Implementation of Multi-attribute Rating Technique Simple in Selection of Acceptance Scholarship of PMDK (Case Study: STMIK Widya Cipta Dharma)

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Abstract: This research aimed to create a decision support system for admission selection of PMDK scholarship pathway using the SMART (Simple Multi-Attribute Rating Technique) method with web-based and if this research was successful, it could help STMIK Widya Cipta Dharma to select PMDK scholarship should be given to a student of STMIK Widya Cipta Dharma. PMDK is the title of scholarship for interest and talent scouting. This research was conducted at STMIK Widya Cipta Dharma Samarinda, a method of data collection used interviews, that asked questions related to the selection of PMDK scholarship admissions by observation directly to STMIK Widya Cipta Dharma Samarinda. This research development system method used the development of a decision support system method. The software model used PHP programming language and database using MYSQL. The final result of this research is a decision support system for admission selection of the PMDK scholarship pathway using the SMART (Simple Multi-Attribute Rating Technique) method with web-based, can help selection of PMDK scholarship faster by admin, and provide information to students. So contribution of this paper is gives a best recommendation for selection of PMDK scholarship using decision support systems.

Index Terms: Decision Support Systems, Scholarships, SMART, Web.

1. Introduction

In this modern era, all matters will be related to the ease of managing data without taking a long time. Therefore, the solution is to form a computerized system to find the best results. The system is a network of procedures that are interconnected, gathered together to carry out activities or to perform certain goals [1-3]. This computerized system has been used by various government agencies and educational institutions. The aim is to improve performance and time efficiency, STMIK WIDYA CIPTA DHARMA is a private tertiary institution addressing Jl. Yamin Samarinda. In its operational process, the College has facilities and technology, namely the presence of several computers that are used by financial department, in processing for searching data it is still right on target to obtain the best value.

PMDK or Interest and Ability Tracking is an entry point organized by each specific university or institute to screen students who have superior talents and academic abilities compared to prospective students. Decisions are the result of thinking in the form of choosing one among several alternatives that can be used to solve the problem at hand [2,4-7].
PMDK entrance not only looks at the variable academic value of prospective students but their talent. The time for holding PMDK depends on the schedule arranged by the university or institute. What must be known from PMDK is that not all universities use PMDK as an entry point to these tertiary institutions. So for prospective students who want to enter the PMDK pathway, it is highly recommended to seek information in advance about whether the university or institute is intended to offer the PMDK entry point.

The Scholarship is income for those who receive it. The definition of scholarship is an additional economic capability by name and in any form that is received or obtained from sources from Indonesia or outside Indonesia that can be used for consumption or to increase the wealth of taxpayers (WP). A lot of money (fees) provided by the collage agencies has been budgeted in the APBD funds. Funds will be determined based on how much income from the collage and how much budget is needed.

STMIK Widya Cipta Dharma is a private collage and the best collage especially in the IT field in East Kalimantan which has various study programs, including Informatics Engineering, Information Systems, and Information Management that can create graduates who can work professionally.

At STMIK Widya Cipta Dharma there are several Scholarships, one of which is the Selection of Interest and Ability Search Scholarship (PMDK), the Scholarship Selection of the PMDK Pathway is specifically for new students and has been held in one semester to the end of the semester, but in the selection is still less professional because only taken from GPA and manually.

A. Problem Formulation

As explained in the background above, a problem statement was made, "How is the PMDK Scholarship Acceptance Support Decision Selection System using the Smart method on Widya Cipta Dharma STMIK Website-based?"

B. Purpose

The purpose of this study is to produce a decision support system for PMDK scholarship selection using the Smart STMIK Widya Cipta Dharma method, so it is expected to be able to assist in the selection of PMDK scholarship pathways at STMIK Widya Cipta Dharma.

C. Limitation Problems

For the writer of this final project to be more focused, the writer makes a limitation of the problem in this final project as follows:

1. This decision support system is created using the Smart method.
2. Making this Decision Support System is focused only on determining the STMIK PMDK Scholarship Selection Widya Cipta Dharma.
3. The criteria chosen in the selection of prospective Scholarship Recipients include several criteria, namely the income of parents, champions of non-academic achievements, GPA, and Student Organizations.

D. Development Methodology

System development aids are tools that are used in the stage of taking a good system, used as a tool, as a modeling tool that is possible for system professionals to describe the system as a network of functional processes needed by each other with data flow both manually and computerized [8-11]. The research will be carried out through several stages of the decision support system as follows:

1. The Intelligence stage is carried out to identify and identify the problem that is happening, usually, an analysis is conducted. From the research methods applied, obtained data used in making this system. From these data, an analysis can be made to facilitate decision making in selecting prospective recipients of PMDK Pathway Scholarships in research.
2. The Design Phase in this stage is designed and designed.
3. The Choice Stage where a real decision is made and a commitment are taken to follow certain follow-up actions. This phase includes the search, evaluation, and recommendations for a solution that is right for the model.
4. Implementation Phase is carried out the application and implementation of the system design that has been made at the planning stage and the implementation and implementation of alternative actions that have been selected at the selection stage.

Each stage is carried out sequentially from the first step to the last step, each step that has been completed must be reviewed.
2. Literature Review

A. System
The system is a network of interrelated procedures, gathered together to carry out activities or to carry out certain goals. The characteristics of a system so that the system is said to be a good system are as follows [9,12]:
1. Components
A system consists of interacting which means mutual System components consist of parts of the system.
2. System Boundary
The system boundary is an area that limits between a system with other systems or with the external environment. This system limit allows a system to be seen as a single unit. The limitation of a system shows the scope of the system.
3. Environment System
The environment outside the system (environment) is outside the boundaries of the system that affect system operation. The environment can be beneficial which must be maintained and the detriment must be maintained and controlled if it will not interfere with the survival of the system.
4. Interface System
The connecting system is a media liaison between subsystems with other subsystems. Through this link allows resources to flow from one subsystem to another subsystem. The output from the subsystem will be input to other subsystems through the connector.
5. Input System
Enter the system is the energy put into the system, which can be in the form of maintenance and enter the signal. maintenance input is the energy put into the system to operate. Signal input is the energy processed to obtain the output.
6. Output System
The system output is the result of energy being processed and classified into useful output and residual waste.
7. System Processing
A system becomes a part of the processor that will convert inputs into outputs. The production system will process raw materials into finished materials, the accounting system will process data into financial reports.
8. System Objectives
A system must have a goal or target. The goal of the system is to determine the input needed by the system and the output that the system will produce, stated in the characteristics of a system
Based on the opinions of the experts above about the system, it can be concluded that the system is an interconnected element and interact with others in unity to achieve a certain goal.

B. Decision
Decisions are the result of thinking in the form of a choice among several alternatives that can be used to solve the problem at hand [13].

C. MySQL
MySQL is an RDBMS that is distributed free of charge under the GPL (General Public License), where everyone is free to use MySQL, but may not be a derivative product that is closed source or commercial [14,15].

D. Website
The website is a collection of pages that are interconnected, which are then online using a local network or the internet [16,17].

3. Result and Discussion

A. The SMART Method Modeling Process
The calculation steps are carried out in the Simple Multi-Attribute Rating Technique method;
1. Determine the weight of each goal factor (Goal Weight Factor) with a Range between 1 to 10
2. Normalized Weight Factor Count of each goal by comparing the value of each goal weight (Goal Weight Factor) to the total number of goal weight (Total Goal Weight Factor). As stated in the formula for calculating Normalized Weight Factor (1).

\[
\text{Normalized Weight Factor} = \frac{\text{Goal Weight Factor}}{\text{Total Goal Weight Factor}}
\]  

(1)

3. Compare the values of the same criteria from each package. Find the difference in value between the highest value and the lowest value. The difference results are divided by the number of alternative packages to determine the class interval of each criterion. As stated in the formula for calculating the interval (2).

\[
\text{Interval} = \frac{\text{Goal Weight Factor}}{\text{Skala}}
\]  

(2)

4. After getting the range of classes on each criterion, we can determine the weight value for each alternative (intervals 1-5)
5. After process number 4, each weight is given a new value after being determined, namely through the utility score. This is the normalization of raw data (between 0-1), according to the foundation of the Multi-Attribute Utility Theory (MAUT). It is listed in the Table 1. Utility Score.

| Normalized Score | Utility Score |
|------------------|--------------|
| 1                | 0            |
| 2                | 0.25         |
| 3                | 0.5          |
| 4                | 0.75         |
| 5                | 1            |

6. Determine the percentage value of each alternative by multiplying the value obtained in process no.5 with the Normalized Weight factor value. The total value of the multiplication process and the total multiplied by 100%
7. After obtaining the percentage value of each alternative, it can be determined that the outcome recommendation that is closest to the predetermined goal, that is, the package that has the highest percentage value. This is ranking [2,5,18].

The solution for the model in this study is to use the SMART (Simple Multi-Attribute Rating Technique) method. Variables used in this decision support system are student organizations, GPA, and non-academic achievement champions, then it will be planned that a system will be implemented into a form of decision support system for PMDK scholarship selection on STMIK Widya Cipta Dharma using the Web programming language where PHP is the programming language by prioritizing user convenience in using this system so that it can help and facilitate STMIK Widya Cipta Dharma in selecting PMDK Scholarship according to needs. The following is an example of PMDK Scholarship selection calculation:

| Name    | Criteria              | Weight | Input       | Utility | Normalization | Results | SMART | Decision       |
|---------|-----------------------|--------|-------------|---------|---------------|---------|-------|----------------|
| Huda    | Parents’ Earnings     | 30%    | <1,000,000  | 100     | 0.3           | 30      |       |                |
|         | GPA                   | 40%    | GPA ≥ 3.00  | 100     | 0.4           | 40      |       |                |
|         | Non Academic Achievement | 20% | 1st Place Province | 40 | 0.2 | 8 |       |                |
|         | organizations         | 10%    | general Secretary | 80 | 0.1 | 8 |       |                |
|         |                       |        |             |         |               |         | 86    | Very decent   |

| Name    | Criteria              | Weight | Input       | Utility | Normalization | Results | SMART | Decision       |
|---------|-----------------------|--------|-------------|---------|---------------|---------|-------|----------------|
| Isnanda | Parents’ Earnings     | 30%    | <1,000,000  | 100     | 0.3           | 30      |       |                |
|         | GPA                   | 40%    | GPA ≥ 3.00  | 100     | 0.4           | 40      |       |                |
|         | Non Academic Achievement | 20% | 2nd place in the Province | 20 | 0.2 | 4 |       |                |
|         | organizations         | 10%    | no          | 0       | 0.1           | 0       |       |                |
|         |                       |        |             |         |               |         | 74    | Worthy         |

Table 2. Calculation of Scholarship Selection Is Very Decent

Table 3. Calculation of Worth Scholarship Selection
Table 4. Calculation of Scholarship Selection Considered

| Name       | Criteria          | Weight | Input   | Utility | Normalization | Results | SMART | Decision |
|------------|-------------------|--------|---------|---------|---------------|---------|-------|----------|
|            | Parents' Earnings | 30%    | <1,000,000 | 100     | 0.3           | 30      |       |          |
|            | GPA               | 40%    | GPA ≥ 3.00 | 0       | 0.4           | 0       |       |          |
|            | Non Academic      | 20%    | 1st National Champion | 100  | 0.2           | 20      |       |          |
|            | Achievement       |        |          |         |               |         |       |          |
|            | organizations     | 10%    | Chairman | 100     | 0.1           | 10      |       |          |

**Table 5. Calculation of Scholarship Selection Is Not Worth It**

| Name       | Criteria          | Weight | Input   | Utility | Normalization | Results | SMART | Decision |
|------------|-------------------|--------|---------|---------|---------------|---------|-------|----------|
|            | Parents' Earnings | 30%    | <1,000,000 | 100     | 0.3           | 30      |       |          |
|            | GPA               | 40%    | GPA ≥ 3.00 | 0       | 0.4           | 0       |       |          |
|            | Non Academic      | 20%    | 1st Place | 40      | 0.2           | 8       |       |          |
|            | Achievement       |        |          |         |               |         |       |          |
|            | organizations     | 10%    | Province | 100     | 0.1           | 0       |       |          |

**Information on Table 2-5**

- **Value Wj** = Weight value / total number of weights
- **Result** = Utility * Wj
- **SMART** = Sum of all Results values

In the Table 2, the PMDK Scholarship selection calculation is very feasible, with the name Huda having 4 criteria namely Parent Income with a weight value of 30, GPA with a Weight of 40, Non-academic Achievement with a weight value of 20, active student organizations with a weight value of 10. STMIK Widya Cipta Dharma input yes for the criteria for Parent Income, grade point ≥ 3.00 for GPA, Champion 1 at the provincial level for nonacademic achievement criteria and general secretary is for student organizations, from these inputs the value of Parent Income Utility is 100, GPA of 100, non-academic achievement of 100, and student organizations of 80.

Wj value for the Parents' Income criteria was obtained from 30/100 = 0.3, GPA was obtained from 40/100 = 0.4, non-academic achievements 20/100 = 0.2, student organizations 10/100 = 0.1.

The value of the results for the Parents' Income criteria utility value X value Wj, 100 X 0.3 = 30, GPA 100 X 0.4 = 40, champion 1 province 40 X 0.2 = 8, student organizations 80 X0.1 = 8. The value of SMART is the sum of the results for each criterion is 30 + 40 + 8 + 8 = 86 and the decision to have the name Huda is declared very feasible.

In Table 3, the PMDK Scholarship selection calculation is feasible, with the name Huda having 4 criteria namely Parent Income with a weight value of 30, GPA with a Weight of 40, Non-academic Achievement with a weight value of 20, active student organizations with a weight value of 10. The STMIK Widya Cipta Dharma input yes for the criteria for Parents' Income, grade point ≥ 3.00 for the GPA, Champion 2 at the provincial level for Non-academic achievement criteria and none for student organizations, from these inputs the value of the Parent Income Utility is 100, GPA of 100, a non-academic achievement of 20, and a student organization of 0.

Wj value for the Parents' Income criteria was obtained from 30/100 = 0.3, GPA was obtained from 40/100 = 0.4, non-academic achievements 20/100 = 0.2, student organizations 10/100 = 0.1.

The value of the results for the Parents' Income criteria utility value X value Wj, 100 X 0.3 = 30, GPA 100 X 0.4 = 40, champion 1 province 40 X 0.2 = 8, student organizations 80 X0.1 = 8. The value of SMART is the sum of the results for each criterion is 30 + 40 + 8 + 8 = 86 and the decision that there is a Huda name is declared appropriate.

In Table 4 the selection calculation for the PMDK Scholarship is feasible, with the name Huda having 4 criteria namely Parent Income with a weight value of 30, GPA with a Weight of 40, Non-academic Achievement with a weight value of 20, active student organizations with a weight value of 10. The STMIK Widya Cipta Dharma input yes for the criteria for Parent Income, grade point <3.00 for GPA, Provincial Champion 2 for Non-academic achievement criteria and general chairman for student organizations, from these inputs the value of Parent Income Utility is 100, GPA of 100, a non-academic achievement of 20, and a student organization of 100.

Wj value for the Parents' Income criteria was obtained from 30/100 = 0.3, GPA was obtained from 40/100 = 0.4, non-academic achievements 20/100 = 0.2, student organizations 10/100 = 0.1.

The value of the results for the Parents' Income criteria utility value X value Wj, 100 X 0.3 = 30, GPA 100 X 0.4 = 40, champion 2 provinces 20 X 0.2 = 4, student organizations 0 X0.1 = 0. The SMART value is the sum of the results for each criterion is 30 + 40 + 4 + 0 = 74 and the decision that there is a Huda name is declared appropriate.

In Table 5 the selection calculation for the PMDK Scholarship is feasible, with the name Huda having 4 criteria namely Parent Income with a weight value of 30, GPA with a Weight of 40, Non-academic Achievement with a weight value of 20, active student organizations with a weight value of 10. The STMIK Widya Cipta Dharma input yes for the criteria for Parent Income, grade point <3.00 for GPA, provincial national Champion for Non-academic achievement criteria and none for student organizations, from these inputs the value of Parent Income Utility is 100, GPA of 0, non-academic achievement of 100, and student organizations of 0.
Wj value for the Parents' Income criteria was obtained from $30/100 = 0.3$, GPA was obtained from $40/100 = 0.4$, non-academic achievements $20/100 = 0.2$, student organizations $10/100 = 0.1$.

The value of the results for the Parents' Income criteria utility value $X$ value $W_j$, $100 \times 0.3 = 30$, GPA $0 \times 0.4 = 0$, champion Profits $40 \times 0.2 = 8$, student organizations $0 \times 0.1 = 0$. SMART value is the sum of values the results of each criterion were $30 + 0 + 8 + 0 = 38$ and the decision that there was a Huda name was declared unfeasible. In Table 5 the PMDK Scholarship selection calculation is feasible, with the name Huda having 4 criteria namely Parent Income with a weight value of 3.

### B. Sequence Diagram

![Sequence Diagram](image)

In Fig. 1 sequence diagram calculation menu illustrates the event a user accesses the calculation form on the website. Where Admin when entering the calculation form can see the results of the calculation, if the admin will edit the assessment click edit will then appear edit form then click save to save changes and click cancel to cancel changes.

### C. Implementation

Fig. 2 is the Login page. The login page is the page to enter the main menu page on the system. This login page is used by the admin to enter email and password then click the login button to go to the main page.

![Login Page](image)

Fig. 3 shows on Login page, students can see the terms and conditions following the PMDK Scholarship selection. This page shown in “Bahasa” Indonesian Language.
Fig. 3. Scholarship terms and conditions page

Fig. 4 is the main page, this main page consists of several menus in the system including dashboard page, student data page menu, criteria data page, sub criteria data page, Scholarship data page menu, scholarship submission data page menu, calculation page menu, report page, change password page, and logout menu.

Fig. 4. Main page

Fig. 5 is the student data page. This student data page consists of number, name, name, photo, email, place of birth, address, department, semester, GPA, occupation, father's name, mother's name, father's address, mother's address, father's occupation, mother's occupation, mobile phone number, organizational position, non-academic achievement. Add data to add student data, action edit button to edit student data, delete button to delete student data, reset button to change student password.

Fig. 5. Student data pages
Fig. 6 is the criteria page, this criteria page consists of no, criteria name, weight, normalization, action button edit button to edit criteria, action button deletes to delete student data, and add criteria to add criteria.

![Fig. 6. Page criteria](image1)

Fig. 7 is the sub criterion page. This sub-criterion page consists of no, criteria, value sub-criteria, action added sub-criteria to add sub-criteria, edit button action to edit sub-criteria, delete button action to delete criteria. Sub-criteria data will be saved in the sub-criteria table.

![Fig. 7. Page sub criteria](image2)

Fig. 8 is the scholarship data page. The scholarship data page consists of number, scholarship name, registration date, closing date, open and closed status, and edit button action to edit scholarship opening and closing dates.

![Fig. 8. Scholarship data page](image3)
Fig. 9 is a scholarship submission page, this scholarship submission page consists of a number, number, name, photo, file, form action for printed forms, verification action for file verification, edit button action for editing scholarship submission.

![Scholarship Submission Data Page](image)

Fig. 9. Scholarship submission data page

Fig. 10 calculation pages, this calculation page consists of a number, name, utility value, results, recommendations, and edit action for editing student assessment.

![Calculation Page](image)

Fig. 10. Calculation page

Fig. 11 is the report page, this report page consists of number, name, name, place of birth date, grades, recommendations, print action for printing semesters, students, feasible and improper.
Fig. 11. Report page

Fig. 12 reports on the results of overall decisions, reports on the results of this decision are taken from the overall printout of students.

4. Conclusion

Based on the results of the implementation and testing of the Scholarship Selection Decision Support System for PMDK pathways at STMIK Widya Cipta Dharma Samarinda Using the SMART Method, it can be concluded that the PMDK Scholarship selection decision support system using the SMART method, the design, and construction of this website uses PHP programming topics and MySql as a database. Scholarship selection decision support system for PMDK path using the SMART method can help the STMIK Widya Cipta Dharma Samarinda in making the right decision in selecting students who pass the selection by the criteria, sub-criteria, and assessment of each criterion that has been determined by the collage. Scholarship selection decision support system for PMDK pathways at STMIK Widya Cipta Dharma, students register online, then submit a hard copy, after that admin verifies files, the admin can input student data, criterion data, sub-criterion data, and assessment processes, and can print reports.

The advice that can be given to developing this research is a decision support system for PMDK scholarship selection using the Web-based SMART method, so it is recommended that in the future this system be developed into a better mobile version, such as the Android platform. It is expected that the PMDK Scholarship selection decision support system can be considered for use on the STMIK Widya Cipta Dharma Samarinda.
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