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Research article

Simulation of TOPSIS calculation in Discrepancy-*Tat Twam Asi* evaluation model

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ABSTRACT

This research's main objective was to provide information related to the simulation of each calculation stage of the TOPSIS method used in the Discrepancy-*Tat Twam Asi* evaluation model. The TOPSIS method is used to find dominant indicators in the Discrepancy-*Tat Twam Asi* evaluation model that determines the effectiveness of blended learning in ICT Vocational Schools. This research used a quantitative approach. The questionnaires were used as a data collection tool in this study. Questionnaires were distributed to 20 respondents (teachers and students at several ICT Vocational Schools in Bali, Indonesia) for initial data needs and distributed to fourexperts to obtain data on the TOPSIS calculation effectiveness results. The analysis technique in this research was carried out by comparing the percentage of effectiveness test results with the standards. The results of this research showed that the simulation of TOPSIS method calculation in the Discrepancy-*Tat Twam Asi* evaluation model had run more effectively, as indicated by score was 93.13%. The simulation results showed the dominant indicator that determines the effectiveness of the blended learning implementation was I-2 (the existence of academic community support).

1. Introduction

The utilization of blended learning as a learning model at the vocational school level can be said to run optimally if its implementation's has been categorized well based on the percentage effectiveness of the five scales [1]. There are several main aspects to determine the effectiveness of blended learning implementation in vocational schools, such as the availability of legal regulations, the availability of funds, the availability of human resources, and the availability of facilities to implement blended learning [2]. Even though those main aspects have been fulfilled, the facts show that there are still many vocational schools (especially vocational schools of IT) in Bali that have not implemented blended learning optimally. This is because it is unknown certainty the dominant indicator that causes the effectiveness of blended learning implementation. Therefore, further evaluation is needed to determine the dominant indicator. Efforts can be made to determine that the dominant indicator applying the MCDM (Multi-Criteria Decision Making) approach. MCDM is a decision-making approach to determine the best alternative from several alternatives based on specific criteria [3, 4]. There are dozens of decision-making methods that refer to the MCDM approach, included: AHP (Analytical Hierarchy Process), ELECTRE (Elimination and Et Choice Translating Reality), PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation), TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), and so on [5].

Based on those several methods, one of the suitable methods to obtain the dominant indicator that determines the blended learning effectiveness is TOPSIS. TOPSIS can choose the best alternative

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from several existing options by guaranteeing the alternative's proximity with the benefit attribute and keeping it away from the cost attribute [6]. However, in reality, not all of the best choices can always be near the benefit attribute because it is influenced by the diversity of weight values from decision-makers [7]. Therefore it is necessary to modify the weighting process to produce balanced weight values among decision-makers.

Another problem is the imbalance of the effectiveness score of the blended learning implementation's with the determined effectiveness standards previously. Therefore it is also necessary to conduct an in-depth evaluation by utilizing one of the educational evaluation models called the Discrepancy model.

Based on the problems related to the weight values from decision-makers and the inequality of the effectiveness score, it is necessary to have an innovation in an appropriate evaluation model. In general, the evaluation model expected is the model that finds a dominant indicator as a determinant of the effectiveness of the blended learning implementation from several indicators of the causes of inequality.

The intended evaluation model is the Discrepancy-*Tat Twam Asi* model, which is integrated with the TOPSIS method calculations to obtain the dominant indicator determining blended learning effectiveness. The Discrepancy-*Tat Twam Asi* model is a combination of the educational evaluation model (Discrepancy) with one of the Balinese local wisdom concepts (*Tat Twam Asi*).The Discrepancy model is one of the evaluation models that provide recommendations based on gaps found from the evaluation results that are compared to established evaluation standards [8, 9, 10, 11]. *Tat Twam Asi* is a concept of the Balinese people's local wisdom that shows the existence of tolerance, equal rights, or the same authority among human beings to create harmony [12, 13, 14]. Therefore, the *Tat Twam Asi* concept is very proper to be used to determine the level of weight equality given by each expert in supporting the accurate process of calculating the TOPSIS method.

TOPSIS is a decision support system method that principle determines recommendations based on the relative closeness between the optimal solutions of an alternative by attention to the farthest distance from a negative ideal solution and the shortest distance from a positive ideal solution [15, 16].

The Discrepancy-*Tat Twam Asi* evaluation model requires the TOPSIS method in the calculation process to determine the dominant indicator of the blended learning effectiveness. Likewise, the TOPSIS method requires the *Tat Twam Asi* concept to assess the uniformity of the weights of decision-makers so that the preference score for each indicator shows more accurate values.

The TOPSIS calculation has seven stages, included: 1) determining the initial data that evaluated, 2) calculating the matrix normalization, 3) calculating the weighted normalized decision matrix, 4) determining the positive ideal solutions and negative ideal solutions, 5) calculating the distance measures between the target alternative-i and the worst condition A- and also the distance measures between the target alternative-i and the best condition A+, 6) Calculating the similarity to the worst condition (or termed the preference scores for each alternative), and 7) ranking of other options [5, 17, 18, 19, 20, 21].

Based on that innovation, it is specifically necessary to further research related to the simulation of the TOPSIS calculation method that is used in the Discrepancy-*Tat Twam Asi* evaluation model to determine the dominant indicators of the blended learning effectiveness. This research question: how is the TOPSIS method calculation simulation used in the Discrepancy-*Tat Twam Asi* evaluation model?

Based on that research question, it was clearly stated that the purpose of this study was to simulate each stage in the TOPSIS method calculations used in the Discrepancy-*Tat Twam Asi* evaluation model.

This research was motivated by the results of research, research findings, and limitations of previous studies. The research was conducted in 2018 by Mohammed, Kasim, and Shaharanee [22] showed the use of TOPSIS and AHP techniques to evaluate the implementation of e-learning. In principle, Mohammed, Kasim, and Shaharanee's research has similarities with this research in terms of the use of decision support methods to evaluate ICT-based learning models. However, the difference lies in the evaluation technique used, which in this research used a combination of the Discrepancy-*Tat Twam Asi* model with the TOPSIS technique. In the research of Mohammed, Kasim, and Shaharanee used a combination of the TOPSIS and AHP techniques. The limitation of Mohammed, Kasim, and

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Shaharanee's research was not yet showed the detailed stages of the TOPSIS and AHP calculations to get the evaluation results. The research was conducted in 2018 by Fatkhurrochman, Kusrini, and Alfatta [23] showed the evaluation results of the lecturer's performance used the TOPSIS method. The similarity between Mohammed, Kasim, and Shaharanee's research with this research is the calculation of the TOPSIS method is used in the evaluation activities. The difference of this research was it used an educational evaluation model combined with a decision support system method that was used as a basis for evaluating. The analysis of Fatkhurrochman, Kusrini, and Alfatta's research not used an educational evaluation model and only used the TOPSIS calculation method. The research was conducted in 2015 by Meyliana, Hidayanto, and Budiardjo [24] used TOPSIS and Entropy methods to evaluate social media's implementation in providing quality services and information. The limitation of Meyliana, Hidayanto, and Budiardjo's research was it had not yet shown the detailed calculation stage of TOPSIS and Entropy.

Based on this research's purpose, the author was interested in discussing the calculations simulation of the TOPSIS method used in the Discrepancy-*Tat Twam Asi* evaluation model. The things that were simulated refer to the seven stages in the TOPSIS method.

2. Method

This research used a quantitative approach by showing the calculation results of the TOPSIS method was used in the Discrepancy-*Tat Twam Asi* evaluation model. The steps of this research followed the seven calculation stages of the TOPSIS method. At stage 1, the initial data that will be evaluated are determined. The data required at this stage included: inequality score data, weight data from decision-makers, and data needed for the calculations of matrix normalization. At stage 2, the process of matrix normalization calculations is carried out. The formula used to perform the process of normalization calculations is Eq. 1 [25-49]. The results of the normalization calculations are converted into a matrix called matrix-R.

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

Where $i = 1,2,3, \dots m$ and $j = 1,2,3, \dots n$.

r_{ij} is a matrix of the normalized results from a basic matrix. x_{ij} is a basic matrix that will be normalized. i denotes the row of the matrix, and j denotes the column of the matrix.

At stage 3, calculations of the weighted normalized decision matrix. The results of its measures are converted into matrix-Y. Matrix Y is obtained by multiplying the matrix-R elements by the weights of the decision-makers. The formula used to obtain matrix-Y is Eq. 2 [25-49],

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

where y_{ij} is matrix-Y, w_i is Decision-maker weights, and r_{ij} is matrix-R.

At stage 4, the positive ideal solutions and negative ideal solutions are determined. The calculations process of the positive ideal solutions (A^+) is based on Eq. 3 [25-49], while the calculations process of the negative ideal solutions (A^-) is based on Eq. 4 [25-49],

$$A^+ = (y_1^+, y_2^+, \dots, y_n^+) \tag{3}$$

$$A^- = (y_1^-, y_2^-, \dots, y_n^-) \tag{4}$$

where

$$y_j^+ = \begin{cases} \max_i y_{ij}; & \textit{if}\ \text{j is benefit attribute} \\ \min_i y_{ij}; & \text{if j is cost attribute} \end{cases}$$

$$y_j^- = \begin{cases} \min_i y_{ij}; & \textit{if}\ \text{j is benefit attribute} \\ \max_i y_{ij}; & \text{if j is cost attribute} \end{cases}$$

At stage 5, the calculations of the distance measures between the target alternative-*i* and the worst condition A^- (which is symbolized by D_i^-) and the distance measures between the target alternative-*i* and the best condition A^+ (which is symbolized by D_i^+). D_i^+ calculations are based on Eq. 5 [25-49], while D_i^- calculations are based on Eq. 6 [25-49].

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

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

At stage 6, the preference score (V_i) is determined for each alternative. The formula used to obtain a preference score is Eq. 7 [25-49].

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad (7)$$

At stage 7, the ranking of each alternative is determined. The order is determined based on a preference score. The highest preference scores for the top ranking. The lowest preference scores for the lowest ranking.

The technique of initial data collection was conducted by distributing questionnaires to the respondents. Respondents were involved 20 people consisting of teachers and students who used blended learning at several IT vocational schools in Bali. The type of blended learning used in several IT vocational schools in Bali is flipped classrooms based on the Moodle platform.

The calculation results analysis of TOPSIS was done by comparing the effectiveness scores given by the expert with effectiveness standard scores. The effectiveness scores from the expert were obtained through the observation and expert evaluation of the TOPSIS calculation process. There were eight questions on the questionnaires which were used as a reference for evaluating the effectiveness test of TOPSIS calculations in the Discrepancy-*Tat Twam Asi* Model. The eight questions included: 1) questions about the readiness of initial data, 2) questions about the smoothness of the matrix-R determination process, 3) questions about the smoothness of the matrix-Y determination process, 4) questions about the smoothness of the process of determining A^+ and A^-, 5) questions about the smoothness of the D_i^+ and D_i^- determination process, 6) questions about the smoothness of determining preference scores, 7) questions about the smoothness of determining rankings, 8) questions about the accuracy level of the simulation results of the TOPSIS method in the Discrepancy-*Tat Twam Asi* evaluation model to assess indicator dominant.

In detail, the question of item-1 as follows: "Does the initial data available indicate the scores of effectiveness standards, the scores of field effectiveness, and the inequality scores of each evaluation indicator in the blended learning implementation?". Question of item-2: "Has the process of determining the matrix-R been smooth, and it has previously gone through normalization calculations well?". Question of item-3: "Has the process of determining the matrix-Y been smooth and has previously gone through the multiplication calculations between the elements of matrix-R with the uniformity of weights based on the *Tat Twam Asi* concept?". Question of item-4: "Is the process of determining the A^+ and A^- doing by smoothly and suitable with the formula is used?". Question of item-5: "Is the process of determining the D_i^+ and D_i^- doing by smoothly and suitable with the formula is used?". Question of item-6: "Is the determination of preference scores for each indicator doing by smoothly and suitable with the formula is used?". Question of item-7: "Has the ranking process been doing by smoothly and got the right decision?". Question of item-8: "Does the simulation calculations of the TOPSIS method in the Discrepancy-*Tat Twam Asi* evaluation model show accurate calculation results?".

Table 1. Scores of effectiveness standard

Scores	Category of Effectiveness
90-100	Very Effective
80-89	Effective
65-79	Enough
55-64	Less
0-54	Ineffective

The effectiveness scores from the experts can be calculated using Eq. 8 [50]. The effectiveness standard scores can be seen in Table 1 [51, 52].

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$$Effectiveness = \frac{f}{N} \times 100\% \quad (8)$$

where f is number of scores was obtained and N is maximum number of scores.

3. Results and Discussion

This research results, following the steps previously mentioned in the research method. There were seven stages in the TOPSIS calculations process used in the Discrepancy-*Tat Twam Asi* evaluation model. That is explained in full as follows.

3.1. Preliminary data

Some preliminary data were obtained in this research, such as data of inequality scores, decision-makers' weights data from experts, and data for calculations of matrix normalization. The data intended can be seen in Table 2 to Table 4.

Table 2. Inequality scores

Indicators	Scores ofEffectiveness Standards	Scores of Field Effectiveness	Inequality Scores
I-1	90	93	3
I-2	85	91	6
I-3	87	90	3
I-4	88	91	3
I-5	88	82	-6
I-6	86	87	1
I-7	87	91	4
I-8	88	89	1
I-9	88	85	-3
I-10	88	89	1
I-11	87	90	3
I-12	90	91	1
I-13	90	91	1
Average		**89.23**	

Table 3. Weights from decision-maker

Indicators	Weights				Average of Weights	Weights Based on *Tat Twam Asi*
	Expert-1	Expert-2	Expert-3	Expert-4		
I-1	4	5	5	4	4.50	0.073
I-2	5	4	5	5	4.75	0.077
I-3	5	4	5	4	4.50	0.073
I-4	4	5	5	5	4.75	0.077
I-5	4	5	4	4	4.25	0.069
I-6	5	4	4	5	4.50	0.073
I-7	4	5	4	4	4.25	0.069
I-8	4	5	5	5	4.75	0.077
I-9	4	4	5	5	4.50	0.073
I-10	5	4	5	5	4.75	0.077
I-11	4	5	5	5	4.75	0.077
I-12	5	5	4	5	4.75	0.077
I-13	5	4	5	4	4.50	0.073
I-14	2	3	2	2	2.25	0.036
Σ					**61.75**	**1.000**

Indicators I-1 until I-13 shown in Table 2 are evaluation indicators that refer to the Discrepancy model.I-1 is an indicator related to the criterion of "the law legality in implementing blended learning". I-2is related to the criteria of "the existence of academic community support". I-3 isrelated to the criteria of "support from parents through school committees". I-4 isrelated to the criteria of "the development team's readiness". I-5 isrelated to the criteria of "the readiness of infrastructures". I-6 isrelated to the criteria of "users competency readiness". I-7 isrelated to the criterion "socialization of the procedure for using blended learning". I-8is related to the criteria "the learning process uses blended learning". I-9 isrelated to the criteria "the physical condition of the classroom and material content in blended learning". I-10 isrelated to the criterion of "the speed of accessing blended learning". I-11 isrelated to the criterion of "the response speed of blended learning platform in the data manipulation". I-12 isrelated to the criteria of "the guarantee of data security in blended learning". I-13 is related to the criteria "the availability of feedback facilities in a blended learning platform". Specifically, for Indicator

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I-14 shown in Table 3 is an indicator related to the "inequality" criteria, which is sourced from the "inequality scores" column in Table 2.

The average weights shown in Table 3 were used to obtain the weighting levels of each expert. The similarity in weighting levels shows that the *Tat Twam Asi* concept has been successfully implemented in the evaluation process.

Table 4. Data for normalized matrix calculations

Indicators	Criteria												
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
I-1	93.00	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	3.00
I-2	89.23	91.00	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	6.00
I-3	89.23	89.23	90.00	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	3.00
I-4	89.23	89.23	89.23	91.00	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	3.00
I-5	89.23	89.23	89.23	89.23	82.00	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	-6.00
I-6	89.23	89.23	89.23	89.23	89.23	87.00	89.23	89.23	89.23	89.23	89.23	89.23	89.23	1.00
I-7	89.23	89.23	89.23	89.23	89.23	89.23	91.00	89.23	89.23	89.23	89.23	89.23	89.23	4.00
I-8	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.00	89.23	89.23	89.23	89.23	89.23	1.00
I-9	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	85.00	89.23	89.23	89.23	89.23	-3.00
I-10	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.00	89.23	89.23	89.23	1.00
I-11	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	90.00	89.23	89.23	3.00
I-12	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	91.00	89.23	1.00
I-13	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	89.23	91.00	1.00

Table 5. Result of normalization matrix calculation

r_{11}	=	0.2881	r_{12}	=	0.2769	r_{13}	=	0.2772	r_{14}	=	0.2769
r_{21}	=	0.2764	r_{22}	=	0.2824	r_{23}	=	0.2772	r_{24}	=	0.2769
r_{31}	=	0.2764	r_{32}	=	0.2769	r_{33}	=	0.2796	r_{34}	=	0.2769
r_{41}	=	0.2764	r_{42}	=	0.2769	r_{43}	=	0.2772	r_{44}	=	0.2824
r_{51}	=	0.2764	r_{52}	=	0.2769	r_{53}	=	0.2772	r_{54}	=	0.2769
r_{61}	=	0.2764	r_{62}	=	0.2769	r_{63}	=	0.2772	r_{64}	=	0.2769
r_{71}	=	0.2764	r_{72}	=	0.2769	r_{73}	=	0.2772	r_{74}	=	0.2769
r_{81}	=	0.2764	r_{82}	=	0.2769	r_{83}	=	0.2772	r_{84}	=	0.2769
r_{91}	=	0.2764	r_{92}	=	0.2769	r_{93}	=	0.2772	r_{94}	=	0.2769
r_{101}	=	0.2764	r_{102}	=	0.2769	r_{103}	=	0.2772	r_{104}	=	0.2769
r_{111}	=	0.2764	r_{112}	=	0.2769	r_{113}	=	0.2772	r_{114}	=	0.2769
r_{121}	=	0.2764	r_{122}	=	0.2769	r_{123}	=	0.2772	r_{124}	=	0.2769
r_{131}	=	0.2764	r_{132}	=	0.2769	r_{133}	=	0.2772	r_{134}	=	0.2769
r_{15}	=	0.2790	r_{16}	=	0.2779	r_{17}	=	0.2769	r_{18}	=	0.2774
r_{25}	=	0.2790	r_{26}	=	0.2779	r_{27}	=	0.2769	r_{28}	=	0.2774
r_{35}	=	0.2790	r_{36}	=	0.2779	r_{37}	=	0.2769	r_{38}	=	0.2774
r_{45}	=	0.2790	r_{46}	=	0.2779	r_{47}	=	0.2769	r_{48}	=	0.2774
r_{55}	=	0.2564	r_{56}	=	0.2779	r_{57}	=	0.2769	r_{58}	=	0.2774
r_{65}	=	0.2790	r_{66}	=	0.2709	r_{67}	=	0.2769	r_{68}	=	0.2774
r_{75}	=	0.2790	r_{76}	=	0.2779	r_{77}	=	0.2824	r_{78}	=	0.2774
r_{85}	=	0.2790	r_{86}	=	0.2779	r_{87}	=	0.2769	r_{88}	=	0.2767
r_{95}	=	0.2790	r_{96}	=	0.2779	r_{97}	=	0.2769	r_{98}	=	0.2774
r_{105}	=	0.2790	r_{106}	=	0.2779	r_{107}	=	0.2769	r_{108}	=	0.2774
r_{115}	=	0.2790	r_{116}	=	0.2779	r_{117}	=	0.2769	r_{118}	=	0.2774
r_{125}	=	0.2790	r_{126}	=	0.2779	r_{127}	=	0.2769	r_{128}	=	0.2774
r_{135}	=	0.2790	r_{136}	=	0.2779	r_{137}	=	0.2769	r_{138}	=	0.2774
r_{19}	=	0.2783	r_{110}	=	0.2774	r_{111}	=	0.2772	r_{112}	=	0.2769
r_{29}	=	0.2783	r_{210}	=	0.2774	r_{211}	=	0.2772	r_{212}	=	0.2769
r_{39}	=	0.2783	r_{310}	=	0.2774	r_{311}	=	0.2772	r_{312}	=	0.2769
r_{49}	=	0.2783	r_{410}	=	0.2774	r_{411}	=	0.2772	r_{412}	=	0.2769
r_{59}	=	0.2783	r_{510}	=	0.2774	r_{511}	=	0.2772	r_{512}	=	0.2769
r_{69}	=	0.2783	r_{610}	=	0.2774	r_{611}	=	0.2772	r_{612}	=	0.2769
r_{79}	=	0.2783	r_{710}	=	0.2774	r_{711}	=	0.2772	r_{712}	=	0.2769
r_{89}	=	0.2783	r_{810}	=	0.2774	r_{811}	=	0.2772	r_{812}	=	0.2769
r_{99}	=	0.2651	r_{910}	=	0.2774	r_{911}	=	0.2772	r_{912}	=	0.2769
r_{109}	=	0.2783	r_{1010}	=	0.2767	r_{1011}	=	0.2772	r_{1012}	=	0.2769
r_{119}	=	0.2783	r_{1110}	=	0.2774	r_{1111}	=	0.2796	r_{1112}	=	0.2769
r_{129}	=	0.2783	r_{1210}	=	0.2774	r_{1211}	=	0.2772	r_{1212}	=	0.2824
r_{139}	=	0.2783	r_{1310}	=	0.2774	r_{1311}	=	0.2772	r_{1312}	=	0.2769
r_{113}	=	0.2769	r_{713}	=	0.2769	r_{1313}	=	0.2824	r_{614}	=	0.085
r_{213}	=	0.2769	r_{813}	=	0.2769	r_{114}	=	0.255	r_{714}	=	0.341
r_{313}	=	0.2769	r_{913}	=	0.2769	r_{214}	=	0.511	r_{814}	=	0.085
r_{413}	=	0.2769	r_{1013}	=	0.2769	r_{314}	=	0.255	r_{914}	=	-0.255
r_{513}	=	0.2769	r_{1113}	=	0.2769	r_{414}	=	0.255	r_{1014}	=	0.085
r_{613}	=	0.2769	r_{1213}	=	0.2769	r_{514}	=	-0.511	r_{1114}	=	0.255
									r_{1214}	=	0.085
									r_{1314}	=	0.085

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3.2. Calculations of matrix normalization

Matrix normalization can be calculated using the data in Table 4 and Eq. 1. After knowing the data and its formula, so the matrix normalization calculations can be processed. The calculation results are as Table 5.

3.3. Determination of the Matrix-R

The contents of each Matrix-R element are sourced from the results of matrix normalization calculations that had been obtained previously. The intended matrix-R can be seen in Matrix R.

R=

0.2881	0.2769	0.2772	0.2769	0.2790	0.2779	0.2769	0.2774	0.2783	0.2774	0.2772	0.2769	0.2769	0.255
0.2764	0.2824	0.2772	0.2769	0.2790	0.2779	0.2769	0.2774	0.2783	0.2774	0.2772	0.2769	0.2769	0.511
0.2764	0.2769	0.2796	0.2769	0.2790	0.2779	0.2769	0.2774	0.2783	0.2774	0.2772	0.2769	0.2769	0.255
0.2764	0.2769	0.2772	0.2824	0.2790	0.2779	0.2769	0.2774	0.2783	0.2774	0.2772	0.2769	0.2769	0.255
0.2764	0.2769	0.2772	0.2769	0.2564	0.2779	0.2769	0.2774	0.2783	0.2774	0.2772	0.2769	0.2769	-0.511
0.2764	0.2769	0.2772	0.2769	0.2790	0.2709	0.2769	0.2774	0.2783	0.2774	0.2772	0.2769	0.2769	0.085
0.2764	0.2769	0.2772	0.2769	0.2790	0.2779	0.2824	0.2774	0.2783	0.2774	0.2772	0.2769	0.2769	0.341
0.2764	0.2769	0.2772	0.2769	0.2790	0.2779	0.2769	0.2767	0.2783	0.2774	0.2772	0.2769	0.2769	0.085
0.2764	0.2769	0.2772	0.2769	0.2790	0.2779	0.2769	0.2774	0.2651	0.2774	0.2772	0.2769	0.2769	-0.255
0.2764	0.2769	0.2772	0.2769	0.2790	0.2779	0.2769	0.2774	0.2783	0.2767	0.2772	0.2769	0.2769	0.085
0.2764	0.2769	0.2772	0.2769	0.2790	0.2779	0.2769	0.2774	0.2783	0.2774	0.2796	0.2769	0.2769	0.255
0.2764	0.2769	0.2772	0.2769	0.2790	0.2779	0.2769	0.2774	0.2783	0.2774	0.2772	0.2824	0.2769	0.085
0.2764	0.2769	0.2772	0.2769	0.2790	0.2779	0.2769	0.2774	0.2783	0.2774	0.2772	0.2769	0.2824	0.085

3.4. Determination of the Matrix-Y

Matrix-Y is obtained by multiplying the elements of matrix-R with *Tat Twam Asi* based weights shown earlier in Table 3. The results of the matrix-Y calculations can be seen in Matrix Y.

Y=

0.0210	0.0213	0.0202	0.0213	0.0193	0.0203	0.0191	0.0214	0.0203	0.0214	0.0213	0.0213	0.0202	0.0092
0.0202	0.0217	0.0202	0.0213	0.0193	0.0203	0.0191	0.0214	0.0203	0.0214	0.0213	0.0213	0.0202	0.0184
0.0202	0.0213	0.0204	0.0213	0.0193	0.0203	0.0191	0.0214	0.0203	0.0214	0.0213	0.0213	0.0202	0.0092
0.0202	0.0213	0.0202	0.0217	0.0193	0.0203	0.0191	0.0214	0.0203	0.0214	0.0213	0.0213	0.0202	0.0092
0.0202	0.0213	0.0202	0.0213	0.0177	0.0203	0.0191	0.0214	0.0203	0.0214	0.0213	0.0213	0.0202	-0.0184
0.0202	0.0213	0.0202	0.0213	0.0193	0.0198	0.0191	0.0214	0.0203	0.0214	0.0213	0.0213	0.0202	0.0031
0.0202	0.0213	0.0202	0.0213	0.0193	0.0203	0.0195	0.0214	0.0203	0.0214	0.0213	0.0213	0.0202	0.0123
0.0202	0.0213	0.0202	0.0213	0.0193	0.0203	0.0191	0.0213	0.0203	0.0214	0.0213	0.0213	0.0202	0.0031
0.0202	0.0213	0.0202	0.0213	0.0193	0.0203	0.0191	0.0214	0.0194	0.0214	0.0213	0.0213	0.0202	-0.0092
0.0202	0.0213	0.0202	0.0213	0.0193	0.0203	0.0191	0.0214	0.0203	0.0213	0.0213	0.0213	0.0202	0.0031
0.0202	0.0213	0.0202	0.0213	0.0193	0.0203	0.0191	0.0214	0.0203	0.0214	0.0215	0.0213	0.0202	0.0092
0.0202	0.0213	0.0202	0.0213	0.0193	0.0203	0.0191	0.0214	0.0203	0.0214	0.0213	0.0217	0.0202	0.0031
0.0202	0.0213	0.0202	0.0213	0.0193	0.0203	0.0191	0.0214	0.0203	0.0214	0.0213	0.0213	0.0206	0.0031

3.5. Determination of the matrix for positive and negative ideal solutions

Categorization for each evaluation criterion plays an important role in determining the matrix of positive and negative ideal solutions. In this research, it was shown that all evaluation criteria were included in the "benefit attribute" category. After knowing the categorization of attributes for each criterion, formula of positive ideal solutions ($\boldsymbol{A}^{+}$), and formula of negative ideal solutions ($\boldsymbol{A}^{-}$), then the matrix's calculation process can be performed as follows.

1) Matrix of negative ideal solutions

y_1^- = min{0.0210; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202} = 0.0202

Similarly, the calculations continue until y_{14}^-

y_{14}^- = min{0.0092; 0.0184; 0.0092; 0.0092; -0.0184; 0.0031; 0.0123; 0.0031; -0.0092; 0.0031; 0.0092; 0.0031; 0.0031} = -0.0184

A^- ={0.0202; 0.0213; 0.0202; 0.0213; 0.0177; 0.0198; 0.0191; 0.0213; 0.0194; 0.0213; 0.0213;0.0213;0.0202; -0.0184}

2) Matrix of positive ideal solutions

y_1^+ = max{0.0210; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202; 0.0202} = 0.0210

Similarly, the calculations continue until y_{14}^+

y_{14}^+ = max{0.0092; 0.0184; 0.0092; 0.0092; -0.0184; 0.0031; 0.0123; 0.0031; -0.0092; 0.0031; 0.0092; 0.0031; 0.0031} = 0.0184

A^+ ={0.0210; 0.0217; 0.0204; 0.0217; 0.0193; 0.0203; 0.0195; 0.0214; 0.0203; 0.0214; 0.0215; 0.0217; 0.0206; 0.0184}

3.6. Determination of the distance between the values of each indicator

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The distance between the values of each indicator with the positive ideal solutions is determined using Eq. 5. The distance between the values of each indicator with negative ideal solutions is determined using Eq. 6. The calculating process of the distance between the values of each indicator with negative ideal solutions can be explained as follows.

$$D_1^- = \sqrt{(0.0210-0.0202)^2+(0.0213-0.0213)^2+(0.0202-0.0202)^2+(0.0213-0.0213)^2+}$$
$$\sqrt{+(0.0193-0.0177)^2+(0.0203-0.0198)^2+(0.0191-0.0191)^2+(0.0214-0.0213)^2+}$$
$$\sqrt{+(0.0203-0.0194)^2+(0.0214-0.0213)^2+(0.0213-0.0213)^2+(0.0213-0.0213)^2+}$$
$$\sqrt{+(0.0202-0.0202)^2+(0.0092-(-0.0184))^2}$$
$$= 0.0277$$

Similarly, the calculations continue until D_{13}^-

$$D_{13}^- = \sqrt{(0.0202-0.0202)^2+(0.0213-0.0213)^2+(0.0202-0.0202)^2+(0.0213-0.0213)^2+}$$
$$\sqrt{+(0.0193-0.0177)^2+(0.0203-0.0198)^2+(0.0191-0.0191)^2+(0.0214-0.0213)^2+}$$
$$\sqrt{+(0.0203-0.0194)^2+(0.0214-0.0213)^2+(0.0213-0.0213)^2+(0.0213-0.0213)^2+}$$
$$\sqrt{+(0.0206-0.0202)^2+(0.0031-(-0.0184))^2}$$
$$= 0.0215$$

The calculating process of the distance between the values of each indicator with positive ideal solutions can be explained as follows.

$$D_1^+ = \sqrt{(0.0210-0.0210)^2+(0.0217-0.0213)^2+(0.0204-0.0202)^2+(0.0217-0.0213)^2+}$$
$$\sqrt{+(0.0193-0.0193)^2+(0.0203-0.0203)^2+(0.0195-0.0191)^2+(0.0214-0.0214)^2+}$$
$$\sqrt{+(0.0203-0.0203)^2+(0.0214-0.0214)^2+(0.0215-0.0213)^2+(0.0217-0.0213)^2+}$$
$$\sqrt{+(0.0206-0.0202)^2+(0.0184-0.0092)^2}$$
$$= 0.0093$$

Similarly, the calculations continue until D_{13}^+

$$D_{13}^+ = \sqrt{(0.0210-0.0202)^2+(0.0217-0.0213)^2+(0.0204-0.0202)^2+(0.0217-0.0213)^2+}$$
$$\sqrt{+(0.0193-0.0193)^2+(0.0203-0.0203)^2+(0.0195-0.0191)^2+(0.0214-0.0214)^2+}$$
$$\sqrt{+(0.0203-0.0203)^2+(0.0214-0.0214)^2+(0.0215-0.0213)^2+(0.0217-0.0213)^2+}$$
$$\sqrt{+(0.0206-0.0206)^2+(0.0184-0.0031)^2}$$
$$= 0.0154$$

3.7. Determination of preference scores for each indicator

After obtaining a score of $\boldsymbol{D_1^+}$ to $\boldsymbol{D_{13}^+}$ and a score of $\boldsymbol{D_1^-}$ to $\boldsymbol{D_{13}^-}$, then it can be calculated preference scores for each indicator. The formula that is used to obtain preference scores follows Eq. 7.The calculation results to determine the preference scores of each indicator can be explained as follows.

$$V_1 = \frac{D_1^-}{D_1^- + D_1^+} = \frac{0.0277}{0.0277+0.0093} = 0.74905$$

$$V_2 = \frac{D_1^-}{D_1^- + D_1^+} = \frac{0.0368}{0.0368+0.0012} = 0.96826$$

Similarly, the calculations continue until V_{13}

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$$V_{12} = \frac{D_{12}^-}{D_{12}^- + D_{12}^+} = \frac{0.0215}{0.0215+0.0154} = 0.58342$$

$$V_{13} = \frac{D_{13}^-}{D_{13}^- + D_{13}^+} = \frac{0.0215}{0.0215+0.154} = 0.58341$$

3.8. Decision making

Based on the preference scores of each indicator, the most dominant indicator as a trigger for the effectiveness of the blended learning implementation was I-2 (the existence of academic community support). It was caused the preference score of indicator I-2, namely ($\boldsymbol{V_2}$ = 0.96826) had the highest value compared to other indicators.

The effectiveness test results of the TOPSIS calculation were shown by the effectiveness scores given by four experts. The results of the effectiveness test can be seen in Table 6.

Table 6. The effectiveness test results of the TOPSIS calculation

Respondents	**Items-**								**Σ**	**Effectiveness Scores**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**		
Expert-1	5	5	5	5	4	5	5	4	38	95.00
Expert-2	4	5	5	5	5	4	5	5	38	95.00
Expert-3	5	4	5	5	4	5	4	5	37	92.50
Expert-4	5	5	4	4	5	4	5	4	36	90.00
									Average	**93.13**

Based on the results were shown in Table 6, it appears that the TOPSIS calculation had been running very effectively. It was caused the effectiveness score was 93.13% in the scores range of 90% - 100% when viewed from the effectiveness standard scores previously shown in Table 1.

This research's results were generally able to contribute and answer the limitation of Mohammed, Kasim, and Shaharanee's research [22] by providing a detailed explanation of the TOPSIS calculation stages in showing the evaluation results or decision. The results of this research were also able to answer the limitation of Meyliana, Hidayanto, and Budiardjo's research [24] by explaining in detail the TOPSIS calculation steps was used in the Discrepancy-*Tat Twam Asi* evaluation model.

Generally, the results of this research have similarities with the research of İnce, Yiğit, and Işık [53]. The similarity is the use of the TOPSIS method in evaluation activities. The difference is this research shows the use of the Balinese local wisdom concept as a basis for uniforming the weights of decision-makers. İnce, Yiğit, and Işık's research did not show uniformity in the weights of decision-makers. Sinaga and Hajjah's research also have similarities with this research in using the TOPSIS method for decision-making. However, the difference is also in the weighting of the decision-maker [54]. In Sinaga and Hajjah's research, each expert's weight values were given by each expert without the equalization process of weight values level. In this research was carried out the equalization process of weight values level. Sinaga and Hajjah's research shows that the ANP (Analytic Network Process) and TOPSIS methods were combined for the decision-making process. In contrast, this research combines the TOPSIS method with the *Tat Twam Asi* concept and the Discrepancy evaluation model for the decision-making process. The results of Turker, Baynal, and Turker's research [55] showed similarities with this research in the utilization of TOPSIS to make decisions in the evaluation process. Turker, Baynal, and Turker's research did not show in detail the formula used in the TOPSIS calculation process. This research showed the formula used in the TOPSIS calculation process.

Even though this research results were good, but there was also found the obstacle in this research. That research obstacle was not carried out yet field trials to determine the effectiveness of the TOPSIS calculation in the Discrepancy-*Tat Twam Asi* evaluation model.

4. Conclusion

In general, the calculation simulation of the TOPSIS method was used in the Discrepancy-*Tat Twam Asi* evaluation model had been very effective. The evidenced of effectiveness TOPSIS test result calculation was conduct by the expert with the acquisition of the effectiveness percentage by categorization. From

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the simulation results of TOPSIS calculations, it was found that the dominant indicator to determine the blended learning effectiveness at IT vocational schools was I-2 (the existence of academic community support) because its preference score was the highest. The future work that can be done to solve the research obstacle in this research is to conduct field trials of the TOPSIS calculation used in the Discrepancy-*Tat Twam Asi* evaluation model. The field trials should involved stakeholders directly related to the implementation of blended learning.

Author Contributions

Dewa Gede Hendra Divayana: Conceptualization, methodology, validation, formal analysis, data curation, and writing-original draft; and P. Wayan Arta Suyasa: Formal analysis and data curation.

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Declaration of Competing Interest

We declare that we have no conflict of interest.

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