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# Assessment of English Teaching Systems Using a Single-Valued Neutrosophic MACROS Method

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**Abstract:** Multi-Criteria Decision Making (MCDM) approaches are an effective tool for dealing with decision-making in various areas. It is a very complex and challenging task for computing an admissible solution with different and conflicting criteria. This work developed a new Measurement of Alternatives and Ranking according to the Compromise Solution (MARCOS) approach for English Teaching System (ETS). The main advantage of using this method is using a cost and profit solution for starting the formulation matrix, calculating the utility degree in both solutions, new way for calculation a function of utility and combination method, employed a large set of criteria and alternatives while keeping stability. ETS is very important for organizations, countries, and governments. It is a very critical task for assessing ETS. This paper proposed an example for using the MARCOS method for Assessment ETS. This example contains five main criteria, twenty-two sub-criteria and six alternatives for assessment ETS. The MARCOS method is employed under Single Valued Neutrosophic Sets (SVNSs) because the assessment ETS contains incomplete and uncertain information. So, SVNSs are an effective tool for overcoming this uncertainty. Scale from 1-5 used for evaluated criteria and alternatives by three experts and

decision-makers who have an expert in this field. This paper help organization and countries which want to build an ETS.

**Keywords:** MARCOS, English Teaching System, SVNNSs, Uncertainty.

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## 1. Introduction

Higher education plays a vital role in the assessment English Teaching System (ETS) by improving the quality of training senior talent[1], [2]. Many countries that do not have an English mother tongue are trying to improve the education process in science and the English language by training students. So this goal is very important to evaluate and enhance the quality of English teaching with the ability of English outstanding[3], [4]. Assessment ETS is a very complex task due to contains many various criteria and alternatives like teaching system, management system, research of scientific, teachers, students, innovation, system integrations and mechanism of teaching, course material, employment, resource utilization, self-study communications skills, various methods and technical skills. So many researchers move toward innovation to assess the ETS by using various methods and functions.

The process of evaluation ETS contains incomplete and vague information. So, we propose a Single Valued Neutrosophic Sets (SVNSs) to overcome this problem through introduce three values truth, indeterminacy and falsity membership degrees. SVNSs used to handle with the incomplete, inconsistent and uncertainty information. It used is this paper to deal with vague information in process assessment ETS. SVNS used in scientific and engineering fields. Due to this problem contains multiple and conflict criteria, the multi-criteria decision making (MCDM) methods were used for this evaluation. We select an MCDM method MARCOS for evaluation ETS. MARCOS method is used for calculation weight of criteria and rank alternatives. It is the best method for dealing with conflict and complex criteria and alternatives. It builds a relationship between criteria and alternatives

through cost and benefit ideal solutions. Also, MARCOS is used for calculation the utility degree between cost and benefit ideal solutions. The main benefit of the utility function is to compute the position of alternatives regard cost and benefit ideal solutions. It used to present the anti-ideal and ideal solution and determine utility degree for two solution. It deal effectively with large dimension criteria and alternatives. The best alternative determined by nearest to benefit solution and farness of cost solution.

Stević et al.[5] used the MARCOS method for supplier selection in healthcare industries. They used twenty-one criteria and eight alternatives for their problem. They used fuzzy systems and scales from 1 to 5 to evaluate criteria and alternatives. The main limitations in their paper not considering the indeterminacy value in their calculations. They used only truth, and falsity membership degrees.

Puška et al. [6] used a MARCOS method for the selection of sustainable suppliers. They used fuzzy systems in their calculations. They were not consider the indeterminacy value in their calculations.

The main contributions in this paper, we proposed a hybrid model from SVNSSs and the MARCOS method for overcoming the uncertainty in evaluating ETS. We use six alternatives with five main criteria and twenty-two criteria. The indeterminacy value considers in calculations to overcome incomplete information. This paper help decision makers and government to make a best decisions in process of English teaching. This paper aids many countries to develop process of English teaching by providing many criteria that impact in this process.

The rest of this paper presented section two for hybrid model and section three presented an example and results. Section 4 presented conclusions of this paper.

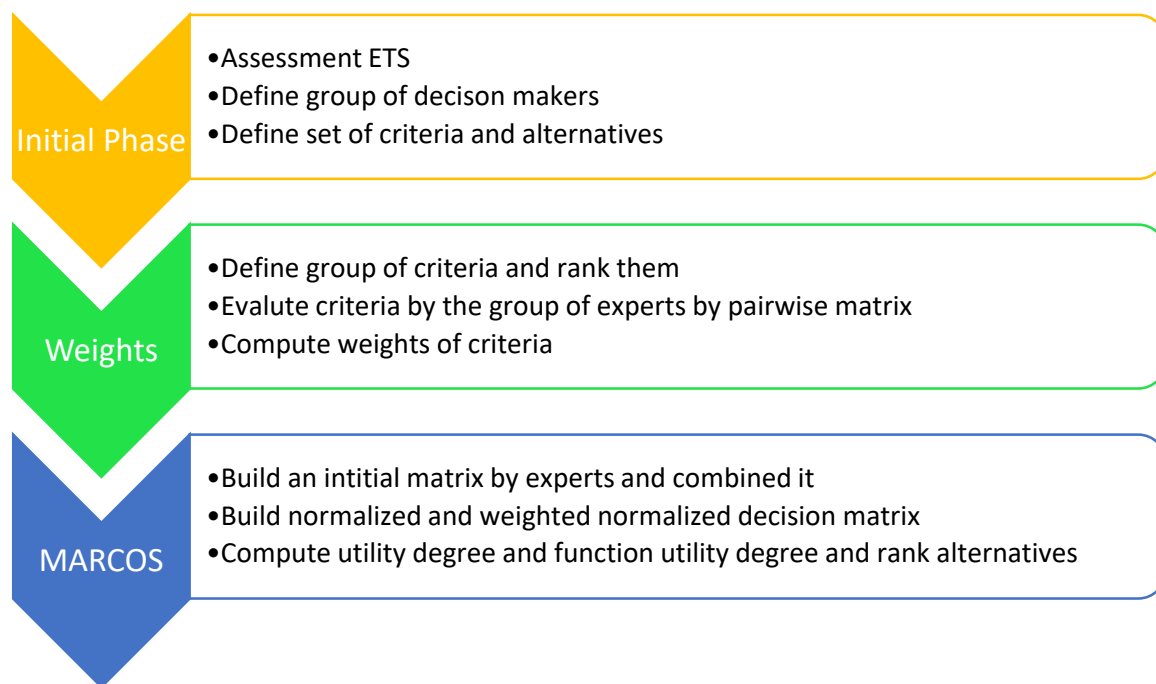


Fig 1. The methodology of this paper

## 2. Framework of this paper

This section consists form two-part. The first part is calculating the weights of criteria, and the second part rank alternatives and introduce neutrosophic equations. The neutrosophic sets created by Smarandache[7]–[14] . Fig 1. presented the methodology of this paper.

The following definitions with SVNNs.

Definition 1: let  $K_1 = (T_1, I_1, F_1)$   $K_2 = (T_2, I_2, F_2)$  two single-value neutrosophic numbers  $(T_1, I_1, F_1)$  present the Truth, Indeterminacy and Falsity and their operations presented as follow:

$$\text{Complement } K_1^c = (F_1, 1 - I_1, T_1) \tag{1}$$

$$\text{Equality } K_1 = K_2 \text{ if and only if } K_1 \subseteq K_2 \text{ and } K_2 \subseteq K_1 \tag{2}$$

$$\text{Union } K_1 \cup K_2 = (T_1 \vee T_2, I_1 \wedge I_2, F_1 \wedge F_2) \tag{3}$$

$$\text{Intersection } K_1 \cap K_2 = (T_1 \wedge T_2, I_1 \vee I_2, F_1 \vee F_2) \tag{4}$$

Definition 2: The following addition and multiplication the two SVNNSs:

$$K_1 \oplus K_2 = (T_1 + T_2 - T_1 T_2, I_1 I_2, F_1 F_2) \quad (5)$$

$$K_1 \otimes K_2 = (T_1 T_2, I_1 + I_2 - I_1 I_2, F_1 + F_2 - F_1 F_2) \quad (6)$$

Definition 3: The following subtraction and division

$$K_1 \ominus K_2 = \left( \frac{T_1 - T_2}{1 - T_2} + \frac{I_1}{I_2}, \frac{F_1}{F_2} \right) k_1 > k_2, T_2 \neq 0, I_2 \neq 0, F_2 \neq 0, \quad (7)$$

$$K_1 \oslash K_2 = \left( \frac{T_1}{T_2} + \frac{I_1 - I_2}{1 - I_2}, \frac{F_1 - F_2}{1 - F_2} \right) k_2 > k_1, T_2 \neq 0, I_2 \neq 0, F_2 \neq 0, \quad (8)$$

The steps of the MARCOS method are organized as follow:

**Step 1:** Build an initial decision matrix between criteria and alternatives. So, define the number of criteria, alternatives and experts who evaluate the decision matrix – then combined the initial matrix that includes opinions of various experts into one decision matrix. Then apply score function to obtain the single value instead of three values.

$$S(A) = \frac{2+a-b-c}{3} \quad (9) \text{ where } a, b, c \text{ refers to Truth, Indeterminacy and Falsity value}$$

**Step 2:** Define the cost (B) and benefit (A) ideal solution in the initial matrix. This matrix called the extended matrix. The ideal benefit solution computed by the maximum of criteria value considers the best characteristics. But ideal cost solution is the opposite benefit ideal solution. Cost ideal solution computed by the minimum value of each criterion.

**Step 3:** Build an extended normalized matrix.

$$norm_{xy} = \frac{S_x}{A_x} \text{ for benefit criteria} \quad (10)$$

$$norm_{xy} = \frac{A_x}{S_x} \text{ for cost criteria} \quad (11)$$

Where  $S_x$  presented value of decision matrix and  $A_x$  present value of benefit ideal solution.  $x$  refers to the number of criteria and  $y$  refers to number of alternatives

**Step 4:** Build a weighted normalized decision matrix by multiplying values of the extended normalized matrix by the value of criteria.

$$Q_{xy} = norm_{xy} * E_y \quad (12)$$

Where, value of  $E_y$  presented weights of criteria.

**Step 5:** Compute the utility degree of alternatives for benefit and cost ideal solution.

$$H_x^+ = \frac{L_x}{L_{Ax}} \text{ for benefit criteria.} \tag{13}$$

$$H_x^- = \frac{L_x}{L_{Bx}} \text{ for cost criteria.} \tag{14}$$

$$L_x = \sum_{x=1}^n Q_{xy} \text{ where } L_x \text{ summation values of weighted normalized decision matrix} \tag{15}$$

**Step 6:** Compute the utility function of alternative which show relationship between best and cost ideal solution.

$$f(H_x) = \frac{H_x^+ + H_x^-}{1 + \frac{1-f(H_x^+)}{f(H_x^+)} + \frac{1-H_x^-}{H_x^-}} \tag{16}$$

Step 6.1 The utility function for cost and benefit ideal solution can compute as:

$$f(H)_x^+ = \frac{H_x^-}{H_x^+ + H_x^-} \text{ for benefit criteria} \tag{17}$$

$$f(H)_x^- = \frac{H_x^+}{H_x^+ + H_x^-} \text{ for cost criteria} \tag{18}$$

**Step 7:** Rank alternatives according to the highest value of utility function.

Table 1. The five main and twenty-two sub criteria.

Main Criteria	Sub Criteria
<b>Student's Learning (SL)</b>	Interest of ET (SL.1)
	Learning initiative (SL.2)
	Self-study (SL.3)
	Ability find and solve problems (SL.4)
<b>Innovation (I)</b>	Intelligent educational technology (I.1)
	Excellent course (I.2)
	Learning base (I.3)
<b>System Integration (SI)</b>	Political Success (SI.1)
	Professional Compaction (SI.2)

	Practices and exercises (SI <sub>3</sub> )
	Transformation Rate (SI <sub>4</sub> )
	Physical achievement (SI <sub>5</sub> )
<b>Management (M)</b>	Ability ET Management (M <sub>1</sub> )
	Reward and punishment (M <sub>2</sub> )
	Resource utilization (M <sub>3</sub> )
<b>Professional Teachers (PT)</b>	Cognitive comprehension (PT <sub>1</sub> )
	Technical skills (PT <sub>2</sub> )
	Course materials (PT <sub>3</sub> )
	Scientific research (PT <sub>4</sub> )
	Communications skills (PT <sub>5</sub> )
	Skilled Teachers (PT <sub>6</sub> )
	Teaching effect (PT <sub>7</sub> )

### 3. An Example and Results

In this section, we provide an example for a MACROS method and introduce its results. First, the five main criteria, twenty-two sub-criteria and six alternatives, are used for an example. Table 1 presents five main criteria and twenty-two sub-criteria. The criteria proposed in this work collected for literature review [4], [15]. Fig 2. Present the alternatives proposed in this work.



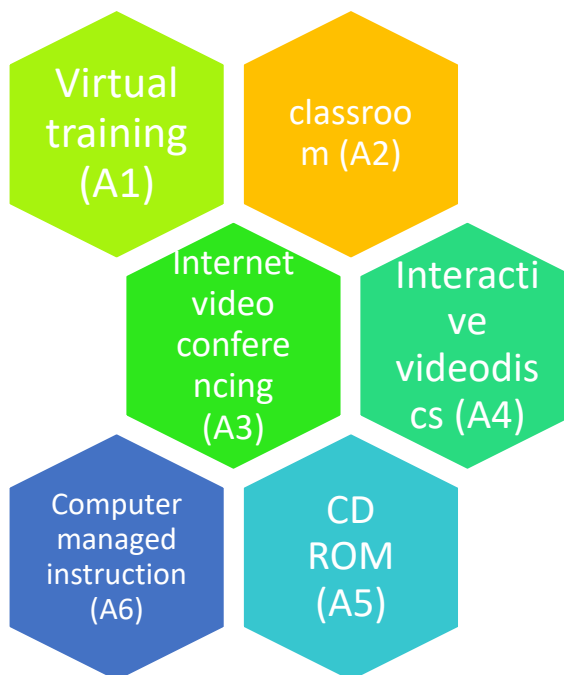


Fig 2. Six alternatives.

Table 2. SVNNS

Linguistics terms	SVNNS
Very Bad (VP)	<0.30,0.75,0.70>
Bad (P)	<0.40,0.65,0.60>
Medium (M)	<0.50,0.50,0.50>
Good (G)	<0.80,0.15,0.20>
Very Good (VG)	<0.90,0.10,0.10>

Three decision-makers and experts evaluated criteria and alternatives by Single-Valued Neutrosophic Numbers in Table 2. Where Very Bad presents the lowest rank and Very Moral presents the highest rank. First, experts evaluated criteria for calculating the weights of criteria. Table 3 presented the opinions of experts for evaluation criteria. The weights of criteria computed by the mean value of criteria for three criteria. Fig 3. presented

the weights of five main criteria from Fig 3. Professional teachers are the highest weight of criteria, and system integration is the lowest weight of criteria.

Values in Table 3. Obtained from applying score function of SVN<sub>S</sub>s using Eq (10).

Table 3. Pairwise matrix for five main criteria

	SL	I	SI	M	PT	Sum
DM1	0.8167	0.383	0.283	0.9	0.8167	3.1994
DM2	0.383	0.9	0.383	0.283	0.8167	2.7657
DM3	0.9	0.9	0.8167	0.383	0.9	3.8997
DM1	0.255267	0.11971	0.088454	0.281303	0.255267	
DM2	0.138482	0.325415	0.138482	0.102325	0.295296	
DM3	0.230787	0.230787	0.209426	0.098213	0.230787	
Mean	0.208179	0.225304	0.145454	0.160613	0.26045	

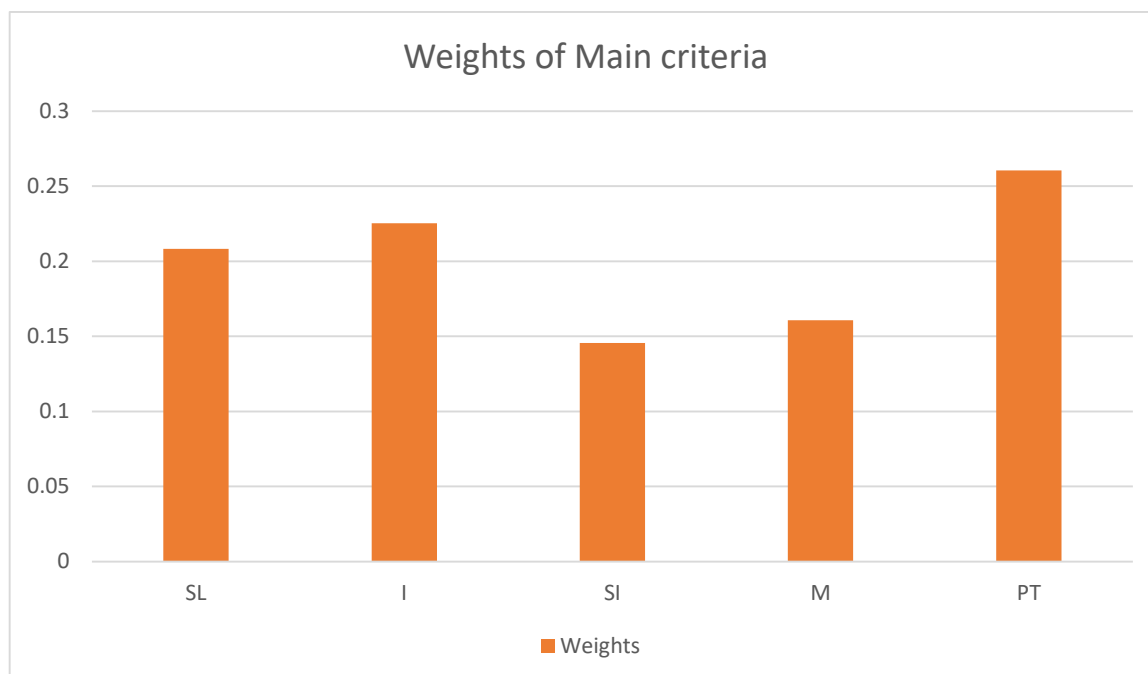


Fig 3. Weights of main criteria

Then evaluate sub-criteria by experts. Table 4-8 present the opinions of experts in twenty-two sub-criteria and weights of sub-criteria. Fig 4-8 present the weights of sub-criteria for five main criteria. Value in Table 4-8 obtained from score function is in Eq. (10).

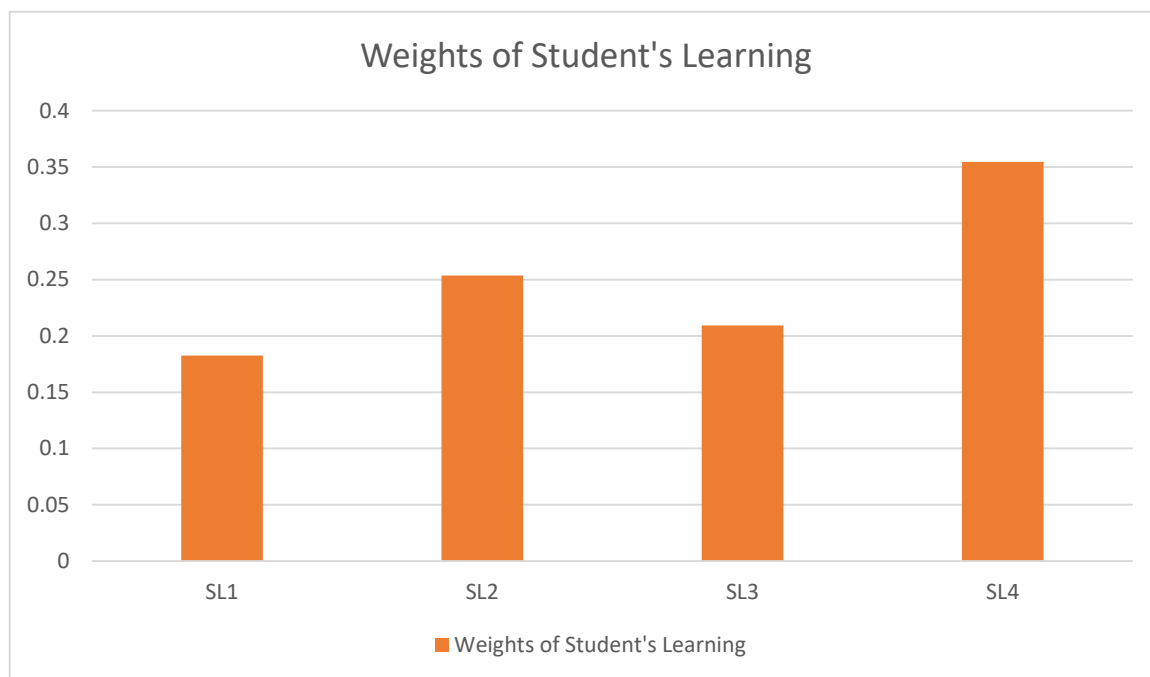


Fig 4. Weights of Student's Learning

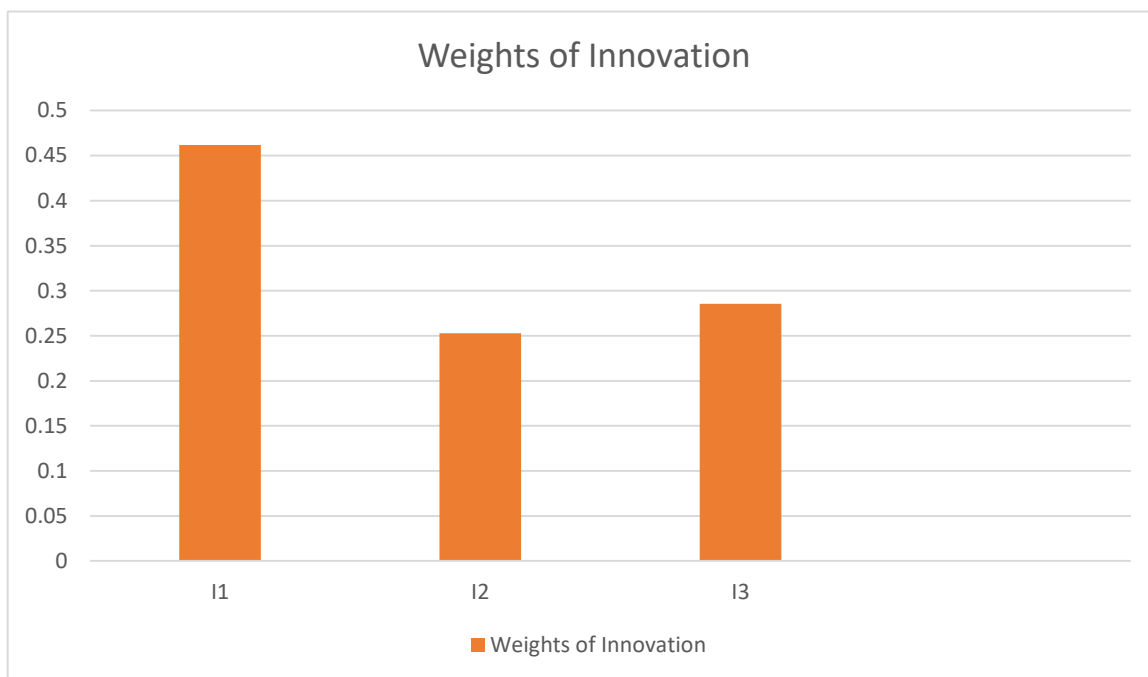


Fig 5. Weights of Innovation.

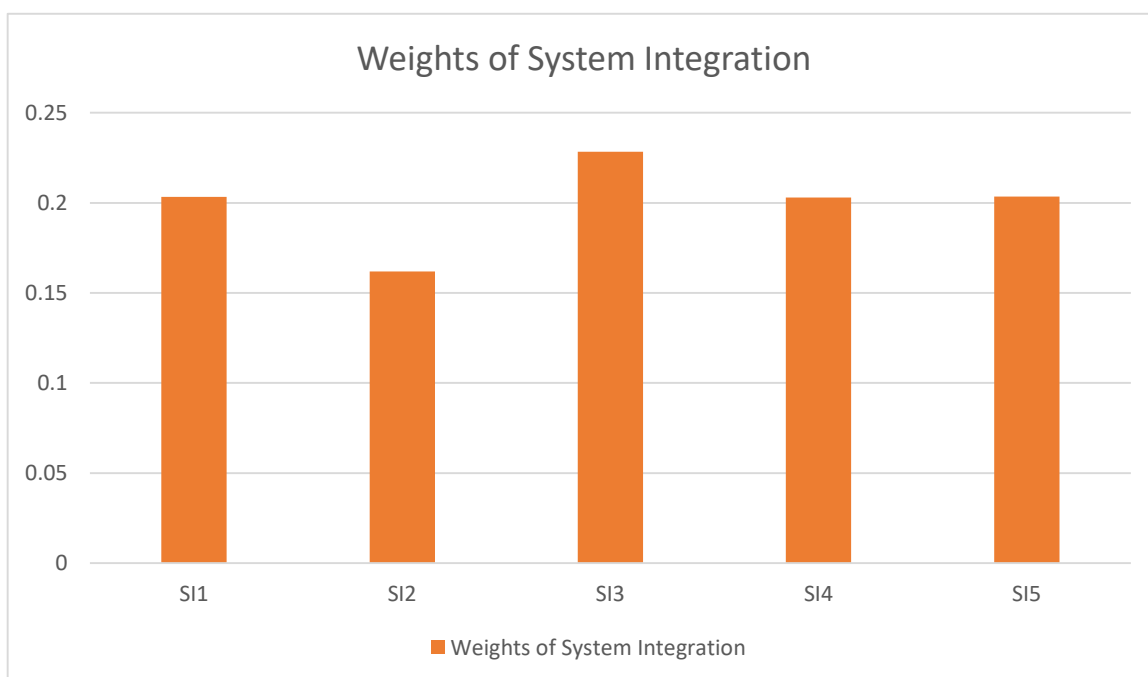


Fig 6. Weights of System Integration.



Fig 7. Weights of Management.

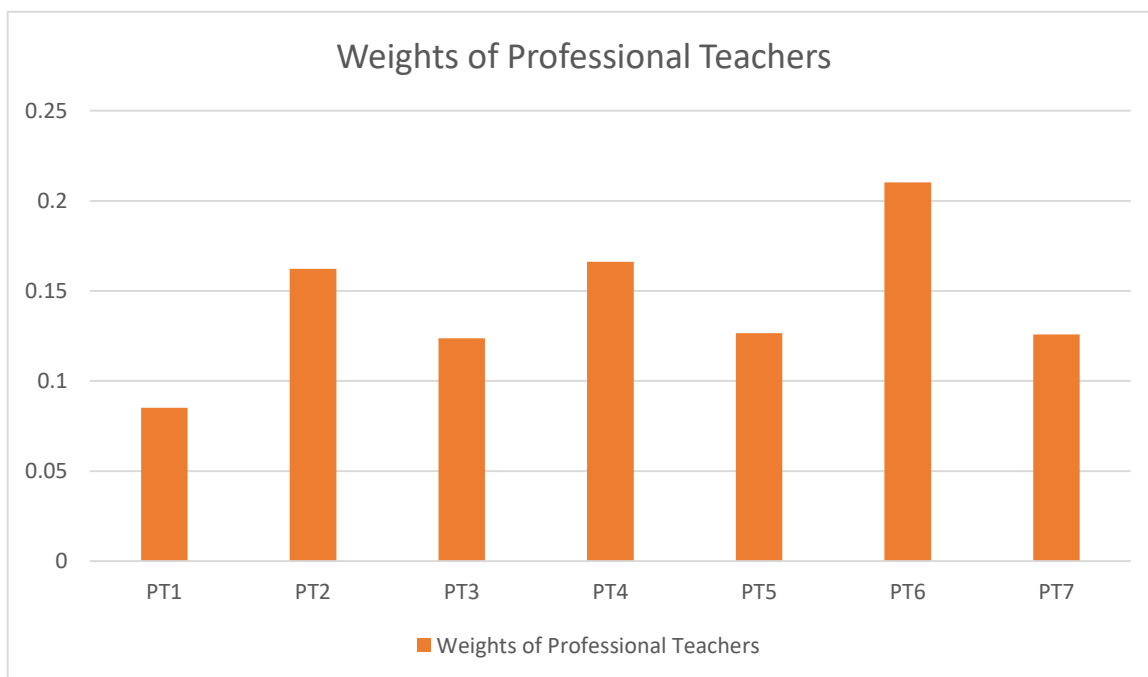


Fig 8. Weights of professional Teachers.

Table 4. Pairwise matrix for Student's Learning

	SL <sub>1</sub>	SL <sub>2</sub>	SL <sub>3</sub>	SL <sub>4</sub>	Sum
<b>DM1</b>	0.283	0.9	0.9	0.8167	2.8997
<b>DM2</b>	0.283	0.283	0.383	0.8167	1.7657
<b>DM3</b>	0.8167	0.8167	0.283	0.9	2.8164
<b>DM1</b>	0.097596	0.310377	0.310377	0.28165	
<b>DM2</b>	0.160276	0.160276	0.216911	0.462536	
<b>DM3</b>	0.28998	0.28998	0.100483	0.319557	
<b>Mean</b>	0.182618	0.253544	0.209257	0.354581	

Table 5. Pairwise matrix for Innovation

	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	Sum
<b>DM1</b>	0.8167	0.383	0.9	2.0997
<b>DM2</b>	0.8167	0.8167	0.5	2.1334
<b>DM3</b>	0.9	0.283	0.283	1.466
<b>DM1</b>	0.38896	0.182407	0.428633	
<b>DM2</b>	0.382816	0.382816	0.234368	
<b>DM3</b>	0.613915	0.193042	0.193042	
<b>Mean</b>	0.461897	0.252755	0.285348	

Table 6. Pairwise matrix for System Integration

	SI <sub>1</sub>	SI <sub>2</sub>	SI <sub>3</sub>	SI <sub>4</sub>	SI <sub>5</sub>	Sum
<b>DM1</b>	0.9	0.283	0.5	0.9	0.8167	3.3997

<b>DM2</b>	0.8167	0.9	0.9	0.283	0.283	3.1827
<b>DM3</b>	0.283	0.383	0.8167	0.8167	0.9	3.1994
<b>DM1</b>	0.264729	0.083243	0.147072	0.264729	0.240227	
<b>DM2</b>	0.256606	0.282779	0.282779	0.088918	0.088918	
<b>DM3</b>	0.088454	0.11971	0.255267	0.255267	0.281303	
<b>Mean</b>	0.203263	0.16191	0.228372	0.202971	0.203483	

Table 7. Pairwise matrix for Management

	<b>M<sub>1</sub></b>	<b>M<sub>2</sub></b>	<b>M<sub>3</sub></b>	<b>Sum</b>
<b>DM1</b>	0.9	0.283	0.383	1.566
<b>DM2</b>	0.8167	0.5	0.8167	2.1334
<b>DM3</b>	0.283	0.283	0.9	1.466
<b>DM1</b>	0.574713	0.180715	0.244572	
<b>DM2</b>	0.382816	0.234368	0.382816	
<b>DM3</b>	0.193042	0.193042	0.613915	
<b>Mean</b>	0.383524	0.202708	0.413768	

Table 8. Pairwise matrix for Professional Teachers

	<b>PT<sub>1</sub></b>	<b>PT<sub>2</sub></b>	<b>PT<sub>3</sub></b>	<b>PT<sub>4</sub></b>	<b>PT<sub>5</sub></b>	<b>PT<sub>6</sub></b>	<b>PT<sub>7</sub></b>	<b>Sum</b>
<b>DM1</b>	0.383	0.8167	0.383	0.8167	0.9	0.8167	0.283	4.3991
<b>DM2</b>	0.283	0.8167	0.283	0.383	0.383	0.9	0.383	3.4317
<b>DM3</b>	0.383	0.283	0.9	0.9	0.283	0.8167	0.9	4.4657

<b>DM1</b>	0.087063	0.185652	0.087063	0.185652	0.204587	0.185652	0.064331	
<b>DM2</b>	0.082466	0.237987	0.082466	0.111606	0.111606	0.262261	0.111606	
<b>DM3</b>	0.085765	0.063372	0.201536	0.201536	0.063372	0.182883	0.201536	
<b>Mean</b>	0.085098	0.162337	0.123689	0.166265	0.126522	0.210265	0.125825	

Then compute the weights of global criteria by multiplying weights of main criteria by weights of sub-criteria. Table 9 presented the values of weights sub-criteria.

Table 9. Global weights for sub criteria.

	<b>Weights</b>
<b>SL<sub>1</sub></b>	0.038017
<b>SL<sub>2</sub></b>	0.052783
<b>SL<sub>3</sub></b>	0.043563
<b>SL<sub>4</sub></b>	0.073816
<b>I<sub>1</sub></b>	0.104067
<b>I<sub>2</sub></b>	0.056947
<b>I<sub>3</sub></b>	0.06429
<b>SI<sub>1</sub></b>	0.029565
<b>SI<sub>2</sub></b>	0.023551
<b>SI<sub>3</sub></b>	0.033218
<b>SI<sub>4</sub></b>	0.029523
<b>SI<sub>5</sub></b>	0.029597
<b>M<sub>1</sub></b>	0.061599
<b>M<sub>2</sub></b>	0.032558
<b>M<sub>3</sub></b>	0.066457
<b>PT<sub>1</sub></b>	0.022164



<b>PT<sub>2</sub></b>	0.042281
<b>PT<sub>3</sub></b>	0.032215
<b>PT<sub>4</sub></b>	0.043304
<b>PT<sub>5</sub></b>	0.032953
<b>PT<sub>6</sub></b>	0.054764
<b>PT<sub>7</sub></b>	0.032771

Then rank six alternatives according to values of the MARCOS method. First, build the three initial matrices that contain the opinions of three matrices with the first row presents the cost ideal solution, and the last row presents the ideal benefit solution. Table 10-12 presented the opinions of three experts. Then combined three decision matrices into one matrix in Table 13. Then normalize the decision matrix in Table 14. Then compute the weighted normalized decision matrix in Table 15. Then compute the utility degree and function utility in Table 16. Then rank alternatives according to the highest value in function utility in Table 16. Fig 9 presented rank of alternatives. The classroom is the highest rank, and CD-ROM is the lowest rank. Values in Table 10-12 obtained through Eq. (10). Column A and B refers to the cost and ideal solution as mentioned in step 2. And all criteria are benefit.

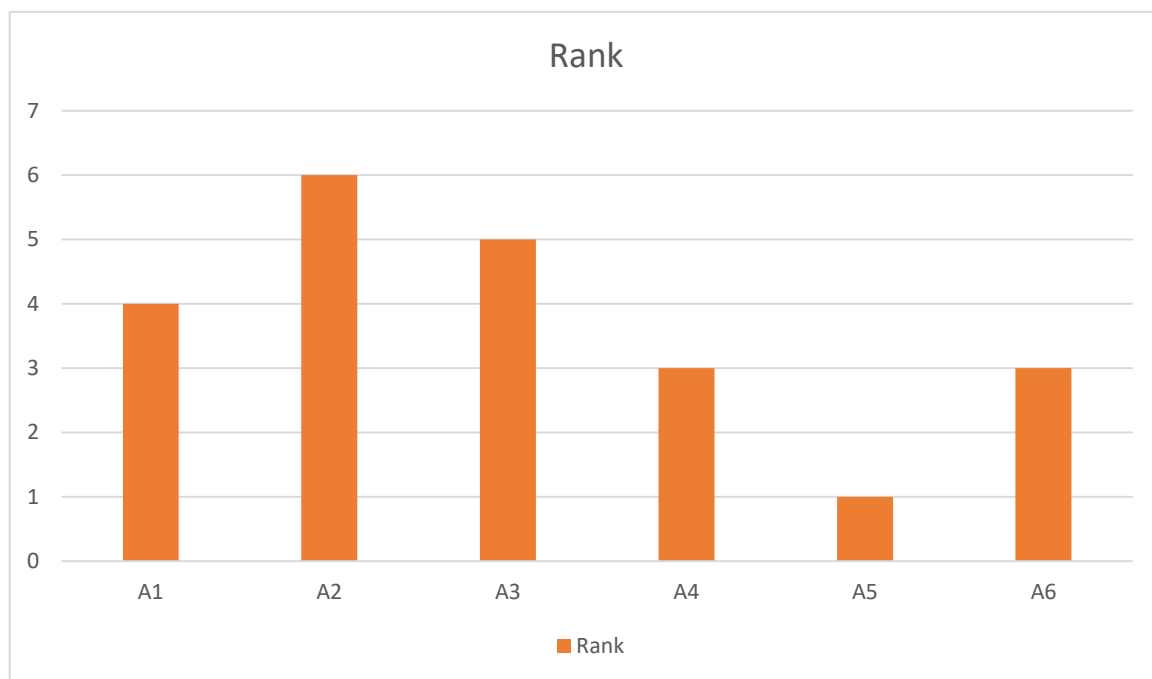


Fig 9. Rank alternatives

Table 10. The initial decision matrix by first expert

	A5	A4	A3	A2	A1	A	DMI
	0.383	0.8167	0.8167	0.5	0.283	0.283	SL <sub>1</sub>
	0.5	0.9	0.5	0.9	0.383	0.383	SL <sub>2</sub>
	0.283	0.8167	0.8167	0.9	0.5	0.283	SL <sub>3</sub>
	0.5	0.9	0.383	0.283	0.8167	0.283	SL <sub>4</sub>
	0.5	0.283	0.9	0.9	0.8167	0.283	I <sub>1</sub>
	0.9	0.9	0.8167	0.8167	0.9	0.283	I <sub>2</sub>
	0.283	0.283	0.8167	0.8167	0.9	0.283	I <sub>3</sub>
	0.283	0.5	0.5	0.9	0.8167	0.283	SI <sub>1</sub>
	0.383	0.8167	0.8167	0.9	0.283	0.283	SI <sub>2</sub>
	0.5	0.283	0.383	0.9	0.383	0.283	SI <sub>3</sub>
	0.8167	0.5	0.9	0.9	0.8167	0.283	SI <sub>4</sub>
	0.383	0.283	0.9	0.5	0.5	0.283	SI <sub>5</sub>
	0.8167	0.8167	0.5	0.5	0.9	0.5	M <sub>1</sub>
	0.5	0.383	0.283	0.383	0.283	0.283	M <sub>2</sub>
	0.5	0.283	0.8167	0.9	0.9	0.283	M <sub>3</sub>
	0.9	0.8167	0.8167	0.283	0.383	0.283	PT <sub>1</sub>
	0.5	0.383	0.283	0.8167	0.5	0.283	PT <sub>2</sub>
	0.8167	0.5	0.9	0.8167	0.9	0.283	PT <sub>3</sub>
	0.8167	0.5	0.9	0.283	0.383	0.283	PT <sub>4</sub>
	0.283	0.8167	0.9	0.8167	0.5	0.283	PT <sub>5</sub>
	0.283	0.9	0.8167	0.5	0.8167	0.283	PT <sub>6</sub>
	0.9	0.9	0.5	0.5	0.8167	0.283	PT <sub>7</sub>

B	A6
0.8167	0.283
0.9	0.383
0.9	0.383
0.9	0.5
0.9	0.9
0.9	0.283
0.9	0.383
0.9	0.383
0.9	0.283
0.9	0.383
0.9	0.283
0.9	0.5
0.9	0.8167
0.5	0.5
0.9	0.283
0.9	0.5
0.9	0.9
0.9	0.283
0.9	0.283
0.9	0.5
0.9	0.383
0.9	0.283

Table 11. The initial decision matrix by second expert

B	A6	A5	A4	A3	A2	A1	A	DM2
0.9	0.283	0.283	0.5	0.9	0.5	0.9	0.283	SL <sub>1</sub>
0.8167	0.8167	0.5	0.5	0.5	0.8167	0.8167	0.5	SL <sub>2</sub>
0.9	0.9	0.283	0.8167	0.5	0.8167	0.8167	0.283	SL <sub>3</sub>
0.9	0.9	0.5	0.9	0.5	0.283	0.5	0.283	SL <sub>4</sub>
0.9	0.8167	0.5	0.283	0.5	0.9	0.283	0.283	I <sub>1</sub>
0.9	0.5	0.9	0.9	0.283	0.8167	0.5	0.283	I <sub>2</sub>
0.9	0.9	0.283	0.283	0.8167	0.8167	0.383	0.283	I <sub>3</sub>
0.9	0.9	0.283	0.283	0.5	0.9	0.5	0.283	SI <sub>1</sub>
0.9	0.9	0.383	0.8167	0.8167	0.9	0.8167	0.383	SI <sub>2</sub>
0.9	0.283	0.5	0.283	0.5	0.9	0.8167	0.283	SI <sub>3</sub>
0.9	0.5	0.8167	0.5	0.8167	0.9	0.9	0.5	SI <sub>4</sub>
0.9	0.8167	0.383	0.283	0.9	0.5	0.8167	0.283	SI <sub>5</sub>
0.8167	0.283	0.8167	0.5	0.8167	0.5	0.5	0.283	M <sub>1</sub>
0.9	0.9	0.5	0.383	0.283	0.383	0.5	0.283	M <sub>2</sub>
0.8167	0.383	0.5	0.283	0.8167	0.5	0.8167	0.283	M <sub>3</sub>
0.9	0.383	0.9	0.8167	0.9	0.283	0.8167	0.283	PT <sub>1</sub>
0.9	0.8167	0.5	0.383	0.283	0.8167	0.9	0.283	PT <sub>2</sub>
0.9	0.5	0.8167	0.5	0.9	0.5	0.8167	0.5	PT <sub>3</sub>
0.9	0.283	0.5	0.5	0.9	0.283	0.5	0.283	PT <sub>4</sub>
0.9	0.5	0.283	0.8167	0.9	0.8167	0.5	0.283	PT <sub>5</sub>
0.9	0.383	0.5	0.9	0.8167	0.5	0.5	0.383	PT <sub>6</sub>
0.9	0.5	0.9	0.9	0.5	0.9	0.5	0.5	PT <sub>7</sub>

Table 12. The initial decision matrix by third expert

B	A6	A5	A4	A3	A2	A1	A	DM3
0.9	0.383	0.283	0.5	0.9	0.283	0.8167	0.283	SL <sub>1</sub>
0.8167	0.383	0.5	0.5	0.5	0.8167	0.283	0.283	SL <sub>2</sub>
0.9	0.283	0.283	0.8167	0.9	0.8167	0.5	0.283	SL <sub>3</sub>
0.9	0.383	0.5	0.9	0.9	0.283	0.9	0.283	SL <sub>4</sub>
0.9	0.283	0.5	0.283	0.8167	0.9	0.383	0.283	I <sub>1</sub>
0.9	0.383	0.9	0.8167	0.283	0.8167	0.9	0.283	I <sub>2</sub>
0.8167	0.5	0.283	0.283	0.5	0.8167	0.283	0.283	I <sub>3</sub>
0.9	0.5	0.283	0.283	0.5	0.9	0.8167	0.283	SI <sub>1</sub>
0.9	0.5	0.383	0.8167	0.8167	0.9	0.5	0.383	SI <sub>2</sub>
0.9	0.5	0.5	0.283	0.5	0.9	0.8167	0.283	SI <sub>3</sub>
0.9	0.5	0.8167	0.5	0.9	0.9	0.8167	0.5	SI <sub>4</sub>
0.9	0.9	0.383	0.283	0.9	0.5	0.9	0.283	SI <sub>5</sub>
0.8167	0.283	0.8167	0.5	0.383	0.5	0.283	0.283	M <sub>1</sub>
0.8167	0.383	0.5	0.383	0.283	0.383	0.8167	0.283	M <sub>2</sub>
0.9	0.283	0.5	0.5	0.8167	0.5	0.9	0.283	M <sub>3</sub>
0.9	0.283	0.9	0.8167	0.9	0.283	0.9	0.283	PT <sub>1</sub>
0.8167	0.5	0.5	0.383	0.283	0.5	0.8167	0.283	PT <sub>2</sub>
0.9	0.8167	0.8167	0.5	0.9	0.5	0.9	0.5	PT <sub>3</sub>
0.9	0.383	0.5	0.5	0.283	0.283	0.9	0.283	PT <sub>4</sub>
0.8167	0.8167	0.283	0.8167	0.283	0.8167	0.383	0.283	PT <sub>5</sub>
0.9	0.8167	0.5	0.9	0.9	0.5	0.8167	0.5	PT <sub>6</sub>
0.9	0.383	0.9	0.283	0.5	0.9	0.8167	0.283	PT <sub>7</sub>

Table 13. The Combined decision matrix.

B	A6	A5	A4	A3	A2	A1	A	
0.872233	0.316333	0.316333	0.605567	0.872233	0.427667	0.666567	0.283	SL <sub>1</sub>
0.844467	0.527567	0.5	0.633333	0.5	0.844467	0.494233	0.388667	SL <sub>2</sub>
0.9	0.522	0.283	0.8167	0.7389	0.844467	0.605567	0.283	SL <sub>3</sub>
0.9	0.594333	0.5	0.9	0.594333	0.283	0.7389	0.283	SL <sub>4</sub>
0.9	0.666567	0.5	0.283	0.7389	0.9	0.494233	0.283	I <sub>1</sub>
0.9	0.388667	0.9	0.872233	0.4609	0.8167	0.766667	0.283	I <sub>2</sub>
0.872233	0.594333	0.283	0.283	0.711133	0.8167	0.522	0.283	I <sub>3</sub>
0.9	0.594333	0.283	0.355333	0.5	0.9	0.711133	0.283	SI <sub>1</sub>
0.9	0.561	0.383	0.8167	0.8167	0.9	0.533233	0.349667	SI <sub>2</sub>
0.9	0.388667	0.5	0.283	0.461	0.9	0.672133	0.283	SI <sub>3</sub>
0.9	0.427667	0.8167	0.5	0.872233	0.9	0.844467	0.427667	SI <sub>4</sub>
0.9	0.7389	0.383	0.283	0.9	0.5	0.7389	0.283	SI <sub>5</sub>
0.844467	0.4609	0.8167	0.605567	0.566567	0.5	0.561	0.355333	M <sub>1</sub>
0.7389	0.594333	0.5	0.383	0.283	0.383	0.533233	0.283	M <sub>2</sub>
0.872233	0.316333	0.5	0.355333	0.8167	0.633333	0.872233	0.283	M <sub>3</sub>
0.9	0.388667	0.9	0.8167	0.872233	0.283	0.6999	0.283	PT <sub>1</sub>
0.872233	0.7389	0.5	0.383	0.283	0.711133	0.7389	0.283	PT <sub>2</sub>
0.9	0.533233	0.8167	0.5	0.9	0.605567	0.872233	0.427667	PT <sub>3</sub>
0.9	0.316333	0.605567	0.5	0.694333	0.283	0.594333	0.283	PT <sub>4</sub>
0.872233	0.605567	0.283	0.8167	0.694333	0.8167	0.461	0.283	PT <sub>5</sub>
0.9	0.527567	0.427667	0.9	0.844467	0.5	0.711133	0.388667	PT <sub>6</sub>
0.9	0.388667	0.9	0.694333	0.5	0.766667	0.711133	0.355333	PT <sub>7</sub>

Table 14. The Normalized decision matrix.

SL <sub>1</sub>
SL <sub>2</sub>
SL <sub>3</sub>
SL <sub>4</sub>
I <sub>1</sub>
I <sub>2</sub>
I <sub>3</sub>
SI <sub>1</sub>
SI <sub>2</sub>
SI <sub>3</sub>
SI <sub>4</sub>
SI <sub>5</sub>
M <sub>1</sub>
M <sub>2</sub>
M <sub>3</sub>
PT <sub>1</sub>
PT <sub>2</sub>
PT <sub>3</sub>
PT <sub>4</sub>
PT <sub>5</sub>
PT <sub>6</sub>
PT <sub>7</sub>

B	A6	A5	A4	A3	A2	A1	A
1	0.362671	0.362671	0.694271	1	0.490312	0.764207	0.324454
1	0.624734	0.59209	0.74998	0.59209	1	0.585261	0.460251
1	0.58	0.314444	0.907444	0.821	0.938296	0.672852	0.314444
1	0.66037	0.555556	1	0.66037	0.314444	0.821	0.314444
1	0.74063	0.555556	0.314444	0.821	1	0.549148	0.314444
1	0.431852	1	0.969148	0.512111	0.907444	0.851852	0.314444
1	0.681393	0.324454	0.324454	0.815302	0.936332	0.598464	0.324454
1	0.66037	0.314444	0.394815	0.555556	1	0.790148	0.314444
1	0.623333	0.425556	0.907444	0.907444	1	0.592481	0.388519
1	0.431852	0.555556	0.314444	0.512222	1	0.746815	0.314444
1	0.475185	0.907444	0.555556	0.969148	1	0.938296	0.475185
1	0.821	0.425556	0.314444	1	0.555556	0.821	0.314444
1	0.545788	0.967119	0.7171	0.670917	0.59209	0.664325	0.420778
1	0.804349	0.676682	0.518338	0.383002	0.518338	0.721658	0.383002
1	0.362671	0.573241	0.407383	0.936332	0.726105	1	0.324454
1	0.431852	1	0.907444	0.969148	0.314444	0.777667	0.314444
1	0.847136	0.573241	0.439103	0.324454	0.815302	0.847136	0.324454
1	0.592481	0.907444	0.555556	1	0.672852	0.969148	0.475185
1	0.351481	0.672852	0.555556	0.771481	0.314444	0.66037	0.314444
1	0.694271	0.324454	0.936332	0.796041	0.936332	0.528528	0.324454
1	0.586185	0.475185	1	0.938296	0.555556	0.790148	0.431852
1	0.431852	1	0.771481	0.555556	0.851852	0.790148	0.394815

Table 15. The weighted normalized decision matrix.

A	SL <sub>1</sub>	SL <sub>2</sub>	SL <sub>3</sub>	SL <sub>4</sub>	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	SI <sub>1</sub>	SI <sub>2</sub>	SI <sub>3</sub>	SI <sub>4</sub>	SI <sub>5</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	PT <sub>1</sub>	PT <sub>2</sub>	PT <sub>3</sub>	PT <sub>4</sub>	PT <sub>5</sub>	PT <sub>6</sub>	PT <sub>7</sub>	
0.012335																							
0.024293																							
0.013698																							
0.023211																							
0.032723																							
0.017907																							
0.020859																							
0.009297																							
0.00915																							
0.010445																							
0.014029																							
0.009307																							
0.02592																							
0.01247																							
0.021562																							
0.006969																							
0.013718																							
0.015308																							
0.013617																							
0.010692																							
0.02365																							
0.012938																							

	A1	A2	A3	A4	A5	A6	A5	A4	A3	A2	A1
B	0.038017	0.013788	0.032975	0.025266	0.048746	0.077075	0.057815	0.032723	0.085439	0.104067	0.057148
	0.038017	0.01864	0.038017	0.026394	0.013788	0.013788	0.056947	0.026394	0.038017	0.01864	0.029053
	0.052783	0.052783	0.031252	0.039586	0.031252	0.032975	0.020859	0.039586	0.031252	0.052783	0.030892
	0.043563	0.040875	0.035765	0.039531	0.013698	0.025266	0.056947	0.039531	0.035765	0.040875	0.029311
	0.073816	0.023211	0.048746	0.073816	0.041009	0.048746	0.020859	0.073816	0.048746	0.023211	0.060603
	0.104067	0.104067	0.085439	0.032723	0.057815	0.077075	0.056947	0.032723	0.085439	0.104067	0.057148
	0.056947	0.051676	0.029163	0.05519	0.056947	0.024593	0.056947	0.05519	0.029163	0.051676	0.04851
	0.06429	0.060197	0.052416	0.020859	0.020859	0.043807	0.020859	0.020859	0.052416	0.060197	0.038475
	0.029565	0.029565	0.016425	0.011673	0.009297	0.019524	0.009297	0.011673	0.016425	0.029565	0.023361
	0.023551	0.023551	0.021371	0.021371	0.010022	0.01468	0.010022	0.021371	0.021371	0.023551	0.013953
	0.033218	0.033218	0.017015	0.010445	0.018454	0.014345	0.018454	0.010445	0.017015	0.033218	0.024807
	0.029523	0.029523	0.028612	0.016402	0.026791	0.014029	0.026791	0.016402	0.028612	0.029523	0.027701
	0.029597	0.016443	0.029597	0.009307	0.012595	0.024299	0.012595	0.009307	0.029597	0.016443	0.024299
	0.061599	0.036472	0.041328	0.044173	0.059574	0.03362	0.059574	0.044173	0.041328	0.036472	0.040922
	0.032558	0.016876	0.01247	0.016876	0.022031	0.026188	0.022031	0.016876	0.01247	0.016876	0.023496
	0.0666457	0.048255	0.062226	0.027073	0.038096	0.024102	0.038096	0.027073	0.062226	0.048255	0.0666457
	0.022164	0.006969	0.02148	0.020112	0.022164	0.009571	0.022164	0.020112	0.02148	0.006969	0.017236
	0.042281	0.034471	0.013718	0.018566	0.024237	0.035817	0.024237	0.018566	0.013718	0.034471	0.035817
	0.032215	0.021676	0.032215	0.017897	0.029233	0.019087	0.029233	0.017897	0.032215	0.021676	0.031221
	0.043304	0.013617	0.033408	0.024058	0.029137	0.01522	0.029137	0.024058	0.033408	0.013617	0.028596
	0.032953	0.030855	0.026232	0.030855	0.010692	0.022878	0.010692	0.030855	0.026232	0.030855	0.017416
	0.054764	0.030424	0.051384	0.054764	0.026023	0.032102	0.026023	0.054764	0.051384	0.030424	0.043271
	0.032771	0.027916	0.018206	0.025282	0.032771	0.014152	0.032771	0.025282	0.018206	0.027916	0.025894

Table 16. Utility, function utility and rank alternatives.

	$L_x$	$H_x^+$	$H_x^-$	$f(H_x^+)$	$f(H_x^-)$	$f(H_x)$	Rank
A	0.354097						
A1	0.738442	0.738442	2.085423	0.7385	0.2615	0.675859	3
A2	0.751279	0.751279	2.121677	0.7385	0.2615	0.687609	1
A3	0.746485	0.746485	2.108137	0.7385	0.2615	0.683221	2
A4	0.636951	0.636951	1.798806	0.7385	0.2615	0.58297	4

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A5	0.606483	0.606483	0.354097	0.368628	0.631372	0.291384	6
A6	0.585865	0.585865	1.654533	0.7385	0.2615	0.536213	5
B	1						

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#### 4. Conclusions

This paper introduces assessment ETS through an MCDM method. A new method is an extension of SVNSSs called MARCOS. The main idea of this method proposed a relationship between alternatives and cost, benefit ideal solutions. Also, MARCOS is used for computing utility degree and function utility degree for cost and benefit ideal solution. Then rank alternatives through the highest value of function utility degree. ETS was proposed through the MARCOS method with six alternatives, five main criteria and twenty-two sub-criteria. Three experts and decision-makers who have experience in this area evaluated criteria and alternatives. In this paper, the weights of criteria and rank of alternatives were determined.

From the outcome, professional teachers are the highest, and system integration is the lowest. While in alternatives, the CD-ROM is the lowest in alternatives, and the classroom is the highest in alternatives. MARCOS method is an effective tool for dealing with uncertain information.

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