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Decision Support System in Kindergarten Selection using TOPSIS Method

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Abstract*: Kindergarten is the most popular school in the world of early childhood, almost in every country put kindergarten into the most important schools for children's education. In Indonesia many kindergartens have emerged as a place to hone children's skills from an early age. This makes the selection of kindergarten schools, especially in Pringsewu district, a matter that is quite difficult to do, especially the lack of a website about each kindergarten school that is still lacking. Therefore, the authors conducted a research on how to create a system to assist in the selection of kindergartens using TOPSIS method, with the aim that people who want to find information about kindergarten can easily access it. Likewise with users who want to get a choice of kindergarten in accordance with their wishes. The TOPSIS method is chosen because the method is simple, easy to understand, the computation is efficient and has the ability to measure the relative performance of decision alternatives in a simple mathematical form.

***Index Terms*: Decision support system, kindergarten, TOPSIS method**

I. INTRODUCTION

A. Background

Kindergarten is a form of early childhood education from the age of 4 to 6 years and kindergarten education has a very important role for the child itself in developing the personality of the child and preparing children for entering the next level of education, namely Elementary School, bahasa: *Sekolah Dasar* (SD). Basically, early childhood education program is very important, this is due to develop the ability to read-write-count, bahasa: *baca*, *tulis*, *hitung* (Calistung) for the preparation of children entering elementary school.

The more public needs for qualified school that is appropriate, selecting schools (especially kindergartens) in Pringsewu in Lampung is not an easy matter. In addition to the increasing number of kindergartens found in Pringsewu Regency, there are also many kindergartens competing to offer various offers to prospective students. As a result, it is increasingly difficult for parents to choose schools, especially kindergartens that are right and in line with expectations.

Decision-making system for selecting Kindergarten with TOPSIS method (Technique for Others References by Similarity to Ideal Solution) with assessment criteria. Kindergarten status, kindergarten category, accreditation, time of establishment, limit of class capacity, number of teachers in class, amount of achievement, tuition fee, registration fee. It will help many parents in deciding on children's education, especially the selection of kindergarten and knowing all the information about the kindergarten through the website. In addition, this website also informs school data (Kindergarten) to indicate the location of the Kindergarten.

B. Problem Formulation

Based on the background so that the problems formulated as follows :

How to implement TOPSIS (Technique for Others Reference by Similarity to Ideal Solution) method in making right and appropriate, so it can fulfill parents desire.

C. Problem Limitation

The problem limitations using TOPSIS (Technique For Others Reference by Similarity to Ideal Solution) method are:

1. Research object at Kindergarten in Pringsewu District
2. Approaching method used was TOPSIS (Technique for Others Reference by Similarity to Ideal Solution).

D. Research Objective

The objective of this research was to design decision support system that can help parents to determine kindergarten located in Pringsewu District appropriately from some existing alternatives and also can be used by kindergarten to deliver information about kindergarten to parents/student guardian.

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II THEORETICAL BASIS

A. Decision Support System

Decision Support System is an interactive system that helps managers in making decisions through the utilization of data and decision models to solve semi-structured problem [1-5]. The steps that must be passed in the decision making process are as follows:

1. Intelligence Step

This step is a process of tracking and detecting the scope of the problem and the process of identifying problem [6-10]. Input data is obtained, processed and tested in order to identify problems [11-15].

2. Design Step

This step is a process of developing and looking for alternative action / solution that can be taken [16-20]. It is a simplified representation of real events, so that a validation and verification process is needed to determine the accuracy of the model in examining the existing problems [21-25].

3. Selection step

This step is carried out the selection of the various alternative solutions appeared [26-30] at the planning step so that it is determined / taking into account the criteria based on the objectives to be achieved [31-35].

4. Implementation step

This step is carried out the implementation of the system design [36-40] that has been made at the development stage and the implementation of alternative actions that have been selected at the election stage [41-45].

B. TOPSIS Method

Topsis is one of the multicriteria decision-making method. Topsis used the principle that the selected alternative must have the closest distance from the positive ideal solution and the longest (farthest) distance from the negative ideal solution from a geometric point of view using Euclidean distance (distance between two points) to determine the relative proximity of an alternative with the optimal solution.

C.

Decision Support System or commonly called the Decision Support System (DSS) is a system that is intended to support managerial decision maker for semi-structured problems [46-50]. DSS as an interactive computer-based system, which helps decision makers to use data and various models to solve unstructured problems [51-55]. DSS is intended to be a tool for decision makers to expand their capabilities [56-60], but not to replace their judgment [61-64]. DSS is intended for decisions that require assessment or decisions that cannot be supported by algorithm.

The TOPSIS method is based on the concept that the best selected alternative only has the closest distance from the positive ideal solution but also has the furthest distance from the solution negative ideal. Positive ideal solutions maximize profit criteria and minimize cost criteria. Negative ideal solution maximizes cost criteria and minimizes profit criteria. In general, the procedure of the TOPSIS method follows the steps as follows:

1. To create normalized decision matrix.
2. To create normalized and weighted decision matrix.
3. To determine positive ideal solution matrix and negative ideal solution matrix.
4. To determine distance and score for each alternative in positive and negative ideal solution matrix.
5. To determine preference score for each alternative

As for the steps from TOPSIS method as follows :

1. Topsis is started by developing decision matrix. X decision matrix referres to m alternative that will be evaluated based on n criteria.

$$X = \begin{Bmatrix} A_1 & X_{11} & X_{12} & X_{13} & \ldots\ldots & X_{1n} \\ A_2 & X_{21} & X_{22} & X_{23} & \ldots\ldots & X_{2n} \\ A_3 & X_{31} & X_{32} & X_{33} & \ldots\ldots & X_{3n} \\ . & . & . & . & & . \\ . & . & . & . & & . \\ A_m & X_{m1} & X_{m2} & X_{m3} & \ldots & X_{mn} \end{Bmatrix}$$

Where A_i (i=1,2,3,....m) is alternative-
The possible alternative, Xj (j=1,2,3,...n) is attribute where alternative performance measured, Xij is Ai alternative performance with Xj attribute as reference.

2. Create normalized decision matrix with i=1,2,...,m; and j=1,2,...,n.

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

Where :
rij = normalized matrixi [i][j] xij = decision matrix [i][j]

3. Create normalized weighted decision matrix **vij = wj.rij ;** with **i=1,2,...,m;** dan **j=1,2,...,n.**
Where :
vij = V element from V normalized decision matrix
wj = weight from j-th criteria
rij = Element from R normalized decision matrix
4. A+ positive ideal solution and A- ideal solution can be determined based on normalized rating weight.
A+ = (y1+, y2 +, ..., yn +); A- = (y1 -, y2 -, ..., yn -); where :
v_j^+ = if j is benefit attribute of max yij
min yij, is j is cost attribute
v_j^- = min yij, if j is benefit attribute
max yij, jika j is cost attribute
5. Distance between Ai alternative with positive ideal solution.

$$D_i^+ = \sqrt{\sum_{i=1}^{n} (v_i^+ - v_{ij})^2} \; ; \quad i=1,2,\ldots,m$$

Where :
D_i^+ = distance between Ai alternative with ideal postive solution

v_i^+ = positive ideal solution [i]
v_{ij} = weighted normalized matrix t[i][j]

6. The distance between Ai with negative ideal solution

$$D_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_i^-)^2} \; ; \quad i=1,2,....,m$$

D_i^- = distance between Ai alternative with negative ideal solution
v_i^- = positive ideal solution [i]
v_{ij} = weighted normalization matrix [i][j]

7. Preference score for each alternative (Vi)

$$Vi = \frac{D_i^-}{D_i^- + D_i^+} \; ; \quad i=1,2,....,m$$

Where :
Vi = The proximity of each alternative to ideal solution.
D_i^+ = the distance between Ai with positive ideal solution
D_i^- = the distance between Ai alternative with negative ideal solution.
The greater Vi score shows that Ai alternative is more selected.

III RESEARCH METHOD

A. Problem Analysis

At present almost all parents when selecting a school especially kindergarten for their children must go to kindergarten one by one to compare the advantages and disadvantages of each kindergarten. This is of course will waste a lot of parents' time especially with many options of kindergarten in big cities , it can take days to determine the kindergarten that will be chosen for his son / daughter.

The reason from parents comparing each kindergarten is to get information about the status of kindergarten, type of kindergarten, category of kindergarten, accreditation, time of establishment, limit of class capacity, number of teachers in class, number of achievements, tuition fees, registration fees. From the data collected, the parents will be selected again.

B. Design

1. Process flow design

The flow of this system process begins with conducting a field study supported by literature study [65-71] for the criteria data used to determine the criteria and data for Kindergarten in Pringsewu District. After all Kindergarten data were obtained, the Kindergarten data were inputted into the database by the admin. And the user or parent will be given a questionnaire so that the recommended kindergarten was in accordance with the criteria proposed by the user. Next it was taking kindergarten data to be assessed. Starting from the process of querying the database on the status of Kindergarten (State, Private, State or Private), kindergarten (Ordinary, Full Day, Special Needs School), and kindergarten categories (Islam, Catholic or Christian, General).

Whereas in the TOPSIS Method each kindergarten will be assessed based on the criteria provided for the assessment on a 1-5 point scale, the same thing applied in determining the priority weight. With the following criteria:

1. Accreditation

Table 1 shows kindergarten accreditation criteria

Table 1. Kindergarten accreditation criteria

Kindergarten accreditation	Weight
A	4
B	3
C	2
Not registered	1

2. Distance from home

Table 2 shows kindergarten distance from home criteria

Table 2. Kindergarten distance from home criteria

Distance from home	Weight
Very close	5
Close	4
Medium	3
Far	2
Very far	1

3. Facilities

Table 3 shows kindergarten facilities criteria

Table 3. Kindergarten facilities criteria

Kindergarten facilities	Weight
Very complete	1
Fairly complete	2
Complete	3
Very complere	4
Very complete	5

4. Kindergarten tuition fee Table 4 shows kindergarten tuition fee

Table 4. Kindergarten tuition fee

Kindergarten tuition fee	Weight
Very cheap (IDR 0 – IDR 100,000)	5
Cheap (IDR 110,000 – IDR 200,000)	4
Medium (IDR 210,000 – IDR 300,000)	3
Expensive (IDR 310,000 – IDR 400,000)	2
Very Expensive (IDR 410,000 – IDR 500,000)	1

5. Kindergarten registration fee Table 5 shows kindergarten registration fee criteria

Table 5. Kindergarten registration fee criteria

Kindergarten registration fee	Weight
Very cheap (IDR 0 - IDR 500,000)	5
Cheap (IDR 510,000 – IDR 1,000,000)	4
Medium (IDR 1,010,000 - IDR 2,000,000)	3
Expensive (IDR 2,010,000 - IDR 3,000,000)	2
Very expensive (> Rp. 3,000,000)	1

All kindergarten data and the value of each criterion in kindergarten were processed in a matrix so that a strategic recommendation was generated in the form of a report of all best kindergarten and best kindergarten based on the results of the parent survey.

2. Database Design

Figure 1 shows database table design from kindergarten selection application shows relation between existing table.

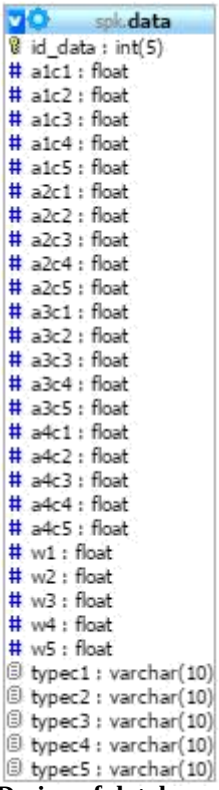

Fig. 1. Design of database table

3. User Interface

Design form that will be used in the Kindergarten application, namely the input form for the selection criteria and the form shows the results of kindergarten selection. Figure 2 shows input application design. Figure 3 shows data view application.

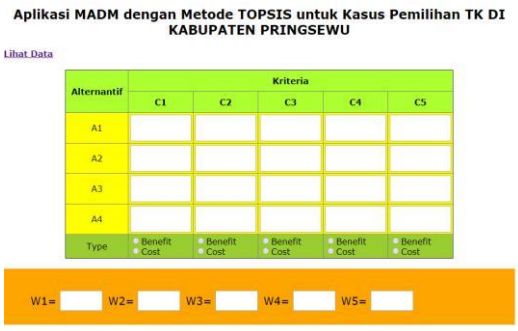

Fig. 2. Input application design

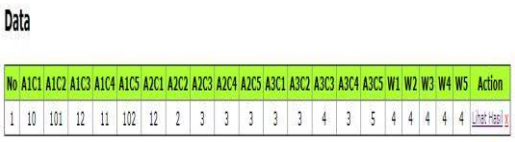

Fig. 3. Data view application

IV. RESULTS AND DISCUSSION

A. Homepage

Main page is the first page opened by user when accessing decision support system in selecting this kindergarten. Figure 4 shows home page implementation

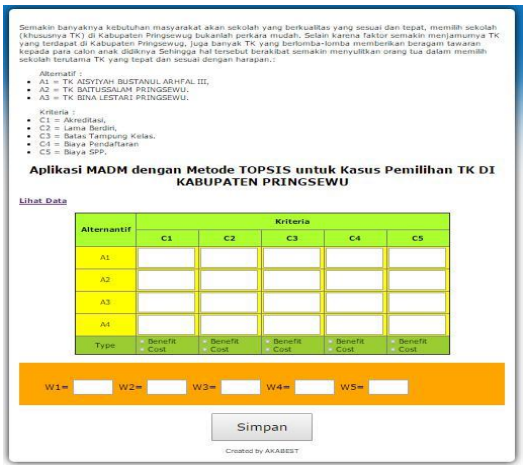

Fig. 4. Homepage implementation

DSS homepage consists of input form to perform weighted score input at each provided criteria.

In this page there was a list of kindergarten in Pringsewu district along with calculated preference values. Data was sorted by preference score from the highest to the lowest. There was also information about the weight score that had been entered previously. If the user had opened this page first, a button will appear at the bottom to save the results of inputting the TK that has been selected from various kindergartens in pringsewu district.

B. Discussion

After implementation, the next step was to test the testing theory of the results of system implementation. System testing was conducted to find out if the system was appropriate and can provide solutions to the problems faced. The trial was conducted by providing a case example of the existing DSS system.

Case Study:

A prospective parent of a kindergarten student planned to enroll her child to study at a kindergarten in Pringsewu District. So the desired criteria was kindergarten which had the closest place from home and had the most complete facilities with a registration fee of less than IDR 250,000 and the range of fees between IDR 50,000 to IDR 100,000. Whereas the weight for each relevant criteria were : 25% distance criteria, 15% criteria for registration fee criteria, 25% tuition fee criteria, 20% facility criteria, 15% accreditation criteria.

From the case above, the weight for each criterion can be defined as shown in table 6, table 7 and table 8.

Table 6. Criteria in presence

C1	C2	C3	C4	C5
25	15	25	20	15

Table 7. Kindergarten interest criteria

Interest	Description
1	Very low
2	low
3	fair
4	high
5	Very high

Table 8. Weight criteria

C1	C2	C3	C4	C5
5	3	5	3	3

From criteria mentioned above by parents of student candidate in Pringsewu district, so there were 3 kindergartens that became sample in calculation using Topsis method. Table 9 shows kindergarten table for calculation model. Table 10 shows kindergarten in normalization form.

Table 9. Kindergarten Table for calculation model

Alternative	Name of kindergarten
A1	Aisyiyah Bustanul Arhfal III
A2	Baitussalam Pringsewu
A3	Bina Lestari Pringsewu

Table 10. Kindergarten in normalization form

A	C1	C2	C3	C4	C5
A1	4	1	1	4	4
A2	3	4	4	1	3
A3	2	3	3	2	4

W1=5, W2=3, W3=5, W4=3, W5=3, criteria type C1 = benefit criteria type, C2 = cost criteria type, C3 = cost criteria type, C4 = benefit criteria type, C5 = benefit.

Steps to finish the case above using TOPSIS method as explained in theoretical base :

Step one : Created normalized decision matrix so the normalization results in matrix form :

$$R = \begin{bmatrix} 0.742781352708 & 0.196116135138 & 0.196116135138 & 0.872871560944 & 0.624695047554 \\ 0.557086014531 & 0.784464540553 & 0.784464540553 & 0.218217890236 & 0.468521285666 \\ 0.371390676354 & 0.588348405415 & 0.588348405415 & 0.436435780472 & 0.624695047554 \end{bmatrix}$$

Step two : created normalized decision matrix that is performing multiplication between weight motrix with normalized matrix. So it is obtained normalized matrix result as follows :

$$Y = \begin{bmatrix} 3.71390676354 & 0.588348405415 & 0.980580675691 & 2.61861468283 & 1.87408514266 \\ 2.78543007266 & 2.35339362166 & 3.92232270276 & 0.654653670708 & 1.405563857 \\ 1.85695338177 & 1.76504521624 & 2.94174202707 & 1.30930734142 & 1.87408514266 \end{bmatrix}$$

Step Three: Determined the positive ideal solution matrix and negative ideal solution matrix. Criteria for registration fee, tuition fee, and distance were criteria that the smaller the score it will increase the profits for the football school. As for the achievement criteria, number of matches, number of training, trainer licenses, and facilities are criteria which, if the score was greater, will increase the profits for football schools. So that the identification of positive and negative ideal solutions was:

Positive ideal solution (A^+)

$y_1^+ = \max\{3.71390676354; 2.78543007266; 1.85695338177\} = 3.71390676354$
$y_2^+ = \min\{0.588348405415; 2.35339362166; 1.76504521624\} = 0.588348405415$
$y_3^+ = \min\{0.980580675691; 3.92232270276; 2.94174202707\} = 0.980580675691$
$y_4^+ = \max\{2.61861468283; 0.654653670708; 1.30930734142\} = 2.61861468283$
$y_5^+ = \max\{1.87408514266; 1.405563857; 1.87408514266\} =$

$A^+ = \{3.71390676354; 0.588348405415; 0.980580675691; 2.61861468283; ; \}$

Negative ideal solution (A^-)

$y_1^- = \min\{3.71390676354; 2.78543007266; 1.85695338177\} = 1.85695338177$
$y_2^- = \max\{0.588348405415; 2.35339362166; 1.76504521624\} = 2.35339362166$
$y_3^- = \max\{0.980580675691; 3.92232270276; 2.94174202707\} = 3.92232270276$
$y_4^- = \min\{2.61861468283; 0.654653670708; 1.30930734142\} = 0.654653670708$
$y_5^- = \min\{1.87408514266; 1.405563857; 1.87408514266\} = 1.405563857$

$A^- = \{1.85695338177; 2.35339362166; 3.92232270276; 0.654653670708; 1.405563857; \}$

Step four : determined the distance between score in each alternative with the ideal matrix solutin and ideal negative matrix solution. So the results of distance D(+) and D(-) calculation was :

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

$D_{1^+} = 1.87408514266$
$D_{2^+} = 4.29698177189$
$D_{3^+} = 3.72901138763$

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

$D_{1^-} = 4.39251200153$
$D_{2^-} = 0.928476690885$
$D_{3^-} = 1.39849059038$

Step Five: determined preference score for each alternative Larger score indicated that the alternative of the score was preferred. So the results of the calculation of the decision support system for the selection of the Best Kindergarten as follows:

$$V_1 = \frac{4.39251200153}{1.87408514266+4.39251200153} = 0.700940542444$$

$$V_2 = \frac{0.928476690885}{4.29698177189+0.928476690885} = 0.177683297552$$

$$V_3 = \frac{1.39849059038}{3.72901138763+1.39849059038} = 0.272743062095$$

Choosen alternative = 0.700940542444

In this research obtained that best solution for the user was AISYIYAH BUSTANUL ARHFAL III kindergarten. Next the calculation and rank performed in created system as shown in figure 5.

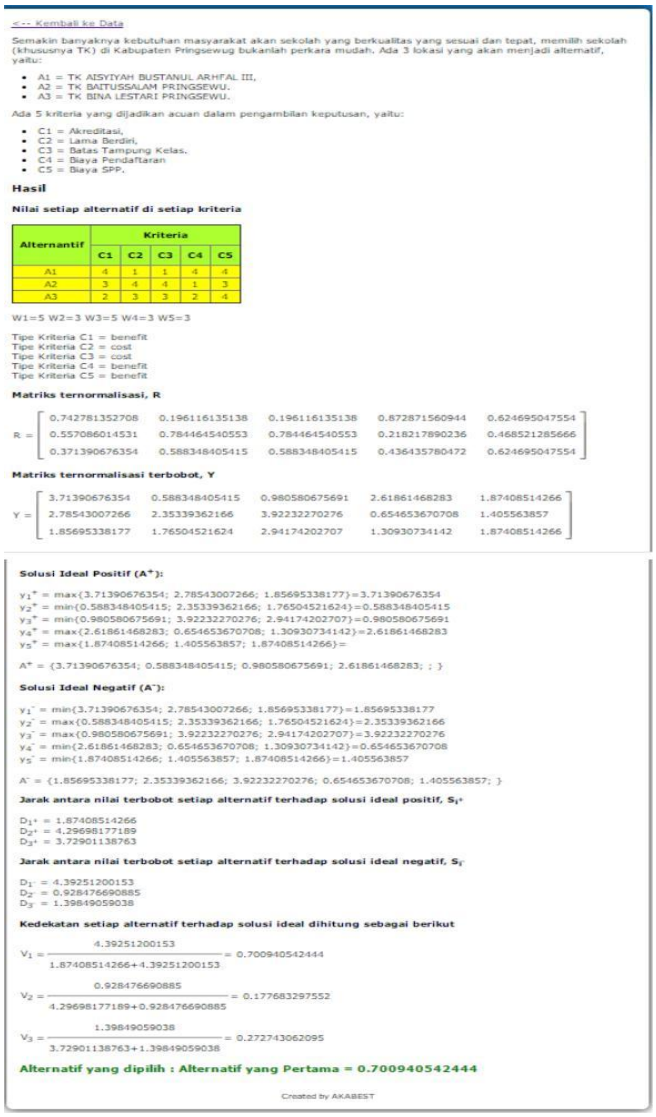

Fig. 5. Test results on the system

From the calculation process carried out by the system the best solution is AISYIYAH BUSTANUL ARHFAL III. With this it can be concluded that the system has been running as expected.

V. CONCLUSION

After be analyzed, system design, implementation and test, it can be obtained the conclusion:

1. TOPSIS ranking method approach to the system can be applied in the case of the selection of land investment location with eight decision support criteria including number of teachers, number of achievements, long time of establishment, status of kindergarten, number of achievements, and capacity of kindergarten room.
2. By using TOPSIS method at system, it can ease the user in selecting kindergarten by giving some alternatives from best kindergarten as parents need so it can be consideration in making decision.
3. The use of decision support criteria derived from several determinants score can help ordinary users to obtain the best kindergarten education.
4. With the concept of information, it does not only facilitate users in the selection of kindergarten education. This system also makes it easy for managers or owners of kindergarten education to inform kindergarten education managed using internet media.

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