Implementation of the Simple Additive Weighting (SAW) Method in Selection of Students Recipients of Single Tuition Fee Assistance

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Abstract—Higher education in Indonesia, including at Budi Darma University, continues to be committed to creating an inclusive and equitable learning environment for all students. In line with this determination, Budi Darma University is implementing the Single Tuition Assistance (BUKT) program to support educational accessibility. Obstacles in the selection process, which is subjective and lacks a structured framework, can lead to inequality in the distribution of aid. This can result in students who should receive greater support being overlooked, while those who may need less may receive greater aid. In the BUKT selection process, there are a number of requirements that must be met, such as parents' income, PKH card ownership, completeness of documents, parents' dependents and home ownership. It is hoped that the use of a decision support system can be a solution to overcome this challenge. Decision Support Systems (DSS) integrate computer technology, mathematical models, and data to provide structured and organized support within a decision-making framework. The Simple Additive Weighting (SAW) method is a multi-criteria decision making method that allows relative weighing between criteria to determine the final score for each alternative. By applying SAW in the selection of BUKT recipient students, it is hoped that more objective and data-based decisions can be obtained. The research results produced the best alternative with a value of 100.00 in the alternative with code A5 in Fitri's name, so that Fitri was declared entitled to receive single tuition assistance.

Keywords: Student Selection; MCDM; Single Tuition Fee; SAW Method; DSS

1. INTRODUCTION

Single Tuition Fee (UKT) is a mechanism used to finance student course payments at state universities under the Ministry of Research, Technology and Higher Education (Kemristek Dikti). This system is different from the previous approach, where education costs include elements such as tuition fees, internship fees, fees for students (IOM), dissertation exam fees, graduation fees, quality improvement awards, Education (SPKP), and other factors. To improve educational standards, motivational aspects, especially in terms of operational budgeting, are very necessary. The cost of educational activities is an important supporting factor for improving the quality of education. Currently, state universities are developing new innovations by adopting the UKT classification system, with the aim of helping individuals from underprivileged communities to continue their education at tertiary level [1]–[5].

Higher education in Indonesia, including at Budi Darma University, continues to be serious in its efforts to create an inclusive and equitable learning environment for all students. In line with this commitment, Budi Darma University implements the Single Tuition Assistance (BUKT) program to support educational accessibility. BUKT has a crucial role in helping students carry out their academic journey smoothly, while reducing the burden of education costs. However, challenges arise when it is necessary to select BUKT recipient students fairly and efficiently. The subjective nature of the selection process and the lack of a structured framework can result in inequality in the distribution of aid. This can result in students who should receive greater support being overlooked, while those who may need less may receive more help. Although this assistance is provided to students at all universities, there are several criteria that can be used as a guide in the process of selecting BUKT recipients. In the BUKT selection process, there are requirements that must be met, including parents' income, ownership of a PKH card, completeness of documents, parents' dependents and home ownership. Universities face difficulties in selecting students who are worthy of this assistance because the number of applicants is very large, while the available quota is limited. Therefore, a solution is needed in the form of a decision support system to assist in selecting eligible BUKT recipient students. In the midst of increasingly stringent financial demands and an increase in the number of students requiring financial assistance, a more structured and objective approach is needed in determining recipients of Single Tuition Assistance (BUKT). It is hoped that the use of a decision support system can be a solution to overcome this challenge.

Decision Support System (DSS) is a term that refers to an information system created with the aim of helping individuals responsible for organizing, analyzing and assessing information that has relevance in a more optimal decision-making process. SPK integrates computer technology, mathematical models and data to provide structured and organized support within a decision-making framework[6]–[8]. SAW is a multi-criteria decision making method that allows relative weighing between criteria to determine the final score for each alternative [9]–[11]. By applying SAW in the selection of BUKT recipient students, it is hoped that more objective and data-based decisions can be obtained.

In Setyani and Sipayung’s previous research in 2023, they examined the application of SAW in determining outstanding students, resulting in the ranking of students with the highest score being ranked first, namely alternative A2 with a score of 1[12]. Research by Syabaniah et al in 2022 examined the application of the SAW method in selecting prospective tahfidz scholarship recipients resulting in 10 students who were entitled to receive scholarships due to obtaining high scores[13]. Research by Putra et al in 2022 examined the application of the SAW method in determining
BLT recipients to produce alternatives who were entitled to receive BLT based on the highest score obtained [14]. Research by Hulu et al in 2022 examined the application of SAW in determining the champion of a vocal group competition resulting in an alternative winner who obtained the highest score, namely 0.932 [15].

Implementing the SAW Method into the selection mechanism for BUKT recipients at Budi Darma University, it is hoped that the quality of decision making will increase, reduce the level of subjectivity, and provide a more structured framework for assessing prospective BUKT recipients. The application of SAW is expected to produce more precise selection according to the criteria set by the university. In this way, the announcement of election results can be done more quickly, providing an opportunity for eligible students to immediately prepare to take part in lecture activities.

2. RESEARCH METHODOLOGY

2.1 Decision Support System

A decision support system (DSS) is an interactive computer system that helps decision makers solve unstructured problems through the use of data and various models. The integration of individual intellectual resources with computer capabilities makes SPK a tool capable of improving the quality of decision making. DSS plays a role as a support for decision makers in dealing with the complexity and uncertainty of information that is often involved in business or organizational decisions. Through SPK assistance, the efficiency and effectiveness of the decision-making process can be improved by providing more timely, accurate and detailed information [16]–[23].

2.2 Single Tuition Fee Assistance

Single Tuition Fee (UKT) is an educational fee structure implemented in higher education institutions in Indonesia, especially in state institutions. UKT was introduced with the aim of integrating and simplifying various previously separate elements of education costs into one single unit. This system is designed to provide clarity and fairness in determining educational costs for students, while also trying to accommodate various economic conditions among students. The fundamental principle of UKT involves grouping different fee amounts for each student based on their family's economic capacity [24]–[26].

2.3 Metode Simple Additive Weighting (SAW)

The Simple Additive Weighting (SAW) method is a technique in decision support systems that is used to carry out evaluations and selections based on a number of relevant criteria. In SAW, various criteria are used to provide assessments with appropriate relative weights or values for each criterion. Generally, SAW is used in situations where we need to choose between alternatives or objects based on a number of predefined criteria [27]–[33]. The following are steps to solve problems with SAW [34]–[36]:

1. Determine the criteria that will be used as a reference in making decisions (Cj), and give a weight to each criterion in terms of linguistic variables.
2. Provide a suitable rating/level of importance for each criterion (W).
3. Normalize the decision matrix.

\[
r^*_{ij} = \frac{X_{ij}}{\max_i X_{ij}} - \frac{X_{ij}}{\min_i X_{ij}}
\]

(1)

4. The final result V1 obtained from the ranking of the normalized sum R multiplying the matrix with weights (W) to get the largest value is the best alternative (Ai).

\[
V_i = \sum_{j=1}^{n} W_j r_{ij}
\]

(2)

2.4 Research Stages

Several studies of decision support systems using simple weighting (SAW) related to this study have been widely described. After conducting research to find the weight of each characteristic, a ranking process is carried out to determine the best alternative, namely the best student. After analysis, design, implementation and testing, the following conclusions can be drawn:

1. Identify the Problem
   In this stage, analyze existing problems for values and criteria that influence utility values.
2. Literature Review
   In this stage, data collection is carried out to look for material related to the case from many sources, both from the internet and available books.
3. Analysis and application of the SAW method
   At this stage, several data are processed by applying the SAW method to determine recipients of tuition assistance, as well as formulating problems and resolving cases.
4. Write a research report
In this step, the work plan that has been completed in making the report is evaluated.

3. RESULT AND DISCUSSION

Challenges arise in selecting students who receive UKT assistance fairly and efficiently. The selection process tends to be subjective and the lack of a structured framework can result in inequality in the distribution of aid. The impact is the potential neglect of students who should receive greater support, while students who may need less support may receive greater allocations. The following are the criteria used as guidelines in determining students who are entitled to receive UKT assistance:

<table>
<thead>
<tr>
<th>Table 1. Criteria Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion</td>
</tr>
<tr>
<td>C₁</td>
</tr>
<tr>
<td>C₂</td>
</tr>
<tr>
<td>C₃</td>
</tr>
<tr>
<td>C₄</td>
</tr>
<tr>
<td>C₅</td>
</tr>
</tbody>
</table>

The following is data on prospective students receiving single tuition assistance which can be seen in Table 2 below.

<table>
<thead>
<tr>
<th>Table 2. Data on prospective UKT recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
</tr>
<tr>
<td>A₁</td>
</tr>
<tr>
<td>A₂</td>
</tr>
<tr>
<td>A₃</td>
</tr>
<tr>
<td>A₄</td>
</tr>
<tr>
<td>A₅</td>
</tr>
</tbody>
</table>

In Table 2 there is still linguistic data, so a weighting table for C₂, C₃ and C₅ is needed as follows:

<table>
<thead>
<tr>
<th>Table 3. Weighting C2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Not available</td>
</tr>
<tr>
<td>Available</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 4. Weighting C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Complete</td>
</tr>
<tr>
<td>Incomplete</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5. Weighting C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Personal</td>
</tr>
<tr>
<td>Rent</td>
</tr>
</tbody>
</table>

3.1 Implementation of SAW Method

In selecting students who receive UKT assistance fairly and efficiently, the SAW method is applied using the following steps.

1. Decision Matrix
   Based on data from prospective students who receive single tuition assistance after weighting, the following matrix values are obtained.

<table>
<thead>
<tr>
<th>Table 6. Match Rating Data Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative</td>
</tr>
<tr>
<td>A₁</td>
</tr>
<tr>
<td>A₂</td>
</tr>
<tr>
<td>A₃</td>
</tr>
<tr>
<td>A₄</td>
</tr>
<tr>
<td>A₅</td>
</tr>
<tr>
<td>MAX</td>
</tr>
<tr>
<td>MIN</td>
</tr>
</tbody>
</table>

2. Normalized Matrix
   C₁ (Cost)
   \[ r_{11} = \frac{2000000}{4000000} = 0.50 \]
\[ r_{21} = \frac{2000000}{3500000} = 0.57 \]
\[ r_{31} = \frac{2500000}{2000000} = 0.80 \]
\[ r_{41} = \frac{3000000}{2000000} = 0.67 \]
\[ r_{51} = \frac{2000000}{2000000} = 1.00 \]

C2 (Benefit)
\[ r_{12} = \frac{5}{10} = 0.50 \]
\[ r_{22} = \frac{10}{10} = 1.00 \]
\[ r_{32} = \frac{10}{10} = 1.00 \]
\[ r_{42} = \frac{10}{10} = 1.00 \]
\[ r_{52} = \frac{10}{10} = 1.00 \]

C3 (Benefit)
\[ r_{13} = \frac{5}{10} = 0.50 \]
\[ r_{23} = \frac{10}{10} = 1.00 \]
\[ r_{33} = \frac{10}{10} = 1.00 \]
\[ r_{43} = \frac{10}{10} = 1.00 \]
\[ r_{53} = \frac{10}{10} = 1.00 \]

C4 (Benefit)
\[ r_{14} = \frac{3}{4} = 0.75 \]
\[ r_{24} = \frac{4}{3} = 0.80 \]
\[ r_{34} = \frac{3}{4} = 0.75 \]
\[ r_{44} = \frac{4}{3} = 0.80 \]
\[ r_{54} = \frac{3}{3} = 1.00 \]

C5 (Cost)
\[ r_{15} = \frac{5}{10} = 0.50 \]
\[ r_{25} = \frac{5}{5} = 1.00 \]
\[ r_{35} = \frac{5}{5} = 1.00 \]
\[ r_{45} = \frac{5}{5} = 1.00 \]
\[ r_{55} = \frac{5}{5} = 1.00 \]

After carrying out the calculation process to obtain the normalized matrix as follows.

<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>A1</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>1.00</td>
<td>0.50</td>
</tr>
<tr>
<td>A2</td>
<td>0.57</td>
<td>0.50</td>
<td>1.00</td>
<td>0.80</td>
<td>1.00</td>
</tr>
<tr>
<td>A3</td>
<td>0.80</td>
<td>1.00</td>
<td>1.00</td>
<td>0.60</td>
<td>0.50</td>
</tr>
<tr>
<td>A4</td>
<td>0.67</td>
<td>1.00</td>
<td>1.00</td>
<td>0.80</td>
<td>1.00</td>
</tr>
<tr>
<td>A5</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

3. Preference Value
\[ V1 = \sum (30 \times 0.50 + 20 \times 0.50 + 15 \times 0.50 + 25 \times 1.00 + 10 \times 0.50) = 62.50 \]
\[ V2 = \sum (30 \times 0.57 + 20 \times 0.50 + 15 \times 1.00 + 25 \times 0.80 + 10 \times 1.00) = 72.14 \]
\[ V3 = \sum (30 \times 0.80 + 20 \times 1.00 + 15 \times 1.00 + 25 \times 0.60 + 10 \times 0.50) = 79.00 \]
\[ V4 = \sum (30 \times 0.67 + 20 \times 1.00 + 15 \times 1.00 + 25 \times 0.80 + 10 \times 1.00) = 85.00 \]
\[ V5 = \sum (30 \times 0.50 + 20 \times 0.50 + 15 \times 0.50 + 25 \times 1.00 + 10 \times 0.50) = 62.50 \]

After carrying out the calculation process to obtain the final result of the preference value as follows.
Based on Table 8, alternative 5 (A5) is the best alternative choice as a student who is entitled to receive single tuition assistance, namely Fitri with a value of 100.0.

4. CONCLUSION

From the research results, it can be concluded that the aid selection system with the support of a Decision Support System (SPK) has the capacity to store, edit and delete data on applicants and recipients of Single Tuition Fee (UKT) aid. Selection of scholarship recipients is carried out by providing recommendations through a ranking model created by applying a simple weighting method using Simple Additive Weighting (SAW) in the system. In the BUKT selection process, there are a number of requirements that must be met, such as parents' income, PKH card ownership, completeness of documents, parents' dependents and home ownership. It is hoped that the use of a decision support system can be a solution to overcome this challenge. By applying SAW in the selection of UKT recipient students, it is hoped that more objective and data-based decisions can be obtained. The results of the research produced the best alternative with a value of 100.0 in the alternative with code A5 in the name of Fitri, so that Fitri was declared entitled to receive single tuition assistance.

REFERENCES


Table 8. Preference Value

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Vi Value</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>62.50</td>
<td>5</td>
</tr>
<tr>
<td>A2</td>
<td>72.14</td>
<td>4</td>
</tr>
<tr>
<td>A3</td>
<td>79.00</td>
<td>3</td>
</tr>
<tr>
<td>A4</td>
<td>85.00</td>
<td>2</td>
</tr>
<tr>
<td>A5</td>
<td>100.00</td>
<td>1</td>
</tr>
</tbody>
</table>

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