Development of Discrepancy Evaluation Model based on Tat Twam Asi with TOPSIS Calculation

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***Abstract*—This research had the main objective to provide information related to the innovation available in the form of an educational evaluation model that integrates the Discrepancy evaluation component, Tat Twam Asi concept, and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method in the framework of determining the dominant indicators triggering the effectiveness of implementing blended learning in IT vocational schools. The approach of this research was development research by an R & D development model that focused on four stages, including a) research and field data collection, b) planning, c) design development, d) initial trial, and e) revisions to the results of the initial trial. There were 34 subjects involved in the trial design of the evaluation model in this research, including two education experts, two informatics experts, and 30 IT vocational teachers in Bali. The instruments used in data collection were in the form of questionnaires, interview guidelines, and photo documentation. The analysis technique for the data that had been collected used quantitative descriptive techniques that referred to percentage descriptive calculations. The results of this research were Tat Twam Asi-based Discrepancy evaluation model design which was integrated with TOPSIS calculations and had been classified as excellent according to the eleven-scale categorization table.**

Keywords*—Discrepancy; evaluation model; tat twam asi; TOPSIS

I. Introduction

Nowadays blended learning has become a vital requirement in the learning process at IT vocational schools because of the demands for flexibility, convenience, speed, and transparency in the educational field as a result of the appearance of industrial revolution 4.0. The fact shows that the blended learning implementation in some IT vocational schools was not optimal. It is following the statement of Mozelius and Rydell [1], who stated that "there were still many cases that show that blended learning has not been implemented well in the learning process". Even though evaluation activities were often carried out in the blended learning implementation, the recommendations given were not yet precise regarding the target, especially in determining the dominant indicators that trigger the level of blended learning effectiveness. Several evaluation models have been used by educational evaluators to evaluate the blended learning implementation, including CSE-UCLA [2], CIPP [3], and Formative-Summative [4]. However, among those models, an exact model has not yet been found in determining the dominant indicators that trigger the effectiveness of blended learning based on the weighting equation given by evaluators to the defining, installation, process, and product components. One innovation to overcome those problems was to use the Tat Twam Asi-based Discrepancy evaluation model with an accurate and systematic calculation process using the TOPSIS method so that a dominant indicator can be determined as a trigger for the blended learning effectiveness. The discrepancy model can show the evaluation components, including definition, installation, process, and product. The concept of Tat Twam Asi (a local wisdom concept in Bali that means I am you) adheres to the philosophy of equality which can be used in determining the weighting equation given by evaluators. The TOPSIS method can be used to determine dominant indicators based on the highest preference value of each evaluation indicator. From the innovation findings in overcoming those problems, the research problem was "How was the design of Tat Twam Asi based Discrepancy evaluation model by TOPSIS calculation in determining the dominant indicators triggering the effectiveness of blended learning implementation in vocational high school (case study in Bali province)?"

This research was motivated by the results of the following studies, including (1) research in 2017 conducted by Embi et al. [5] showed that there was a deep assessment using the Kirkpatrick model in evaluating the implementation of multimedia-based blended learning. Limitation of the Embi et al.'s research has not yet shown in detail the assessment indicators that were the priority determinant of the multimedia-based blended learning effectiveness; (2) research conducted in 2018 by Istanbul and Supriadi [6] showed the use of the CIPP model to evaluate the blended learning implementation that supports the learning process at Widyatama University. The limitation shown in Istanbul and Supriadi's research was that priority indicators have not been shown to trigger the successful implementation of blended learning in the learning process; (3) research conducted in 2019 by Agustina and Mukhtaruddin [7] basically showed four evaluation components that were the same as the evaluation components used in this research, including defining (same with Context component), installation (same with Input component), process (same with Process component), and product (same with Product component). The four components serve as the basis for evaluating the blended learning implementation that was used to support the integrated English learning process. The limitation of Agustina and Mukhtaruddin's research was that they have not been able to show the most dominant indicators as triggers for the effectiveness of blended learning implementation; (4) research conducted in 2019 by Ngala et al. [8] showed the use of the CIPP model to evaluate the implementation of distance education based on e-learning and

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blended learning. The limitation of Ngala et al.'s research was not yet showing the evaluation standards in detail and had not been able to show the dominant indicators that trigger the successful implementation of distance education; (5) research conducted in 2019 by Siswadi et al. [9] showed the limitations of the CIPP model, especially on aspects in the context component and the input component used in evaluating national standards of nursing education. Besides, in research of Siswadi et al. also has not shown any aspects or indicators that trigger the effectiveness of learning in nursing education; (6) research conducted in 2020 by Sugianto [10] showed the utilization of the discrepancy model used to evaluate individual learning programs at junior high school level. The findings obtained in Sugianto's research were two aspects of individual learning programs that were unsuitable to program standards. Those aspects include: (a) aspects of the preparation and organization, and (b) aspects of the implementation and assessment. Besides, the limitations found in Sugianto's research was that it had not shown a dominant indicator that was the main cause of the success of the program implementation. Based on the problems that occur in the field, the innovations that were initiated, as well as the results and limitations of some previous studies, it was necessary to conduct more in-depth research related to the development of a Discrepancy model based on Tat Twam Asi combined with TOPSIS calculations to get a dominant indicator triggering the effectiveness of the blended learning implementation (case studies at several IT vocational schools in Bali Province).

II. Basic Theory

A. Discrepancy Evaluation Model

The discrepancy is an evaluation model that is used to determine the comparison between actual performance that occurs and standards that have been previously set in the evaluation [11]. The discrepancy is an evaluation model that consists of four evaluation components, including definition, installation, process, and product [12]. Based on those several definitions of discrepancy, a general conclusion is that discrepancy is one of the evaluation models comparing work results with existing standards to obtain the level of discrepancy using four stages/components of evaluation, including definition, installation, process, and product.

B. Tat Twam Asi

According to Evitasari and Wiranti, "Tat Twam Asi" is one of the Balinese local wisdom that teaches equality in the behavior of every human being in establishing a relationship to create harmony [13]. According to Perbowosari, the term "Tat Twam Asi" means I am you. This contains the concept of togetherness. Four elements need to be built to maintain togetherness, including 1) having the same vision, 2) not being selfish, 3) being willing to sacrifice, and 4) being humble [14,15]. Based on some of those statements, the general conclusion is that Tat Twam Asi is a concept that was born from the philosophy of local Balinese wisdom which shows equality, and alignment in authority so that later it can lead to harmony and effectiveness in living life.

C. TOPSIS

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is one of the multi-criteria of the decision-making methods, the principle of which works to find alternative choices by taking into account the closest distance from the positive ideal solution and the farthest from the negative ideal solution to determine the relative closeness between the optimal solutions with an alternative [16]. The steps to search for alternative options using TOPSIS can be described as follows [17]:

1) Make a normalized decision matrix.
2) Make a normalized weighted decision matrix.
3) Determine the matrix for the positive ideal solution and the matrix for the negative ideal solution.
4) Determine the distance between the values of each alternative and the matrix for positive ideal solutions and the matrix for negative ideal solutions.
5) Determine the preference value for each alternative.

TOPSIS requires a performance rating of each Ai alternative on each normalized Cj criteria, by the following formula [18].

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

The positive ideal solution of A^+ and the negative ideal solution of A^- can be determined based on the normalized weight rating (y_{ij}), by the following formula [19].

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

$$A^+ = \left(y_1^+, y_2^+, \cdots, y_n^+\right) \quad (3)$$

$$A^- = \left(y_1^-, y_2^-, \cdots, y_n^-\right) \quad (4)$$

Which:

$$y_j^+ = \begin{cases} \max_i y_{ij}; & \text{If j is the profit attribute} \\ \min_i y_{ij}; & \text{If j is a cost attribute} \end{cases}$$

$$y_j^- = \begin{cases} \min_i y_{ij}; & \text{If j is the profit attribute} \\ \max_i y_{ij}; & \text{If j is a cost attribute} \end{cases}$$

The distance between the A_i alternatives and the positive ideal solution is formulated as follows [20].

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

The distance between the alternative A_i with a negative ideal solution is formulated as follows [21].

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

The preference value for each alternative (V_i) is formulated as follows [22].

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

A greater value of V_i indicates that alternative A_i is preferred.

D. Blended Learning

Blended learning is a learning model that combines conventional learning that is carried out in the classroom and learning based on internet technology or other digital media, so that the learning process can be done quickly, easily, flexibly, and interaction between teachers and students through discussion in class and online outside the classroom [23]. Blended learning presents flexibility in place, time, and media used in the learning process without ignoring the elements of interaction that occur between teachers and students because the learning process can be done in the classroom or outside the classroom assisted by information technology [24,25]. Based on those statements, blended learning is a learning model that combines face-to-face learning directly in the room and outdoor learning assisted by information technology.

E. Discrepancy Evaluation Model based on Tat Twam Asi using TOPSIS Calculation

This model is a new breakthrough in developing the Discrepancy evaluation model that combines the concept of Tat Twam Asi with the TOPSIS method, making it easier to determine the dominant indicators that trigger the effectiveness of blended learning. The four components of discrepancy evaluation are given equal weight from evaluators based on the Tat Twam Asi concept reference then the weighting results are used in the TOPSIS calculation to obtain the preference value of each evaluation indicator so that later indicators can be obtained dominantly triggers the effectiveness of blended learning accurately.

III. Method

A. Research Approach

This research used a development approach by the Research and Development method. The research development model was Borg and Gall which consists of 10 stages of development [26-28], including: (1) research & field data collection; (2) planning; (3) design development; (4) initial trials; (5) revisions to the results of the initial trial; (6) field trial; (7) revision of the results of field trial; (8) usage trial; (9) final product revisions; (10) dissemination and implementation of the final product. Specifically, this paper focused on several stages undertaken to create a Tat Twam Asi-based Discrepancy evaluation model with TOPSIS calculations, including: (1) research & field data collection; (2) planning; (3) design development; (4) initial trial; and (5) revisions to initial trial results.

B. Research Subjects

The subjects involved in this research were two educational experts, two informatics experts, and 30 teachers, who would later be involved in conducting the initial trial. The education experts involved have a specific scientific field that was educational evaluation, while the informatics experts involved have a specific scientific field namely IT education.

C. Research Object

The object of research is the main topic that must be studied and solved. The object of this research was the design of a Discrepancy evaluation model based on Tat Twam Asi with TOPSIS calculation.

D. Research Location

The implementation of this research was located at IT vocational schools spread across six regencies in Bali. The six regencies include: Gianyar, Buleleng, Tabanan, Badung, Klungkung, and Denpasar.

E. Data Collection Instruments

Instruments used for collecting data in this research were in the form of questionnaires, photo documentation, and interview guidelines. The questionnaires were used to obtain primary data in the form of quantitative data from respondents as a basis for making decisions about the effectiveness percentage of the blended learning implementation. Interview guidelines were used to obtain secondary data as a basis for strengthening arguments qualitatively in supporting research findings. Photo documentation was used as proof that this research was indeed carried out and also used as valid evidence that showed the source of primary and secondary data obtained in this research.

F. Data Analysis Techniques

The technique used to analyze the data that had been collected was a quantitative descriptive technique through percentage descriptive calculation. The percentage descriptive calculation results were used as a basis for interpreting the research results on the Tat Twam Asi-based Discrepancy evaluation model. The percentage descriptive calculation is formulated as follows [29-35].

$$\text{Percentage} = \frac{\sum(\text{Answer} \times \text{Weight of Each Choice})}{\text{n} \times \text{Highest Weight}} \times 100\% \quad (8)$$

Notes:

$\sum$ = Total; n = Number of all questionnaire items.

The percentage results were obtained from that formula and then converted into the eleven's scale categorization. That categorization can be seen in Table I [36,37].

TABLE I. ELEVEN'S SCALE CATEGORIZATION

Effectiveness Percentage (%)	Category	Follow-up
95 to 100	Excellent	No needs revision
85 to 94	Very good	No needs revision
75 to 84	Good	No needs revision
65 to 74	More than enough	No needs revision
55 to 64	Enough	Revision
45 to 54	Almost enough	Revision
35 to 44	Minus	Revision
25 to 34	Very minus	Revision
15 to 24	Poor	Revision
5 to 14	Very poor	Revision
0 to 4	Highly poor	Revision

IV. RESULTS AND DISCUSSION

At the research stage and field data collection, several results were obtained, including aspects of evaluation standards, evaluation results in the field, and the weight of decision-makers. The full aspects related to standard evaluation can be seen in Table II, the evaluation results in the field can be seen in Table III, and the weight of decision-makers can be seen in Table IV.

Based on the data shown in Table III, there appears to be an imbalance that occurs between the percentage of effectiveness in field evaluation with the established effectiveness standards. Positive inequality occurs if the percentage of effectiveness in the field was higher than the percentage of effectiveness standards. Otherwise, if the percentage of effectiveness in the field was lower than percentage of effectiveness standards then negative inequality occurs. From Table III, several indicators were classified as negative inequality, including: indicators 11, 12, 13, 16, 18, 21, 22, 23, and 27. Indicators classified as positive inequality, including: indicators 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 15, 17, 19, 20, 24, 25, 26, 28, 29, 30, and 31.

TABLE II. THE EVALUATION STANDARD ASPECTS OF THE BLENDED LEARNING IMPLEMENTATION IN SEVERAL VOCATIONAL SCHOOLS IN BALI PROVINCE WHICH REFERRED TO THE DISCREPANCY MODEL

Evaluation Components	Aspects/Criteria of Evaluation		Indicators		Percentage of Effectiveness Standards
Definition	C1	The legality of conducting blended learning	I-1	Education service regulation regarding the needs of blended learning	88
			I-2	Principals' regulation regarding the implementation of blended learning	90
	C2	Academics support	I-3	Principals' agreement	88
			I-4	Developer team support	90
			I-5	Teacher enthusiasm	85
			I-6	Students enthusiasm	85
	C3	Community support	I-7	Support from board of trustees / school committees	87
			I-8	Support from students' parents	87
Installation	C4	Management team readiness	I-9	Suitability of academic qualifications and scientific fields of the management team	88
			I-10	Management team competence	88
	C5	Facility and infrastructure readiness	I-11	Availability of hardware with adequate specifications	88
			I-12	Availability of software / platforms that suit on the needs	88
			I-13	Adequate internet access availability	90
			I-14	Availability of supporting physical infrastructure (such as tables, chairs, air conditioners, LCD projectors, etc.) that are still suitable for use	87
	C6	User competency readiness	I-15	The ability of teachers in operating computers and accessing the internet	86

			I-16	The ability of teachers to prepare digital teaching materials to support blended learning	86
			I-17	Students' expertise in operating computers and accessing the internet	86
Processes	C7	The socialization of the procedures for using blended learning	I-18	There was a socialization to teachers about the procedures for making digital teaching materials	87
			I-19	There was a socialization of the use of blended learning to teachers and students	87
	C8	Implementation of learning using blended learning	I-20	The implementation time of learning is in accordance with the time agreed upon by students and teachers	88
			I-21	The quality of material transferred by the teacher through blended learning can be easily understood by students	88
Product	The effectiveness of implementing blended learning from several dimensions:				
	C9	Tangibles	I-22	The condition of the classroom/ lab that is used in the organization of blended learning	88
			I-23	The condition of digital teaching materials that is used in the learning process based on blended learning	88
	C10	Reliability	I-24	Speed in accessing a blended learning platform	88
			I-25	Ease of operating a blended learning platform	88
	C11	Responsiveness	I-26	Platform speed in responding to the process of data manipulation (input, edit, and delete digital teaching materials) into blended learning	87
			I-27	The speed of response given by the teacher when discussing with students through blended learning	86
	C12	Assurance	I-28	Security guarantees questions/tests which are provided by teachers in blended learning	90
			I-29	The security guarantee of each task deposited by students into blended learning	90
	C13	Empathy	I-30	The availability of facilities for giving advice/ complaints from students to the learning process through blended learning	90
			I-31	The availability of feedback facilities from teachers on existing suggestions/ complaints related to the learning process through blended learning	90

TABLE III. FIELD EVALUATION RESULTS REFERRING TO THE DISCREPANCY MODEL OF BLENDED LEARNING IMPLEMENTATION IN SEVERAL IT VOCATIONAL SCHOOLS IN BALI PROVINCE

Code of Indicators	Percentage of Effectiveness Standards	Percentage of Effectiveness in Field Evaluation (%)	*Discrepancy*
I-1	88.000	91.765	3.765
I-2	90.000	92.353	2.353
I-3	88.000	91.176	3.176
I-4	90.000	90.588	0.588
I-5	85.000	85.294	0.294
I-6	85.000	85.882	0.882
I-7	87.000	88.824	1.824
I-8	87.000	89.412	2.412
I-9	88.000	88.235	0.235
I-10	88.000	88.824	0.824
I-11	88.000	80.588	-7.412
I-12	88.000	85.294	-2.706
I-13	90.000	85.882	-4.118
I-14	87.000	87.647	0.647
I-15	86.000	86.471	0.471
I-16	86.000	80.588	-5.412
I-17	86.000	87.059	1.059
I-18	87.000	75.294	-11.706
I-19	87.000	87.059	0.059
I-20	88.000	88.235	0.235
I-21	88.000	86.176	-6.824
I-22	88.000	86.471	-1.529
I-23	88.000	82.353	-5.647
I-24	88.000	88.235	0.235
I-25	88.000	88.824	0.824
I-26	87.000	88.235	1.235
I-27	86.000	84.118	-1.882
I-28	90.000	91.765	1.765
I-29	90.000	91.176	1.176
I-30	90.000	92.353	2.353
I-31	90.000	92.941	2.941
Average		**87.230**	

The data in Table IV shows the weighted value given by experts for each evaluation criteria. The weight value given to each evaluation criteria refers to the Tat Twam Asi concept. Tat Twam Asi was a concept that prioritizes equality/similarity of authority for each expert in providing a weighting assessment of each evaluation criteria. Therefore an average weight score calculation was performed to achieve the same authority of each expert. The weighted average results were then divided by the total number of weighted average, so we got a weight value that refers to Tat Twam Asi for each evaluation criteria. There were 14 evaluation criteria that were given weight referring to Tat Twam Asi.

TABLE IV. THE WEIGHTS GIVEN BY THE DECISION-MAKERS TO EACH EVALUATION CRITERIA REFERS TO THE TAT TWAM ASI CONCEPT

Code of Criteria	Weights Given by Experts				Average of Weights	Weights Refers to Tat Twam Asi
	Expert 1	Expert 2	Expert 3	Expert 4		
C1	5	4	5	5	4.75	0.080
C2	4	4	5	4	4.25	0.071
C3	4	5	4	4	4.25	0.071
C4	5	5	5	4	4.75	0.080
C5	4	4	4	5	4.25	0.071
C6	4	5	4	4	4.25	0.071
C7	4	4	5	4	4.25	0.071
C8	4	4	5	5	4.50	0.076
C9	4	3	4	4	3.75	0.063
C10	4	5	4	4	4.25	0.071
C11	4	5	5	4	4.50	0.076
C12	4	5	4	5	4.50	0.076
C13	4	5	5	5	4.75	0.080
C14	2	3	3	2	2.50	0.042
∑					59.50	1.000

Notes:

• C1 to C13 were evaluation criteria as mentioned earlier in Table III.

• C14 was specifically an *Discrepancy* criteria.

At the planning stage, activities and time were regulated, as well as personnel involved in developing the evaluation model design. The details of activities and time needed in developing the design of a Tat Twam Asi-based Discrepancy evaluation model with a TOPSIS calculation can be seen in Table V. Personnel arrangements can be seen in Table VI.

At the design development stage, was made conceptual design and user interface design of the evaluation model. The design of the Discrepancy evaluation model based on Tat Twan Asi with TOPSIS calculation in finding dominant indicators that determine the success of blended learning implementation can be seen in Fig. 1 and user interface design in Fig. 2.

TABLE V. ACTIVITIES DETAILS IN THE DEVELOPMENT OF TAT TWAM ASI-BASED ON DISCREPANCY EVALUATION MODEL DESIGN USING TOPSIS CALCULATION

No.	Activities	Time (Day)
1	Determination of evaluation components	2
2	Determination of evaluation criteria/aspects	2
3	Determination of evaluation indicators	2
3	Determination of weights for each criteria	2
4	Making initial design	3
5	Trial calculation of TOPSIS	2
6	Revised trial results	2
7	Making final design	2
	Total	17

TABLE VI. PERSONNEL DETAILS WERE INVOLVED IN THE DEVELOPMENT OF TAT TWAM ASI-BASED ON DISCREPANCY EVALUATION MODEL DESIGN WITH TOPSIS CALCULATIONS

No	Activities	Number of personnel	Information
1	Determination of evaluation components	3	1 Research chair and 2 Research members
2	Determination of evaluation criteria/aspects	3	1 Research chair and 2 Research members
3	Determination of evaluation indicators	3	1 Research chair and 2 Research members
3	Determination of weights for each criteria	4	2 Education experts and 2 Informatics experts
4	Making initial design	3	1 Research chair and 2 Research members
5	Trial calculation of TOPSIS	34	2 Education experts, 2 Informatics expert, and 30 teachers
6	Revised trial results	3	1 Research chair and 2 Research members
7	Making final design	3	1 Research chair and 2 Research members

Fig. 1 shows the Discrepancy evaluation model consists of four evaluation components, including definition, installation, process, and product. From each of the evaluation components, there were several indicators used to measure the effectiveness of the blended learning implementation at the IT vocational schools. In Fig. 1, the evaluation indicators were displayed in the form of an indicator code. For more details about the description of each indicator's code can be seen in Table II. The results of the effectiveness percentage obtained in the field were then compared with the percentage of effectiveness standards. The inequality that occurs due to the process of comparing the effectiveness percentage, then it was used as one of the evaluation criteria from a total of 14 existing evaluation criteria. Those fourteen criteria were then given a weight value obtained from the weighting process of experts referring to the Tat Twam Asi concept. Based on the weight value given by the experts to each evaluation criteria, then the calculation process can be performed using the TOPSIS formula to determine the most dominant indicators as triggers for the success or effectiveness of blended learning implementation.

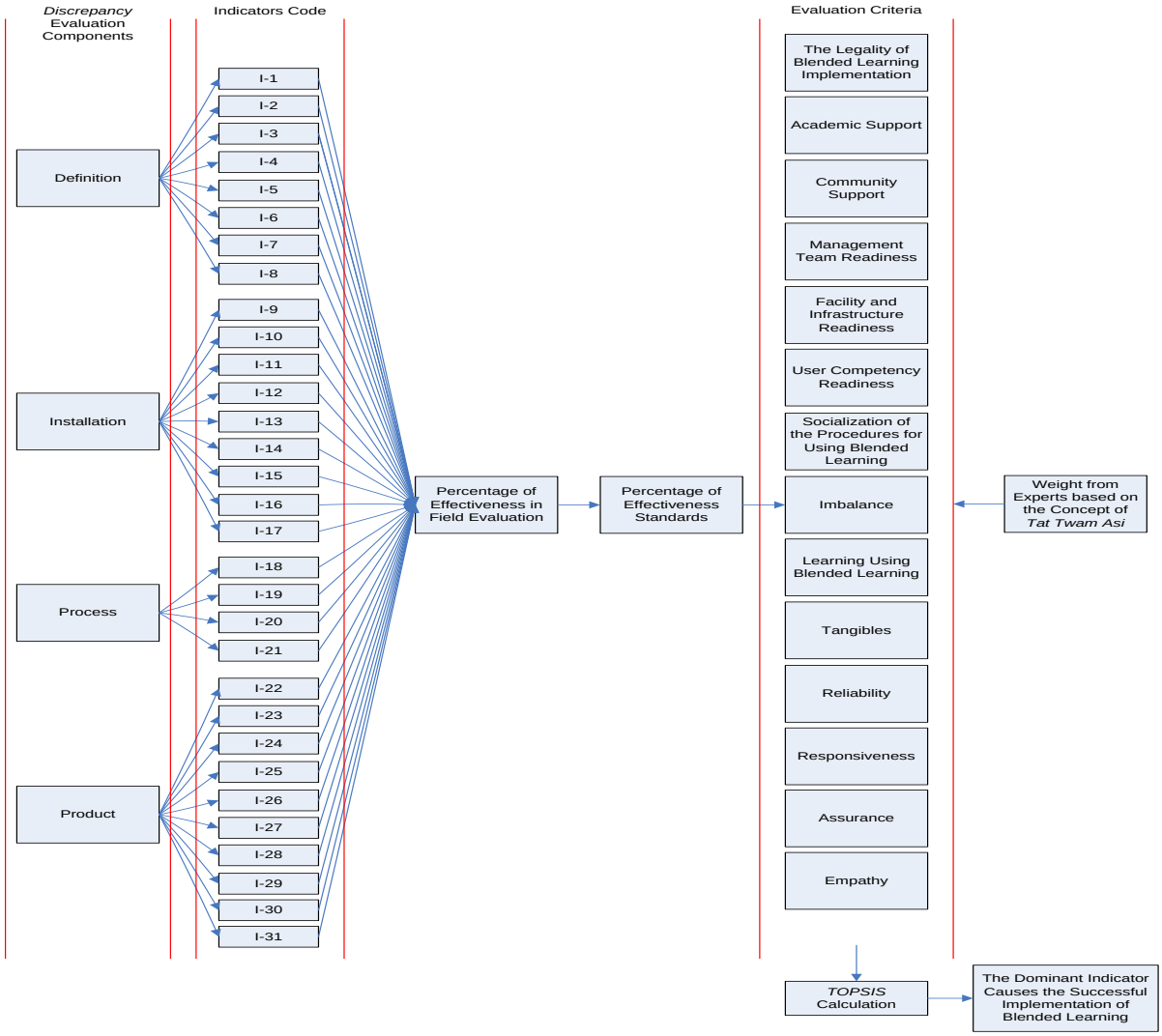
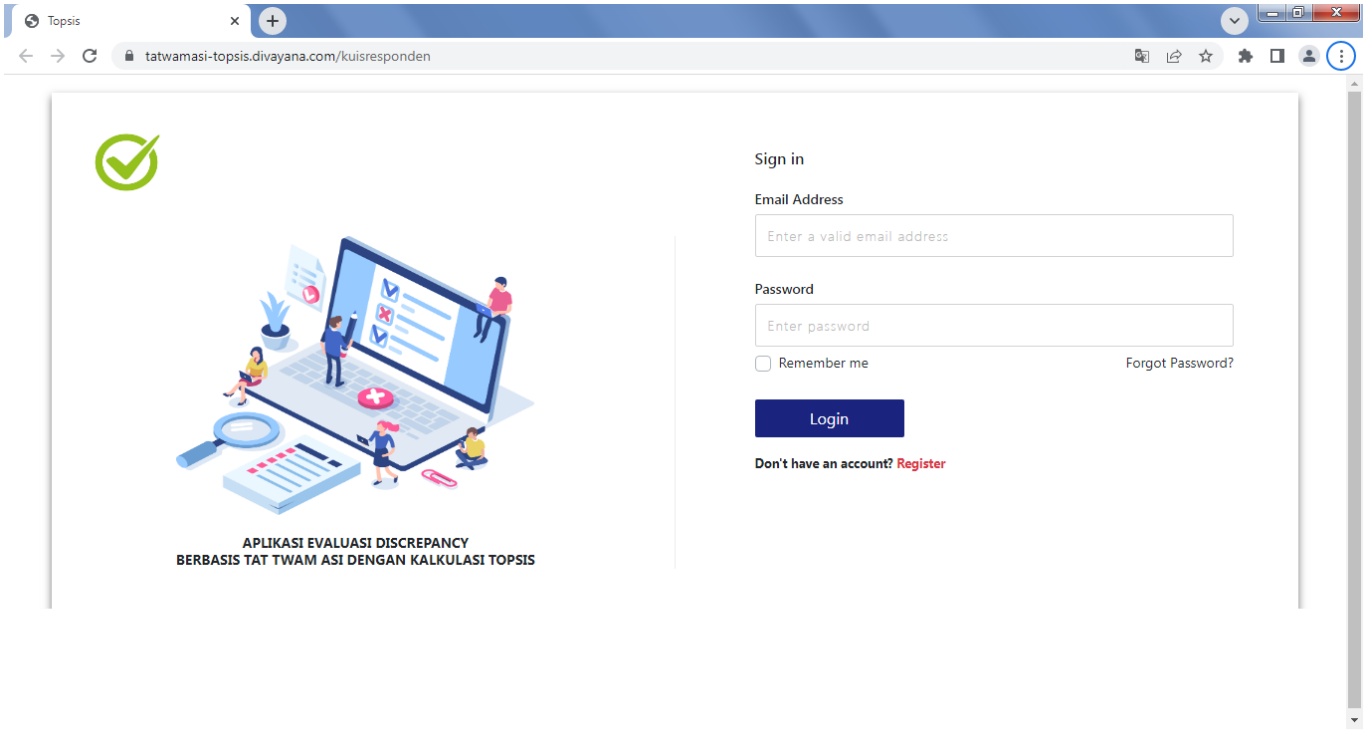
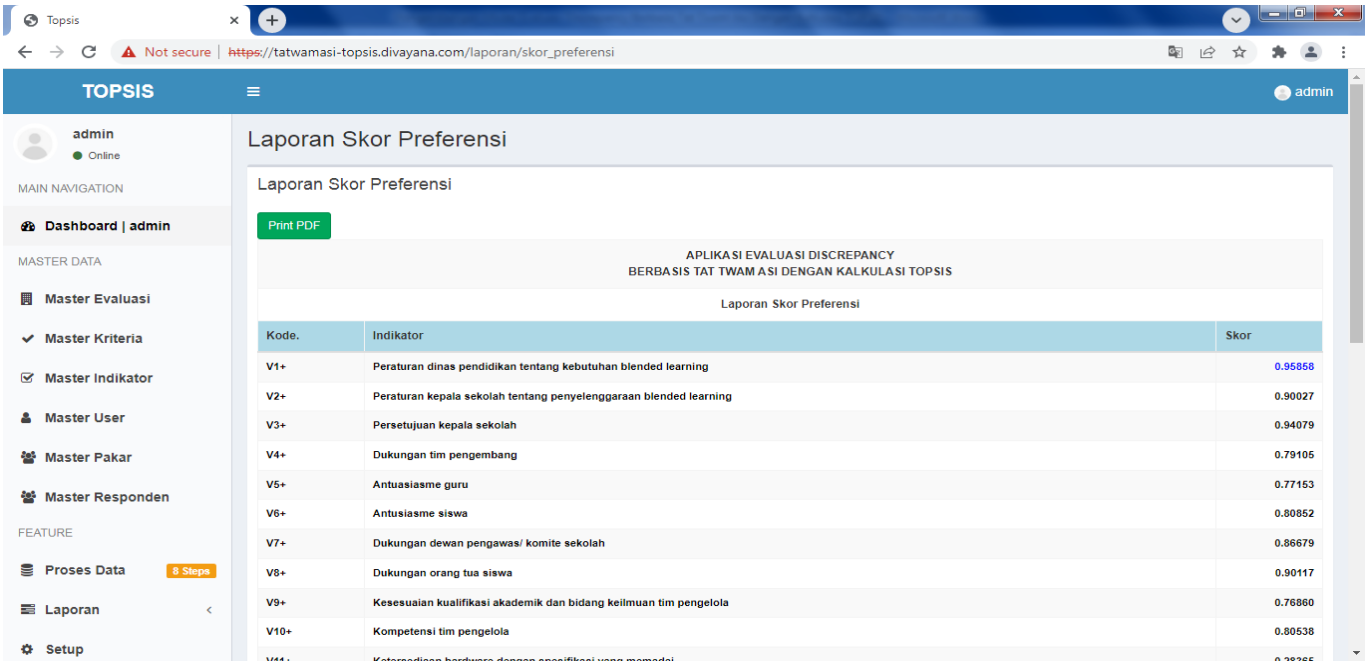


Fig. 1. Conceptual Design of Discrepancy Evaluation Model based on Tat Twam Asi with TOPSIS Calculation in Finding Dominant Indicators that Determine the Success of Blended Learning Implementation.





Kode.	Indikator	Skor
V1+	Peraturan dinas pendidikan tentang kebutuhan blended learning	0.95858
V2+	Peraturan kepala sekolah tentang penyelenggaraan blended learning	0.90027
V3+	Persetujuan kepala sekolah	0.94079
V4+	Dukungan tim pengembang	0.79105
V5+	Antuasiasme guru	0.77153
V6+	Antusiasme siswa	0.80852
V7+	Dukungan dewan pengawas/ komite sekolah	0.86679
V8+	Dukungan orang tua siswa	0.90117
V9+	Kesesuaian kualifikasi akademik dan bidang keilmuan tim pengelola	0.76860
V10+	Kompetensi tim pengelola	0.80538

Fig. 2. User Interface Design of Discrepancy Evaluation Model based on Tat Twam Asi with TOPSIS Calculation in Finding Dominant Indicators that determine the Success of Blended Learning Implementation (Indonesian Version).

In the initial testing phase toward the accuracy of the use of the TOPSIS method in the evaluation model design, a simulation calculation of the TOPSIS formula was performed to determine the dominant indicator. There were two education experts, two informatics experts, and 30 teachers involved in the TOPSIS calculation simulation process. The data which was used in the complete TOPSIS calculation simulation can be seen in Table VII.

From the data shown in Table VII, it can be explained that the scores given by the black block in columns C1 to C13 were obtained from the percentage value of effectiveness in field evaluation for each evaluation indicator (as shown in Table III). Unblocked scores were obtained from the average value of the percentage of effectiveness in field evaluation (as shown in Table III). The score entered in column C14 (indicated by a gray block) was obtained from the inequality score also shown in Table III.

TABLE VII. PRELIMINARY DATA FOR SIMULATION OF TOPSIS CALCULATION

Code of Indicators	Criteria													
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
I-1	91.765	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	3.765
I-2	92.353	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	2.353
I-3	87.230	91.176	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	3.176
I-4	87.230	90.588	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	0.588
I-5	87.230	85.294	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	0.294
I-6	87.230	85.882	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	0.882
I-7	87.230	87.230	88.824	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	1.824
I-8	87.230	87.230	89.412	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	2.412
I-9	87.230	87.230	87.230	88.235	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	0.235
I-10	87.230	87.230	87.230	88.824	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	0.824
I-11	87.230	87.230	87.230	87.230	80.588	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	-7.412
I-12	87.230	87.230	87.230	87.230	85.294	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	-2.706
I-13	87.230	87.230	87.230	87.230	85.882	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	-4.118
I-14	87.230	87.230	87.230	87.230	87.647	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	0.647
I-15	87.230	87.230	87.230	87.230	87.230	86.471	87.230	87.230	87.230	87.230	87.230	87.230	87.230	0.471
I-16	87.230	87.230	87.230	87.230	87.230	80.588	87.230	87.230	87.230	87.230	87.230	87.230	87.230	-5.412
I-17	87.230	87.230	87.230	87.230	87.230	87.059	87.230	87.230	87.230	87.230	87.230	87.230	87.230	1.059
I-18	87.230	87.230	87.230	87.230	87.230	87.230	75.294	87.230	87.230	87.230	87.230	87.230	87.230	-11.706
I-19	87.230	87.230	87.230	87.230	87.230	87.230	87.059	87.230	87.230	87.230	87.230	87.230	87.230	0.059
I-20	87.230	87.230	87.230	87.230	87.230	87.230	87.230	88.235	87.230	87.230	87.230	87.230	87.230	0.235
I-21	87.230	87.230	87.230	87.230	87.230	87.230	87.230	86.176	87.230	87.230	87.230	87.230	87.230	-6.824
I-22	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	86.471	87.230	87.230	87.230	87.230	-1.529
I-23	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	82.353	87.230	87.230	87.230	87.230	-5.647
I-24	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	88.235	87.230	87.230	87.230	0.235
I-25	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	88.824	87.230	87.230	87.230	0.824
I-26	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	88.235	87.230	87.230	1.235
I-27	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	84.118	87.230	87.230	-1.882
I-28	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	91.765	87.230	1.765
I-29	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	91.176	87.230	1.176
I-30	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	92.353	2.353
I-31	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	87.230	92.941	2.941

Based on the data shown in Table VII, the TOPSIS calculation process was then performed by following the steps as follows:

1) Determine the normalized matrix using the formula shown earlier in equation (1)

$$|x_1| = \sqrt{91.765^2 + 92.353^2 + 29(87.230)^2} = 487.454$$

$$r_{11} = \frac{x_{11}}{|x_1|} = \frac{91.765}{487.454} = 0.1883$$

$$r_{21} = \frac{x_{21}}{|x_1|} = \frac{92.353}{487.454} = 0.1895$$

$$r_{31} = \frac{x_{31}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{41} = \frac{x_{41}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{51} = \frac{x_{51}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{61} = \frac{x_{61}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{71} = \frac{x_{71}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{81} = \frac{x_{81}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{91} = \frac{x_{91}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{101} = \frac{x_{101}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{111} = \frac{x_{111}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{121} = \frac{x_{121}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{131} = \frac{x_{131}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{141} = \frac{x_{141}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{151} = \frac{x_{151}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{161} = \frac{x_{161}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{171} = \frac{x_{171}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{181} = \frac{x_{181}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{191} = \frac{x_{191}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{201} = \frac{x_{201}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{211} = \frac{x_{211}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{221} = \frac{x_{221}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{231} = \frac{x_{231}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{241} = \frac{x_{241}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{251} = \frac{x_{251}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{261} = \frac{x_{261}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{271} = \frac{x_{271}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{281} = \frac{x_{281}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{291} = \frac{x_{291}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{301} = \frac{x_{301}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

$$r_{311} = \frac{x_{311}}{|x_1|} = \frac{87.230}{487.454} = 0.1789$$

↓ same calculation up to $|x_{14}|$

$$|x_{14}| = \sqrt{3.765^2 + 2.353^2 + 3.176^2 + 0.588^2 + 0.294^2 + 0.882^2 + 1.824^2 + \sqrt{+2.412^2 + 0.235^2 + 0.824^2 + (-7.412)^2 + (-2.706)^2 + (-4.118)^2 + \sqrt{+0.647^2 + 0.471^2 + (-5.412)^2 + 1.059^2 + (-11.706)^2 + 0.059^2 + \sqrt{+0.235^2 + (-6.824)^2 + (-1.529)^2 + (-5.647)^2 + 0.235^2 + 0.824^2 + \sqrt{+1.235^2 + (-1.882)^2 + 1.765^2 + +1.176^2 + 2.353^2 + (2.941)^2}}}} = 19.837$$

$$r_{114} = \frac{x_{114}}{|x_{14}|} = \frac{3.765}{19.837} = 0.1898$$

$$r_{214} = \frac{x_{214}}{|x_{14}|} = \frac{2.353}{19.837} = 0.1186$$

$$r_{314} = \frac{x_{314}}{|x_{14}|} = \frac{3.176}{19.837} = 0.1601$$

$$r_{414} = \frac{x_{414}}{|x_{14}|} = \frac{0.588}{19.837} = 0.0296$$

$$r_{514} = \frac{x_{514}}{|x_{14}|} = \frac{0.294}{19.837} = 0.0148$$

$$r_{614} = \frac{x_{614}}{|x_{14}|} = \frac{0.882}{19.837} = 0.0445$$

$$r_{714} = \frac{x_{714}}{|x_{14}|} = \frac{1.824}{19.837} = 0.0919$$

$$r_{814} = \frac{x_{814}}{|x_{14}|} = \frac{2.412}{19.837} = 0.1216$$

$$r_{914} = \frac{x_{914}}{|x_{14}|} = \frac{0.235}{19.837} = 0.0118$$

$$r_{1014} = \frac{x_{1014}}{|x_{14}|} = \frac{0.824}{19.837} = 0.0415$$

$$r_{1114} = \frac{x_{1114}}{|x_{14}|} = \frac{-7.412}{19.837} = -0.3736$$

$$r_{1214} = \frac{x_{1214}}{|x_{14}|} = \frac{-2.706}{19.837} = -0.1364$$

$$r_{1314} = \frac{x_{1314}}{|x_{14}|} = \frac{-4.118}{19.837} = -0.2076$$

$$r_{1414} = \frac{x_{1414}}{|x_{14}|} = \frac{0.647}{19.837} = 0.0326$$

$$r_{1514} = \frac{x_{1514}}{|x_{14}|} = \frac{0.471}{19.837} = 0.0237$$

$$r_{1614} = \frac{x_{1614}}{|x_{14}|} = \frac{-5.412}{19.837} = -0.2728$$

$$r_{1714} = \frac{x_{1714}}{|x_{14}|} = \frac{1.059}{19.837} = 0.0534$$

$$r_{1814} = \frac{x_{1814}}{|x_{14}|} = \frac{-11.706}{19.837} = -0.5901$$

$$r_{1914} = \frac{x_{1914}}{|x_{14}|} = \frac{0.059}{19.837} = 0.0030$$

$$r_{2014} = \frac{x_{2014}}{|x_{14}|} = \frac{0.235}{19.837} = 0.0118$$

$$r_{2114} = \frac{x_{2114}}{|x_{14}|} = \frac{-6.824}{19.837} = -0.3440$$

$$r_{2214} = \frac{x_{2214}}{|x_{14}|} = \frac{-1.529}{19.837} = -0.0771$$

$$r_{2314} = \frac{x_{2314}}{|x_{14}|} = \frac{-5.647}{19.837} = -0.2847$$

$$r_{2414} = \frac{x_{2414}}{|x_{14}|} = \frac{0.235}{19.837} = 0.0118$$

$$r_{2514} = \frac{x_{2514}}{|x_{14}|} = \frac{0.824}{19.837} = 0.0415$$

$$r_{2614} = \frac{x_{2614}}{|x_{14}|} = \frac{1.235}{19.837} = 0.0623$$

$$r_{2714} = \frac{x_{2714}}{|x_{14}|} = \frac{-1.882}{19.837} = -0.0949$$

$$r_{2814} = \frac{x_{2814}}{|x_{14}|} = \frac{1.765}{19.837} = 0.0890$$

$$r_{2914} = \frac{x_{2914}}{|x_{14}|} = \frac{1.176}{19.837} = 0.0593$$

$$r_{3014} = \frac{x_{3014}}{|x_{14}|} = \frac{2.353}{19.837} = 0.1186$$

$$r_{3114} = \frac{x_{3114}}{|x_{14}|} = \frac{2.941}{19.837} = 0.1483$$

2) Determine the R matrix: The results of the normalization were plotted into the 31 × 14. R matrix with the intended normalized matrix can be seen in Figure 3.

$$R = \begin{bmatrix}
0.1883 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.1898 \\
0.1895 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.1186 \\
0.1789 & 0.1874 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.1601 \\
0.1789 & 0.1862 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0296 \\
0.1789 & 0.1753 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0148 \\
0.1789 & 0.1766 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0445 \\
0.1789 & 0.1793 & 0.1826 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0919 \\
0.1789 & 0.1793 & 0.1838 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.1216 \\
0.1789 & 0.1793 & 0.1794 & 0.1815 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0118 \\
0.1789 & 0.1793 & 0.1794 & 0.1827 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0415 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1665 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & -0.3736 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1762 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & -0.1364 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1774 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & -0.2076 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1811 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0326 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1785 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0237 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1664 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & -0.2728 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1797 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0534 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1557 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & -0.5901 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1800 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0030 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1817 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & 0.0118 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1774 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & -0.3440 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1784 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & -0.0771 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1699 & 0.1794 & 0.1797 & 0.1790 & 0.1789 & -0.2847 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1815 & 0.1797 & 0.1790 & 0.1789 & 0.0118 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1827 & 0.1797 & 0.1790 & 0.1789 & 0.0415 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1818 & 0.1790 & 0.1789 & 0.0623 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1733 & 0.1790 & 0.1789 & -0.0949 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1883 & 0.1789 & 0.0890 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1871 & 0.1789 & 0.0593 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1894 & 0.1186 \\
0.1789 & 0.1793 & 0.1794 & 0.1794 & 0.1802 & 0.1801 & 0.1804 & 0.1796 & 0.1800 & 0.1794 & 0.1797 & 0.1790 & 0.1906 & 0.1483
\end{bmatrix}$$

Fig. 3. R Matrix.

3) Determine the Y matrix: After the R matrix was obtained, then calculation was performed to determine the Y matrix. The Y matrix was the weighted normalized matrix. The way to get the Y matrix was to do a multiplication of the R matrix with expert weights referring to the Tat Twam Asi concept shown in Table IV. In general, the matrix multiplication to determine the Y matrix can be written as follows.

$$Y = [R] \times [0.080\ \ 0.071\ \ 0.071\ \ 0.080\ \ 0.071\ \ 0.071\ \ 0.076\ \ 0.063\ \ 0.076\ \ 0.076\ \ 0.076\ \ 0.080\ \ 0.042]$$

The complete results of the calculation of determining the Y matrix can be seen in Fig. 4.

$$
Y = \begin{bmatrix}
0.01506 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00797 \\
0.01516 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00498 \\
0.01431 & 0.01331 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00672 \\
0.01431 & 0.01322 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00124 \\
0.01431 & 0.01245 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00062 \\
0.01431 & 0.01254 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00187 \\
0.01431 & 0.01273 & 0.01296 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00386 \\
0.01431 & 0.01273 & 0.01305 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00511 \\
0.01431 & 0.01273 & 0.01274 & 0.01452 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00050 \\
0.01431 & 0.01273 & 0.01274 & 0.01462 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00174 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01182 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.01569 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01251 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.00573 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01260 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.00872 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01286 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00137 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01267 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.00100 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01281 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.01146 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01276 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00224 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01105 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.02478 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01278 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00013 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01381 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & 0.00050 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01348 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.01445 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.00324 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01070 & 0.01274 & 0.01366 & 0.01360 & 0.01431 & -0.01196 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01289 & 0.01366 & 0.01360 & 0.01431 & 0.00050 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01297 & 0.01366 & 0.01360 & 0.01431 & 0.00174 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01382 & 0.01360 & 0.01431 & 0.00262 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01317 & 0.01360 & 0.01431 & -0.00399 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01431 & 0.01431 & 0.00374 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01422 & 0.01431 & 0.00249 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01515 & 0.00498 \\
0.01431 & 0.01273 & 0.01274 & 0.01435 & 0.01279 & 0.01279 & 0.01281 & 0.01365 & 0.01134 & 0.01274 & 0.01366 & 0.01360 & 0.01515 & 0.00623
\end{bmatrix}
$$

Fig. 4. Y Matrix.

4) Determine the matrix for positive ideal solutions and the matrix for negative ideal solutions.

The matrix for positive and negative ideal solutions was strongly influenced by the classification of each evaluation criteria. The fourteen evaluation criteria in this research were classified as profit attributes. Based on those, it can be calculated the matrix for positive ideal solutions and the matrix for negative ideal solutions as follows.

a) The Matrix for Positive Ideal Solutions

y_1^+= max{0.01506; 0.01516; 0.01431} = 0.01506

↓ same calculation up to y_{14}^+

y_{14}^+=max{0.00797; 0.00498; 0.00672; 0.00124; 0.00062; 0.00187; 0.00386; 0.00511; 0.00050; 0.00174; -0.01569; -0.00573; -0.00872; 0.00137; 0.00100; -0.01146; 0.00224; -0.02478; 0.00013; 0.00050; -0.01445; -0.00324; -0.01196; 0.00050; 0.00174; 0.00262; -0.00399; 0.00374; 0.00249; 0.00498; 0.00623} = 0.00797

A^+ = {0.01516; 0.01331; 0.01305; 0.01462; 0.01286; 0.01279; 0.01281; 0.01381; 0.01134; 0.01297; 0.01382; 0.01431; 0.01525; 0.00797}

b) The Matrix for Negative Ideal Solutions

y_1^- = min{0.01506; 0.01516; 0.01431} = 0.01431

y_2^- = min{0.01273; 0.01273; 0.01331; 0.01322; 0.01245; 0.01254; 0.01273} = 0.01245

↓ same calculation up to y_{14}^-

y_{14}^- =min{0.00797; 0.00498; 0.00672; 0.00124; 0.00062; 0.00187; 0.00386; 0.00511; 0.00050; 0.00174; -0.01569; -0.00573; -0.00872; 0.00137; 0.00100; -0.01146; 0.00224; -0.02478; 0.00013; 0.00050; -0.01445; -0.00324; -0.01196; 0.00050; 0.00174; 0.00262; -0.00399; 0.00374; 0.00249; 0.00498; 0.00623} = -0.02478

A^- = {0.01431; 0.01245; 0.01274; 0.01435; 0.01182; 0.01181; 0.01105; 0.01348; 0.01070; 0.01274; 0.01317; 0.01360; 0.01431; -0.02478}

5) Determine the distance between the scores of each indicator with the matrix for a positive ideal solution and a negative ideal solution.

a) The distance between the scores of each indicator and the matrix for a positive ideal solution.

$$D_1^+ = \sqrt{(0.01506-0.01516)^2+(0.01273-0.01331)^2+(0.01274-0.01305)^2+(0.01435-0.01462)^2+\ldots}$$

$$\sqrt{..+(0.01279-0.01286)^2+(0.01279-0.01279)^2+(0.01281-0.01281)^2+(0.01365-0.01381)^2+\ldots}$$

$$\sqrt{..+(0.01134-0.01134)^2+(0.01274-0.01297)^2+(0.01366-0.01382)^2+(0.01360-0.01431)^2+\ldots}$$

$$\sqrt{..+(0.01431-0.01525)^2+(0.00797-0.00797)^2}$$

= 0.00141

↓ same calculation up to D_{31}^+

$$D_{31}^+ = \sqrt{(0.01431-0.01516)^2+(0.01273-0.01331)^2+(0.01274-0.01305)^2+(0.01435-0.01462)^2+\ldots}$$

$$\sqrt{..+(0.01279-0.01286)^2+(0.01279-0.01279)^2+(0.01281-0.01281)^2+(0.01365-0.01381)^2+\ldots}$$

$$\sqrt{..+(0.01134-0.01134)^2+(0.01274-0.01297)^2+(0.01366-0.01382)^2+(0.01360-0.01431)^2+\ldots}$$

$$\sqrt{..+(0.01525-0.01525)^2+(0.00623-0.00797)^2}$$

= 0.00221

b) The distance between the scores of each indicator and the matrix for negative ideal solutions

$$D_1^- = \sqrt{(0.01506-0.01431)^2+(0.01273-0.01245)^2+(0.01274-0.01274)^2+(0.01435-0.01435)^2+\ldots}$$

$$\sqrt{..+(0.01279-0.01182)^2+(0.01279-0.01181)^2+(0.01281-0.01105)^2+(0.01365-0.01348)^2+\ldots}$$

$$\sqrt{..+(0.01134-0.01070)^2+(0.01274-0.01274)^2+(0.01366-0.01317)^2+(0.01360-0.01360)^2+\ldots}$$

$$\sqrt{..+(0.01431-0.01431)^2+(0.00797-(-0.02478))^2}$$

= 0.03285

↓ same calculation up to D_{31}^-

$$D_{31}^- = \sqrt{(0.01431-0.01431)^2+(0.01273-0.01245)^2+(0.01274-0.01274)^2+(0.01435-0.01435)^2+\ldots}$$
$$\sqrt{..+(0.01279-0.01182)^2+(0.01279-0.01181)^2+(0.01281-0.01105)^2+(0.01365-0.01348)^2+\ \ldots}$$
$$\sqrt{..+(0.01134-0.01070)^2+(0.01274-0.01274)^2+(0.01366-0.01317)^2+(0.01360-0.01360)^2+\ldots}$$
$$\sqrt{..+(0.01525-0.01431)^2+(0.00623-(-0.02478))^2}$$
$$= 0.03112$$

6) Determine the preference score for each indicator.

$$V_1 = \frac{D_1^-}{D_1^- + D_1^+}$$
$$= \frac{0.03285}{0.03285+0.00141}$$
$$= 0.95880$$

↓ same calculation up to V_{31}

$$V_{31} = \frac{D_{31}^-}{D_{31}^- + D_{31}^+}$$
$$= \frac{0.03112}{0.03112+0.00221}$$
$$= 0.93381$$

7) Make decisions based on preference scores: Based on the results of the preference score, the most dominant indicator as a trigger for the success of blended learning implementation at IT vocational schools was V1, namely, I1 (the education service regulation regarding the need for blended learning).

At the revision stage of the initial trial results, there was nothing that needs to be revised in major related to the TOPSIS calculation process used in the design of the evaluation model. In addition, based on the results of the field evaluation shown in Table III, the effectiveness percentage was 87.230%. If that effectiveness percentage was matched with eleven's scale categorization (as shown in Table I) shows that the evaluation model design was included in the excellent category. So, In general, there was nothing that needs to revise in the evaluation model design. Therefore it can be concluded in general that the evaluation model design has been made optimally and the calculation simulation of the TOPSIS formula has been able to show an accurate calculation in determining the most dominant indicator as a trigger for the success of blended learning implementation at IT vocational schools.

Ma and Lee's research has similarities with this study in evaluating the effectiveness of blended learning implementation. However, the difference is in the uses of the evaluation model. Ma and Lee's research [38] used the ARCS (Attention, Relevance, Confidence, and Satisfaction) model, while this study in principle used the Discrepancy model. The limitation of Ma and Lee's research was it had not shown an accurate calculation process in determining the trigger indicators for the effectiveness of the blended learning implementation. Martín-Martínez et al.'s research have similarities with this study related to the object being evaluated, the difference is the evaluation mechanism. This study used a combination of the Discrepancy model, the TOPSIS method, and the Tat Twam Asi concept to determine the trigger indicators for the effectiveness of the blended learning implementation. The research of Martín-Martínez et al. [39] used a matrix of rotated factors to determine the level of effectiveness of the blended learning implementation. Sukirman et al.'s research have similarities with this study related to measuring the effectiveness of the blended learning implementation. The difference is the research approach. This study used an evaluative approach, while Sukirman et al.'s research [40] used an experimental study approach.

In general, this research has been able to give contributions to answering some of the limitations previously found in Embi et al.'s research, Istanbul and Supriadi's research, Agustina and Mukhtaruddin's research, Ngala et al.'s research, Siswadi et al.'s research, and Sugianto's research, through showing the dominant indicators that were the main cause of the successful implementation of the program (in this case blended learning at IT vocational schools in Bali Province) using the Discrepancy evaluation model based on Tat Twam Asi with TOPSIS calculation. Although this research was felt to solve the limitations of some previous studies, this research was also not perfect. There were several things found as limitations in this research, including 1) the indicators related to the readiness of funds in realizing blended learning have not been discussed in detail and 2) indicators related to the governance of the use of funds incurred in the blended learning administration have not been discussed in detail

V. Conclusion

The design of the Discrepancy evaluation model based on Tat Twam Asi with the TOPSIS calculation developed through this research was able to show the stages of structured evaluation and through an accurate calculation process in determining the dominant indicators that trigger the effectiveness/success of blended learning implementation in IT vocational schools in Bali Province. The evaluation stages used in this model were based on the Discrepancy model which has four evaluation components, including definition, installation, process, and product. The calculation process to determine the dominant indicators in this evaluation model uses the TOPSIS formula with the average weight given by experts for each criteria referring to the Tat Twam Asi concept that prioritizes

equality of rights/authority. Future work that can be done to overcome the limitations found in this research is to include indicators of the readiness of funds in the installation component and include indicators of funding governance in the process components contained in the evaluation model.

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