Identification of Student Ability to Select High Achieving Students Using the SAW Method as a Decision Support System

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Abstract—**Lectures are a stage of education that is a process of improving students' abilities in a specific field. Assessment will be carried out on students through assignments and exams as a benchmark. Sometimes the assessment process is less than optimal or cannot be determined directly without the right determination parameters. These obstacles can hinder the assessment process. The SAW method is simple and can support a decision. The overall assessment is based on learning values, attitudes, and attendance, to obtain maximum value. Identification is carried out to select outstanding students in one field of study. The results of the selection of exceptional students are expected to be used as evaluation material for student learning outcomes. The maximum value in the MA5 alternative is 0.9644. The minimum value in the MA1 alternative is 0.8935. The final result can be a recommendation for a decision based on the level of student ability.**

Keywords—education, evaluation, recommendation, SAW.

I. INTRODUCTION

Lectures are a stage of education that has a process to improve students' abilities in specific fields. Ability is a benchmark for the learning process. This is based on a number of assessments that will be carried out to determine the level of ability. Assessments will be carried out on students through assignments and exams.

Sometimes the assessment process is less than optimal or cannot be determined directly without the right determination parameters. In terms of construction, the assessment parameters have been determined by the institution, so that it can facilitate the assessment process.

Students' abilities are not only assessed based on the results of learning scores but also on their obedient and disciplined attitudes and attendance in learning activities. In general, grades are calculated based on the presentation of all lecture meetings during one semester. Assessments are carried out separately from learning scores.

In this study, students' abilities will be assessed overall based on learning scores, attitudes, and attendance, in order to obtain maximum scores. Attitude is one of the important things in the assessment, because if the attitude is inversely proportional to the ability to learn, then it cannot be concluded as a student who has the best abilities. The value calculation process uses additional methods to support decisions.

The final results of the student ability assessment will be recommended as a decision support for selecting outstanding students in one subject area. The results of the selection of outstanding students are expected to be used as evaluation material for student learning outcomes. The evaluation process is expected to be able to describe the assessment results objectively and can then be improved based on the learning process, materials, interactions in learning activities, and support for technological facilities and infrastructure.

II. LITERATURE REVIEW

Decision support methods are diverse, so they can be adjusted to cases and constraints. One of the decision methods is SAW, this method has been widely used to assist the decision-making process. Interactively, decision support systems can help make decisions in both structured and unstructured situations [1]. Decision-making can be based on several alternative choices [2]. The concept of the method refers to the weight of the criteria in the calculation process. So the SAW method becomes a simple method with a Multi-Attribute Decision Making (MADM) problem-solving approach [3]. MADM is the study of identifying and selecting alternatives based on the values and preferences of decision-makers [4]

Scholarship recipients are determined based on several criteria, especially grades and other supporting abilities. The distribution of scholarships to outstanding students must be carried out transparently and effectively so that they are right on target. As a result, it can help select scholarship recipients using the SAW method to support decisions [5].

In the study to select outstanding school students using the SAW method. As a result, by using the method, five outstanding students can be obtained as scholarship candidates. So that the selection through the system is more efficient and effective [6].

Previously, student discipline level assessments were carried out manually so that they were less than optimal. Students who were not disciplined would be given a warning according to the violation. The student discipline level assessment system can help resolve more effectively and efficiently. The system can help assess and record student violations. The SAW method is an algorithm that supports decisions [7].

The previous level of student achievement was only based on academic assessments. This creates an opportunity for wrong decision-making because it does not consider the attitudes values and non-academic achievements of students. The study was conducted to combine academic and non-academic assessments as a basis for selecting outstanding students. As a result, the SAW method provides the best results according to the specified criteria[8].

The assessment of exemplary students is determined by various aspects. The selection of exemplary students is carried out to increase student enthusiasm and motivation. The selection of exemplary students uses the SAW method. As a result, the determination of exemplary students who excel is right on target because it is objective. The system will help schools to more easily choose criteria as a reference for assessment [9].

III. METHOD

The process of identifying student abilities in courses is carried out based on supporting criteria to determine the level of student ability and become a recommendation in selecting outstanding students through several stages in Figure 1.
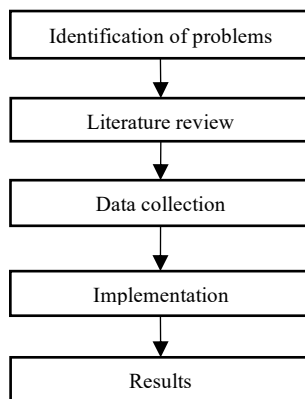

Figure 1. Stage Framework

The following is a description of the stage framework in Figure 1.

1) Identification of problems regarding obstacles in the process of identifying student ability levels for selecting outstanding students based on predetermined assessment criteria in one course. Analysis is carried out to find the right solution.

2) Literature study regarding information processing as a basis for solving problems. Information comes from previous research, validated journals, and books. The theory will support the final results of problem identification.

3) Data collection regarding supporting research data in the form of student grade data in one course and observations of research needs. Data is the main requirement in research so methods and data must have a close relationship.

4) Implementation of the SAW method calculation process in solving problems using stages of student value data processing. The addition stage weights the performance rating of each alternative for all criteria. Matrix normalization is carried out on a scale that is compared with the alternative performance rating.

5) Results regarding data that has been processed using the SAW method and produces information. All stages of the process are carried out to obtain the results of the selection of outstanding students. Criteria and weights are the main keys in the final results of identification.

IV. RESULTS AND DISCUSSION

A. Results

Calculation of the SAW method in the process of selecting outstanding students in one course based on the student's ability level. Information and data are sourced from all components of values, attitudes, and attendance in one course. The scope of identification is only in the trial of one course. Alternatives come from several students who will be candidates for outstanding students. All student data is described in Table 1.

TABLE I.   ALTERNATIVE DATA

Alternative	C1	C2	C3	C4	C5	C5
MA1	2	81	90	91	80	86
MA2	1	87	95	92	80	87
MA3	1	85	80	91	73	91
MA4	2	85	80	91	85	95
MA5	1	84	95	88	85	87

B. Discussion

The discussion is conducted using the SAW method. There are stages of the SAW method process to select outstanding students based on their ability levels, as follows: [10]

The initial stage is to determine alternative student data from sample data obtained from one course as described in Table 2.

TABLE II.   ALTERNATIVE DATA

Alternative	C1	C2	C3	C4	C5	C5
MA1	2	81	90	91	80	86
MA2	1	87	95	92	80	87
MA3	1	85	80	91	73	91
MA4	2	85	80	91	85	95
MA5	1	84	95	88	85	87

The second stage is to determine the criteria for the SAW method calculation process in decision support which is described in Table 3.

TABLE III.   CRITERIA DATA

Criteria	Information
C1	Absenteeism
C2	Attitude

C3	Formative Test
C4	Exercise/Assignment
C5	NUTS
C6	NUAS

Based on Table 3 there are six criteria, the first criterion has a parameter of the number of student absences from a total of 16 meetings. The second criterion is the attitude based on the assessment of attitudes from the learning process. The third to sixth criteria are based on assessment parameters from a value of 1 to 100.

The third stage is determining the weight for each alternative criterion that will be used in the calculation process described in Table 4.

TABLE IV. CRITERIA WEIGHT

Criteria	Information
C1	0,1
C2	0,1
C3	0,15
C4	0,15
C5	0,2
C6	0,3

The weight of the criteria is determined from the assessment criteria of the lecturer and institution, with each having a different level of importance.

The fourth stage is the level of suitability of each criterion is determined based on the profit criteria and cost criteria described in Table 5. The higher the profit value, the more profitable it is. The lower the cost value, the more profitable it is.

TABLE V. RATING VALUE

Criteria	Information
C1	Cost
C2	Benefit
C3	Benefit
C4	Benefit
C5	Benefit
C6	Benefit

The next stage is to form a decision matrix from the level of suitability of each criterion for each alternative.

$$\begin{bmatrix} 2 & 81 & 90 & 91 & 80 & 86 \\ 1 & 87 & 95 & 92 & 80 & 87 \\ 1 & 85 & 80 & 91 & 73 & 91 \\ 2 & 85 & 80 & 91 & 85 & 95 \\ 1 & 84 & 95 & 88 & 85 & 87 \end{bmatrix}$$

The sixth stage is to normalize the matrix f. from the calculation of the normalized performance value of the alternative.

The cost criteria are:

$$r_{ij} \left\{ \frac{Min_i x_{ij}}{x_{ij}} \right\} \tag{1}$$

C1 (Absenteeism)

$$r_{11} = \frac{1}{2} = 0,5$$

$$r_{12} = \frac{1}{1} = 1$$

$$r_{13} = \frac{1}{1} = 1$$

$$r_{14} = \frac{1}{2} = 0,5$$

$$r_{15} = \frac{1}{1} = 1$$

The benefit criteria are:

$$r_{ij} \left\{ \frac{x_{ij}}{Max_i x_{ij}} \right\} \tag{2}$$

C2 (Attitude)

$$r_{21} = \frac{81}{87} = 0,931$$

$$r_{22} = \frac{87}{87} = 1$$

$$r_{23} = \frac{85}{87} = 0,977$$

$$r_{24} = \frac{85}{87} = 0,977$$

$$r_{25} = \frac{84}{87} = 0,965$$

C3 (Formative Test)

$$r_{31} = \frac{90}{95} = 0,947$$

$$r_{32} = \frac{95}{95} = 1$$

$$r_{33} = \frac{80}{95} = 0,842$$

$$r_{34} = \frac{80}{95} = 0,842$$

$$r_{35} = \frac{95}{95} = 1$$

C4 (Exercise/Assignment)

$$r_{41} = \frac{91}{92} = 0,989$$

$$r_{42} = \frac{92}{92} = 1$$

$$r_{43} = \frac{91}{92} = 0,989$$

$$r_{44} = \frac{91}{92} = 0,989$$

$$r_{45} = \frac{88}{92} = 0,956$$

C5 (NUTS)

$$r_{51} = \frac{80}{85} = 0,941$$

$$r_{52} = \frac{80}{85} = 0,941$$

$$r_{53} = \frac{73}{85} = 0,858$$

$$r_{54} = \frac{85}{85} = 1$$

$$r_{55} = \frac{85}{85} = 1$$

C6 (NUAS)

$$r_{61} = \frac{86}{95} = 0,905$$

$$r_{62} = \frac{87}{95} = 0,915$$

$$r_{63} = \frac{91}{95} = 0,957$$

$$r_{64} = \frac{95}{95} = 1$$

$$r_{65} = \frac{87}{95} = 0,915$$

The next stage is the normalization results to form a new normalized matrix.

$$\begin{bmatrix} 0,5 & 0,931 & 0,947 & 0,989 & 0,941 & 0,905 \\ 1 & 1 & 1 & 1 & 0,941 & 0,915 \\ 1 & 0,977 & 0,842 & 0,989 & 0,858 & 0,957 \\ 0,5 & 0,977 & 0,842 & 0,989 & 1 & 1 \\ 1 & 0,965 & 1 & 0,956 & 1 & 0,915 \end{bmatrix}$$

Next, the final preference value comes from the total multiplication between the normalized matrix and the criteria weights.

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \qquad (3)$$

V_i is the ranking for each alternative, w_j is the weight value of each criterion, and r_{ij} is the normalized performance rating value.

$V_1 = 0,5(0,1) + 0,931(0,1) + 0,947(0,15) + 0,989(0,15) + 0,941(0,2) + 0,905(0,3) = 0,8935$

$V_2 = 1(0,1) + 1(0,1) + 1(0,15) + 1(0,15) + 0,941(0,2) + 0,915(0,3) = 0,9627$

$V_3 = 1(0,1) + 0,977(0,1) + 0,842(0,15) + 0,989(0,15) + 0,858(0,2) + 0,957(0,3) = 0,93105$

$V_4 = 0,5(0,1) + 0,977(0,1) + 0,842(0,15) + 0,989(0,15) + 1(0,2) + 1(0,3) = 0,92235$

$V_5 = 1(0,1) + 0,965(0,1) + 1(0,15) + 0,956(0,15) + 1(0,2) + 0,915(0,3) = 0,9644$

TABLE VI.   PREFERENCE VALUE RESULTS

Alternative	Vi	Ranking
MA1	0,8935	5
MA2	0,9627	2
MA3	0,93105	3
MA4	0,92235	4
MA5	0,9644	1

Table 6 describes the results of the preference values for each alternative using the SAW method. The calculation results are based on 5 alternative student example data that have criteria, namely, absence, attitude, formative exams, exercises/assignments, NUTS, and NUAS. The alternative with the highest v value is a recommendation for students with the highest level of ability who can be recommended as outstanding students in one course. Alternative MA5 with a maximum value of 0.9644. Alternative MA1 with a minimum value of 0.8935. The calculation results from the example data can be a reference for the development and application of test data as a recommendation for selecting outstanding students.

V. CONCLUSION

The results of the identification in this study using the SAW method are as follows:

1) Identification carried out on sample data for selecting outstanding students can be used for test data in determining the level of student ability in one course as a recommendation to support decisions.

2) The criteria are by the identification needs and have met the requirements based on the different weights, according to each level of importance of the criteria.

3) The calculation results are that there is a maximum value in the MA5 alternative with a value of 0.9644. The minimum value in the MA1 alternative with a value of 0.8935. The results of the selection of outstanding students can be used as evaluation material for student learning outcomes.

4) The research was conducted based on references from previous studies using the SAW method. Sample data and criteria are in accordance with the needs so that they have different need specifications with specific results.

5) Alternatives and criteria come from data from one course in the software engineering technology study program to identify the SAW method process so that it can be developed and applied to test data and applications.

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