Comparison of the WASPAS and MOORA Methods in Providing Single Tuition Scholarships

Nelly Khairani Daulay1,*, Bunga Intan2, Muhammad Irvai3

1Fakultas Ilmu Komputer, Prodi Rekayasa Sistem Komputer, Universitas Bina Insan, Lubuklinggau, Indonesia
2Fakultas Ilmu Komputer, Prodi Sistem Informasi, Universitas Bina Insan, Lubuklinggau, Indonesia
3Fakultas Ilmu Komputer, Prodi Teknik Informatika, Universitas Bina Darma, Palembang, Indonesia

Email: 1.nellydaulay@univbinainsan.ac.id, 2.bungaintan@univbinainsan.ac.id, 3.irvaimuhammad9@gmail.com

Corresponding Author: nellydaulay@univbinainsan.ac.id

Submitted: 07/03/2021; Accepted: 29/03/2021; Published: 29/03/2021

Abstract—Single Tuition Scholarship (UKT) is a grant provided by the Ministry of Education and Culture (Kemendikbud) to universities, both State Universities (PTN) and Private Universities (PTS). This aims to help underprivileged people so they can get education in higher education, both PTN and PTS. The large number of UKT recipient participants overwhelmed the University and made the decision not objective. For this reason, it is necessary to have a decision support system (SPK) in order to help deal with these problems. There are many methods that can be used in SPK including the MOORA method, WASPAS, TOPSIS, SAW, WPS and many more. In this study, researchers tried to compare two methods between the WASPAS method and the MOORA method in determining UKT scholarship recipients. There are five criteria for selecting recipients of UKT assistance, namely parents' income, electricity bills, water bills, land and building taxes and family expenses. The results of this study were students who got the first rank with the WASPAS method, namely 4,152 and students with the MOORA method, namely 3,218. This shows that these students are entitled to receive UKT grants.

Keywords: Student Selection; Single Tuition Scholarship; Decision Support System; WASPAS; MOORA

1. INTRODUCTION

The Single Tuition Fee Scholarship (UKT) is a grant provided by the Ministry of Education and Culture (Kemendikbud) to universities, both State Universities (PTN) and Private Universities (PTS). Student tuition fees before the single tuition fee consist of several types of fees such as tuition fees, proposal and thesis examination fees, graduation fees and other fees. However, tuition fees are replaced with Single Tuition Fees (UKT). Single tuition fees consist of several groups, namely UKT 1 (one) group, UKT 2 (two) groups, UKT 3 (three) groups, UKT 4 (four) groups, UKT 5 (five) groups, UKT 6 (six) groups and group 7 (seven) whose nominal value varies [1]. In the process of determining the Single Tuition Fee scholarship, students submit the application documents for the UKT scholarship that have been determined, such as data on parents' income, electricity bills, water bills, land and building taxes, family expenses and so on. The large number of students registering or submitting UKT scholarship files to the relevant administration department indirectly affects the level of fatigue, the transparency level of file selection and requires time in student file selection and directly affects the decisions taken which are no longer objective.

To avoid decisions that are not objective, it is necessary to have a Decision Support System (SPK) to help determine the recipients of student UKT scholarships. The Concept of a Decision Support System (Decision Support System) is a computer-based interactive system that helps decision makers utilize data and models to solve unstructured and semi-structured problems[2].

There are many methods that can be used in SPK including the MOORA method, WASPAS, TOPSIS, SAW, WPS and many more. In this study, researchers tried to compare two methods between the WASPAS method and the MOORA method in determining UKT scholarship recipients. WASPAS is a method that makes decisions effectively on complex problems by simplifying and accelerating the decision-making process to solve these problems. In consideration of the WASPAS method can provide a solution for the best alternative selection of employees. By using WASPAS, problems are grouped based on criteria and weight so that the value of each criterion is obtained [3]. MOORA (Multi-Objective Optimization on The Basis of Ratio Analysis) This method Multi-objective optimization (or programming), also known as multi-criteria optimization or multiple attributes, is the process of simultaneously optimizing two or more conflicting attributes (goals) subject to certain restrictions [4] [5]. The purpose of this study was to compare two methods, namely WASPAS and MOORA in determining the single tuition fee scholarship assistance. In the end, one of the best methods can be chosen to support a decision in receiving a Single Tuition scholarship assistance.

2. RESEARCH METHODOLOGY

2.1 Research Stage

The research was carried out using several stages, as follows:

a. Sample data collection
b. Data analysis
c. Testing the application of the WASPAS and MOORA Methods
d. Decision making
e. Research Report Making

2.2 Decision Support System

Decision Support Systems according to various experts including Man and Watson, defines that a Decision Support System (DSS) is an interactive system that helps decision makers through the use of data and decision models to solve semi-structured and unstructured problems [4], [6].

2.3 Weight Aggregated Sum Product Assessment (WASPAS)

In making a decision involves many supporting factors, for that we need a certain method in its processing. One of the methods used is the Weight Aggregated Sum Product Assessment (WASPAS) method. The Weighted Aggregated Sum Product Assessment (WASPAS) method is a combined method consisting of the SAW method and the WP method [7]–[9].

1. Determine the Normalization Matrix in Decision Making

\[
x = \begin{bmatrix}
    x_{11} & x_{12} & \cdots & x_{1n} \\
    x_{21} & x_{22} & \cdots & x_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    x_{m1} & x_{m2} & \cdots & x_{mn}
\end{bmatrix}
\]

(1)

2. Normalize the matrix X

Benefit Criteria

\[x_{ij} = \frac{x_{ij}}{\text{Max} x_{ij}}\]

(2)

Cost Criteria

\[x_{ij} = \frac{x_{ij}}{\text{Min} x_{ij}}\]

(3)

3. Calculating Value Qi

\[Q_i = 0.5 \sum_{j=1}^{n} x_{ijw} + 0.5 \prod_{j}^{n} (x_{ij})^{w_j}\]

(4)

Where:

Qi = Value from Q to i
Xijw = Multiply the Xij values by the weight (w)
0.5 = Statutes

The best alternative is the alternative that has the highest Qi value.

2.4 Multi-Objective Optimization on The Basis of Ratio Analysis (MOORA)

The Multi-Objective Optimization by Ratio Analysis (MOORA) method is a method introduced by Brauers and Zavadkas. The MOORA method has a degree of flexibility and ease of understanding in separating the subjective part of an evaluation process into decision weight criteria with several attributes of decision making. MOORA method is easy to understand and flexible in separating objects to the evaluation process of decision weight criteria. The MOORA method also has a good level of selectivity in determining conflicting objectives and criteria, namely criteria that are beneficial (Benefit) or not profitable (Cost) [10]–[12].

Steps to solve problems using the MOORA method [8], among others:

1. Formation of the matrix

\[
x = \begin{bmatrix}
    x_{11} & x_{12} & \cdots & x_{1n} \\
    x_{21} & x_{22} & \cdots & x_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    x_{m1} & x_{m2} & \cdots & x_{mn}
\end{bmatrix}
\]

(5)

x is the criterion value of each criterion which is represented as a matrix.

2. Determine the Normalization Matrix

\[X_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}\]

(6)

The Xij ratio shows the size of the alternatives in the jth criterion, m shows the number of alternatives and n shows the number of criteria.

3. If the attributes or criteria for each alternative are not given a weighted value.

The normalized size is added in the case of maximization (for beneficial attributes) and reduced in minimization (for unprofitable attributes) or in other words, reducing the maximum and minimum values for each row to get the ranking on each row, if formulated then:

\[y_j = \sum_{i=1}^{g} X_{ij}^* - \sum_{i=g+1}^{n} X_{ij}^*\]

(7)

Where:
i: 1, 2, 3, ..., g is an attribute or criterion with maximized status
j: g+1, g+2, g+3, ..., n is an attribute or criterion with minimized status

\( y^*j \): Alternative max-min Normalized Matrix

4. If the attribute or criterion for each alternative is given a weighted value of importance. Assigning a weight value to the criteria, provided that the maximum criterion specific gravity value is greater than the minimum criterion specific gravity value. A more important attribute can be multiplied by the appropriate weight (significance coefficient). Following is the formula for calculating the MOORA Multiobjective Optimization value, the Multi-Objective Criteria Weighted Multiplication of the Maximum Attribute Value minus the Multiplication of the Criteria Weight against the Minimum Attribute Value, if formulated then:

\[
Y_i = \sum_{j=1}^{g} w_j X^*_i j - \sum_{j=g+1}^{n} X^*_i j
\]

Where
i: 1, 2, 3, ..., g is the attribute or criterion with maximized status
j: g+1, g+2, g+3, ..., n is the attribute or criterion with minimized status

\( w_j \): weight to alternative j

\( y^*j \): The normalized assessment value of alternative j on all attributes

3. RESULT AND DISCUSSION

The selection process for single tuition fees requires a system that can assist in the assessment. The assessment of the existing criteria is carried out using a quantitative assessment model. One of the quantitative calculation methods is the WASPAS and MOORA methods. At the initial stage of problem solving, first determine the types of criteria in selecting a single tuition fee. The criteria are as follows: parents’ income, electricity bills, water bills, land and building taxes and family expenses. The number of student data taken is 10 people which are shown in table 1 below.

**Table 1. Student Alternative Data**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Student Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Hendra</td>
</tr>
<tr>
<td>M2</td>
<td>Tri Lestari</td>
</tr>
<tr>
<td>M3</td>
<td>Wiwik</td>
</tr>
<tr>
<td>M4</td>
<td>Lilis</td>
</tr>
<tr>
<td>M5</td>
<td>Dea Ayu</td>
</tr>
<tr>
<td>M6</td>
<td>Desi</td>
</tr>
<tr>
<td>M7</td>
<td>Betti</td>
</tr>
<tr>
<td>M8</td>
<td>Desi</td>
</tr>
<tr>
<td>M9</td>
<td>Bambang</td>
</tr>
<tr>
<td>M10</td>
<td>Davit Prana</td>
</tr>
</tbody>
</table>

In selecting students to be given single tuition assistance, there are several criteria that are used as general requirements. Following are the criteria used in selecting students who deserve UKT assistance.

**Table 2. Criteria Value Data**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight Code</th>
<th>Weight Value</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Income</td>
<td>C1</td>
<td>5</td>
<td>Benefit</td>
</tr>
<tr>
<td>Electricity bills</td>
<td>C2</td>
<td>3</td>
<td>Benefit</td>
</tr>
<tr>
<td>Water Account</td>
<td>C3</td>
<td>4</td>
<td>Benefit</td>
</tr>
<tr>
<td>Property taxes</td>
<td>C4</td>
<td>2</td>
<td>Benefit</td>
</tr>
<tr>
<td>Family Expenses</td>
<td>C5</td>
<td>5</td>
<td>Benefit</td>
</tr>
</tbody>
</table>

Based on table 2, the student data that has been obtained will be given a value according to the predetermined range as in table 3.

**Table 3. Score for each criteria**

<table>
<thead>
<tr>
<th>Value</th>
<th>C1</th>
<th>C2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; 1 M</td>
<td>&lt; 100 K</td>
</tr>
<tr>
<td>2</td>
<td>1 M ≤ x &lt; 4 M</td>
<td>100 K ≤ x &lt; 200 K</td>
</tr>
<tr>
<td>3</td>
<td>4 M ≤ x &lt; 7 M</td>
<td>200 K ≤ x &lt; 300 K</td>
</tr>
<tr>
<td>4</td>
<td>7 M ≤ x &lt; 10 M</td>
<td>300 K ≤ x &lt; 400 K</td>
</tr>
<tr>
<td>5</td>
<td>≥ 10 M</td>
<td>≥ 400 K</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value</th>
<th>C3</th>
<th>C4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; 10 K</td>
<td>&lt; 100 K</td>
</tr>
<tr>
<td>2</td>
<td>10 K ≤ x &lt; 40 K</td>
<td>100 K ≤ x &lt; 200 K</td>
</tr>
</tbody>
</table>

Page 86
Nelly Khairani Daulay, *Comparison of the WASPAS and MOORA Methods in Providing Single Tuition Scholarships*

<table>
<thead>
<tr>
<th>Value</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; 1 M</td>
</tr>
<tr>
<td>2</td>
<td>1 M ≤ x &lt; 4 M</td>
</tr>
<tr>
<td>3</td>
<td>4 M ≤ x &lt; 7 M</td>
</tr>
<tr>
<td>4</td>
<td>7 M ≤ x &lt; 10 M</td>
</tr>
<tr>
<td>5</td>
<td>≥ 10 M</td>
</tr>
</tbody>
</table>

The match rating can be seen in the following table:

**Table 4. Data on Criteria for Students Receiving Single Tuition Assistance**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Name</th>
<th>Parent Income</th>
<th>Electricity bills</th>
<th>Water Account</th>
<th>Property taxes</th>
<th>Family Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Hendra</td>
<td>1 M ≤ x &lt; 4 M</td>
<td>200 K ≤ x &lt; 300 K</td>
<td>40 K ≤ x &lt; 70 K</td>
<td>300 K ≤ x &lt; 400 K</td>
<td>&lt; 1 M</td>
</tr>
<tr>
<td>M2</td>
<td>Tri Lestari</td>
<td>7 M ≤ x &lt; 10 M</td>
<td>200 K ≤ x &lt; 300 K</td>
<td>70 K ≤ x &lt; 100 K</td>
<td>300 K ≤ x &lt; 400 K</td>
<td>4 M ≤ x &lt; 7 M</td>
</tr>
<tr>
<td>M3</td>
<td>Wiwik</td>
<td>4 M ≤ x &lt; 7 M</td>
<td>100 K ≤ x &lt; 200 K</td>
<td>70 K ≤ x &lt; 100 K</td>
<td>100 K ≤ x &lt; 200 K</td>
<td>1 M ≤ x &lt; 4 M</td>
</tr>
<tr>
<td>M4</td>
<td>Lilis</td>
<td>1 M ≤ x &lt; 4 M</td>
<td>&lt; 100 K</td>
<td>40 K ≤ x &lt; 70 K</td>
<td>200 K ≤ x &lt; 300 K</td>
<td>&lt; 1 M</td>
</tr>
<tr>
<td>M5</td>
<td>Dea Ayu</td>
<td>≥ 10 M</td>
<td>300 K ≤ x &lt; 400 K</td>
<td>≥ 100 K</td>
<td>300 K ≤ x &lt; 400 K</td>
<td>7 M ≤ x &lt; 10 M</td>
</tr>
<tr>
<td>M6</td>
<td>Depi Arisanti</td>
<td>7 M ≤ x &lt; 10 M</td>
<td>100 K ≤ x &lt; 200 K</td>
<td>40 K ≤ x &lt; 70 K</td>
<td>200 K ≤ x &lt; 300 K</td>
<td>1 M ≤ x &lt; 4 M</td>
</tr>
<tr>
<td>M7</td>
<td>Betti</td>
<td>≥ 10 M</td>
<td>≥ 400 K</td>
<td>70 K ≤ x &lt; 100 K</td>
<td>300 K ≤ x &lt; 400 K</td>
<td>4 M ≤ x &lt; 7 M</td>
</tr>
<tr>
<td>M8</td>
<td>Desi</td>
<td>1 M ≤ x &lt; 4 M</td>
<td>100 K ≤ x &lt; 200 K</td>
<td>40 K ≤ x ≤ 70 K</td>
<td>100 K ≤ x &lt; 200 K</td>
<td>&lt; 1 M</td>
</tr>
<tr>
<td>M9</td>
<td>Bambang</td>
<td>4 M ≤ x &lt; 7 M</td>
<td>100 K ≤ x &lt; 200 K</td>
<td>40 K ≤ x ≤ 70 K</td>
<td>100 K ≤ x &lt; 200 K</td>
<td>1 M ≤ x &lt; 4 M</td>
</tr>
<tr>
<td>M10</td>
<td>Davit Prana</td>
<td>≥ 10 M</td>
<td>300 K ≤ x &lt; 400 K</td>
<td>≥ 100 K</td>
<td>300 K ≤ x &lt; 400 K</td>
<td>4 M ≤ x &lt; 7 M</td>
</tr>
</tbody>
</table>

Based on the range value in table 3, normalization is carried out. The value of the normalized decision is seen in table 5.

**Table 5. Decision Value Normalized**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>M2</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>M3</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>M4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>M5</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>M6</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>M7</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>M8</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>M9</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>M10</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

The steps for the WASPAS method are as follows:

1. Make a decision matrix

   \[ X_{ij} = \begin{bmatrix} 2 & 3 & 3 & 4 & 1 \\ 4 & 3 & 4 & 4 & 3 \\ 3 & 2 & 4 & 2 & 2 \\ 2 & 1 & 3 & 3 & 1 \\ 5 & 4 & 5 & 4 & 4 \\ 4 & 2 & 3 & 3 & 2 \\ 5 & 5 & 4 & 4 & 3 \\ 2 & 2 & 3 & 2 & 1 \\ 3 & 2 & 3 & 2 & 2 \\ 5 & 4 & 5 & 4 & 3 \end{bmatrix} \]

   \[ Max = \begin{bmatrix} 5 & 5 & 5 & 4 & 4 \end{bmatrix} \]

2. For the stage of normalizing the decision matrix, according to the type of each criterion, whether it is a profit or cost criterion

   \[ C1 = Max \{ 2; 4; 3; 2; 5; 4; 5; 2; 3; 5 \} = 5 (Benefit) \]

   \[ X_{11} = \frac{2}{5} = 0.4 \]

   \[ X_{21} = \frac{4}{5} = 0.8 \]

   \[ X_{31} = \frac{3}{5} = 0.6 \]
\[ \frac{X_{41}}{2/5} = 0.4 \]
\[ X_{51} = \frac{5}{5} = 1 \]
\[ X_{61} = \frac{4}{5} = 0.8 \]
\[ X_{71} = \frac{5}{5} = 1 \]
\[ X_{81} = \frac{2}{5} = 0.4 \]
\[ X_{91} = \frac{3}{5} = 0.6 \]
\[ X_{101} = \frac{2}{5} = 0.4 \]

\[ C_2 = \text{Max} \{3; 3; 2; 1; 4; 2; 5; 2; 2; 4\} = \text{Benefit} \]
\[ X_{11} = \frac{3}{5} = 0.6 \]
\[ X_{21} = \frac{3}{5} = 0.6 \]
\[ X_{31} = \frac{2}{5} = 0.4 \]
\[ X_{41} = \frac{1}{5} = 0.2 \]
\[ X_{51} = \frac{4}{5} = 0.8 \]
\[ X_{61} = \frac{2}{5} = 0.4 \]
\[ X_{71} = \frac{5}{5} = 1 \]
\[ X_{81} = \frac{2}{5} = 0.4 \]
\[ X_{91} = \frac{2}{5} = 0.4 \]
\[ X_{101} = \frac{4}{5} = 0.8 \]

\[ C_3 = \text{Max} \{3; 4; 4; 3; 5; 3; 4; 3; 3; 5\} = \text{Benefit} \]
\[ X_{11} = \frac{3}{5} = 0.6 \]
\[ X_{21} = \frac{4}{5} = 0.8 \]
\[ X_{31} = \frac{4}{5} = 0.8 \]
\[ X_{41} = \frac{3}{5} = 0.6 \]
\[ X_{51} = \frac{5}{5} = 1 \]
\[ X_{61} = \frac{3}{5} = 0.6 \]
\[ X_{71} = \frac{4}{5} = 0.8 \]
\[ X_{81} = \frac{3}{5} = 0.6 \]
\[ X_{91} = \frac{3}{5} = 0.6 \]
\[ X_{101} = \frac{5}{5} = 1 \]

\[ C_4 = \text{Max} \{4; 4; 2; 3; 4; 3; 2; 2; 4\} = \text{Benefit} \]
\[ X_{11} = \frac{4}{4} = 1 \]
\[ X_{21} = \frac{4}{4} = 1 \]
\[ X_{31} = \frac{2}{4} = 0.5 \]
\[ X_{41} = \frac{3}{4} = 0.75 \]
\[ X_{51} = \frac{4}{4} = 1 \]
\[ X_{61} = \frac{3}{4} = 0.75 \]
\[ X_{71} = \frac{4}{4} = 1 \]
\[ X_{81} = \frac{2}{4} = 0.5 \]
\[ X_{91} = \frac{2}{4} = 0.5 \]
\[ X_{101} = \frac{4}{4} = 1 \]

\[ C_5 = \text{Max} \{1; 3; 2; 1; 4; 2; 3; 1; 2; 3\} = \text{Benefit} \]
\[ X_{11} = \frac{1}{4} = 0.25 \]
\[ X_{21} = \frac{3}{4} = 0.75 \]
\[ X_{31} = \frac{2}{4} = 0.5 \]
\[ X_{41} = \frac{1}{4} = 0.25 \]
\[ X_{51} = \frac{4}{4} = 1 \]
\[ X_{61} = 2/4 = 0.5 \]
\[ X_{71} = 3/4 = 0.75 \]
\[ X_{81} = 1/4 = 0.25 \]
\[ X_{91} = 2/4 = 0.5 \]
\[ X_{101} = 3/4 = 0.75 \]

The result of the normalization matrix \( x \) obtained the matrix \( x_{ij} \)

\[
\begin{bmatrix}
0.4 & 0.6 & 0.6 & 1 & 0.25 \\
0.8 & 0.6 & 0.8 & 1 & 0.75 \\
0.6 & 0.4 & 0.8 & 0.5 & 0.5 \\
0.4 & 0.2 & 0.6 & 0.75 & 0.25 \\
1 & 0.8 & 1 & 1 & 1 \\
0.8 & 0.4 & 0.6 & 0.75 & 0.5 \\
1 & 1 & 0.8 & 1 & 0.75 \\
0.4 & 0.4 & 0.6 & 0.5 & 0.25 \\
0.6 & 0.4 & 0.6 & 0.5 & 0.5 \\
0.4 & 0.8 & 1 & 1 & 0.75
\end{bmatrix}
\]

3. The next step is to optimize the attributes by multiplying the weight of each criterion

\[ Q1 = 0.5 \sum((0.4*5) + (0.6*3) + (0.6*4) + (1*2) + (0.25*5) + 0.5 \prod((0.4)^5 + (0.6)^3 + (0.6)^4 + (1)^2 + (0.25)^5)) = 4.725 + 0.678 = 5.403 \]

\[ Q2 = 0.5 \sum((0.8*5) + (0.6*3) + (0.8*4) + (1*2) + (0.75*5) + 0.5 \prod((0.8)^5 + (0.6)^3 + (0.8)^4 + (1)^2 + (0.75)^5)) = 7.375 + 1.095 = 8.470 \]

\[ Q3 = 0.5 \sum((0.6*5) + (0.4*3) + (0.8*4) + (0.5*2) + (0.5*5) + 0.5 \prod((0.6)^5 + (0.4)^3 + (0.8)^4 + (0.5)^2 + (0.5)^5)) = 5.450 + 0.416 = 5.866 \]

\[ Q4 = 0.5 \sum((0.4*5) + (0.2*3) + (0.6*4) + (0.75*2) + (0.25*5) + 0.5 \prod((0.4)^5 + (0.2)^3 + (0.6)^4 + (0.75)^2 + (0.25)^5)) = 3.875 + 0.356 = 4.231 \]

\[ Q5 = 0.5 \sum((1*5) + (0.8*3) + (1*4) + (1*2) + (1*5) + 0.5 \prod((1)^5 + (0.8)^3 + (1)^4 + (1)^2 + (1)^5)) = 9.200 + 2.256 = 11.456 \]

\[ Q6 = 0.5 \sum((0.8*5) + (0.4*3) + (0.6*4) + (0.75*2) + (0.5*5) + 0.5 \prod((0.8)^5 + (0.4)^3 + (0.6)^4 + (0.75)^2 + (0.5)^5)) = 3.800 + 0.558 = 6.358 \]

\[ Q7 = 0.5 \sum((1*5) + (1*3) + (0.8*4) + (1*2) + (0.75*5) + 0.5 \prod((1)^5 + (1)^3 + (0.8)^4 + (1)^2 + (0.75)^5)) = 8.475 + 1.823 = 10.298 \]

\[ Q8 = 0.5 \sum((0.4*5) + (0.4*3) + (0.6*4) + (0.5*2) + (0.25*5) + 0.5 \prod((0.4)^5 + (0.4)^3 + (0.6)^4 + (0.5)^2 + (0.25)^5)) = 3.925 + 0.227 = 4.152 \]

\[ Q9 = 0.5 \sum((0.6*5) + (0.4*3) + (0.6*4) + (0.5*2) + (0.5*5) + 0.5 \prod((0.6)^5 + (0.4)^3 + (0.6)^4 + (0.5)^2 + (0.5)^5)) = 5.050 + 0.276 = 5.326 \]

\[ Q10 = 0.5 \sum((0.4*5) + (0.8*3) + (1*4) + (1*2) + (0.75*5) + 0.5 \prod((0.4)^5 + (0.8)^3 + (1)^4 + (1)^2 + (0.75)^5)) = 7.075 + 1.380 = 8.455 \]

The final score for each student is shown in Table 6 below.
Nelly Khairani Daulay, *Comparison of the WASPAS and MOORA Methods in Providing Single Tuition Scholarships*

### Table 6. Final Grade for each student

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Student Name</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₁</td>
<td>Hendra</td>
<td>5.403</td>
</tr>
<tr>
<td>M₂</td>
<td>Tri Lestari</td>
<td>8.470</td>
</tr>
<tr>
<td>M₃</td>
<td>Wiwik</td>
<td>5.866</td>
</tr>
<tr>
<td>M₄</td>
<td>Lilis</td>
<td>4.231</td>
</tr>
<tr>
<td>M₅</td>
<td>Dea Ayu</td>
<td>11.456</td>
</tr>
<tr>
<td>M₆</td>
<td>Depi Arisanti</td>
<td>6.358</td>
</tr>
<tr>
<td>M₇</td>
<td>Betti</td>
<td>10.298</td>
</tr>
<tr>
<td>M₈</td>
<td>Desi</td>
<td>4.152</td>
</tr>
<tr>
<td>M₉</td>
<td>Bambang</td>
<td>5.326</td>
</tr>
<tr>
<td>M₁₀</td>
<td>Davit Prana</td>
<td>8.455</td>
</tr>
</tbody>
</table>

From the data presented in table 5, the ranking calculations are carried out in table 6 below:

### Table 7. The Rank Value of each Student

<table>
<thead>
<tr>
<th>Alternatif</th>
<th>Final Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>M₅</td>
<td>11.456</td>
<td>10</td>
</tr>
<tr>
<td>M₇</td>
<td>10.298</td>
<td>9</td>
</tr>
<tr>
<td>M₂</td>
<td>8.470</td>
<td>8</td>
</tr>
<tr>
<td>M₁₀</td>
<td>8.455</td>
<td>7</td>
</tr>
<tr>
<td>M₆</td>
<td>6.358</td>
<td>6</td>
</tr>
<tr>
<td>M₃</td>
<td>5.866</td>
<td>5</td>
</tr>
<tr>
<td>M₁</td>
<td>5.403</td>
<td>4</td>
</tr>
<tr>
<td>M₉</td>
<td>5.326</td>
<td>3</td>
</tr>
<tr>
<td>M₄</td>
<td>4.231</td>
<td>2</td>
</tr>
<tr>
<td>M₈</td>
<td>4.152</td>
<td>1</td>
</tr>
</tbody>
</table>

From the analysis of students receiving single tuition assistance using the Weighted Aggregated Sum Product Assessment (WASPAS) method based on student grade selection, the ranking is seen in table 7 where the lowest score of M₈ in the name of Desi gets a value of 4.152 indicating that the student has a great chance of receiving assistance and so on. based on ranking.

Furthermore, the value of students who receive the Single Tuition Fee is calculated using the MOORA method. The MOORA method has criteria for calculating the value of students who receive the assistance. The steps for determining recipients of the Single Tuition Fee using the MOORA method are presented as follows:

1. **Determine the assessment criteria**

   Data on criteria for recipients of Single Tuition assistance can be seen in table 5.

   Benefits: parents’ income, electricity bill, water bill, land and building tax and family expenses

   The following are the steps to solve it using MOORA:

   $$X = \begin{bmatrix} 2 & 3 & 3 & 4 & 1 \\ 4 & 3 & 4 & 4 & 3 \\ 3 & 2 & 4 & 2 & 2 \\ 2 & 1 & 3 & 3 & 1 \\ 5 & 4 & 5 & 4 & 4 \\ 4 & 2 & 3 & 3 & 2 \\ 5 & 5 & 4 & 4 & 3 \\ 2 & 2 & 3 & 2 & 1 \\ 3 & 2 & 3 & 2 & 2 \\ 5 & 4 & 5 & 4 & 3 \end{bmatrix}$$

2. **Perform normalization X**

   $$C₁ = \sqrt{2^2 + 4^2 + 3^2 + 2^2 + 5^2 + 4^2 + 5^2 + 2^2 + 3^2 + 5^2}$$

   $$= \sqrt{4 + 16 + 9 + 4 + 25 + 16 + 25 + 4 + 9 + 25}$$

   $$= 11.705$$

   $$X_{x₁} = 2/11.705 = 0.171$$

   $$X_{x₂} = 4/11.705 = 0.342$$

   $$X_{x₃} = 3/11.705 = 0.256$$

   $$X_{x₄} = 2/11.705 = 0.171$$

   $$X_{x₅} = 5/11.705 = 0.427$$

   $$X_{x₆} = 4/11.705 = 0.342$$

   $$X_{x₇} = 5/11.705 = 0.427$$
\[ X_{01} = \frac{2}{11.705} = 0.171 \]
\[ X_{01} = \frac{3}{11.705} = 0.256 \]
\[ X_{101} = \frac{5}{11.705} = 0.427 \]
\[ C_2 = \sqrt{3^2 + 3^2 + 2^2 + 1^2 + 4^2 + 2^2} = \sqrt{9 + 9 + 4 + 1 + 16 + 4 + 25 + 4 + 4 + 16} = 9.592 \]
\[ X_{22} = \frac{3}{9.592} = 0.313 \]
\[ X_{23} = \frac{2}{9.592} = 0.209 \]
\[ X_{41} = \frac{1}{9.592} = 0.104 \]
\[ X_{31} = \frac{4}{9.592} = 0.417 \]
\[ X_{61} = \frac{2}{9.592} = 0.209 \]
\[ X_{101} = \frac{2}{9.592} = 0.209 \]
\[ X_{01} = \frac{2}{9.592} = 0.209 \]
\[ X_{101} = 4 / 9.592 = 0.417 \]
\[ C_3 = \sqrt{3^2 + 4^2 + 2^2 + 3^2 + 5^2 + 3^2 + 4^2 + 3^2 + 3^2 + 5^2} = \sqrt{9 + 16 + 9 + 25 + 9 + 16 + 9 + 9 + 25} = 11.958 \]
\[ X_{11} = \frac{3}{11.958} = 0.251 \]
\[ X_{12} = \frac{4}{11.958} = 0.335 \]
\[ X_{31} = \frac{3}{11.958} = 0.251 \]
\[ X_{41} = \frac{2}{11.958} = 0.251 \]
\[ X_{61} = \frac{3}{11.958} = 0.251 \]
\[ X_{101} = \frac{5}{11.958} = 0.418 \]
\[ C_4 = \sqrt{4^2 + 4^2 + 2^2 + 3^2 + 4^2 + 3^2 + 2^2 + 4^2} = \sqrt{16 + 16 + 4 + 9 + 16 + 9 + 16 + 4 + 4 + 16} = 10.488 \]
\[ X_{11} = \frac{4}{10.488} = 0.381 \]
\[ X_{12} = \frac{4}{10.488} = 0.381 \]
\[ X_{31} = \frac{2}{10.488} = 0.191 \]
\[ X_{41} = \frac{3}{10.488} = 0.286 \]
\[ X_{61} = \frac{4}{10.488} = 0.381 \]
\[ X_{01} = \frac{3}{10.488} = 0.286 \]
\[ X_{101} = \frac{4}{10.488} = 0.381 \]
\[ X_{11} = \frac{4}{10.488} = 0.381 \]
\[ X_{101} = \frac{4}{10.488} = 0.381 \]
\[ C_5 = \sqrt{1^2 + 3^2 + 2^2 + 1^2 + 4^2 + 2^2 + 3^2 + 1^2 + 2^2 + 3^2} = \sqrt{1 + 9 + 4 + 1 + 16 + 4 + 9 + 1 + 4 + 9} = 7.616 \]
\[ X_{11} = \frac{1}{7.616} = 0.131 \]
\[ X_{12} = \frac{3}{7.616} = 0.286 \]
\[ X_{31} = \frac{2}{7.616} = 0.191 \]
\[ X_{41} = \frac{1}{7.616} = 0.095 \]
\[ X_{51} = \frac{4}{7.616} = 0.381 \]
\[ X_{61} = \frac{2}{7.616} = 0.191 \]
\[ X_{71} = \frac{3}{7.616} = 0.286 \]
\[ X_{01} = \frac{1}{7.616} = 0.095 \]
\[ X_{01} = \frac{2}{7.616} = 0.191 \]
\[ X_{101} = \frac{3}{7.616} = 0.286 \]
The IJICS (International Journal of Informatics and Computer Science)  
Vol 5 No 1, March 2021, Page 84-94  
Nelly Khairani Daulay, Comparison of the WASPAS and MOORA Methods in Providing Single Tuition Scholarships

The result of the calculation is the normalization matrix

\[
X_{ij} = \begin{bmatrix}
0.171 & 0.313 & 0.251 & 0.381 & 0.131 \\
0.342 & 0.313 & 0.335 & 0.381 & 0.286 \\
0.256 & 0.209 & 0.335 & 0.191 & 0.191 \\
0.171 & 0.104 & 0.251 & 0.286 & 0.095 \\
0.427 & 0.417 & 0.418 & 0.381 & 0.381 \\
0.342 & 0.209 & 0.251 & 0.286 & 0.191 \\
0.427 & 0.521 & 0.335 & 0.381 & 0.286 \\
0.171 & 0.209 & 0.251 & 0.191 & 0.095 \\
0.256 & 0.209 & 0.251 & 0.191 & 0.191 \\
0.427 & 0.417 & 0.418 & 0.381 & 0.286 \\
\end{bmatrix}
\]

3. Optimizing attributes to include weight in normalized searches

\[
X_{ij} = \begin{bmatrix}
5 \times 0.171 & 3 \times 0.313 & 4 \times 0.251 & 2 \times 0.381 & 5 \times 0.131 \\
5 \times 0.342 & 3 \times 0.313 & 4 \times 0.335 & 2 \times 0.381 & 5 \times 0.286 \\
5 \times 0.256 & 3 \times 0.209 & 4 \times 0.335 & 2 \times 0.191 & 5 \times 0.191 \\
5 \times 0.171 & 3 \times 0.104 & 4 \times 0.251 & 2 \times 0.286 & 5 \times 0.095 \\
5 \times 0.427 & 3 \times 0.417 & 4 \times 0.418 & 2 \times 0.381 & 5 \times 0.381 \\
5 \times 0.342 & 3 \times 0.209 & 4 \times 0.251 & 2 \times 0.286 & 5 \times 0.191 \\
5 \times 0.427 & 3 \times 0.521 & 4 \times 0.335 & 2 \times 0.381 & 5 \times 0.286 \\
5 \times 0.171 & 3 \times 0.209 & 4 \times 0.251 & 2 \times 0.191 & 5 \times 0.095 \\
5 \times 0.256 & 3 \times 0.209 & 4 \times 0.251 & 2 \times 0.191 & 5 \times 0.191 \\
5 \times 0.427 & 3 \times 0.417 & 4 \times 0.418 & 2 \times 0.381 & 5 \times 0.286 \\
\end{bmatrix}
\]

The result after being calculated:

\[
X_{ij} = \begin{bmatrix}
0.855 & 0.939 & 1.004 & 0.762 & 0.655 \\
1.71 & 0.939 & 1.34 & 0.762 & 1.43 \\
1.28 & 0.627 & 1.34 & 0.382 & 0.955 \\
0.855 & 0.312 & 1.004 & 0.572 & 0.475 \\
2.135 & 1.251 & 1.672 & 0.762 & 1.905 \\
1.71 & 0.627 & 1.004 & 0.572 & 0.955 \\
2.135 & 1.563 & 1.34 & 0.762 & 1.43 \\
0.855 & 0.627 & 1.004 & 0.382 & 0.475 \\
1.28 & 0.627 & 1.004 & 0.382 & 0.955 \\
2.135 & 1.251 & 1.672 & 0.762 & 1.43 \\
\end{bmatrix}
\]

Then look for the value \( Y_i \)

Table 8. Value Lookup \( Y_i \)

<table>
<thead>
<tr>
<th>Alternative</th>
<th>MAX (C1+C2+C3+C4+C5)</th>
<th>MIN (0)</th>
<th>( Y_i = \text{Max} - \text{Min} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>0.855+0.939+1.004+0.762+0.655</td>
<td>0</td>
<td>4.215</td>
</tr>
<tr>
<td>M2</td>
<td>1.71+0.939+1.34+0.762+1.43</td>
<td>0</td>
<td>6.181</td>
</tr>
<tr>
<td>M3</td>
<td>1.28+0.627+1.34+0.382+0.955</td>
<td>0</td>
<td>4.584</td>
</tr>
<tr>
<td>M4</td>
<td>0.855+0.312+1.004+0.572+0.475</td>
<td>0</td>
<td>3.218</td>
</tr>
<tr>
<td>M5</td>
<td>2.135+1.251+1.672+0.762+1.905</td>
<td>0</td>
<td>7.725</td>
</tr>
<tr>
<td>M6</td>
<td>1.71+0.627+1.004+0.572+0.955</td>
<td>0</td>
<td>4.868</td>
</tr>
<tr>
<td>M7</td>
<td>2.135+1.563+1.34+0.762+1.43</td>
<td>0</td>
<td>7.23</td>
</tr>
<tr>
<td>M8</td>
<td>0.855+0.627+1.004+0.382+0.475</td>
<td>0</td>
<td>3.343</td>
</tr>
<tr>
<td>M9</td>
<td>1.28+0.627+1.004+0.382+0.955</td>
<td>0</td>
<td>4.248</td>
</tr>
<tr>
<td>M10</td>
<td>2.135+1.251+1.672+0.762+1.43</td>
<td>0</td>
<td>7.25</td>
</tr>
</tbody>
</table>

Count that has been ranked from largest to smallest

Table 9. Rank

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Value</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>7.725</td>
<td>10</td>
</tr>
<tr>
<td>M10</td>
<td>7.25</td>
<td>9</td>
</tr>
<tr>
<td>M7</td>
<td>7.23</td>
<td>8</td>
</tr>
<tr>
<td>M2</td>
<td>6.181</td>
<td>7</td>
</tr>
<tr>
<td>M6</td>
<td>4.868</td>
<td>6</td>
</tr>
<tr>
<td>M3</td>
<td>4.584</td>
<td>5</td>
</tr>
<tr>
<td>M9</td>
<td>4.248</td>
<td>4</td>
</tr>
</tbody>
</table>
Nelly Khairani Daulay, *Comparison of the WASPAS and MOORA Methods in Providing Single Tuition Scholarships*

<table>
<thead>
<tr>
<th>Alternative</th>
<th>WASPAS Rank</th>
<th>MOORA Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>M8</td>
<td>3,343</td>
<td>2</td>
</tr>
<tr>
<td>M4</td>
<td>3,218</td>
<td>1</td>
</tr>
</tbody>
</table>

Judging from table 9 of the results of the student grade ranking for the determination of Single Tuition assistance using the MOORA method, the results show that M4 is ranked first on Lilis's name, getting a result of 3,218. This shows that the alternative M4 is entitled to receive Single Tuition assistance.

From the results of the discussion of the WASPAS and MOORA methods above, it can be seen the results of the comparison ranking of the WASPAS and MOORA methods in the following 10:

**Table 10. Comparison Ranking Result of WASPAS and MOORA Methods**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>WASPAS Rank</th>
<th>MOORA Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>M2</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>M3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>M4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>M5</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>M6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>M7</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>M8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>M9</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>M10</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

Judging from table 10, the results of the calculation of the WASPAS and MOORA methods in determining the single tuition fee scholarship assistance obtained the first ranking results and a great opportunity to get a scholarship, namely the M8 alternative with a value of 4.152 in the name of Desi (the WASPAS method) and the M4 alternative with a value of 3.128 on behalf of Lilis.

4. CONCLUSION

From the results of research conducted using two methods, namely the WASPAS and MOORA methods, different comparison results were obtained. The calculation of the WASPAS method in determining the Tuition Fee scholarship provides an alternative M8 with the first ranking getting a value of 4.152. While calculations using the MOORA method get the results of M4 occupying the first rank with a value of 3,218. This shows that the M8 and M4 alternatives are entitled to receive Single Tuition assistance. Thus both methods give the best results.

REFERENCES