Decision support system design of higher education scholarship recipients with android-based

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Abstract. The purpose of this study is to present the design of Decision Support System (DSS) to analyse the college scholarship recipients on the android-based. The design methodology for selecting scholarship recipients is used Fuzzy Multiple Attribute Decision Making (Fuzzy MADM). Fuzzy MADM is an algorithm that used to find the optimal result of a number of alternatives with certain criteria. This method is chosen because the calculation of this method uses multiplication to correlate the attribute rating and only yields the largest value that will be selected as an alternative scholarship recipient. The object set in this research is UIN Sunan Gunung Djati Bandung student. The design system is made based on android with hardware in the form of smart phone. The design results have a level of compliance with regulatory standards that have been established. The results also indicate the logical and appropriate target selection mechanism for scholarship recipients for the most eligible students who received scholarship assistance.

1. Introduction
Scholarships in Higher Education are programs that are widely offered to students as a form of appreciation for achievement and/ or financial assistance for students who are academically capable, but not economically capable. To assist in the decision making process in determining scholarships, an information system can be implemented. The purpose of the information system implementation is the improvement of the system used previously [1]. The information system (IS) consists of components called building blocks, which consist of input components, process components, output components, technology components, hardware components, software components, database components, and control components [2]. All components are interconnected with each other in achieving a goal [3]. In the world of education, IS is the main pillar in regulating everything related to information on university activities [4].

The information system model that matches the decision-making decision of scholarships is the Decision Support System (DSS) [5]. DSS is an information system that uses a base model that provides recommendations for users in making decisions on a particular problem.

Similar studies have been conducted, including: determining scholarship recipients by using Fuzzy Multiple Attribute Decision Making [6]; Web-based information system to accelerate the selection of PPA and BBP scholarship recipients at Bengkalis State Polytechnic [7]; Multi Criterion Decision Making analysis on the Decision Support System for decision making in determining scholarship recipients [8]; and Decision Support System for scholarship recipients with the Multiple AHP Method [9]. This study discusses the DSS design of the determination of scholarships for students using the Weighted Product (WP) method as a basis for calculation in decision making.
2. Methods
The research method used to design the DSS in determining the scholarship recipients follows the stages:
1) Observation: Search and collect data, where the data has relevance to the topic of this research,
2) Literature review: Using books, previous research and journals related to the topics and problems in this study,
3) Analysis: The method of the WP method is applied by determining the criteria of prospective students who are scholarship recipients, and 4) DSS Design: the system design methodology used in this study is the UML approach, with designs in the form of use case diagrams and class diagram data.

Reliability of system applications in this research, it is used: analytical, logical, conceptual, and operational verification by an expert[10].

3. Results and Discussion
A college generally has a student information system in educational institutions, as well as the components contained therein, each component is related to the flow of the highest education institution information system [1]. The information system is a combination of information technology and the activities of people using computerized technology [11], which is generally used to support management [12]. Information systems are systems that process data in an organized manner [13], information systems have a high degree of flexibility that allows them to be developed into better systems [14], efficient in time [15], good data accessibility [16], efficient in financing, [17], accuracy/ precision [18], wide accessibility [19], supporting decisions appropriately [20], improving productivity [21], presenting data and information well [22], improving user understanding [23], and data storage media [24].

The hardware for this system is a smart phone, the reason for choosing this device is based on the consideration of the advantages of Android-based application programs on smart phones, namely: usage that is concise and mobile [25], has the ability to provide multimedia-based information [26], fun [27], efficient [28], and accessibility [29].

One part of the information system that needs to be implemented in the student information system is the DSS for the determination of scholarships. In this study weighted product method (WP) is used as an analysis tool in determining scholarship recipients.

3.1. Weighted Product Method
The WP method is a method to complete Multi Attribute Decision Making (MADM). WP uses the multiplication technique to connect the rating attribute, where the rating of each attribute must be raised first with the corresponding weight attribute [30]. Calculation phases with the WP method:

a. Determine selection criteria (C1, C2,..., Cn)
b. Assess the importance of each criterion.
c. Assessment of each alternative using attributes.
d. From the assessment data, each attribute weight and alternative values are made by the decision matrix (X)
e. Normalization or improvement of weights equation (1):

\[ W_j = \frac{w_j}{\sum w_j} \] (1)

Normalize or correct weights to produce a value of \( \Sigma W_j = 1 \) where \( j = 1, 2, ..., n \) is a lot of alternatives \( \Sigma w_j \) is the total number of weight values.
f. Normalization process (S) decision matrix is normalized by multiplying the attribute rating, where the attribute rating must first be raised with the attribute weight equation (2).

\[ S_i = \prod_{j=1}^{n} x_{ij}^{w_j} \] (2)

Where: \( S_i \) = Results of normalization of the matrix; \( j \) = Criteria value;
\( w_j \) = Criteria weighting value;
\( i \) = Alternative value;
\( x_{ij} \) = Variable values of alternatives in each attribute
g. Determining Vector Values (V) equation (3)

$$V_i = \frac{\prod_{j=1}^{n} X_{ij} W_j}{\prod_{j=1}^{n} (S_j W_j)}$$

(3)

Where: $V_i =$ Results of the first (I) alternative preference; $n =$ Number of criteria; $X_{ij} =$ Variable values of alternatives in each attribute; $i =$ Alternative value; $j =$ Criteria value;

Figure 1 shows the flow chart of the Weighted Product method and Figure 2 shown diagram on SIS.

![Flowchart](Image)

**Figure 1. Flowchart**

**Weighted Product**

![Use case diagram on SIS](Image)

**Figure 2. Use case diagram on SIS**

![Class Diagram](Image)

**Figure 3. Class Diagram**
3.2. System Design

The designed system design requires the establishment of criteria in the determination of scholarships that are integrated in the Student Information System (SIS) with Android-Based. Figure 2 shows the use case diagram design in SIS, for Class Diagram shown in Figure 3. Table 1 shows the attributes used in making decisions determined in the determination of scholarships.

Table 1. Attributes in Determining Scholarships

| Criteria     | Weight | Classification | Score |
|--------------|--------|----------------|-------|
| C1 UN Score  | 0.15   | 5.0-5.9        | 1     |
|              |        | 6.0-6.9        | 2     |
|              |        | 7.0-7.9        | 3     |
|              |        | 8.0-10         | 4     |
| C2 Parent income | 0.12   | >2.000.000     | 1     |
|              |        | >1.500.000-2.000.000 | 2     |
|              |        | >1.000.000-1.500.000 | 3     |
|              |        | <1.000.000     | 4     |
| C3 Dependent parents | 0.12   | 1               | 1     |
|              |        | 2               | 2     |
|              |        | 3               | 3     |
|              |        | >4              | 4     |
| C4 Achievement | 0.10   | None            | 1     |
|              |        | Exist           | 2     |
| C5 House Criteria | 0.10   | Permanent House | 1     |
|              |        | House Ground    | 4     |
|              |        | Pedestal House  | 6     |
| C6 Home ownership | 0.09   | Personal        | 1     |
|              |        | Annual Rent     | 2     |
|              |        | Monthly rent    | 3     |
|              |        | Hitchhiking     | 4     |
| C7 Fill in the house | 0.08   | >4              | 1     |
|              |        | 3               | 2     |
|              |        | 2               | 3     |
|              |        | 1               | 4     |
| C8 Bath/ wash toilet | 0.08   | It's in the house | 1     |
|              |        | Out of Home     | 2     |
|              |        | Not Eligible    | 3     |
| C9 House surface area | 0.06   | >200 m²         | 1     |
|              |        | 100-200 m²      | 2     |
|              |        | 50-100 m²       | 3     |
|              |        | <50 m²          | 4     |
| C10 Distance to city center | 0.05   | 5 km            | 1     |
|              |        | 5-10 km         | 2     |
|              |        | 10-15 km        | 3     |
|              |        | >15 km          | 4     |
| C11 Water resource | 0.05   | bottled water   | 1     |
|              |        | tap water        | 2     |
|              |        | well water       | 3     |
|              |        | River            | 4     |

3.3. System Implementation

The implementation of this scholarship recipient selection system has a positive contribution to the determination of student scholarship recipients in a transparent, effective, efficient, logical and objective manner. Information system implementation. At the stage of testing the system is carried out with hypothetical case studies, with calculation examples as presented in Table 2.

Table 2. Case Study Example

| No | Name             | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | Score | Rank |
|----|------------------|----|----|----|----|----|----|----|----|----|-----|-----|-------|------|
| S1 | Roni Firmansyah   | 2  | 3  | 3  | 2  | 3  | 1  | 4  | 1  | 2  | 2   | 3   | 2.2010 | 9    |
| S2 | A. Septidi        | 3  | 3  | 3  | 2  | 3  | 2  | 3  | 1  | 2  | 2   | 2   | 2.3596 | 6    |
| S3 | Rizki Novita      | 3  | 3  | 2  | 2  | 2  | 1  | 3  | 2  | 2  | 2   | 2   | 2.1656 | 10   |
| S4 | Rizki Fauzi       | 3  | 3  | 3  | 2  | 3  | 2  | 3  | 2  | 1  | 2   | 2   | 2.3938 | 5    |
| S5 | Sandi Gustian     | 2  | 1  | 4  | 2  | 1  | 1  | 4  | 1  | 2  | 1   | 2   | 1.6358 | 15   |
| S6 | Dini Nur          | 3  | 2  | 3  | 2  | 2  | 2  | 4  | 1  | 3  | 1   | 2   | 2.2085 | 8    |
| S7 | Dien Ahmad        | 2  | 1  | 4  | 2  | 1  | 1  | 3  | 2  | 1  | 2   | 1   | 1.6550 | 14   |
| S8 | Sunny Ni’         | 3  | 1  | 2  | 2  | 2  | 2  | 3  | 1  | 2  | 2   | 3   | 1.9504 | 12   |
| S9 | Fauzi Muzaki      | 3  | 4  | 4  | 2  | 3  | 4  | 2  | 3  | 3  | 3   | 3   | 3.1110 | 1    |
| S10| Firman Rahman     | 2  | 4  | 4  | 2  | 3  | 4  | 2  | 3  | 3  | 3   | 3   | 2.8856 | 11   |
| S11| Asop Syahrnon     | 3  | 2  | 2  | 2  | 2  | 2  | 1  | 2  | 1  | 3   | 3   | 1.9820 | 11   |
| S12| M. Hidayatullah   | 2  | 1  | 4  | 2  | 2  | 1  | 4  | 1  | 2  | 2   | 2   | 1.8791 | 13   |
| S13| Rissal Alfyassin  | 3  | 3  | 3  | 2  | 3  | 3  | 3  | 1  | 2  | 1   | 3   | 2.4374 | 4    |
| S14| Ridwan Saprudin   | 3  | 3  | 4  | 2  | 3  | 2  | 3  | 3  | 3  | 2   | 1   | 2.6560 | 3    |
| S15| Selvia Rahmawati  | 4  | 2  | 3  | 2  | 2  | 2  | 3  | 1  | 2  | 2   | 2   | 2.2768 | 7    |
4. Conclusion
The design results have a level of compliance with regulatory standards that have been established. The results indicate the logical and appropriate target selection mechanism for scholarship recipients for the most eligible students who received scholarship assistance.

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