

Design of Decision Support System Application for Determining Scholarship Grantee Using Analytical Hierarchy Process and Factor Rating

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Abstract— Scholarship refers to a program provided by organization that is given to students to relieve the tuition fee. There are several criteria and requirements that have to be fulfilled to get the scholarship. In practice, all the requirements will be checked manually for each applicant to determine who deserves to be granted the scholarship. Therefore, the process of determining the scholarship grantee can take very long time. To help the decision maker of scholarship grantee, a decision support system is needed. Thus, this study aims to design the decision support system to help the decision maker in determining the applicant to be chosen as scholarship grantee. The mixed method of analytical hierarchy process and factor rating were employed in this study to determine the recommendation of scholarship grantee. Data was collected from the scholarship mechanism in one of private university in Bandung, Indonesia. There are five criteria to be considered in this study. The result of the decision support system design is further discussed in this study.

Keywords—*decision support system, factor rating, analytical, hierarchy process, scholarship grantee*

I. INTRODUCTION

The scholarship refers to a program provided by organization that is given to students to relieve the tuition fee [1]. Scholarship is usually provided by most university to be offered to their students. There are many scholarship chances that can be utilized by the students where the scholarship offered to the student can be in the form of internal scholarship or external scholarship. Through the existence of scholarship offered by universities, student can be motivated to improve their ability in learning [1].

Moreover, scholarship also provides the chance for the student with economy limitation to study in university and ease the burden of the parents towards tuition fee [1]. There are several criteria and requirements that have to be fulfilled to get the scholarship. In practice, all the requirements will be checked manually for each applicant to determine who deserves to be granted the scholarship. Therefore, the process of determining the scholarship grantee can take very long time especially when the number of applicant is extremely large. To help the decision maker of scholarship recipient, an information system that can assist the determination the scholarship grantee is needed.

The use of information system can make the activity of collecting, processing, distributing, and sharing data more efficient in the term of time [2]. Moreover, the use of

information system such as decision support system (DSS) enables organization to make decision faster [3]. Decision support system (DSS) is an information system, to facilitate decision makers in making decision by using various data and models in solving unstructured and semi-structured problems [4]. Thus, this study aims to design the decision support system to help the decision maker in determining the applicant to be chosen as scholarship recipient in one of private university in Bandung, Indonesia.

The mixed method of analytical hierarchy process and factor rating method were employed as a decision making tools to make a rank from all the scholarship applicants by combining the score of all criteria used to determine the scholarship applicant. Analytical hierarchy process was used in this study to generate the weight of the criteria in this study. After the weight for each criterion was obtained, the calculation of applicant score will be generated by using factor rating step. The model obtained from analytical hierarchy process and factor rating then will be translated into decision support system. This decision support system will provide output in the form of recommendations of some students who has highest score and recommended to be scholarship grantee.

II. RESEARCH METHOD

The first step, the model for scholarship grantee selection was developed. Moreover, waterfall method was adopted as a method to develop the application.

A. Scholarship grantee selection model

The model for scholarship grantee selection was developed using mixed method between analytical hierarchy process and factor rating.

1) Analytical Hierarchy Process

Analytical hierarchy process is a decision-making method for multi-criteria decision making [5]. Analytical hierarchy process was used to determine the weight for each criteria. The step of analytical hierarchy process adopted in this study is as follow:

1. Determine the criteria to be considered in determining scholarship grantee.
2. Gather the comparison data.
3. Calculate the weight and consistency of the data

There are five criteria to be considered to determine the scholarship grantee i.e. grade point average (GPA), parent's earning, the number of family member, non academic student activity point, and student's achievement .The criteria used in this study was adopted from the study of Kurniawan [6].

2) Factor Rating

Factor rating method was used to calculate the score for each scholarship applicant.. The step in factor rating is as follow [7], [8].

1. Identify the criteria
2. Determine the weight for each factor that is reflecting as the relative importance of each criteria
3. Determine the scale for each criteria
4. Determine the score for each criteria for each alternative based on scale, then normalized the score
5. Multiply the score and the weight for each alternative
6. Make recommendation based on highest score

The score generated from factor rating will be used as based for stakeholder to make decision related applicant that will be granted as scholarship grantee. This study only employed the step 3 to step 6 in factor rating since the criteria and the determination of weight of each criterion by using analytical hierarchy process.

B. Waterfall method

The waterfall model is a non-iterative process to develop information system that contains the step of determine specification requirements, design and code the system, implementation, testing and maintenance [9]. The steps in the waterfall method in this study are as follows.

- 1) Software requirement analysis
The requirement of the system will be identified in detailed. The requirement of the system should be clear before going to the next stage.
- 2) System Design
At this stage, the system will be designed according to the requirement. The feature and the functionality of the system determined in the previous step will be translate to develop the application.
- 3) Implementation and testing
At this stage the programming activity and the test for the finished application were performed. The programming languages used to make this decision support system include HTML, CSS, and PHP. Testing was done to ensure that all the function expected in the system can run and no bugs were found.

III. RESULT AND DISCUSSION

A. Model of scholarship grantee selection

The first step of the model development is by calculating the weight of each criteria. The calculation of the weight of the criteria was employed by using analytical hierarchy process. The result of the weight calculation can be seen in Table 1. In order to ensure that the respond from respondents was consistent, the calculation of consistency ratio was

performed. The value of consistency ratio obtained from the calculation is 0.03. Since the value of consistency ratio is less than 0.1, the respond from respondents is considered consistent and valid. After the weight of each criteria was determined, the next step was to determine the scale of each criteria. The notation and the scale used for each criteria can be seen in Table II.

TABLE I. WEIGHT OF CRITERIA

Criteria	Code	Weight
Grade point average (GPA)	C1	0.046
Parent's salary	C2	0.112
The number of family member	C3	0.103
Student Achievement	C4	0.394
Student activity level	C5	0.345

TABLE II. SCALE FOR EACH CRITERIA

Criteria	Scale Used	Priority criteria
C1	1-10	Higher C1, higher priority
C2	1-10	Lower C2, higher Priority
C3	1-10	Higher C3, higher priority
C4	1-10	Higher C4, higher priority
C5	1-10	Higher C5, higher priority

Therefore, the model to calculate the score for each applicant is as follow:

$$SAS_i = 0.046(NC1_i) + 0.112(NC2_i) + 0.103(NC3_i) + 0.394(NC4_i) + 0.345(NC5_i) \quad (1)$$

$$NC1_i = \frac{SC1_i}{4} \times 10 \quad (2)$$

$$NC2_i = \frac{\text{Min}\{SC2\}}{SC2_i} \times 10 \quad (3)$$

$$NC3_i = \frac{SC3_i}{\text{Max}\{SC4\}} \times 10 \quad (4)$$

$$NC4_i = \frac{SC4_1}{\text{Max}\{SC4\}} \times 10 \quad (5)$$

$$NC5_i = \frac{SC5_i}{\text{Max}\{SC5\}} \times 10 \quad (6)$$

Where,

- SAS_i : Factor rating score for applicant-i
- NC_{ij} : Normalized score for applicant-i in criteria-j
- SC_{ij} : Score for applicant-I in criteria-j
- Min {SC_{nj}} : Minimum score of criteria-j from all applicant
- Max {SC_{nj}} : Maximum score of criteria-j from all applicant

B. System development

The first stage of system development is the identification of system requirement. The system requirements were then translated to system functionality that can be seen in Table III. The system was developed based on the activity performed in scholarship grantee selection. The initial activity of scholarship grantee selection is the student login to the system and then visits the scholarship information menu. The system then will respond by displaying scholarship information available at that time and the minimum requirement to apply to the scholarship. Then, student can select which scholarship to be registered and then fill the registration form and fulfill the requirement. Admin then will verify the submission made by the student whether it already met the requirement needed or not. After the due date for registration close, admin will run the calculation from the system and then determine the number of scholarship grantee. The system then will display the score for each applicant and the recommended applicant. Admin then will determine the final result of scholarship grantee and submit it to the system. Student will view their status whether accepted or rejected as scholarship grantee. According to the previous explanation, there are two entities in the system i.e. admin (from university student affair) and student. The task of admin is to input data related to available scholarship, the minimum requirement for the particular scholarship, the number of student that will be rewarded by the scholarship, and input the final result of scholarship grantee to the system. The student can login data, input data to the system, view the available scholarship, register and input data required to a particular scholarship, and view their status and result of the selection. The context diagram of the system designed in this study can be seen in Fig. 1. Moreover, the application of decision support system are began to design. The example of user interfaces of the system can be seen in Fig 2 to Fig 5. Implementation and testing were conducted after web programming was done.

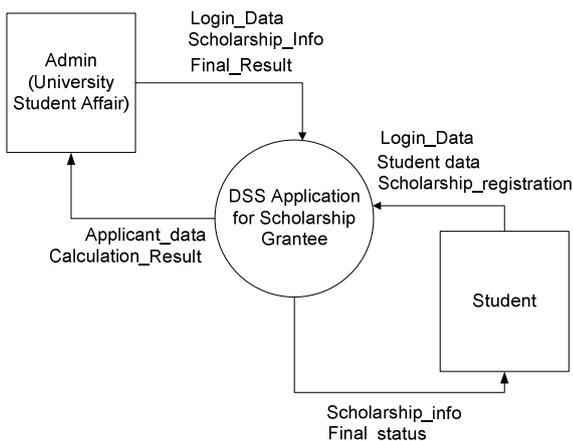


Fig. 1 Context Diagram

TABLE III. FUNCTIONALITY OF APPLICATION

Criteria	Functionality
Student	<ul style="list-style-type: none"> • Login • Edit Profile • View Profile • View Scholarship info • Register for scholarship • Manage registered scholarship data • Delete registered scholarship • View the result of scholarship selection
Admin	<ul style="list-style-type: none"> • Login • Manage user data • Manage scholarship data • Manage the minimum requirement for the scholarship • Manage the number of scholarship grantee • Delete scholarship registered by student • View the recommendation from the system • Manage final result of scholarship



Fig. 2 Scholarship information menu



Fig. 3 Scholarship Registration menu



Fig. 4 Result of model calculation menu



Fig. 5 Scholarship grantee menu

TABLE IV MENU OF THE APPLICATION

User	Menu	Functionality
Student	Home Menu	See the description of scholarship and testimony of precious scholarship recipients
	Scholarship information	Contains list of available scholarship including the requirement and registration deadline information of each scholarship
	Registration form	There's submenu for the scholarship applicant to fill the registration form and all the required data
	Announcement	Display the announcement of the student that successfully receive the scholarship
Admin	Home Menu	Home menu for admin
	Database of Applicant	Show the database of all student who apply for each scholarship
	Ranking Menu	See the result of data processing using analytical hierarchy process and factor rating

IV. CONCLUSION

The purpose of this study is to design a decision support system application to determine the scholarship grantee by first develop the model of scholarship grantee selection. The model was developed using mixed method between analytical hierarchy process and factor rating. There are five criteria considered in scholarship grantee selection. The model to calculate the score for each applicant was developed in this study. After the calculation model was developed, the application of scholarship grantee selection was developed. The system has capability to give recommendation of scholarship grantee. The limitation of this study is the criteria used in this study is a fixed criteria, the model when the user want to add or

remove a particular criteria have not been developed yet. Further study will consider the flexibility for the user to add or remove some particular criteria.

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