DIVAYANA formula for determining priority ranking the recommendations in evaluation applications

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Abstract. Determination of appropriate recommendations through an evaluation application greatly affects the quality of decisions resulting from evaluation activities. Therefore it is necessary to do an accurate calculation process in determining recommendations in the evaluation applications. The purpose of this study was to introduce one of the innovations in the form of the DIVAYANA formula, which can be used to determine priority recommendations in evaluation applications. The method used in this research was qualitative by showing the results of calculations used the DIVAYANA formula. There were six experts involved in conducting the effectiveness test on the DIVAYANA formula. The testing tool used the questionnaires for a formula effectiveness test consisting of 10 questions. The analysis was done by interpreting the testing results of formula effectiveness with effectiveness standards. The test results showed that the DIVAYANA formula was very effective used to determine priority recommendations in evaluation applications with effectiveness score was 90.33%.

1. Introduction

Evaluation in the field of education is an important activity carried out to obtain accurate, in-depth, and quality information [1-17]. Quality information is needed to provide the alternatives of appropriate recommendations to decision-makers so that decisions taken are more optimal.

The reality that happened was not as expected. Sometimes, decision-makers have difficulty in making decisions, if the alternatives of recommendations that variety appears and all of the good quality. Therefore, it is necessary to do an accurate calculation in determining the priority of recommendations starting from the highest priority to the lowest.

One formula that can be used to determine recommendations with the highest priority to the lowest is the DIVAYANA formula. This formula is an innovation that functions to process the nomination calculation from several alternatives of recommendations shown in evaluation applications. This formula was created by Dewa Gede Hendra Divayana to complete the calculation process at the ‘nominate’ stage contained in the DIVAYANA model.

Based on the innovation was offered, so the problem statement in this research: “how is the simulation calculation of the DIVAYANA formula is used to determine the priority of recommendations in evaluation applications?” In general, the purpose of this study was to obtain information about the existence of the DIVAYANA formula, which can be used in determining the priority of recommendations in a stage of evaluation activities.
Research that was conducted in 2017 by Kamaludin et al. [18] was underlying the emergence of this research. This statement is based on the limitations found in the research of Kamaludin et al. that showed there had not been any quantitative calculation in determining the priority of recommendations in their evaluation activities carries out using the CIPP model. The research that was conducted in 2019 by Santoso et al. [19] was the underlying of this research because, in principle, the research of Santoso et al. had similarities with this research in terms of the research approach was used, namely evaluation research. The difference lies in the evaluation model that was used. Research by Santoso et al. used the Countenance model to determine general recommendations in evaluation activities. In contrast, this research used the DIVAYANA model as the basis for using the DIVAYANA formula to determine priority recommendations in evaluation activities. Research that was conducted in 2019 by Yi [20] also underlying this research because of the limitations of Yi’s research, which had not shown in detail recommendation alternatives as results of the evaluation activities that had been carried out.

2. Methods

This research used an evaluative approach. The evaluation stages refer to the DIVAYANA model, which includes: Description, Input, Verification, Action, Yack, Analysis, Nominate, and Actualization stages. This research focus was only on the simulation of the DIVAYANA formula, which was located at the Nominate stage. There are three equations used in the DIVAYANA formula, including equation (1) to determine the repair of weight average, equation (2) to determine the normalization values, and equation (3) to determine the ranking values. Each of those equations can be seen as follows.

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

Notes:
- \(W_{Yack}\) = The repair of weight average
- \(\bar{x}\) = Average of weight given by experts/evaluators through joint discussions

\[
D_i = \frac{\prod_{j=1}^{n} x_{ij}^{(W_{Yack})_j}}{m}
\]

With i=1,2,3,...,n; and \(\sum (W_{Yack})_j\) must be valuable 1.

Notes:
- \(D\) = Vector-D
- \(x\) = Assessment score of each criterion
- \(m\) = The total number of decision-makers

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

Notes:
- \(R\) = Vector-R
- \(D\) = Vector-D
Subjects that were involved in obtaining preliminary data for the simulation of DIVAYANA formula calculation were 14 people using data collection tools in the form of the questionnaires consisting of 8 questions. The subjects that were involved in testing the effectiveness of the DIVAYANA formula were six experts using test tools in the form of the questionnaires consisting of 10 questions with measuring scores that following the Likert scale. The analysis was done by interpreting the testing results of the DIVAYANA formula effectiveness that reference to the formula effectiveness standards. The formula effectiveness standard that intended can be seen in Table 1 [8].

### Table 1. Formula effectiveness standards.

| Classification | Percentage |
|----------------|------------|
|                | 90-100     |
|                | 80-89      |
|                | 65-79      |
|                | 55-64      |
|                | 54-0       |

3. Results and discussion
Simulation of DIVAYANA formula calculation requires preliminary data and data of decision-maker weights. The initial data was used in the simulation can be seen in Table 2, while the weights of decision-makers can be seen in Table 3.

### Table 2. Preliminary data for simulation of DIVAYANA formula.

| Alternatives   | Criteria-1 | Criteria-2 | Criteria-3 | Criteria-4 | Criteria-5 | Criteria-6 | Criteria-7 | Criteria-8 | Criteria-9 |
|----------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Alternative-1  | 87.14      | 12.86      | 12.86      | 12.86      | 12.86      | 12.86      | 12.86      | 12.86      | 12.86      |
| Alternative-2  | 27.43      | 27.43      | 72.57      | 27.43      | 27.43      | 27.43      | 27.43      | 27.43      | 27.43      |
| Alternative-3  | 17.71      | 17.71      | 17.71      | 17.71      | 17.71      | 17.71      | 17.71      | 17.71      | 17.71      |
| Alternative-4  | 19.14      | 19.14      | 19.14      | 19.14      | 19.14      | 19.14      | 19.14      | 19.14      | 19.14      |
| Alternative-5  | 24.29      | 24.29      | 24.29      | 24.29      | 24.29      | 24.29      | 24.29      | 24.29      | 75.71      |
| Alternative-6  | 21.43      | 21.43      | 21.43      | 21.43      | 21.43      | 21.43      | 21.43      | 21.43      | 78.57      |
| Alternative-7  | 25.71      | 25.71      | 25.71      | 25.71      | 25.71      | 25.71      | 25.71      | 74.29      | 25.71      |
| Alternative-8  | 22.86      | 22.86      | 22.86      | 22.86      | 22.86      | 22.86      | 22.86      | 77.14      | 22.86      |

### Table 3. Data of decision-maker weights.

| Criteria Codes | Weights of Decision-Makers | Average | Repair of Weight Average (W_{max}) |
|----------------|-----------------------------|---------|-----------------------------------|
| EV1            | 5                           | 4       | 4.500                             | 0.117                             |
| EV2            | 5                           | 4       | 4.375                             | 0.114                             |
| EV3            | 4                           | 4       | 4.125                             | 0.107                             |
| EV4            | 4                           | 4       | 4.250                             | 0.111                             |
| EP1            | 4                           | 4       | 3.500                             | 0.091                             |
| EP2            | 4                           | 4       | 4.250                             | 0.111                             |
| EP3            | 4                           | 4       | 4.500                             | 0.117                             |
| EP4            | 4                           | 4       | 4.375                             | 0.114                             |
| sum (W_{max})  |                             |         | 1.000                             | 2.000                             |

Vector-D was able to be determined using equation (2) based on the data in Table 2 and Table 3. The Vector-D calculation can be shown as follows.

\[
D_1 = \sum \frac{(78.14^{1.17})(12.86^{1.11})(12.86^{1.11})(12.86^{0.099})(12.86^{0.091})(12.86^{0.112})(12.86^{0.112})(12.86^{0.112})(12.86^{0.112})}{8} = 2.01
\]

\[
D_2 = \sum \frac{(27.43^{0.101})(27.43^{0.101})(72.57^{0.107})(72.57^{0.107})(27.43^{0.101})(27.43^{0.101})(27.43^{0.101})(27.43^{0.101})(27.43^{0.101})}{8} = 3.81
\]

\[
D_3 = \sum \frac{(17.71^{0.101})(17.71^{0.101})(17.71^{0.101})(17.71^{0.101})(17.71^{0.101})(17.71^{0.101})(17.71^{0.101})(17.71^{0.101})(17.71^{0.101})}{8} = 2.64
\]
\[ D_4 = \frac{19.14^{0.117}(19.14^{0.117})(19.14^{0.117})(19.14^{0.117})(19.14^{0.117})(80.86^{0.117})(19.14^{0.117})}{8} = 2.82 \]
\[ D_5 = \frac{24.29^{0.117}(24.29^{0.117})(24.29^{0.117})(24.29^{0.117})(24.29^{0.117})(24.29^{0.117})(24.29^{0.117})}{8} = 3.46 \]
\[ D_6 = \frac{21.43^{0.117}(21.43^{0.117})(21.43^{0.117})(21.43^{0.117})(21.43^{0.117})(21.43^{0.117})(78.57^{0.117})}{8} = 3.11 \]
\[ D_7 = \frac{25.71^{0.117}(25.71^{0.117})(25.71^{0.117})(25.71^{0.117})(25.71^{0.117})(74.29^{0.117})(25.71^{0.117})}{8} = 3.64 \]
\[ D_8 = \frac{22.86^{0.117}(22.86^{0.117})(22.86^{0.117})(22.86^{0.117})(22.86^{0.117})(22.86^{0.117})(77.14^{0.117})}{8} = 3.28 \]

The ranking process was able to be done by determining the Vector-R value using equation (3) after successfully obtaining the Vector-D value. The Vector-R calculation can be explained as follows.

\[ R_1 = \frac{D_1}{D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8} \]
\[ R_1 = \frac{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28}{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28} = 0.081 \]
\[ R_2 = \frac{D_2}{D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8} \]
\[ R_2 = \frac{3.81}{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28} = 0.154 \]
\[ R_3 = \frac{D_3}{D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8} \]
\[ R_3 = \frac{2.64}{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28} = 0.107 \]
\[ R_4 = \frac{D_4}{D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8} \]
\[ R_4 = \frac{2.82}{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28} = 0.114 \]
\[ R_5 = \frac{D_5}{D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8} \]
\[ R_5 = \frac{3.46}{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28} = 0.140 \]
\[ R_6 = \frac{D_6}{D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8} \]
\[ R_6 = \frac{3.11}{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28} = 0.125 \]
\[ R_7 = \frac{D_7}{D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8} \]
\[ R_7 = \frac{3.64}{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28} = 0.147 \]
\[ R_8 = \frac{D_8}{D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8} \]
\[ R_8 = \frac{3.28}{2.01 + 3.81 + 2.64 + 2.82 + 3.46 + 3.11 + 3.64 + 3.28} = 0.133 \]

The ranking recapitulation of recommendation alternatives from the lowest to the highest level was able to be done after successfully obtaining Vector-R value. The highest level was obtained based on the
largest Vector-R value, while the lowest level was obtained based on the smallest Vector-R value. The complete recapitulation of the recommendation alternatives can be seen in Table 4.

Table 4. The priority ranking recapitulation of the recommendation alternatives.

| Alternatives | Vector-R Values | Rank |
|--------------|----------------|------|
| Alternative-2 | 0.154          | I    |
| Alternative-7 | 0.147          | II   |
| Alternative-5 | 0.140          | III  |
| Alternative-8 | 0.133          | IV   |
| Alternative-6 | 0.125          | V    |
| Alternative-4 | 0.114          | VI   |
| Alternative-3 | 0.107          | VII  |
| Alternative-1 | 0.081          | VIII |

The effectiveness test of using the DIVAYANA formula involved six experts consisting of three informatics experts and three education experts. The effectiveness test results of the DIVAYANA formula by the six experts can be seen in Table 5.

Table 5. Effectiveness test results of the DIVAYANA formula utilization.

| No | Testers (Experts) | Items- | ∑ | Percentage of Effectiveness (%) |
|----|-------------------|--------|---|---------------------------------|
| 1  | Informatics Expert-1 | 5 4 5 5 4 4 5 4 5 4 5 5 | 46 | 92.00 |
| 2  | Informatics Expert-2 | 4 5 5 4 4 5 4 5 5 4 4 4 | 45 | 90.00 |
| 3  | Informatics Expert-3 | 4 4 4 4 4 4 4 4 4 4 4 4 | 45 | 90.00 |
| 4  | Education Expert-1  | 5 5 5 4 4 4 4 5 4 5 4 4 | 45 | 90.00 |
| 5  | Education Expert-2  | 4 5 5 4 4 4 4 5 5 4 5 5 | 45 | 90.00 |
| 6  | Education Expert-3  | 5 5 4 4 5 4 4 5 4 5 4 4 | 45 | 90.00 |

Average 90.33

The preliminary data shown in Table 2 were obtained from the average results of respondents’ assessments of the several alternatives to recommendations that were offered in the evaluation application. The number of respondents was involved in the assessment was 14 people consisting of four informatics experts, four educational evaluators, and six stakeholders in the schools. The values of the repair of the weight’s average shown in Table 3 were obtained by calculations using equation (1).

From the results shown in Table 5, it appears that the DIVAYANA formula had been effective was used to determine the priority ranking of the recommendation alternatives that were offered through evaluation applications. This is reinforced by the effectiveness percentage of the test results of the DIVAYANA formula utilization, which was included in the category of excellent when it was viewed from the effectiveness standard previously shown in Table 1. From the results shown in Table 5, it appears that alternative to recommendations that become the main priority is Alternative-2, while the last priority is Alternative-1.

The results of this research have successfully answered the limitations of the research of Kamaludin et al. and also Yi’s research by showing the simulation calculation of the DIVAYANA model to determine the ranking of priorities of several alternatives to recommendations from highest to lowest ranking. Principally, this is similar to the results of Ariawan et al.’s research in 2018 [21], which showed the dominant aspects in determining the quality of computer learning based on the ranking of evaluation aspects starting from the lowest to highest. Nevertheless, this research also had weaknesses that need to be solved in the future. The weakness is the simulation calculation of the DIVAYANA formula shown in this research is still done manually.
4. Conclusion
Simulation of DIVAYANA formula calculation to determining priority recommendations in an evaluation application had been running optimally. The DIVAYANA formula is very effective to be used to determine the priority ranking of the several alternatives of recommendations is offered through evaluation applications. Even though this research had presented finding in the form of new formulas that were useful in the field of educational evaluation, but future work must still be done to solve weaknesses in this research. That future work shows the calculating process of DIVAYANA formula with the computerized and directly attached to the evaluation application.

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References
[1] Peiris K D A and Gallupe R B 2018 Evaluating a prototype of a recommender-driven online learning system Decision Sciences Journal of Innovative Education 16(4) 281–309
[2] Lowenthal P, Bauer C and Chen K Z 2015 Student perceptions of online learning: an analysis of online course evaluations American Journal of Distance Education 29(2) 85–97
[3] Lovvorn A S and Timmerman J E 2019 The flipped assessment: aligning evaluation of student success with the flipped classroom Journal on Excellence in College Teaching 15(1) 109–131
[4] Liu J C 2019 Evaluating online learning orientation design with a readiness scale Online Learning Journal 23(4) 42–61
[5] Baldwin S and Ching Y H 2019 Online course design: a review of the canvas course evaluation checklist International Review of Research in Open and Distributed Learning 20(3) 268–282
[6] Foug D and Chen J 2019 A learning analytics approach to the evaluation of an online learning package in a Hong Kong University Electronic Journal of e-Learning 17(1) 11–24
[7] Esmael S 2017 Teaching quality evaluation: online vs manually, facts and myths Journal of Information Technology Education: Innovations in Practice 16 277–290
[8] Divayana D G H, Ariawan I P W, Adiarta A, Parmiti D P, Sanjaya D B, Kertih I W and Wibawa S C 2018 Design of countenance evaluation model based on ANEKA-Tri Hita Karana in computer learning for vocational students of information technology in Bali Mathematics, Informatics, Science and Education International Conference (MISEIC), Journal of Physics: Conference Series 1108 1–6
[9] Zurqoni, Retnawati H, Apino E and Anazifa R D 2018 Impact of character education implementation: a goal-free evaluation Problems of Education in the 21st Century 76(6) 881–899
[10] Milzow K, Reinhardt A, Söderberg S and Zinöcker K 2019 Understanding the use and usability of research evaluation studies Research Evaluation 28(1) 94–107
[11] Hull K, Lawford H, Hood S, Oliveira V, Murray M, Trempe M, Crooks J and Jensen M 2019 Student anxiety and evaluation Collected Essays on Learning and Teaching 12 23–35
[12] Chikazinga W W N 2018 Perceptions of lecturers of student evaluations of their teaching International Education Journal: Comparative Perspectives 17(4) 36–48
[13] Thawabieh A M 2017 Students evaluation of faculty International Education Studies 10(2) 35–43
[14] Hornstein H A 2017 Student evaluations of teaching are an inadequate assessment tool for evaluating faculty Cogent Education 4 1–8
[15] Patton M Q 2018 Evaluation science American Journal of Evaluation 39(2) 183–200
[16] Alkin M C and King J A 2017 Definitions of Evaluation Use and Misuse, Evaluation Influence, and Factors Affecting Use American Journal of Evaluation 38(3) 434–450
[17] Hus V and Matjašič J 2017 Evaluation and Assessment in Early Social Science Universal Journal of Educational Research 5(4) 664–670

[18] Kamaludin M, Munawar W, Mahdan D, Simanjuntak M V, and Wendi H F 2018 The evaluation of industry practical of mechanical engineering in vocational education: a CIPP model 2nd International Conference on Innovation in Engineering and Vocational Education (ICIEVE 2017), IOP Conference Series: Materials Science and Engineering 306 1–4

[19] Santoso A B, Yusro A C, Malawi I, Hanif M and Kokotiasa W 2019 Evaluation of the application of information technology and communication in lectures in the primary school teacher education study program The 1st Workshop on Environmental Science, Society, and Technology, Journal of Physics: Conference Series 1363 1–6

[20] Yi D 2019 Construction of multi-evaluation system of practical tourism Korean flip classroom teaching based on CIPP 2019 International Conference on Artificial Intelligence Technologies and Applications, Journal of Physics: Conference Series 1325 1–7

[21] Ariawan I P W, Simatupang W, Ishak A M, Agung A A G, Suratmin, Adiarta A and Divayana D G H 2018 Development of aneka evaluation model based on topsis in searching the dominant aspects of computer learning quality determinants Journal of Theoretical and Applied Information Technology 96(19) 6580–6596