{2}{4.4721} = 0.4472$$

$$x_{55} = \frac{1}{4.4721} = 0.2236$$

$$x_{56} = \frac{1}{4.4721} = 0.2236$$



The matrix formed by the normalization calculation results above is:

$$R = \begin{bmatrix} 1500 & 0.4714 & 0.4170 & 0.3779 & 0.2236 \\ 250 & 0.4714 & 0.4170 & 0.3779 & 0.4472 \\ 1500 & 0.4714 & 0.6255 & 0.5669 & 0.6708 \\ 1500 & 0.4714 & 0.4170 & 0.5669 & 0.4472 \\ 250 & 0.2357 & 0.2085 & 0.1889 & 0.2236 \\ 150 & 0.2357 & 0.2085 & 0.1889 & 0.2236 \end{bmatrix}$$

In the next stage, it is carried out by multiplying the results of R with the weights:

$$Y = \begin{bmatrix} 0.457 * 1500 & 0.257 * 0.4714 & 0.157 * 0.4170 & 0.090 * 0.3779 & 0.040 * 0.2236 \\ 0.457 * 250 & 0.257 * 0.4714 & 0.157 * 0.4170 & 0.090 * 0.3779 & 0.040 * 0.4472 \\ 0.457 * 1500 & 0.257 * 0.4714 & 0.157 * 0.6255 & 0.090 * 0.5669 & 0.040 * 0.6708 \\ 0.457 * 1500 & 0.257 * 0.4714 & 0.157 * 0.4170 & 0.090 * 0.5669 & 0.040 * 0.4472 \\ 0.457 * 250 & 0.257 * 0.2357 & 0.157 * 0.2085 & 0.090 * 0.1889 & 0.040 * 0.2236 \\ 0.457 * 150 & 0.257 * 0.2357 & 0.157 * 0.2085 & 0.090 * 0.1889 & 0.040 * 0.2236 \end{bmatrix}$$

$$Y = \begin{bmatrix} 685.5 & 0.1212 & 0.0655 & 0.0340 & 0.0089 \\ 114.25 & 0.1212 & 0.0655 & 0.0340 & 0.0179 \\ 685.5 & 0.1212 & 0.6255 & 0.5669 & 0.0268 \\ 685.5 & 0.1212 & 0.4170 & 0.5669 & 0.0179 \\ 114.25 & 0.0606 & 0.2085 & 0.1889 & 0.0089 \\ 68.55 & 0.0606 & 0.2085 & 0.1889 & 0.0089 \end{bmatrix}$$

Next, a positive ideal value is selected, namely the highest value that belongs to the alternative and a negative ideal value, namely the value that is owned by the lowest and the results can be seen in table 7 below.

**Table 7. Ideal Positive and Negative Ideal Values**

Alternative	C1(benefit)	C2(benefit)	C3(benefit)	C4(benefit)	C5(cost)
A1	685.5	0.1212	0.0655	0.0340	0.0089
A2	114.25	0.1212	0.0655	0.0340	0.0179
A3	685.5	0.1212	0.6255	0.5669	0.0268
A4	685.5	0.1212	0.4170	0.5669	0.0179
A5	114.25	0.0606	0.2085	0.1889	0.0089
A6	68.55	0.0606	0.2085	0.1889	0.0089
$y^+$	<b>685.5</b>	<b>0.1212</b>	<b>0.6255</b>	<b>0.5669</b>	<b>0.0268</b>
$y^-$	<b>68.55</b>	<b>0.0606</b>	<b>0.0655</b>	<b>0.0340</b>	<b>0.0089</b>

Then calculate the value of D+ and D- in the following way:

$$D_1^+ = \sqrt{(685.5 - 685.5)^2 + (0.1212 - 0.1212)^2 + (0.0655 - 0.6255)^2 + (0.0340 - 0.5669)^2 + (0.0089 - 0.0089)^2} = 0.7730$$

$$D_2^+ = \sqrt{(114.25 - 685.5)^2 + (0.1212 - 0.1212)^2 + (0.0655 - 0.6255)^2 + (0.0179 - 0.5669)^2 + (0.0179 - 0.0089)^2} = 0.7789$$

$$D_3^+ = \sqrt{(685.5 - 685.5)^2 + (0.1212 - 0.1212)^2 + (0.6255 - 0.6255)^2 + (0.5669 - 0.5669)^2 + (0.0268 - 0.0089)^2} = 0.1349$$

$$D_4^+ = \sqrt{(685.5 - 685.5)^2 + (0.1212 - 0.1212)^2 + (0.4170 - 0.6255)^2 + (0.5669 - 0.5669)^2 + (0.0179 - 0.0089)^2} = 0.2293$$

$$D_5^+ = \sqrt{(114.25 - 685.5)^2 + (0.0606 - 0.1212)^2 + (0.2085 - 0.6255)^2 + (0.1889 - 0.5669)^2 + (0.0089 - 0.0089)^2} = 0.5660$$

$$D_6^+ = \sqrt{(68.55 - 685.5)^2 + (0.0606 - 0.1212)^2 + (0.2085 - 0.6255)^2 + (0.1889 - 0.5669)^2 + (0.0089 - 0.0089)^2} = 0.5660$$

Untuk nilai D- didapatkan sebagai berikut ini:

$$D_1^+ = \sqrt{(685.5 - 68.55)^2 + (0.1212 - 0.0606)^2 + (0.0655 - 0.0655)^2 + (0.0340 - 0.0340)^2 + (0.0089 - 0.0268)^2} = 616.95$$

$$D_2^+ = \sqrt{(114.25 - 68.55)^2 + (0.1212 - 0.0606)^2 + (0.0655 - 0.0655)^2 + (0.0179 - 0.0340)^2 + (0.0179 - 0.0268)^2} = 45.7000$$

$$D_3^+ = \sqrt{(685.5 - 68.55)^2 + (0.1212 - 0.0606)^2 + (0.6255 - 0.0655)^2 + (0.5669 - 0.0340)^2 + (0.0268 - 0.0268)^2} = 616.9505$$

$$D_4^+ = \sqrt{(685.5 - 68.55)^2 + (0.1212 - 0.0606)^2 + (0.4170 - 0.0655)^2 + (0.5669 - 0.0340)^2 + (0.0179 - 0.0268)^2} = 616.9503$$

$$D_5^+ = \sqrt{(114.25 - 68.55)^2 + (0.0606 - 0.0606)^2 + (0.2085 - 0.0655)^2 + (0.1889 - 0.0340)^2 + (0.0089 - 0.0268)^2} = 45.7000$$

$$D_6^+ = \sqrt{(68.55 - 68.55)^2 + (0.0606 - 0.0606)^2 + (0.2085 - 0.0655)^2 + (0.1889 - 0.0340)^2 + (0.0089 - 0.0268)^2} = 0.2116$$

The final stage is to calculate the reference value in order to get the best value

$$v_1 = \frac{616.95}{616.95+0.7730} = 0,9987$$

$$v_2 = \frac{45.7000}{45.7000+0.7789} = 0.9832$$

$$v_3 = \frac{616.9505}{616.9505+0.1349} = 0.9998$$

$$v_4 = \frac{616.9503}{616.9503+0.2293} = 0.9996$$

$$v_5 = \frac{45.7000}{45.7000+0.5660} = 0.9878$$

$$v_6 = \frac{0.2116}{0.2116+0.5660} = 0.2721$$

From the calculation of the last stages above, Table 11 is the final ranking result.

**Table 11. Final Ranking Results**

Alternative	Application	Value	Rank
A1	CoLearn	0.9987	3
A2	Qanda	0.9832	5
A3	Ruang Guru	0.9998	1
A4	Zenius	0.9996	2
A5	Pocket Physics	0.9878	4
A6	Socratic by Google	0.2721	6

From the results of the calculations that have been carried out from the 6 alternatives to produce the best alternative which can be seen in table 11, namely alternative A3 the name of the application is the teacher's room with a value of 0.9998 as a physics learning media aid.

## Conclusion

From the research that the writer has done, the writer can conclude that in combining the TOPSIS method with the ROC method it can be used as a tool in determining physics learning media aids. The application of the TOPSIS and ROC methods will produce an accurate and clear reference value. So with this the process and results of the determination of implementing a decision support system make a selection of techniques that can be used as a recommendation in the process of determining the best physics learning media aids from obtaining calculations of the actual value of application data with results found to be more accurate and precise. The highest final result was obtained by applying the TOPSIS and ROC methods, namely the alternative to alternative P3, the name of the application being Ruang Guru with a value of 0.9998.

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