IConVET 2020
Journal of Physics: Conference Series 1810 (2021) 012044 doi:10.1088/1742-6596/1810/1/012044

The simulation of divayana formula calculation to determine the priority of recommendation in evaluation activities

D G H Divayana

1Department of Informatics Education, Universitas Pendidikan Ganesha

Email : hendra.divayana@undiksha.ac.id

Abstract. Evaluation activities are not carried out to determine whether to pass or not the program being evaluated. Evaluation activities tend to provide recommendations for improving or completion of the constraints that are still found in the program being evaluated. The problem that often occurs in the field is the difficulty in determining recommendation priority for each evaluation aspect. Therefore, a precise and accurate formula is needed to determine the recommendation priority in an evaluation activity. Hence, the evaluation results will be more optimal. The purpose of this study was to demonstrate a DIVAYANA formula calculation simulation in determining recommendation priority. This research approach was evaluative with research stages that follow the DIVAYANA model stages. This research focused on the DIVAYANA formula part which lies at the Nominate stage. The subjects involved in the initial data collection were ten students from the Department of Informatics Education, Universitas Pendidikan Ganesha. The subjects involved in determining the weight for the evaluation component were four experts. The tool used for initial data collection and expert weight determination was questionnaires. The analysis technique of this research was done by checking the correctness of the DIVAYANA formula calculation based on case proof. The results showed that the process of DIVAYANA formula calculating simulation had been running well as evidenced by the accuracy of the results of determining priority recommendation.

1. Introduction

Recommendations are the most important thing in an evaluation activity [1-5]. Evaluation results can be said to be good if the recommendations given are correct [6-9]. In general, the step to obtain appropriate recommendations in an evaluation activity is choosing an evaluation model that follows the evaluated object. However, in reality, not all evaluation models can provide accurate recommendations. This is due to the difficulty in determining evaluation aspects that gets recommendation priority. Sometimes evaluation aspects that are not the priority improvement given optimal recommendations, and even the treatments are the same as aspects that must receive top priority. It is necessary to determine recommendation priority on the evaluation aspect starting from the highest priority to the lowest priority. The determination of recommendation priority must be measurable and quantifiable using an appropriate formula. A new problem arises when there is a need for a formula in an evaluation model to determine recommendation priority on evaluation aspects. It is ranging from the highest priority to the lowest with a clear quantitative measure. This is due to the fact that often occurs in the field, in which the recommendation determination is not entirely based on quantitative data from evaluation results. Sometimes the recommendation determination is based on the findings of constraints in evaluation which tend to be qualitative in nature and high subjectivity.

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI. Published under licence by IOP Publishing Ltd.
Based on those problems, there is an innovation in the form of a formula called the DIVAYANA formula. This formula can be used to determine the recommendation priority ranking from highest priority to lowest. The presence of the DIVAYANA formula raises questions in this study. The research question is how does the DIVAYANA formula calculation simulation determine recommendation priority on evaluation aspects ranging from the highest to the lowest priorities in an evaluation activity?

The limitations found from several previous studies were a reference in this study. Research in 2018 was conducted by Santoso, Wibawa, and Pujianto [10], it showed the use of the SAW (Simple Additive Weighting) method in determining recommendations for vocational students’ internships. It has not shown the priority recommendations from lowest to highest priority yet was the limitedness of Santoso, Wibawa, and Pujianto’s research. Research in 2018 was conducted by Ibrahim and Surya [11], it showed the SAW method implementation to determine the best school selection decisions. The limitation of Ibrahim and Surya’s research was that it has not shown the recapitulation of SAW calculation results from the highest to the lowest preference score as a basis for determining the best recommendation in school selection. Research in 2019 was conducted by Myint, Soe, and Toe [12], it used the SAW approach to carry out an evaluation process in determining which students deserve a grant. Myint, Soe, and Toe’s research had shown the preference values recapitulation ranging from the highest to the lowest scores, but the limitation is that they have not shown the calculation process simulation detail yet. Research by Ramli et al. was conducted in 2017 [13], it showed the AHP (Analytic Hierarchy Process) approach to evaluate teaching performance in tertiary institutions. Research by Ramli et al. had succeeded in showing the results recapitulation of teaching performance evaluation from the highest to the lowest levels in the form of a bar chart. Their research limitedness is that they have not shown a gradual and complete calculation process to produce the recapitulation results yet. Research conducted in 2019 by Naveed et al. [14] showed the use of AHP to evaluate the determinant factor of e-learning implementation success. However, research done by Naveed et al. does not show clearly and structurally about the results of the recapitulation of priority factors that determine the success of implementing e-learning starting from the highest to the lowest priority.

2. Method
This research approach was evaluative research. The stages used in this study followed the DIVAYANA model stages. The DIVAYANA model stages, included: Description, Input, Verification, Action, Yack, Analysis, Nominate, and Actualization [15]. Based on the research questions that had been previously disclosed in the introduction, this research focuses on the Nominate stage. This is because the DIVAYANA formula is processed at the Nominate stage. The DIVAYANA formula has three equations. Equation (1) is used to determine the weight improvement average. Equation (2) is used to determine the normalized value. Equation (3) is used to determine the ranking value. Each equation can be shown as follows.

\[
(W_{Yack})_j = \frac{x_j}{\sum_{j=1}^{n} x_j} \quad (1)
\]

Notes:
\[W_{Yack}\] = The average of weights improvement
\[\bar{x}\] = The weighted average is given by experts through joint discussion
With \( i=1,2,3,\ldots,n \); and \( \sum (W_{Yack})_j \) the value must be 1.

Notes:
- \( D \) = vector-D
- \( x \) = assessment score of each criterion
- \( m \) = the total of all experts

\[
R_i = \frac{D_i}{\sum_{i=1}^{n} D_i}
\]

Notes:
- \( R \) = vector-R
- \( D \) = vector-D

The initial data used for the DIVAYANA formula simulation came from filling in ten questions from the questionnaire given to ten students of the Department of Informatics Education, Universitas Pendidikan Ganesha. The selection of ten students used a purposive sampling technique with the assumption that the ten students clearly knew and were directly involved in the ICT-based learning process carried out at Undiksha. The expert weight data came from the weighting done by four experts, including two experts in the field of informatics and two experts in the field of educational evaluation. Analysis in this study was carried out by checking the correctness of DIVAYANA formula calculation through case proof. Specifically, for this study, the case chosen was e-learning which was used in the learning process in the Department of Informatics Education.

3. Results and Discussion

Some data related to e-learning evaluation that needs to be prepared as material to simulate the DIVAYANA formula included: 1) the converted initial data and 2) weights data from experts. The initial data can be seen in Table 1, the converted initial data can be seen in Table 2, and the weights data given by experts can be seen in Table 3.

| Evaluation Aspects | Respondents | Evaluation Components | Total | Effectiveness Percentage |
|--------------------|-------------|-----------------------|-------|--------------------------|
|                    |             | **Context** | **Input** | **Process** | **Product** |       |                     |
|                    |             | Items-1 | Items-2 | Items-3 | Items-4 | Items-5 | Items-6 | Items-7 | Items-8 | Items-9 | Items-10 |       |                     |
| Quality            | Student-1   | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 4 | 4 | 43 | 86.00 |
|                    | Student-2   | 4 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 44 | 88.00 |
|                    | Student-3   | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 5 | 5 | 4 | 43 | 86.00 |
|                    | Student-4   | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 44 | 88.00 |
|                    | Student-5   | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 5 | 4 | 5 | 43 | 86.00 |
|                    | Student-6   | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 44 | 88.00 |
|                    | Student-7   | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 44 | 88.00 |
|                    | Student-8   | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 43 | 86.00 |
|                    | Student-9   | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 5 | 4 | 45 | 90.00 |
|                    | Student-10  | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 43 | 86.00 |

Average 87.20
Table 1 shows the initial data used to simulate the DIVAYANA formula. Based on Table 1, there are four evaluation aspects to evaluate e-learning, included: quality, services, cost efficiency, and speed. The evaluation component used refers to the CIPP component, which consists of four components, included: Context, Input, Process, and Product. Ten respondents namely students from the Department of Informatics Education, Universitas Pendidikan Ganesha which were involved in conducting an assessment of the e-learning used in the learning process. The assessment was carried out using a questionnaire consisting of 10 questions. The assessment of the context component used 2 questions (item-1 and item-2) related to each evaluation aspect. The assessment of the input components used 2 questions (item-3 and item-4) related to each evaluation aspect. Assessment of the process component used 3 questions (item-5, item-6, and item-7) related to each evaluation aspect. The assessment of the product components used 3 questions (item-8, item-9, and item-10) related to each evaluation aspect. The portion taken from table 1 and converted to table 2 is the average percentage effectiveness of each evaluation aspect.

**Table 2. Data Conversion.**

| Aspects      | Evaluation Components | Context | Input   | Process | Product |
|--------------|------------------------|---------|---------|---------|---------|
| Quality      |                        | 4.27    | 4.27    | 4.27    | 87.20   |
| Services     |                        | 9.27    | 72.20   | 9.27    | 9.27    |
| Cost Efficiency |                    | 83.60   | 5.47    | 5.47    | 5.47    |
| Speed        |                        | 6.07    | 6.07    | 81.80   | 6.07    |

The data shown by the black block cells in Table 2 are obtained from the average percentage effectiveness of each evaluation aspect shown in the gray block cells in Table 1. Other data that is not
black-blocked on each evaluation aspect is obtained by the score of 100 reduced with the score shown in the black blocked cell on the row where the evaluation aspect is located. The reduction results were then divided by 3. For example, a score of 4.27 on the quality aspect row was obtained by (100-87.20)/3. A score of 9.27 on the service aspect line was obtained by (100-72.20)/3. A score of 5.47 on the cost efficiency aspect line was obtained by (100-83.60)/3. A score of 6.07 on the speed aspect row was obtained by (100-81.80)/3. The reason for using this calculation is that all scores on each line are normal. It is indicated by the sum of all the scores on each line was 100. Example: on the quality aspect line, where 4.27 + 4.27 + 4.27 + 87.20 = 100.

Table 3. Weights from Experts.

| Evaluation Components | Weights that had given by experts | Average | Improvement of Weights Average |
|-----------------------|----------------------------------|---------|-------------------------------|
|                       | Expert-1 | Expert-2 | Expert-3 | Expert-4 |                   |
| Context               | 5        | 4        | 4        | 5        | 4.50 0.26        |
| Input                 | 4        | 4        | 5        | 4        | 4.25 0.24        |
| Process               | 4        | 5        | 4        | 4        | 4.25 0.24        |
| Product               | 4        | 4        | 5        | 5        | 4.50 0.26        |
|                       |          |          |          |          | ΣWtech 1.00      |

The weight for each evaluation component was determined by two educational evaluation experts and two informatics experts. The purpose of doing weight improvement is to normalize the weight of each evaluation component. The process of calculating the weight improvement is carried out using equations (1). Example: the weight average improvement for context components = 4.50/(4.50+4.25+4.25+4.50) = 0.26. Referring to Table 2 and Table 3, vector-D calculations can be performed. The process of calculating vector-D is carried out using equation (2) which can be shown in full as follows.

D₁ = \frac{(12.80^{0.26})(12.80^{0.24})(12.80^{0.24})(87.20^{0.26})}{4} = 5.24
D₂ = \frac{(27.80^{0.26})(72.20^{0.24})(27.80^{0.24})(27.80^{0.26})}{4} = 8.76
D₃ = \frac{(83.60^{0.26})(16.40^{0.24})(16.40^{0.24})(16.40^{0.26})}{4} = 6.23
D₄ = \frac{(18.20^{0.26})(18.20^{0.24})(81.80^{0.24})(18.20^{0.26})}{4} = 6.55

Based on the results of vector-D calculations, then the Vector-R calculation process is carried out to get the ranking results. The R-vector calculating process is carried out using equation (3) which can be shown in full as follows.

R₁ = \frac{D₁}{D₁ + D₂ + D₃ + D₄} = \frac{5.24}{5.24 + 8.76 + 6.23 + 6.55} = \frac{5.24}{26.79} = 0.20
R₂ = \frac{D₂}{D₁ + D₂ + D₃ + D₄} = \frac{8.76}{5.24 + 8.76 + 6.23 + 6.55} = \frac{8.76}{26.79} = 0.33
R₃ = \frac{D₃}{D₁ + D₂ + D₃ + D₄} = \frac{6.23}{5.24 + 8.76 + 6.23 + 6.55} = \frac{6.23}{26.79} = 0.23
R₄ = \frac{D₄}{D₁ + D₂ + D₃ + D₄} = \frac{6.55}{5.24 + 8.76 + 6.23 + 6.55} = \frac{6.55}{26.79} = 0.24

Then the Vector-R calculation results are recapitulated to make it easier in determining priority recommendations. The recapitulation results of priority recommendations can be seen in Table 4.
Table 4. Recapitulation of Priority Recommendations.

| Priority of Recommendations | Rank | Vector-R | Aspects      |
|------------------------------|------|----------|--------------|
| 1st                          | 1    | 0.33     | Services     |
| 2nd                          | 2    | 0.24     | Speed        |
| 3rd                          | 3    | 0.23     | Cost Efficiency |
| 4th                          | 4    | 0.20     | Quality      |

Based on Table 4, it can be stated the aspect that gets the priority of recommendations was the service aspect. It was because the services aspect got the highest vector-R score compared to other aspects.

This research had been able to overcome the limitations found in previous studies conducted by Santoso, Wibawa, and Pujianto [10]; Ibrahim and Surya [11]; Myint, Soe, and Toe [12]; Ramli et al. [13]; and Naveed et al. [14]. The research limitation was resolved by showing a gradual and complete simulation of DIVAYANA formula calculation, so that recommendation priority can be determined quickly and precisely.

4. Conclusion
The DIVAYANA formula is an innovation in the field of educational evaluation that presents the calculation process accuracy to determine priority recommendations in an evaluation activity. The results of this study indicate that the simulation calculation of the DIVAYANA formula has gone well. This is shown from the truth and accuracy of each stage that is passed in the calculation process to determine recommendation priority using the DIVAYANA formula.

Acknowledgment
The author would like to express his deep gratitude to the Head of Research and Community Service, Universitas Pendidikan Ganesha who had provided the opportunity and funded this research as evidenced by the research grant contract no. 760/UN48.16/LT/2020.

References
[1] Curry D W 2019 Perspectives on monitoring and evaluation American Journal of Evaluation. 40 147-150
[2] Karabatzaki Z, Statthopoulou A, Kokkalia G, Dimitriou E, Loukeri P I, Economou A and Drigas A 2018 Mobile application tools for students in secondary education: an evaluation study International Journal of Interactive Mobile Technologies. 12 142-161
[3] Karayaka H B and Adams R 2015 The evaluation of a new hybrid flipped classroom approach to teaching power electronics Global Journal of Engineering Education 17 61-69
[4] Kong F 2020 Evaluation model of adaptive teaching ability of college art teachers International Journal of Emerging Technologies in Learning 15 143-155
[5] Bennett A 2018 Access and equity programme provision-evaluation in Australian higher education: a what matters approach Educational Research and Evaluation 24 523-537
[6] Al-Azzemy A F T and Al-Jamal D A H 2019 Evaluating cognitive, metacognitive and social listening comprehension teaching strategies in Kuwaiti classrooms Heliyon 5 1-16
[7] Taut S, Jiménez D, Puente-Duran S, Palacios D, Godoy M I and Manzi J 2019 Evaluating the quality of teaching: can there be valid differentiation in the middle of the performance distribution? School Effectiveness and School Improvement 30 328-348
[8] Adom D, Mensah J A and Duke D A 2020 Test, measurement, and evaluation: understanding and use of the concepts in education International Journal of Evaluation and Research in Education, 9 109-119
[9] Varga-Atkins T, McIsaac J and Willis I 2017 Focus group meets nominal group technique: an effective combination for student evaluation? Innovations in Education and Teaching International 54 289-300
[10] Santoso P A, Wibawa A P and Pujianto U 2018 Internship recommendation system using simple additive weighting *Bulletin of Social Informatics Theory and Application* 2 15-21

[11] Ibrahim A and Surya R A 2019 The implementation of simple additive weighting (SAW) method in decision support system for the best school selection in Jambi *The 2nd International Conference on Applied Sciences Mathematics and Informatics, Journal of Physics: Conference Series* 1338 1-7

[12] Myint K K, Soe T T and Toe M M 2019 Grant selection process using simple additive weighting approach *International Journal of Trend in Scientific Research and Development* 3 1681-1686

[13] Ramli A A, Kasim S, Fuzzee M F M and Mahdin H 2017 Teaching performance evaluation framework: an analytic hierarchy process approach *Acta Informatica Malaysia* 1 1-6

[14] Naveed QN, Qureshi MRN, Tairan N, Mohammad A, Shaikh A, Alsayed AO, Shah A and Alotaibi F M 2020 Evaluating critical success factors in implementing E-learning system using multi-criteria decision-making. *PLoS ONE* 15 1-25

[15] Divayana D G H 2020 *DIVAYANA evaluation model* (Jakarta: Ministry of Law and Human Rights of the Republic of Indonesia. Copyright Number: 000197532)