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APPLICATION OF TOPSIS METHOD FOR DETERMINATION OF ENGLISH COURSE INSTITUTION

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Abstract: English course institutions are one of the most sought after non-formal education places to learn and improve English language skills, especially to be able to master the TOEFL well. To choose a suitable course institution, that is by visiting the respective course places. Of course, things like this take a lot of time, effort, and money. For this reason, a decision support system is needed that can provide recommendations for the best course institutions using the TOPSIS method. The data used are 18 alternatives with criteria including course fees, number of facilities, length of study hours, instructor's TOEFL, and distance from the course. The calculation results provide a recommendation that the alternative A Class IBT is the best English course institution.

Keywords: English Course; Decision Support System; TOPSIS

Abstrak:. Lembaga kursus bahasa inggris merupakan salah satu tempat pendidikan nonformal yang saat ini banyak dicari untuk mempelajari dan meningkatkan kemampuan bahasa inggris khususnya untuk dapat menguasai TOEFL dengan baik. Untuk memilih lembaga kursus yang cocok yaitu dengan mendatangi ke tempat kursus masing-masing. Tentunya hal seperti ini banyak waktu, tenaga, dan biaya yang diperlukan. Untuk itu diperlukan suatu sistem pendukung keputusan yang dapat memberikan rekomendasi lembaga kursus yang terbaik menggunakan metode TOPSIS. Data yang digunakan adalah 18 alternatif dengan kriteria antara lain uang kursus, jumlah fasilitas, lama jam belajar, TOEFL instruktur, dan jarak tempat kursus. Hasil perhitungan memberikan rekomendasi bahwa alternatif A Class IBT merupakan lembaga kursus bahasa Inggris yang terbaik.

Kata kunci: Kursus Bahasa Inggris; Sistem Pendukung Keputusan; TOPSIS

INTRODUCTION

English is used as an introduction in communicating between nations. With the implementation of English as an international language, people will tend to want to learn English so that they do not lose in international competition. Many people try to learn and master in their own way. Thus, English course institutions are an option for places to study and improve English language skills.

In the city of Pekanbaru, there are several English language courses that provide TOEFL, IELTS and TOEIC programs. To choose the appropriate course institutions, that is by visiting the respective course places. Of course, this kind of thing takes a lot of time, effort, and money. For this reason, a decision support

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system is needed that is useful in determining the best course institution.

Decision support system (DSS) is a tool that can help make decisions based on certain parameters or to assess certain objects so that ranking can be done to get the best object [1].

Previous studies using the TOPSIS method, namely, DSS for prospective teachers [2], DSS for the best employee [3], and DSS for elective courses [4].

While the research that applies the TOPSIS method, among others, is the selection of flat screen TV's [5], the study program selection [6], to determine book publisher [7], to landfills [8], and social media selection [9]. Furthermore, another DSS researchs are to provide loans [10], service quality with SMART [11], to determining the selection of majors with the PROMETHEE method [12], and to determining the plot of the tomb with SAW [13].

The purpose of the research is to build a system as a recommendation for a TOEFL English course institution that will be selected using the TOP-SIS method.

METHOD

Data Collection Technique

The data were obtained through interviews at the TOEFL venue in Pekanbaru City, so that the data obtained were as in table 1, table 2, and table 3.

Table 1. Criteria

Symbol	Criteria
K_1	Course Fee
K_2	Number of Facilities
K_3	Study Hours Length
K_4	TOEFL Instructor
K_5	Course Distance

Table 2. Alternative

No	Alternative	TOEFL Name
1	P	Class 1 Regular
		Class 2 Regular
		Class 3 Regular
		Class 4 Regular
		Class 1 Special
		Class 2 Special
		Class 3 Special
		Class 4 Special
		Class IBT
2	A	Class 1 Regular
		Class 2 Regular
		Class 3 Regular
		Class 4 Regular
		Class 1 Special
		Class 2 Special
		Class 3 Special
		Class 4 Special
		Class IBT

Table 3. Criteria and Sub-Criteria

Criteria	Sub-Criteria	Value
K_1	> 5.000.000	5
	4.000.000 - 5.000.000	4
	3.000.000 - 3.999.999	3
	2.000.000 - 2.999.999	2
	< 2.000.000	1
K_2	> 11	5
	8 – 11	4
	5 – 7,9	3
	3 – 4,9	2
	< 3	1
K_3	> 50	5
	40 – 50	4
	30 – 39,9	3
	20 – 29,9	2
	< 20	1
K_4	> 560	5
	540 – 560	4
	520 – 539,9	3
	500 – 519,9	2
	< 500	1
K_5	> 9	5
	7 – 9	4
	4 – 6,9	3
	1 – 3,9	2
	< 1	1

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Furthermore, the types of criteria are as seen in table 4.

Table 4. Type and Weight

Symbol	Type	Weight
K_1	Biaya	5
K_2	Keuntungan	4
K_3	Keuntungan	3
K_4	Keuntungan	2
K_5	Biaya	1

Method of TOPSIS

The TOPSIS method is a method in which the chosen alternative not only has the shortest distance from a positive solution, but also has the longest distance from a negative solution [14]. The calculation of TOPSIS method ([15], [16], [17]) :

1) Develop a normalized decision matrix :

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

whre i : 1,2, ..., m; j : 1,2, ..., n; r_{ij} : normalization matrix [i][j]; x_{ij} : decision matrix [i][j].

2) Compile the weight normalization matrix:

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

whre w_j : weight of criteria y_{ij} : decision weight normalization matrix.

3) Solution matrix :

$$A^+ = (y_1^+, y_2^+, \cdots, y_j^+) \quad (3)$$

$$A^- = (y_1^-, y_2^-, \cdots, y_j^-) \quad (4)$$

where y_j^+ and y_j^- are :

$$y_j^+ = \begin{Bmatrix} \max\ y_{ij} & , \text{jika } j = \text{benefit} \\ \min\ y_{ij} & , \text{jika } j = \text{cost} \end{Bmatrix} \quad (5)$$

$$y_j^- = \begin{Bmatrix} \min\ y_{ij} & , \text{jika } j = \text{benefit} \\ \max\ y_{ij} & , \text{jika } j = \text{cost} \end{Bmatrix} \quad (6)$$

If the criteria is benefit, then:
$y_j^+ = \max y_{ij}$ and $y_j^+ = \min y_{ij}$.
and if critreria is cost, then:
$y_j^- = \min y_{ij}$ and $y_j^- = \max y_{ij}$.

4) Calculating distance
- Solution is positive :

$$d_j^+ = \sqrt{\sum_{i=1}^{m} (y_{j+} - y_{ij})^2} \quad (7)$$

where d_i^+ : alternative distance; y_j^+ : solution of positive [i]; y_{ij} : normalization weight matrix [i][j].
- Solution of negative:

$$d_j^- = \sqrt{\sum_{i=1}^{m} (y_{ij} - y_{j-})^2} \quad (8)$$

where d_j^-: alternative distancef; y_j^- : solution of negative [i];

5) Calculating of preferences:

$$v_i = \frac{d_i -}{d_i^- + d_i^+} \quad (9)$$

where v_i : preference value

6) The rangking, the largest value of v_i is the best alternative of A_i.

Implementasi Sistem

Implementasi menggunakan bahasa pemrograman PHP dan HTML serta database dengan MySQL.

RESULTS AND DISCUSSION

Data Processing

TOEFL course institution data is given in table 5.

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Table 5. Alternative and Criteria TOEFL

No	Alternative	Criteria				
		K_1	K_2	K_3	K_4	K_5
1	P Class 1 Regular	1.050.000	7	14	530	< 1
2	P Class 1 Special	1.472.000	8	14	530	< 1
3	P Class 2 Regular	1.750.000	7	30	530	< 1
4	P Class 2 Special	3.040.000	8	30	530	< 1
5	P Class 3 Regular	1.750.000	7	30	530	< 1
6	P Class 3 Special	3.040.000	8	30	530	< 1
7	P Class 4 Regular	1.670.000	7	24	530	< 1
8	P Class 4 Special	2.352.000	8	24	530	< 1
9	P Class IBT	4.420.000	8	32	530	< 1
10	A Class 1 Regular	1.050.000	7	14	530	8
11	A Class 1 Special	1.472.000	8	14	530	8
12	A Class 2 Regular	1.750.000	7	30	530	8
13	A Class 2 Special	3.040.000	8	30	530	8
14	A Class 3 Regular	1.750.000	7	30	530	8
15	A Class 3 Special	3.040.000	8	30	530	8
16	A Class 4 Regular	1.670.000	7	24	530	8
17	A Class 4 Special	2.352.000	8	24	530	8
18	A Class IBT	4.420.000	8	32	530	8

Furthermore, from table 5 and table 3, the match rating data is obtained as table 6.

Table 6. Match Rating

No	Alternatif	Kriteria				
		K_1	K_2	K_3	K_4	K_5
1	P Class 1 Regular	1	3	1	3	1
2	P Class 1 Special	1	4	1	3	1
3	P Class 2 Regular	1	3	3	3	1
4	P Class 2 Special	3	4	3	3	1
5	P Class 3 Regular	1	3	3	3	1
6	P Class 3 Special	3	4	3	3	1
7	P Class 4 Regular	1	3	2	3	1
8	P Class 4 Special	2	4	2	3	1
9	P Class IBT	4	4	3	3	1
10	A Class 1 Regular	1	3	1	3	4
11	A Class 1 Special	1	4	1	3	4
12	A Class 2 Regular	1	3	3	3	4
13	A Class 2 Special	3	4	3	3	4
14	A Class 3 Regular	1	3	3	3	4
15	A Class 3 Special	3	4	3	3	4
16	A Class 4 Regular	1	3	2	3	4
17	A Class 4 Special	2	4	2	3	4
18	A Class IBT	4	4	3	3	4

Calculating TOPSIS Method

The calculation using the TOPSIS method is:

1) Develop a normalized matrix *r*.
   From table 6 and eq. (1), we obtain:
   $r_{11} = \frac{1}{\sqrt{1^2 + 1^2 + \ldots + 4^2}} = 0{,}1240$
   $r_{21} = 0{,}1240$; $r_{31} = 0{,}1240$; ....;
   $r_{181} = 0{,}4961$
   With table 6 and eq. (1), we obtain r_{ij}, and matrix r :

$$r = \begin{pmatrix} 0{,}1240 & 0{,}2171 & 0{,}1037 & 0{,}2582 & 0{,}0976 \\ 0{,}1240 & 0{,}2894 & 0{,}1037 & 0{,}2582 & 0{,}0976 \\ 0{,}1240 & 0{,}2171 & 0{,}3111 & 0{,}2582 & 0{,}0976 \\ 0{,}3721 & 0{,}2894 & 0{,}3111 & 0{,}2582 & 0{,}0976 \\ 0{,}1240 & 0{,}2171 & 0{,}3111 & 0{,}2582 & 0{,}0976 \\ 0{,}3721 & 0{,}2894 & 0{,}3111 & 0{,}2582 & 0{,}0976 \\ 0{,}1240 & 0{,}2171 & 0{,}2074 & 0{,}2582 & 0{,}0976 \\ 0{,}2481 & 0{,}2894 & 0{,}2074 & 0{,}2582 & 0{,}0976 \\ 0{,}4961 & 0{,}2894 & 0{,}3111 & 0{,}2582 & 0{,}0976 \\ 0{,}1240 & 0{,}2171 & 0{,}2074 & 0{,}2582 & 0{,}3904 \\ 0{,}1240 & 0{,}2894 & 0{,}2074 & 0{,}2582 & 0{,}3904 \\ 0{,}1240 & 0{,}2171 & 0{,}3111 & 0{,}2582 & 0{,}3904 \\ 0{,}3721 & 0{,}2894 & 0{,}3111 & 0{,}2582 & 0{,}3904 \\ 0{,}1240 & 0{,}2171 & 0{,}3111 & 0{,}2582 & 0{,}3904 \\ 0{,}3721 & 0{,}2894 & 0{,}3111 & 0{,}2582 & 0{,}3904 \\ 0{,}1240 & 0{,}2171 & 0{,}2074 & 0{,}2582 & 0{,}3904 \\ 0{,}2481 & 0{,}2894 & 0{,}2074 & 0{,}2582 & 0{,}3904 \\ 0{,}4961 & 0{,}2894 & 0{,}3111 & 0{,}2582 & 0{,}3904 \end{pmatrix}$$

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2) Compile the weight normalization matrix. Using eq. (2), table 4, and matrix *r*, we obtain:

$y_{11} = 1 * 0{,}1240 = 0{,}1240$
$y_{21} = 1 * 0{,}1240 = 0{,}1240$
y_{31} = 0,1240; y_{41} = 1,1163;
...
y_{181}=1,9846

so that we obtain y_{ij} and matrix *y* :

$$y = \begin{pmatrix} 0{,}1240 & 0{,}6512 & 0{,}1037 & 0{,}7746 & 0{,}0976 \\ 0{,}1240 & 1{,}1577 & 0{,}1037 & 0{,}7746 & 0{,}0976 \\ 0{,}1240 & 0{,}6512 & 0{,}9333 & 0{,}7746 & 0{,}0976 \\ 1{,}1163 & 1{,}1577 & 0{,}9333 & 0{,}7746 & 0{,}0976 \\ 0{,}1240 & 0{,}6512 & 0{,}9333 & 0{,}7746 & 0{,}0976 \\ 1{,}1163 & 1{,}1577 & 0{,}9333 & 0{,}7746 & 0{,}0976 \\ 0{,}1240 & 0{,}6512 & 0{,}4148 & 0{,}7746 & 0{,}0976 \\ 0{,}4961 & 1{,}1577 & 0{,}4148 & 0{,}7746 & 0{,}0976 \\ 1{,}9846 & 1{,}1577 & 0{,}9333 & 0{,}7746 & 0{,}0976 \\ 0{,}1240 & 0{,}6512 & 0{,}4148 & 0{,}7746 & 1{,}5614 \\ 0{,}1240 & 1{,}1577 & 0{,}4148 & 0{,}7746 & 1{,}5614 \\ 0{,}1240 & 0{,}6512 & 0{,}9333 & 0{,}7746 & 1{,}5614 \\ 1{,}1163 & 1{,}1577 & 0{,}9333 & 0{,}7746 & 1{,}5614 \\ 0{,}1240 & 0{,}6512 & 0{,}9333 & 0{,}7746 & 1{,}5614 \\ 1{,}1163 & 1{,}1577 & 0{,}9333 & 0{,}7746 & 1{,}5614 \\ 0{,}1240 & 0{,}6512 & 0{,}4148 & 0{,}7746 & 1{,}5614 \\ 0{,}4961 & 1{,}1577 & 0{,}4148 & 0{,}7746 & 1{,}5614 \\ 1{,}9861 & 1{,}1577 & 0{,}9333 & 0{,}7746 & 1{,}5614 \end{pmatrix}$$

3) Solution matrix
- Solution of positive (A^+)
  Using matrix *y* and eq. (5) we obtain
  y_1^+ = max (0,1240; 0,1240; 0,1240; 1,1163; 0,1240; 1,1163; 0,1240; 0,4961; 1,9846; 0,1240; 0,1240; 0,1240; 1,1163; 0,1240; 1,1163; 0,1240; 0,4961; 1,9861) = 1,9846
  y_2^+ = 1,1577; y_3^+ = 0,9333; y_4^+ = 0,7746; y_5^+ = 1,5614
  Using eq. (3) we obtain
  A^+ = (1,9846; 1,1577; 0,9333; 0,7746; 1,5614)
- Solution of negative (A^-)
  In the same way and eq. (6) we obtain
  y_1^- = min (0,1240; 0,1240; 0,1240; 1,1163; 0,1240; 1,1163; 0,1240; 0,4961; 1,9846; 0,1240; 0,1240; 0,1240; 1,1163; 0,1240; 1,1163; 0,1240; 0,4961; 1,9861) = 0,1240
  y_2^- = 0,6512; y_3^- = 0,1037;
  y_4^- = 0,7746; y_5^- = 0,0976.
  Using eq. (4) we obtain
  A^- = (0,1240; 0,6512; 0,1037; 0,7746; 0,0976)

4) Calculating distance
- Solution of positive
  Using matrix *y*, A^+ and eq. (7) we obtain
  $$d_1^+ = \sqrt{(1{,}9846 - 0{,}1240)^2 + \cdots + (1{,}5614 - 0{,}0976)^2}$$
  = 2,5591
  $d_2^+ = 2{,}5085$; $d_3^+ = 2{,}4209$;
  $d_4^+ = 1{,}7020$; $d_5^+ = 2{,}4209$;
  $d_6^+ = 1{,}7020$; $d_7^+ = 2{,}4758$;
  $d_8^+ = 2{,}1511$; $d_9^+ = 1{,}4639$;
  $d_{10}^+ = 2{,}0991$; $d_{11}^+ = 2{,}0371$;
  d_{12}^+ = 1,9282; $d_{13}^+ = 0{,}8682$;
  $d_{14}^+ = 1{,}9282$; $d_{15}^+ = 0{,}8682$;
  d_{16}^+ =1,9967; $d_{17}^+ = 1{,}5761$;
  $d_{18}^+ = 0{,}0000$.
- Solution of negative
  Using matrix *y*, A^- and eq. (8) we obtain
  $$d_1^- = \sqrt{(0{,}1240 - 0{,}1240)^2 + \cdots + (0{,}0976 - 0{,}0976)^2}$$
  = 0,0000
  d_2^- = 0,5065; d_3^- = 0,8296;
  d_4^- = 1,3890; d_5^- = 0,8296;
  d_6^- = 1,3890; d_7^- = 0,3111;
  d_8^- = 0,7013; d_9^- = 2,0991;
  d_{10}^- = 1,4639; d_{11}^- = 1,5490;
  d_{12}^- = 1,6826; d_{13}^- = 2,0180;
  d_{14}^- = 1,6826; d_{15}^- = 2,0180;
  d_{16}^- = 1,4965; d_{17}^- = 1,6232;
  d_{18}^- = 2,5591.

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5) Calculating of preferences
Using d_i^+, d_i^- and eq. (9), we obtain
$v_1 = \frac{0,0000}{0,0000 + 2,5591} = 0,0000$
v_2 = 0,1680;
v_3 = 0,2552;
v_4 = 0,4494;
v_5 = 0,2552;
v_6 = 0,4494;
v_7 = 0,1116;
v_8 = 0,2459;
v_9 = 0,5891;
v_{10} 0,4109;
v_{11} = 0,4319;
v_{12} = 0,4660;
v_{13} = 0,6992;
v_{14} = 0,4660;
v_{15} = 0,6992;
v_{16} = 0,4284;
v_{17} = 0,5073;
v_{18} = 1,0000

The preference value v_i are in table 7.

Tabel 7. Preference Value

No	Alternative	Preference
1	P Class 1 Regular	0,0000
2	P Class 1 Special	0,1680
3	P Class 2 Regular	0,2552
4	P Class 2 Special	0,4494
5	P Class 3 Regular	0,2552
6	P Class 3 Special	0,4494
7	P Class 4 Regular	0,1116
8	P Class 4 Special	0,2459
9	P Class IBT	0,5891
10	A Class 1 Regular	0,4109
11	A Class 1 Special	0,4319
12	A Class 2 Regular	0,4660
13	A Class 2 Special	0,6992
14	A Class 3 Regular	0,4660
15	A Class 3 Special	0,6992
16	A Class 4 Regular	0,4284
17	A Class 4 Special	0,5073
18	A Class IBT	1,0000

6) The rangking
Using table 7, which is sorted from the largest value to the smallest, the ranking is obtained as table 8.

Tabel 8. Perangkingan

No	Alternatif	Preferensi
1	A Class IBT	1,0000
2	A Class 2 Special	0,6992
3	A Class 3 Special	0,6992
4	P Class IBT	0,5891
5	A Class 4 Special	0,5073
6	A Class 2 Regular	0,4660
7	A Class 3 Regular	0,4660
8	P Class 2 Special	0,4494
9	P Class 3 Special	0,4494
10	A Class 1 Special	0,4319
11	A Class 4 Regular	0,4284
12	A Class 1 Regular	0,4109
13	P Class 2 Regular	0,2552
14	P Class 3 Regular	0,2552
15	P Class 4 Special	0,2459
16	P Class 1 Special	0,1680
17	P Class 4 Regular	0,1116
18	P Class 1 Regular	0,0000

From Table 7 can recommend that the best English course institution is A Class IBT**.**

Display of System

Display system consists of :

1) Criteria page, admin manages criteria data, namely adding, changing, and deleting, see Image 1.

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Image 1. Display of Criteria

2) Course page, describes the admin page to add or delete course data, see Image 2.

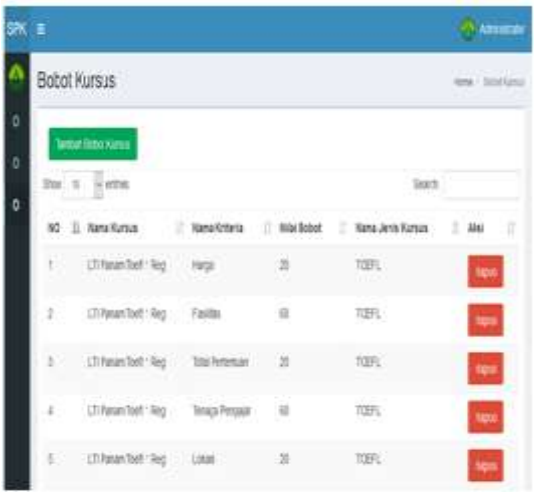

Image 2. Display of Course

CONCLUSION

The TOPSIS method can be applied to the DSS for determining the English language course institution. The results of calculations with 18 alternative data, the system provides recommendations, namely alternative A Class IBT is the best English language institution.

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