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THE *CIPP-SAW* EVALUATION MODEL DESIGN IN MEASUREMENT THE EFFECTIVENESS OF E-LEARNING AT HEALTH UNIVERSITIES IN BALI

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ABSTRACT

This research aims to provide information about the design of an evaluation model that is suitable to be used to evaluate the level of effectiveness of the application of e-learning in health colleges in Bali. The evaluation model intended is called *CIPP-SAW*, where this model is a combination of the *CIPP* (*Context-Input-Process-Product*) evaluation model with *SAW* (*Simple Additive Weighting*) method. The *CIPP-SAW* model is capable of presenting accurate calculation results in determining evaluation aspects which are classified based on preference values ranging from the lowest to the highest value. This research was carried out with a development approach used the Borg and Gall method which focused on three stages, including: 1) design development; 2) initial trial; and 3) initial trial revision. Subjects that were involved in the stage of design development and stage of initial trial revision were three people (all researchers). Subjects that were involved in the stage of initial trial were 34 respondents (4 knowledge experts and 30 lecturers). The instrument that was used in data collection was a questionnaire consisting of 10 question items. The analysis technique was used was the quantitative descriptive, with the results of the analysis showed the evaluation model design that was classified as good with an effectiveness percentage was 88.00%.

Keywords: *CIPP, SAW, Evaluation Model, E-Learning, Health Universities*

1. INTRODUCTION

The implementation of ICT in the industrial revolution era 4.0 is an essential thing to do because all activities carried out by humans today require a quick, easy, and optimal solution through an integrated, predictable and real-time computer system. This matter is following the statement of Khan and Turowski [1] which states that the scenario of the industrial revolution 4.0 can be running optimally in solving the human life problems as long as the computerized system can work in real-time, integrated, and easily predict the threats or possibilities of risks that occur in the future.

Likewise, also in higher education, the use of information technology has supported the teaching process carried out by lecturers, where conventional teaching methods have gradually shifted towards computer-assisted learning. This matter is following the opinion of Neo *et al.* [2], which stated that current the conventional teacher-centered teaching methods had transform become student-centered information technology-based teaching methods.

One ICT-based learning model that is commonly used in the learning process in higher education is e-learning. E-learning is computer-assisted learning that is used to help student-centered collaborative learning processes. That matter is following the opinion of Jethro, Grace, and Thomas [3] which stated that E-learning could be seen as student-centered learning and it was able to create a collaborative learning climate with the learning process that utilizes computer assistance.

The existence of e-learning in the field of education can provide an opportunity for everyone to be able to learn and share knowledge resources with easy access without being limited by distance and time. This matter is in accordance with the opinion of Lin *et al.* [4] which in principle stated that e-learning systems can share educational resources in various fields without being limited by time and space, so that the learning model could reduce the gap of people to it was able to access knowledge and get a quality education. That Lin *et al.*'s statement was also reinforced by the Reeves *et al.*'s statement [5] which stated that the existence of e-learning could save education costs because the students could learn from home without must be come to school, so the cost of travel to school could be minimized.

The implementation of e-learning in higher education must be supported by adequate specifications of digital tools and readiness of human resources to use them so that the learning process can run optimally. This matter is in accordance with the opinion of Arkorful and Abaidoo [6] which stated that in the teaching and learning process based on e-learning model were needed the digital devices with appropriate specifications and readiness of the user's ability to operate those the digital devices, so the effectiveness of implementation e-learning could be realized well.

Even so, in reality, there are still many universities (especially in health universities in Bali) that have not been effective in implementing this learning model in the learning process. The cause of those ineffectiveness needs to be sought with use the appropriate evaluation model. Some evaluation model that can be used to measure the implementation of e-learning optimally, such as formative summative and *CIPP* model. But if only relying on the evaluation components of each of those model, then it is still difficult to determine the dominant aspects that need attention to be improved. Based on those problems, it is necessary to determine the innovation of evaluation model that can be used to determine the dominant aspects that are prioritized for revision in realize the effectiveness of the implementation of e-learning in health universities.

The evaluation model innovation that can be designed is in the form of the *CIPP-SAW* model which is a combination of educational evaluation model with artificial intelligence model so that it can determine the dominant aspects in each component context, input, process, and product based on the highest vector value through the results of *SAW* calculation. Based on that innovation, the purpose of this study was to found the form of innovation design from modified the *CIPP* (*Context-Input-Process-Product*) evaluation model with *SAW* (*Simple Additive Weighting*) which could be used as an evaluation model of the e-learning in health universities. The problem statement of this study was "how was the design of the *CIPP-SAW* model that was used to measure the effectiveness of the e-learning implementation in health colleges, especially those in Bali?".

This research was motivated by several results and constraints that were found in relevant studies that had conducted by several previous researchers. Research that was conducted by Tymczyńska [7] showed that the Moodle platform could be used to support the collaborative learning process that allows students to create learning communities independently outside the classroom. The obstacles that were found in the Tymczyńska's research were it didn't yet show the input and process components that were used to evaluate online learning activities, because in this research only focus on context and product evaluation components. Research that was conducted by Zhang *et al*. [8] explained that the suitable platform for e-learning of social medicine is Moodle, where Moodle can provide modules for self-learning and modules for mixed learning. The constraints that were found in Zhang *et al*.'s research were it didn't yet discuss the dominant aspects that need to be prioritized for reforming the e-learning of social medicine starting from context evaluation components, input evaluation components, process evaluation components, product evaluation components. Evaluation that was carried out in Zhang *et al*.'s research was only limited to show the correlation that was occurred between the log of online activities with the test results that was obtained by students. The research that was conducted by Dhir *et al*. [9] also explained things which in principle was the same as Zhang *et al*. E-learning provides the self-learning modules and blended learning. The self-learning module enables students to learn actively and explore learning resources themselves through full online, while the blended learning module makes it possible the students doing learning together both with the teachers in full face-to-face through online. The limitations that were found in Dhir *et al*.'s research were it didn't yet explain about the types of evaluation model that could be used to measure the e-learning effectiveness, because Dhir *et al*.'s research only focuses to explained the resolution, characteristics, advantages, and perceptions of users to e-learning.

Based on previous research problems and relevant research, the authors were interested and felt it was important to research and provide essential information to readers about the design of *CIPP* evaluation model that modified with the *SAW* concept to obtained an overview of how to measure the e-learning effectiveness in the several health universities in Bali.

2. RESEARCH METHODOLOGY

Generally, this research used a development approach, with ten development stages of the Borg and Gall method. However, especially in 2019, this research focused on several stages, including 1) design development; 2) initial trial; 3) initial trial revision. During the design development stage, the initial design of the evaluation model was made by combining the concept of *CIPP* with *SAW*. During the design development stage, all members of the researcher had expertise in the fields of education evaluation, health, and informatics engineering education.

In the initial trial phase, it was conducted the assessment on the initial design of the *CIPP-SAW* evaluation model that involved two educational evaluation experts, two informatics education experts, and 30 lecturers from health universities in the Province of Bali. Determination of subjects that involved in conducting the initial trial used a purposive sampling technique that determined the parties involved and comprehending thoroughly about the object being studied or assessed. In the initial trial revision phase, the trial results were revised on the suggestions given by experts and lecturers who had made an initial assessment of the design of the *CIPP-SAW* evaluation model. The time that was needed to make a model design for one week. The time that was needed to conduct an initial trial for one month. The time that was needed to revised the model design that according to the recommendations of experts and lecturers for one week. The location of this research was carried out at six health universities that were located in 4 districts in the province of Bali. As for the six health universities, including *STIKES Buleleng* that is located in *Buleleng* Regency; *STIKES Bina Usada Bali* that is located in *Badung* Regency; *STIKES Wiramedika Bali*, *STIKES Bali*, and Polytechnic State of *Denpasar* that is located in *Denpasar*; as well as *STIKES Advaita Medika* that is located in *Tabanan* Regency. The tool that was used to conduct an initial trial on the design of the *CIPP-SAW* evaluation model in the form of questionnaires instruments. The questionnaires consist of 10 questions with five answer items that used a Likert scale. The analysis technique that was used in analyzing the results of the answers to the questionnaires was quantitative descriptive, by explained the comparison results of the quality score of the evaluation model design with a standard reference score that refers to the five-scale quality categorization. The way to determine the design quality score of the model uses the formula of the quantitative descriptive percentage that completely can be seen in equation (1) [10], while the five-scale quality categorization score can be shown in Table 1.

$$\text{Quality Score} = \frac{\sum (\text{Respondents Answer} * \text{The Weight of Each Respondents Answer Choice})}{n * \text{Highest Weight}} * 100\% \quad (1)$$

Where:
n = The Total Number of Questionnaires Items
∑ = total

Table 1: Conversion of Effectiveness Level on Scale's Five

Range Percentage (%)	Category	Decision
0-54	Very Less	Revision
55-64	Less	Revision
65-79	Enough	Revision
80-89	Good	No Revision Needed
90-100	Very Good	No Revision Needed

3. RESULTS AND DISCUSSION

The design of the *CIPP-SAW* evaluation model design was made using the *yEd Graph Editor* application. The form of the evaluation model design that was intended can be seen in Figure 1.

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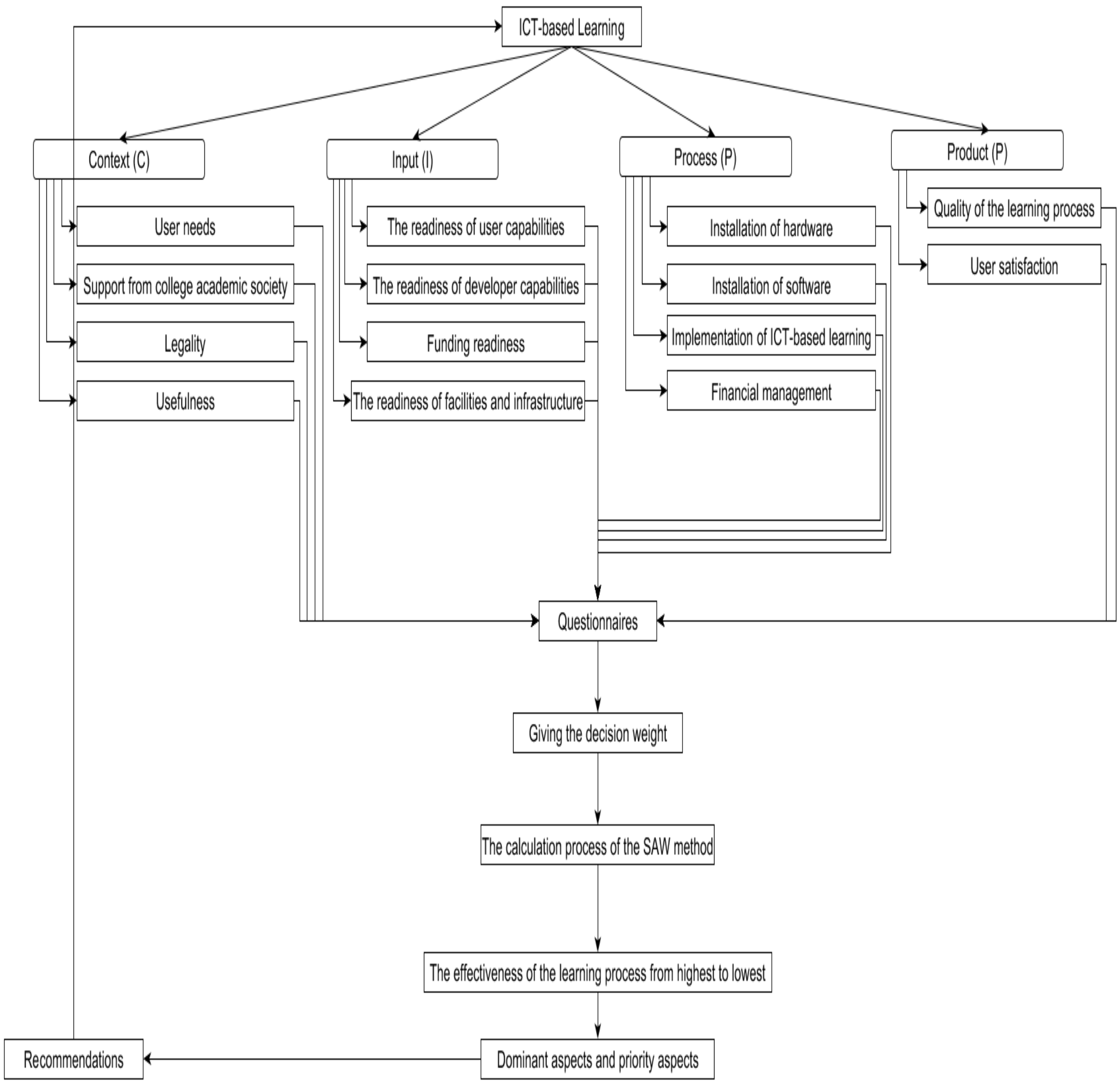

Figure 1 above showed the design form of the *CIPP-SAW* evaluation model that is used to provide an overview of the mechanism of the evaluation process for the implementation of e-learning in several health universities in the province of Bali. That evaluation model uses a combination of *CIPP* evaluation models with one of the decision-making methods, namely, *SAW*. The *CIPP* evaluation model is used as a basis for determining evaluation aspects, while the *SAW* method is used as the basis for calculations in determining the dominant aspects that need to be improved in implementing e-learning. The *CIPP* evaluation model is one of the educational evaluation models consisting of 4 main components, including context components, input components, process components, and product components. Asfaroh, Rosana, and Supahar [11] stated that *CIPP* is the abbreviation of Context-Input-Process-Product. Aziz, Mahmood, and Rehman [12] stated that the *CIPP* model is an effective educational evaluation model that is used to evaluate school services.

The number of aspects that are used in the context, input, and process components in the *CIPP-SAW* evaluation model is four aspects, while for the product components, there are two aspects. Each evaluation aspect is measured those use questionnaires. The measurement results of each aspect are then given the weight of the decision by the experts/decision makers, to proceed with the calculation process using the *SAW* method in determine the dominant aspects that need to get the treatment. Adriyendi [13] stated that *SAW* is the best method of decision making, and the calculation is simple. Podvezko [14] stated that *SAW* is the decision support method that most are used, most simple, and natural.

Experts/decision makers give recommendations based on the results of determining the most dominant aspects of all aspects of evaluation, starting from the lowest level to the highest level using the *SAW* method. The calculation process of the *SAW* method to determine the dominant aspects can be simulated using simulation data shown in Table 2.

Table 2: The Data of Assessment Average for Each Aspect of Evaluation by Experts

No	Evaluation Aspects	Evaluation Components			
		Context	Input	Process	Product
1	User needs	4.25	1.00	1.00	1.00
2	Support form college academic society	4.50	1.00	1.00	1.00
3	Legality	4.75	1.00	1.00	1.00
4	Usefulness	4.50	1.00	1.00	1.00
5	The readiness of user capabilities	1.00	3.75	1.00	1.00
6	The readiness of developer capabilities	1.00	4.25	1.00	1.00
7	Funding readiness	1.00	3.25	1.00	1.00
8	The readiness of facilities and infrastructure	1.00	3.25	1.00	1.00
9	Installation of hardware	1.00	1.00	4.25	1.00
10	Installation of software	1.00	1.00	3.75	1.00
11	Implementation of ICT-based learning	1.00	1.00	3.75	1.00
12	Financial management	1.00	1.00	3.00	1.00
13	Quality of the learning process	1.00	1.00	1.00	3.75
14	User satisfaction	1.00	1.00	1.00	4.00

Based on the data that was shown in Table 2, then the *SAW* calculation can be carried out to determine the most dominant aspects to be the priority of improvement. The calculation stages are as follows.

1. Determination of data normalization

At this stage, it begins by identifying aspects that include benefit attributes and cost attributes. Some aspects that are classified as benefit attributes are based on the data in Table 2, including: aspects of the user need, aspects of the support form college academic society, aspects of the legality, aspects of the usefulness, aspects of the readiness of user capabilities, aspects of the readiness of developer capabilities, aspects of the readiness of facilities and infrastructure, aspects of the hardware installation, aspects of the software installation, aspects of the ICT-based learning implementation, aspects of the quality of the learning process, and aspects of user satisfaction. Aspects classified as cost attributes, including aspects of the funding readiness and aspects of financial management. The next step, normalization calculation is done by using formula (2) [15].

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{\underset{i}{Max}\ x_{ij}} & \text{if j is benefit attribute} \\ \dfrac{\underset{i}{Min}\ x_{ij}}{x_{ij}} & \text{if j is cost attribute} \end{cases} \quad (2)$$

Where:

r_{ij} is the normalized performance rating of the A_i alternative on the C_j attribute; i=1,2,...,m and j=1,2,...,n [15].

Based on the formula (2) and the data available in Table 2, the normalization of data can be completed. The normalization calculation process completely can be shown as follows.

$$r_{1\text{-}1} = \frac{4.25}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{4.25}{4.75} = 0.895$$

$$r_{2\text{-}1} = \frac{4.50}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{4.50}{4.75} = 0.947$$

$$r_{3\text{-}1} = \frac{4.75}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{4.75}{4.75} = 1.000$$

$$r_{4\text{-}1} = \frac{4.50}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{4.50}{4.75} = 0.947$$

$$r_{5\text{-}1} = \frac{1.00}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.75} = 0.211$$

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$$r_{6-1} = \frac{1.00}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.75} = 0.211$$

$$r_{7-1} = \frac{\min\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}}{1.00} = \frac{1.00}{1.00} = 1.000$$

$$r_{8-1} = \frac{1.00}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.75} = 0.211$$

$$r_{9-1} = \frac{1.00}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.75} = 0.211$$

$$r_{10-1} = \frac{1.00}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.75} = 0.211$$

$$r_{11-1} = \frac{1.00}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.75} = 0.211$$

$$r_{12-1} = \frac{\min\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}}{1.00} = \frac{1.00}{1.00} = 1.000$$

$$r_{13-1} = \frac{1.00}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.75} = 0.211$$

$$r_{14-1} = \frac{1.00}{\max\{4.25;4.50;4.75;4.50;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.75} = 0.211$$

$$r_{1-2} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{2-2} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{3-2} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{4-2} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{5-2} = \frac{3.75}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{3.75}{4.25} = 0.882$$

$$r_{6-2} = \frac{4.25}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{4.25}{4.25} = 1.000$$

$$r_{7-2} = \frac{\min\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}}{3.25} = \frac{1.00}{3.25} = 0.308$$

$$r_{8-2} = \frac{3.25}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{3.25}{4.25} = 0.765$$

$$r_{9-2} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{10-2} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{11-2} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{12-2} = \frac{\min\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}}{1.00} = \frac{1.00}{1.00} = 1.000$$

$$r_{13-2} = \frac{1.00}{} = \frac{1.00}{} = 0.235$$

$$\overline{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} \quad \overline{4.25}$$

$$r_{14-2} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;3.75;4.25;3.25;3.25;1.00;1.00;1.00;1.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{1-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{2-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{3-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{4-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{5-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{6-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{7-3} = \frac{\min\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}}{1.00} = \frac{1.00}{1.00} = 1.000$$

$$r_{8-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{9-3} = \frac{4.25}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{4.25}{4.25} = 1.000$$

$$r_{10-3} = \frac{3.75}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{3.75}{4.25} = 0.882$$

$$r_{11-3} = \frac{3.75}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{3.75}{4.25} = 0.882$$

$$r_{12-3} = \frac{\min\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}}{3.00} = \frac{1.00}{3.00} = 0.333$$

$$r_{13-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{14-3} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;4.25;3.75;3.75;3.00;1.00;1.00\}} = \frac{1.00}{4.25} = 0.235$$

$$r_{1-4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{2-4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{3-4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{4-4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{5-4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{6-4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{7-4} = \frac{\min\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}}{1.00} = \frac{1.00}{1.00} = 1.000$$

$$r_{8\text{-}4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{9\text{-}4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{10\text{-}4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{11\text{-}4} = \frac{1.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{1.00}{4.00} = 0.250$$

$$r_{12\text{-}4} = \frac{\min\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}}{1.00} = \frac{1.00}{1.00} = 1.000$$

$$r_{13\text{-}4} = \frac{3.75}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.00\}} = \frac{3.75}{4.00} = 0.938$$

$$r_{14\text{-}4} = \frac{4.00}{\max\{1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;1.00;3.75;4.0} = \frac{4.00}{4.00} = 1.000$$

2. Determination of the Matrix

The results of the normalization above are then mapped into the normalization matrix. That matrix is intended can be shown as follows.

$$R = \begin{bmatrix} 0.895 & 0.235 & 0.235 & 0.250 \\ 0.947 & 0.235 & 0.235 & 0.250 \\ 1.000 & 0.235 & 0.235 & 0.250 \\ 0.947 & 0.235 & 0.235 & 0.250 \\ 0.211 & 0.882 & 0.235 & 0.250 \\ 0.211 & 1.000 & 0.235 & 0.250 \\ 1.000 & 0.308 & 1.000 & 1.000 \\ 0.211 & 0.765 & 0.235 & 0.250 \\ 0.211 & 0.235 & 1.000 & 0.250 \\ 0.211 & 0.235 & 0.882 & 0.250 \\ 0.211 & 0.235 & 0.882 & 0.250 \\ 1.000 & 1.000 & 0.333 & 1.000 \\ 0.211 & 0.235 & 0.235 & 0.938 \\ 0.211 & 0.235 & 0.235 & 1.000 \end{bmatrix}$$

3. Stage of Ranking

Things that need to be prepared before making a ranking are determining the weights for each evaluation component. After the weight is determined, then the calculation can be done using the following formula (3) [16].

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \quad (3)$$

Where:

V_i = preference values for each alternative
W_j = weight of decision makers
r_{ij} = a performance rating that has been normalized from each alternative
j = the initial limit value of an iteration
n = the final limit value of an iteration

The weight given by experts for context components is 25%, the input component is 25%, the process component is 25%, and product component is 25%. Based on the weight and data in the R matrix, the ranking can be calculated as follows.

V_1 = (0.25)(0.895) + (0.25)(0.235) + (0.25)(0.235) + (0.25)(0.250) = 0.404
V_2 = (0.25)(0.947) + (0.25)(0.235) + (0.25)(0.235) + (0.25)(0.250) = 0.417
V_3 = (0.25)(1.000) + (0.25)(0.235) + (0.25)(0.235) + (0.25)(0.250) = 0.430
V_4 = (0.25)(0.947) + (0.25)(0.235) + (0.25)(0.235) + (0.25)(0.250) = 0.417
V_5 = (0.25)(0.211) + (0.25)(0.882) + (0.25)(0.235) + (0.25)(0.250) = 0.395
V_6 = (0.25)(0.211) + (0.25)(1.000) + (0.25)(0.235) + (0.25)(0.250) = 0.424
V_7 = (0.25)(1.000) + (0.25)(0.308) + (0.25)(1.000) + (0.25)(1.000) = 0.827
V_8 = (0.25)(0.211) + (0.25)(0.765) + (0.25)(0.235) + (0.25)(0.250) = 0.365
V_9 = (0.25)(0.211) + (0.25)(0.235) + (0.25)(1.000) + (0.25)(0.250) = 0.424
V_{10} = (0.25)(0.211) + (0.25)(0.235) + (0.25)(0.882) + (0.25)(0.250) = 0.395
V_{11} = (0.25)(0.211) + (0.25)(0.235) + (0.25)(0.882) + (0.25)(0.250) = 0.395
V_{12} = (0.25)(1.000) + (0.25)(1.000) + (0.25)(0.333) + (0.25)(1.000) = 0.833
V_{13} = (0.25)(0.211) + (0.25)(0.235) + (0.25)(0.235) + (0.25)(0.938) = 0.405
V_{14} = (0.25)(0.211) + (0.25)(0.235) + (0.25)(0.235) + (0.25)(1.000) = 0.420

Based on the results of the ranking calculation, the recapitulation can be made. The ranking recapitulation can be shown in Table 3.

Table 3: The Recapitulation of Ranking Results

Rank	V	Preference Value	Aspects
1	V_{12}	0.833	Financial management
2	V_7	0.827	Funding readiness
3	V_3	0.430	Legality
4	V_6	0.424	The readiness of developer capabilities
5	V_9	0.424	Installation of hardware
6	V_{14}	0.420	User satisfaction
7	V_2	0.417	Support form college academic society
8	V_4	0.417	Usefulness
9	V_{13}	0.405	Quality of the learning process
10	V_1	0.404	User needs
11	V_5	0.395	The readiness of user capabilities
12	V_{10}	0.395	Installation of software
13	V_{11}	0.395	Implementation of ICT-based learning
14	V_8	0.365	The readiness of facilities and infrastructure

Based on the data in Table 3 above, the aspect of readiness of facilities and infrastructure is the most dominant aspect of getting the top priority to be improved because the preference value shows the lowest score. The aspect that is retained its effectiveness is the financial management aspect because they get the highest score. The initial trial of the *CIPP-SAW* evaluation model design involved four experts and 30 lecturers. The trial results completely can be shown in Table 4.

Table 4: Initial Test Results

Respondents	Item-										Σ	Effectiveness Percentage (%)
	1	2	3	4	5	6	7	8	9	10		
Expert-1	5	4	5	5	4	4	5	4	5	5	46	92.00
Expert-2	4	4	4	4	5	3	4	5	4	5	42	84.00
Expert-3	5	4	4	5	4	4	5	4	5	4	44	88.00
Expert-4	5	4	5	4	5	4	5	4	4	4	44	88.00
Lecturer-1	5	4	4	4	5	5	4	5	4	4	44	88.00
Lecturer-2	4	5	4	4	4	4	5	5	4	5	44	88.00
Lecturer-3	5	4	5	4	4	5	4	5	4	4	44	88.00
Lecturer-4	4	4	4	5	4	4	5	4	5	4	43	86.00
Lecturer-5	5	4	4	5	4	4	5	5	4	5	45	90.00
Lecturer-6	4	5	5	4	5	3	4	4	5	5	44	88.00
Lecturer-7	4	4	4	5	4	3	5	5	5	4	43	86.00
Lecturer-8	4	4	5	4	5	4	4	4	5	5	44	88.00
Lecturer-9	5	4	4	5	4	4	4	4	5	4	43	86.00
Lecturer-10	4	4	5	4	4	3	5	4	5	4	42	84.00
Lecturer-11	5	5	4	4	5	4	5	4	5	5	46	92.00
Lecturer-12	4	4	5	4	4	5	4	5	5	5	45	90.00
Lecturer-13	4	4	4	5	4	4	5	5	4	4	43	86.00
Lecturer-14	5	4	5	5	5	3	4	4	5	4	44	88.00
Lecturer-15	5	5	4	4	4	5	5	4	4	4	44	88.00
Lecturer-16	4	4	5	4	4	4	4	5	4	4	42	84.00
Lecturer-17	4	5	4	5	4	4	5	4	4	5	44	88.00
Lecturer-18	5	5	5	4	5	3	4	4	4	4	43	86.00
Lecturer-19	4	5	4	4	5	5	4	5	4	5	45	90.00
Lecturer-20	5	4	4	4	4	4	5	4	5	4	43	86.00
Lecturer-21	4	4	4	5	5	4	4	5	4	4	43	86.00
Lecturer-22	4	4	5	4	5	4	4	4	5	4	43	86.00

Respondents	Item-										∑	Effectiveness Percentage (%)
	1	2	3	4	5	6	7	8	9	10		
Lecturer-23	5	5	4	5	5	5	4	5	5	4	47	94.00
Lecturer-24	5	4	4	4	4	3	5	4	4	5	42	84.00
Lecturer-25	4	5	5	4	5	4	5	5	4	4	45	90.00
Lecturer-26	4	4	4	5	5	4	4	5	5	4	44	88.00
Lecturer-27	5	5	4	5	4	3	5	4	5	5	45	90.00
Lecturer-28	5	4	5	4	5	4	4	5	4	4	44	88.00
Lecturer-29	4	4	4	5	4	5	5	5	4	4	44	88.00
Lecturer-30	5	4	5	4	4	4	4	5	4	4	43	86.00
Average												**88.00**

Generally, the results of the initial trial design of the *CIPP-SAW* evaluation model have been going well. The average percentage of effectiveness showed that the evaluation model design was in a good category, so there wasn't need to make major revisions. However, there were some suggestions given by respondents when conducted the initial trials. Those suggestions can be shown in Table 5.

Table 5: Respondents Suggestions for the Design of the CIPP-SAW Evaluation Model

Respondents	Suggestions
Expert-1	I recommend that you display the *SAW* formula in the model design
Expert-2	It is better to show the details of giving scores from all four experts so that it appears the source of values that have obtained and shown on each aspect of evaluation in the simulation data.
Expert-3	It is recommended for the font size in the evaluation model design be enlarged
Expert-4	Show the *SAW* formula in the model design
Lecturer-6	If make it possible, the picture of model design is enlarged so we can see clear
Lecturer-7	If make it possible, the size of all fonts in the model design must be more is enlarged, so it easier to read.
Lecturer-10	If make it possible, the font size is zoomed, because the font size is too small so difficult to read it.
Lecturer-14	If make it possible, display the *SAW* formula in the model design
Lecturer-18	Please enlarge each font that is used on the model design
Lecturer-24	If make it possible, explain how to get the score of each evaluation aspect shown in the simulation data table
Lecturer-27	If make it possible, The model design is equipped with the *SAW* formula

Based on the suggestions given by the respondents when conducting an initial trial of the design of the *CIPP-SAW* evaluation model that has shown in Table 5, the next step was carried out a revised of the model design and revised the simulation data. The complete revision of simulation data can be shown in Table 6, while the revised model design can be shown in Figure 2.

Table 6: The Revision of Simulation Data

Evaluation Aspects	Evaluation Components															
	Context				Input				Process				Product			
	E1	E2	E3	E4	E1	E2	E3	E4	E1	E2	E3	E4	E1	E2	E3	E4
User needs	5	4	4	4	1	1	1	1	1	1	1	1	1	1	1	1
	Average		4.25		Average		1.00		Average		1.00		Average		1.00	
Support form college academic society	4	5	5	4	1	1	1	1	1	1	1	1	1	1	1	1
	Average		4.50		Average		1.00		Average		1.00		Average		1.00	
Legality	5	5	4	5	1	1	1	1	1	1	1	1	1	1	1	1
	Average		4.75		Average		1.00		Average		1.00		Average		1.00	
Usefulness	4	5	4	5	1	1	1	1	1	1	1	1	1	1	1	1
	Average		4.50		Average		1.00		Average		1.00		Average		1.00	
The readiness of user capabilities	1	1	1	1	3	4	4	4	1	1	1	1	1	1	1	1
	Average		1.00		Average		3.75		Average		1.00		Average		1.00	
The readiness of developer capabilities	1	1	1	1	4	5	4	4	1	1	1	1	1	1	1	1
	Average		1.00		Average		4.25		Average		1.00		Average		1.00	
Funding readiness	1	1	1	1	3	4	3	3	1	1	1	1	1	1	1	1

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Evaluation Aspects	Evaluation Components															
	Context				Input				Process				Product			
	E1	E2	E3	E4	E1	E2	E3	E4	E1	E2	E3	E4	E1	E2	E3	E4
	Average		1.00		Average		3.25		Average		1.00		Average		1.00	
The readiness of facilities and infrastructure	1	1	1	1	3	4	3	3	1	1	1	1	1	1	1	1
	Average		1.00		Average		3.25		Average		1.00		Average		1.00	
Installation of hardware	1	1	1	1	1	1	1	1	4	5	4	4	1	1	1	1
	Average		1.00		Average		1.00		Average		4.25		Average		1.00	
Installation of software	1	1	1	1	1	1	1	1	4	3	4	4	1	1	1	1
	Average		1.00		Average		1.00		Average		3.75		Average		1.00	
Implementation of ICT-based learning	1	1	1	1	1	1	1	1	4	4	4	3	1	1	1	1
	Average		1.00		Average		1.00		Average		3.75		Average		1.00	
Financial management	1	1	1	1	1	1	1	1	3	4	2	3	1	1	1	1
	Average		1.00		Average		1.00		Average		3.00		Average		1.00	
Quality of the learning process	1	1	1	1	1	1	1	1	1	1	1	1	4	3	4	4
	Average		1.00		Average		1.00		Average		1.00		Average		3.75	
User satisfaction	1	1	1	1	1	1	1	1	1	1	1	1	4	4	5	3
	Average		1.00		Average		1.00		Average		1.00		Average		4.00	

Notes: E1 = Expert-1; E2 = Expert-2; E3 = Expert-3; E4 = Expert-4

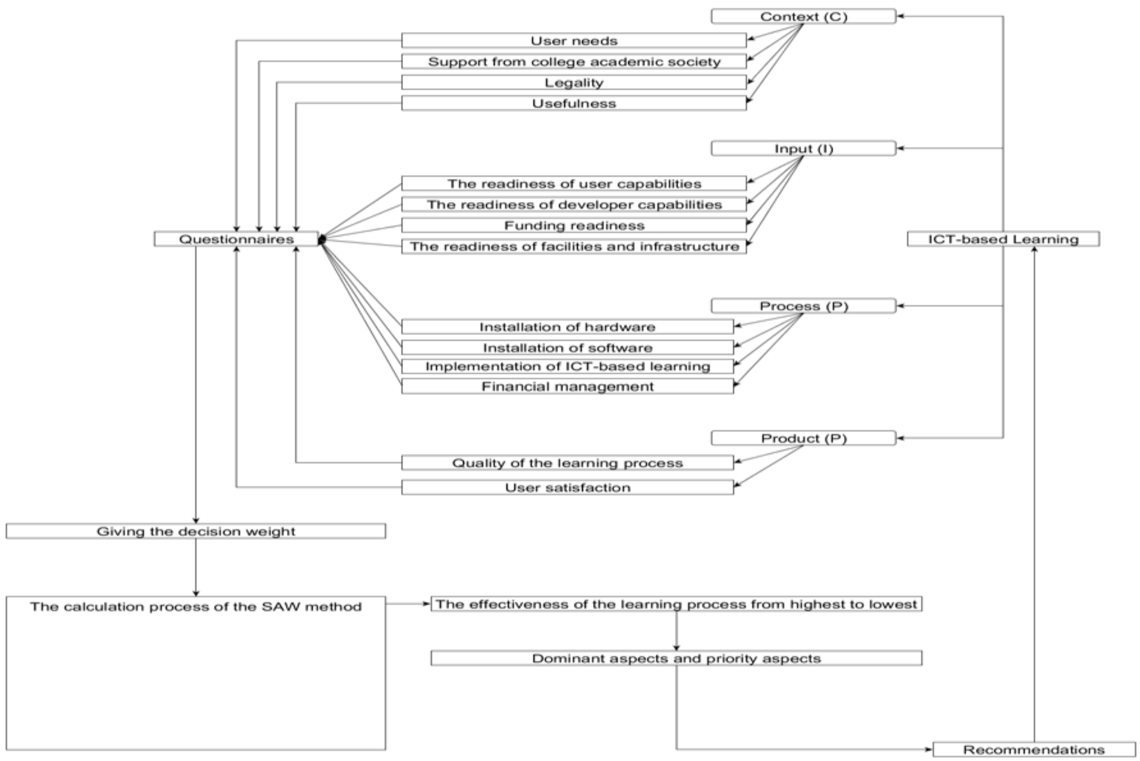

Figure 2: The Revision Design of CIPP-SAW Evaluation Model

The novelty of this study when is compared with previous studies is to present a *CIPP* evaluation model combined with the *SAW* concept, so that this model is able to show the calculation process based on artificial intelligence to determine the dominant aspects that are improvements priority in each component evaluation, including context, input, process, and product based on preference value from highest to lowest value. The results of this study are also reinforced by research conducted by Sanjaya *et al.* in 2019 [17] and Jampel *et al.* in 2017 [18] which show the accuracy of the *SAW* method that used to determine evaluation aspects which are the top priority for improvement.

The results of this study are able to answer the constraints of Tymczyńska's research by showing the existence of input components and process components to evaluate e-learning. Besides, this study was also able to overcome the research constraints of Zhang *et al.* by presenting *SAW* calculations in determining the dominant aspects that are prioritized for improvement in e-learning.

Although it had novelty and was a solution to other research constraints, this research also has

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constraints. Those constraints are there aren't yet evaluation standards set for each *CIPP* component.

4. CONCLUSIONS

The design and simulation of the *CIPP-SAW* evaluation model have been able to describe the accuracy of the process of determining the dominant aspects that need to be improved and must be maintained to obtain the effectiveness of the implementation of e-learning in health universities in Bali. The future work that needs to be done to answer the obstacles in this research is set the clear evaluation standard based on regulations owned by the government of the Republic of Indonesia regarding the use of ICT-based learning in health universities.

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