Decision Making Analysis for Free Internet Quota Assistance Online Learning during the Covid-19 Pandemic

E Budiman† and U Hairah†
†Department of Informatics, Engineering Faculty, Universitas Mulawarman, Samarinda, East-Kalimantan, Indonesia

E-mail: edy.budiman@fkti.unmul.ac.id

Abstract. One of the Indonesian government’s efforts to reduce the impact of the crisis due to the Covid-19 pandemic is through the distribution of social assistance through the distribution of free internet data for students to support online learning during the implementation of government policies regarding large-scale social restrictions. This social assistance involves 350 students as an alternative as a target for decision making. In an effort to support this policy, this study offers a multi-criteria decision-making analysis approach using the Moora and Vikor methods. The results of this study present the optimal performance of the accuracy, precision and error rate of the two methods.

1. Introduction

In order to reduce the spread of the Covid-19. In Indonesia, not through quarantine or regional lockdowns, but through large-scale social restrictions. Large-scale social restrictions are restrictions on activities to prevent the spread of disease in areas suspected of being infected or contaminated with the disease. This policy covers a number of points, including school and work holidays, to limiting activities in public places. Government Regulation on Large-Scale Social Restrictions[1] for the handling of the Covid-19 pandemic.

In supporting government policies to implement social restrictions, the role of information and communication technology (ICT) is very large to support the use of learning media platforms such as teleconferencing, telemedicine and e-learning. The use of this ICT-based platform eases the need to work, learn and even pray without having to leave the house. However, some groups still face challenges such as network availability and affordability of internet data usage, particularly for students in accessing distance learning facilities with limited budgets(cost). For this reason, the Indonesian Government's policy is to re-implement a Regulation through the Secretary of the Ministry of Education and Culture concerning Technical Guidelines for Internet Data Quota Assistance in 2020[2]. These technical guidelines serve as guidelines in distributing internet data quota assistance for educators and students so that they can support the implementation of distance learning during the COVID-19 pandemic. Internet data quota assistance is provided to students and teachers or lecturers. The technical guidelines explained that the form of assistance provided was in the form of internet data quota with details divided into general quota and learning quota.

The internet quota package for students in early childhood education (PAUD) gets 20 GB per month with details of 5 GB for general quota and 15 GB for learning quota. Elementary, Junior and
Senior High School students get 35 GB per month, with details of 5 GB for general quota and 30 GB for learning quota[2].

The policy of free internet assistance to higher education institutions (lecturers and students) is considered less proportional and right on target to users according to their learning needs, due to several factors such as the amount of learning load; courses and academic credit, and students’ economic ability problems. For this reason, this research is expected to be able to become the basis of policy for decision makers in managing free internet assistance based on the need for internet data consumption to users in the use of internet access for the integrity of online learning.

This study aims to apply a multi-criteria decision-making method in supporting the management of distribution of free internet assistance to students, in particular, to determine the performance of the Multi Objective Optimization method on the Basic of Ratio Analyzer (MOORA) and Visekriterijumsko Kompromisno Rangiranje (VIKOR) for decision making for prospective beneficiaries based on five criteria; internet quota, academic credit, number of courses, ability purchase quota and student monthly costs. To measure the performance method, the confusion matrix testing is used. The result of method preference is the actual data of beneficiaries.

The research contribution is expected to be a reference for decision support analysis approaches in the management of internet data package assistance for online learning needs during the Covid-19 pandemic in education.

2. Testing Methodology and Analysis
An overview of the analytical methodology of decision making and performance testing of multi-criteria methods is presented in Figure 1.

2.1. Data Collection Methods
Data collection through observation and measurement of internet data usage during online learning, data is taken from the undergraduate program in informatics department Mulawarman University, East Kalimantan, Indonesia, where the population is all students who are currently carrying out online learning from home during the Covid-19. From the results of observations, a total sample of 350 students filled out the questionnaire. Questionnaire techniques are used to obtain data criteria; the number of courses, academic credits and the student's economic ability[3], while the measurement is used to find out how much internet data package usage in each meeting (duration 45 minutes).
2.2. Criteria and Attribute Set

Determination of the criteria for decision making originates from observation and measurement of data consumption, and the criteria data are obtained along with the weights of importance, including the benefit or cost attributes. The criteria and attributes are shown in Table 1.

### Table 1. Criteria, weighting and attributes.

| Criteria                              | Crisp                     | Weights | Attribute |
|---------------------------------------|---------------------------|---------|-----------|
| C1: Internet Quota                    | Internet data usage (MB)  | 5→(0.333) | Benefit   |
| C2: Academic Credit                   | 14 to 24                  | 4→(0.267) | Benefit   |
| C3: Amount Course                     | 5; 6; 7; 8; 9             | 3→(0.2)  | Benefit   |
| C4: Quota Purchase Ability            | IDR 100.000 up to IDR 400.000 | 2→(0.133) | Cost      |
| C5: Monthly Cost                      | IDR 500.000 up to IDR 2.000.000 | 1→(0.067) | Cost      |

The weighting importance method in Table 1 criteria used the Rank Sum (RS) ranking technique which refers to Mats D and L Ekenberg[4],[5] where the weights for the 5 criteria for each straight rank (rj) value are C1 =0.333, C2 =0.267, C3 =0.2, C4 = 0.133 and C5 =0.067.

2.3. Decision Analysis Methods

Moora method, for the analysis of work stages this method refers to W Brauers et al [6],[7] with a calculation analysis such as in the following equation:

\[
x_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{n} x_{ij}^2}}, \quad y_j^* = \sum_{i=1}^{g} x_{ij}^* - \sum_{i=g+1}^{n} x_{ij}^*,
\]

(1)

Vikor method, the analysis stage this method according to A Mardani et al[8], analysis calculation as in the following equation:

\[
Q_k = \nu \left[ \frac{(s_k-s_{max})}{(s_{max}-s_{min})} \right] + (1 - \nu) \left[ \frac{(r_k-r_{max})}{(r_{max}-r_{min})} \right]
\]

(2)

2.4. Performance Decision Analysis Methods

The confusion matrix represents the performance and actual conditions of the data for each preference methods. will test the method; accuracy, precision, and error rate. The calculation for each test following equation[9],[10] in table 2.

3. Results

The analysis results of the Moora method use equation (1) through several process; weighting calculation, normalized data and preferences. Briefly, the calculation results of the preference value of 350 alternatives along with their attributes (benefit-cost) and criteria are presented in Table 4 and Figure 2 and 3.
Furthermore, the preference value of each alternative is sorted from largest to smallest (descending), so that the result of the ranking of preference values is the alternative ranking order. The results of sorting preference values are presented in the Table 5.

### Table 5. Ranking result of Moora analysis method

| Alt. | Preference | Sorting | Alt. | Ranking |
|------|------------|---------|------|---------|
| A1   | 0.0383     |         | A136 | 0.0516  |
| A2   | 0.0401     |         | A37  | 0.0512  |
| A3   | 0.0289     |         | A124 | 0.0496  |
| A4   | 0.0431     |         | A75  | 0.0484  |
| A5   | 0.0343     |         | A110 | 0.0481  |
| A6   | 0.0343     |         | A67  | 0.0479  |
| A346 | 0.0349     |         | A54  | 0.0478  |
| A347 | 0.0336     |         | A114 | 0.0478  |
| A348 | 0.0311     |         | A42  | 0.0477  |
| A349 | 0.0359     |         | A41  | 0.0469  |
| A350 | 0.0312     |         | A142 | 0.0463  |

Figure 2. Alternative rank of the Moora method
Figure 3. Scatter of the Moora references

Figure 4. Alternative Rank of the Moora method
3.1. Result: Vikor analysis method

The analysis Vikor results method using equation (2) are presented in Table 6 and Figure 5 and 6.

![Figure 5. Alternative rank of the Vikor](image)

![Figure 6. Scatter of the Vikor references](image)

Table 6. Reference result of Vikor analysis methods

| Alt. | Internet Quota | Academic Credit | Courses | Quota Ability | Monthly Cost | Q1  | Q2  | Q   |
|------|----------------|-----------------|---------|---------------|--------------|-----|-----|-----|
| A1   | 456.640        | 24              | 9       | 100000        | 700000       | 0.4245 | 0.4386 | 0.8631 |
| A2   | 582.180        | 24              | 9       | 200000        | 800000       | 0.4296 | 0.4225 | 0.852  |
| A3   | 530.510        | 24              | 9       | 400000        | 2000000      | 0.3766 | 0.3472 | 0.7237 |
| A4   |                |                 |         |               |              |      |     |     |
| A5   |                |                 |         |               |              |      |     |     |
| A6   |                |                 |         |               |              |      |     |     |
| A7   |                |                 |         |               |              |      |     |     |
| A8   |                |                 |         |               |              |      |     |     |
| A9   |                |                 |         |               |              |      |     |     |
| A10  |                |                 |         |               |              |      |     |     |
| A11  |                |                 |         |               |              |      |     |     |
| A12  |                |                 |         |               |              |      |     |     |
| A13  |                |                 |         |               |              |      |     |     |
| A14  |                |                 |         |               |              |      |     |     |
| A15  |                |                 |         |               |              |      |     |     |
| A16  |                |                 |         |               |              |      |     |     |
| A17  |                |                 |         |               |              |      |     |     |
| A18  |                |                 |         |               |              |      |     |     |
| A19  |                |                 |         |               |              |      |     |     |
| A20  |                |                 |         |               |              |      |     |     |
| A21  |                |                 |         |               |              |      |     |     |
| A22  |                |                 |         |               |              |      |     |     |
| A23  |                |                 |         |               |              |      |     |     |
| A24  |                |                 |         |               |              |      |     |     |
| A25  |                |                 |         |               |              |      |     |     |
| A26  |                |                 |         |               |              |      |     |     |
| A27  |                |                 |         |               |              |      |     |     |
| A28  |                |                 |         |               |              |      |     |     |
| A29  |                |                 |         |               |              |      |     |     |
| A30  |                |                 |         |               |              |      |     |     |
| A31  |                |                 |         |               |              |      |     |     |
| A32  |                |                 |         |               |              |      |     |     |
| A33  |                |                 |         |               |              |      |     |     |
| A34  |                |                 |         |               |              |      |     |     |
| A35  |                |                 |         |               |              |      |     |     |
| A36  |                |                 |         |               |              |      |     |     |
| A37  |                |                 |         |               |              |      |     |     |
| A38  |                |                 |         |               |              |      |     |     |
| A39  |                |                 |         |               |              |      |     |     |
| A40  |                |                 |         |               |              |      |     |     |
| A41  |                |                 |         |               |              |      |     |     |
| A42  |                |                 |         |               |              |      |     |     |
| A43  |                |                 |         |               |              |      |     |     |
| A44  |                |                 |         |               |              |      |     |     |
| A45  |                |                 |         |               |              |      |     |     |
| A46  |                |                 |         |               |              |      |     |     |
| A47  |                |                 |         |               |              |      |     |     |
| A48  |                |                 |         |               |              |      |     |     |
| A49  |                |                 |         |               |              |      |     |     |
| A50  |                |                 |         |               |              |      |     |     |

Furthermore, the preference value of each alternative is sorted from largest to smallest (descending), so that the result of the ranking of preference values is the alternative ranking order. The results of sorting preference values are presented in the Table 7.

Table 7. Ranking result of Vikor analysis method

| Alt. | Preference | Sort | Alt. | Ranking |
|------|------------|------|------|---------|
| A1   | 0.8631     | 1    | A124 |         |
| A2   | 0.852      | 37   | A37  | 0.9929  |
| A3   | 0.7237     | 136  | A136 | 0.9728  |
| A4   | 0.9117     | 110  | A110 | 0.967   |
| A5   | 0.7505     | 42   | A42  | 0.9648  |
| A6   |            | 42   |      |         |
| A7   |            |      |      |         |
| A8   |            |      |      |         |
| A9   |            |      |      |         |
| A10  |            |      |      |         |
| A11  |            |      |      |         |
| A12  |            |      |      |         |
| A13  |            |      |      |         |
| A14  |            |      |      |         |
| A15  |            |      |      |         |
| A16  |            |      |      |         |
| A17  |            |      |      |         |
| A18  |            |      |      |         |
| A19  |            |      |      |         |
| A20  |            |      |      |         |
| A21  |            |      |      |         |
| A22  |            |      |      |         |
| A23  |            |      |      |         |
| A24  |            |      |      |         |
| A25  |            |      |      |         |
| A26  |            |      |      |         |
| A27  |            |      |      |         |
| A28  |            |      |      |         |
| A29  |            |      |      |         |
| A30  |            |      |      |         |
| A31  |            |      |      |         |
| A32  |            |      |      |         |
| A33  |            |      |      |         |
| A34  |            |      |      |         |
| A35  |            |      |      |         |
| A36  |            |      |      |         |
| A37  |            |      |      |         |
| A38  |            |      |      |         |
| A39  |            |      |      |         |
| A40  |            |      |      |         |
| A41  |            |      |      |         |
| A42  |            |      |      |         |
| A43  |            |      |      |         |
| A44  |            |      |      |         |
| A45  |            |      |      |         |
| A46  |            |      |      |         |
| A47  |            |      |      |         |
| A48  |            |      |      |         |
| A49  |            |      |      |         |
| A50  |            |      |      |         |

![Figure 7. Alternative Rank of the Vikor method](image)
3.2. Performance analysis methods

Performance testing uses a confusion matrix that compares/matches the ranking results of the Moora and Vikor methods toward actual data shown in Table 8.

| Alt. | Moora method | Vikor method |
|------|--------------|--------------|
|      | Accuracy | Precision | Error rate | Accuracy | Precision | Error rate |
| 10   | 0.954    | 0.2857    | 0.040      | 0.951    | 0.2308    | 0.049      |
| 20   | 0.917    | 0.3548    | 0.083      | 0.906    | 0.2593    | 0.094      |
| 30   | 0.874    | 0.3478    | 0.126      | 0.863    | 0.2857    | 0.137      |

4. Discussion

From the research results that have been presented in the previous section, several important points were found i.e. 1). Both methods of decision-making analysis (Moora and Vikor) have their own preferred characteristics, where the accuracy, precision and error rate of the Moora method are better than the Vikor method (for the case of five criteria; 350 alts.). Another thing is that the weighting method also has an effect on the preference value, so it has a significant effect on performance results. 2). The performance results of the Moora and Vikor methods show a decrease in the level of accuracy, precision and error rate when the target beneficiary is increased, the more target beneficiaries, the lower the performance of the method. The importance of criteria in terms of how much weight is given to them in the decision-making process. In determining the decision-making method for the case of social assistance management according to the needs and targets, this affects the value of accuracy and performance accuracy. Free internet data assistance for students is a case study of how the performance of decision-making analysis methods is applied and the results of this study have provided interesting things in the future for further studies[11].

5. Conclusions

The importance of criteria in terms of how much weight is given to them in the decision-making process. In determining the decision-making method for the case of social assistance management according to the needs and targets, this affects the value of accuracy and performance accuracy. Free internet data assistance for students is an example of a case study on how the performance of decision-making methods is applied and the results of this study have provided interesting things in the future for further studies. This study offers a multi-criteria decision-making analysis approach using the Moora and Vikor methods. The research results of both methods produce the best alternative preference from a set of targeted alternatives. The results of this study still require better performance optimization through the development of criteria, weighting methods, data normalization and other decision-making methods, considering that this social assistance case study is very important because it is a concern for the welfare of the community[12].

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