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STUDY PROGRAM SELECTION MODELING WITH SIMPLE ADDITIVE WEIGHT (SAW) METHOD

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Abstract

The suitability of choosing study programs in higher education will have an impact on the quality of graduates who have competence. This study aims to analyze and design a decision support system that can be used as a reference in choosing a study program that suits students' abilities. Data was collected through the observation method, then the multi Attribute Decision Making (MADM) method was used to process several criteria, namely academic scores, ability test scores and language tests for several students who were going to continue their studies to college. The system is designed using the Simple Additive Weight (SAW) method. While the data processed is academic scores in the form of student report cards, MIPA ability tests (Mathematics, Physics, Chemistry and biology) and language tests (Indonesian and English). The results of the study indicate that the designed decision support system can produce information on the priority of study programs in accordance with students' abilities, so that it can be used as a basis for decision making in the selection of study programs.

Keywords— *Decision Support System (DSS), Fuzzy, Simple Additive Weight (SAW).*

INTRODUCTION

Higher education is an institution that functions to produce qualified and competent graduates. To produce good graduates, many universities improve the best facilities and infrastructure. The improvement of good facilities and infrastructure without being accompanied by the basic abilities of prospective students has an impact on incompetent student graduates. This problem is much anticipated by conducting entrance tests with general questions and conducting interviews for prospective new students. However, it is very rare for universities to conduct specialization tests for prospective students, to test the interests and talents of prospective students.

Competition is intense, many universities do not pay attention to the specialization of prospective new students. This is because there are few prospective new students who apply to the college. Because there is a target from the owner of the college to include as many prospective students as possible to get a big profit, all prospective new students are included in the college and the result is graduates who are not qualified or competent because they are not in accordance with their specialization.

To produce competent graduates, the interest of prospective students must be in accordance with the available study programs, because the suitability of the interests of prospective students with the courses to be given has an impact on the resulting results will be maximal. employee performance (Muhammad Rifqi M, 2012) In this study, the method of multi-attribute decision making (MADM) will be used, with problem solving using the simple additive weighting method (SAW). So that the specialization of prospective students will be

generated in accordance with the available study programs or study programs that are close to the interests of prospective students.

LITERATURE REVIEW

2.1. Basic Concepts of Decision Support System (DSS)

Decision Support System is generally defined as a system that is able to provide capabilities both in terms of problem solving and communication skills for semi-structured problems. In particular, a decision support system is defined as a system that supports the work of a manager or a group of managers in solving semi-structured problems by providing information or suggestions towards certain decisions. In processing, a decision support system can use the help of other systems such as Artificial Intelligence, Expert Systems, Fuzzy Logic, simple additive weighting etc. According to Turban (2005), the initial concept of a decision support system was introduced by Scott Morton in the early 1970s. He defines DSS as an interactive computer-based system, which helps decision makers to use data and various models to solve unstructured problems. Decision support system denotes a system intended to support managerial decision makers in semi-structured decision situations. According to Alter, defining a decision support system is an interactive information system that provides information, modeling and manipulating data. The system is used to assist decision making in semi-structured and unstructured situations, where no one knows for sure how decisions should be made.

These objectives refer to the three basic principles of decision support systems, namely;

1. Problem Structure For semi-structured problems, the solution can be done using the appropriate formulas, while for structured problems it cannot be computerized. Meanwhile, the decision support system was developed specifically to solve semi-structured problems.
2. Decision Support Decision support systems are not intended to replace managers, because the computer is in the structured section, while the manager is in the unstructured section to carry out assessment and analysis, the manager and the computer work together as a semi-structured problem-solving team.
3. Decision Effectiveness The main purpose of a decision support system is not only to shorten decision-making time but also to support managers in making decisions.

RESEARCH METHODS

2.2. Basic Concepts of Multi Attribute Decision Making (MADM)

FMADM is a method used to find optional alternatives from a number of alternatives with certain criteria. The essence of FMADM is to determine the weight value for each attribute, then proceed with a ranking process that will select the alternatives that have been given. There are several methods that can be used to solve FMADM problems. Among others (Henry Wibowo S, 2010):

1. Simple Additive Weighting (SAW)
2. Weighted Products (WP) 3. ELECTR 4. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) 5. Analytic Hierarchy Process (AHP)

Basically the MADM process is carried out in 3 stages, namely the preparation of the components of the situation, analysis and synthesis of information. At the component preparation stage, an estimation table will be formed which contains alternatives and specifications for objectives, criteria and attributes. The analysis phase is carried out in 2 steps. First, it provides an estimate of the distribution and potential, probability and uncertainty associated with the possible impacts on each alternative. Second, includes the selection of decision-making preferences for each value, and indifference to the risks involved.

Basically the MADM process is carried out through 3 stages, namely: preparation of the components of the situation, analysis and synthesis of information. At the component preparation stage, the situation component will be formed an estimation table containing the identification of alternatives and the specification of objectives, criteria and attributes. One way to specify the objective situation |Oi, i=1,...,t | is to list the possible consequences of the identified alternatives | Ai, i=1,...,n|. In addition, the attributes that will be used |ak, k=1,...,n| are also arranged. The analysis phase is carried out through 2 steps, namely: a. Generates estimates of the potential magnitudes, probabilities and uncertainties associated with the possible impacts of each alternative. b. Includes the selection of the decision maker's preference for each value and disregard for the risks involved.

The Multi Attribute Decision Making (MADM) problem is evaluating m alternatives Ai (i=1,2,...,m) against a set of attributes or criteria Cj (j=1,2,...,n), where each attribute is mutually do not depend on one another. The decision matrix of each alternative for each attribute X. In this study using FMADM Fuzzy SAW method. The steps are:

a. Determine the criteria that will be used as a reference in decision making, namely Ci.
b. Determine the suitability rating of each alternative on each criterion.
c. Make a decision matrix based on the criteria (Ci), then normalize the matrix based on the equation that is adjusted to the type of attribute (profit attribute or cost attribute) in order to obtain a normalized matrix
d. The final result is obtained from the ranking process, namely the addition of the normalized matrix multiplication R with the weight vector so that the largest value is chosen as the best alternative (Ai) as the solution (Sri Kusumadewi, 2006).

2.3. Basic Concepts of Simple Additive Weighting (SAW)

Information system as a system within the organization that brings together daily transaction processing needs, supports operations, is managerial and strategic activities of an organization that provides certain outside parties with the necessary reports. Another explanation mentions, as an integrated system, a man-machine system, to provide information to support operations, management and decision-making functions within an organization. This system utilizes computer hardware and software, manual procedures, management and decision-making models and databases.

Fuzzy SAW is often also known as the weighted addition method. Fuzzy SAW is one of the methods to solve Fuzzy Multi Attribute Decision Making (Fuzzy MADM) problems. The basic concept of the Fuzzy SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes.

The Fuzzy SAW method requires the normalization process of the decision matrix (X) to a scale that can be compared with all existing alternative ratings. The SAW method is one of the methods used to solve the FDADM (Fuzzy Multiple Attribute Decision Making) number problem. The SAW method is also known as the weighted sum method, the basic concept of the SAW method is to find the weighted summation of the performance ratings of each alternative on all attributes (Fishburn).

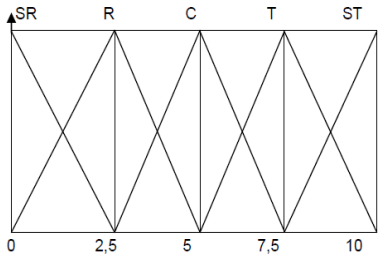
$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{\max_i X_{ij}} & \text{If J is the profit attribute} \\ \dfrac{\min_i X_{ij}}{X_{ij}} & \text{If J is a cost attribute} \end{cases}$$

Description :
r_{ij} = normalized performance rating
Max_{ij} = the maximum value of each row and
kolom Min_{ij} = the minimum value of each row and
kolom X_{ij} = rows and columns of a matrix
With r_{ij} is the normalized performance rating of *alternative* A_i on attribute C_j; i =1,2,…, n dan j = 1,2,…,n.
Preference value for each *alternative* (V_i) given as:

$$V_i = \sum_{j=1}^{n} w_j \, r_{ij}$$

Description :
V_i = Final value of alternative
w_j = predetermined weight
r_{ij} = Normalized matrix

A larger Vi value indicates that alternative Ai is preferred. Fuzzy Multiple Attribute Decision Making (FDADM) is a decision-making method to determine the best alternative from a number of alternatives based on certain criteria, the criteria are usually in the form of measures, rules or standards used in decision making (Sri Kusumadewi, 2005). In this method the value of the weight of each criterion will be adjusted to the fuzzy number, from each weight will be made variables where from a variable is converted into a number. In this method a number has a value interval between 0-10.



The steps in using the SAW method according to Kusumadri (2006) are:

1. Determine Criteria (C_j)
2. Giving the preference weight value (W) by the decision maker for each of the predetermined criteria. W= [W1, W2, … Wj]
3. Normalize the decision matrix X by calculating the normalized performance rating value (r_{ij}) from alternative Ai on the attribute

C_j..
r_{ij}=

$$\begin{cases} \dfrac{x_{ij}}{MAX_i(x_{ij})} \\ \dfrac{MIN_i(x_{ij})}{x_{ij}} \end{cases}$$

Under the condition :
a. It is said to be a profit attribute if the attribute provides many benefits for decision makers, while the cost attribute is an attribute that provides a lot of expenditure if the value is greater for decision makers.

b. If it is a profit attribute, then the value (x_{ij}) of each attribute column is divided by the value (MAX x_{ij}) of each column, while for the cost attribute, the value (MIN x_{ij}) of each attribute column is divided by the value (x_{ij}) of each column.

4. The results of the normalized performance rating value (rij) form a normalized matrix (R)

$$R= \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{i1} & r_{i2} & \cdots & ij \end{bmatrix}$$

5. Perform the ranking process by multiplying the normalized matrix (R) with the preference weight value (W). 6. Determine the preference value for each alternative (Vi) by adding up the product of the normalized matrix (R) and the preference weight value (W).

$$Vi = \sum_{j=1}^{n} w_j \quad r_{ij}$$

A larger Vi value indicates that alternative Ai is preferred.

Research sites

The data used were obtained from the results of questionnaires distributed to prospective new students at Pasir Pengaraian University, STKIP Rokania, and high school in Rokan Hulu-Riau district, in this study only samples from the Pasir Pengaraian area were used.

Population and Sample

1. Population The population is the totality of all possible values, the results of calculations or measurements, quantitative or qualitative about certain characteristics of all members of a complete and clear set whose properties are wanted to be studied. In this study, the population used were universities in Rokan Hulu-Riau and senior high schools in Rokan Hulu-Riau, especially Pasir Pengaraian.
2. Sample The samples taken in this study were Pasir Pengaraian University, STKIP Rokania and several senior high schools in Rokan Hulu-Riau, especially the Pasir Pengaraian.

Consistency Test and Ratio

Test What distinguishes this model from other decision-making models is that there is no absolute consistency requirement. The pooling of opinions between one factor and another is independent of one another, and this can lead to inconsistencies as well as undesirable. It is sometimes necessary to repeat interviews with the same number of respondents if the degree of inconsistency is large. To prove that the consistency index of the order n matrix can be obtained by the formula:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

CI = Consistency Index

λ_{max} = The largest normalized value of a matrix of order

n n = Ordo matrix

If the CI is zero, then the pair wise comparison matrix is consistent. The inconsistency limit that has been set by Thomson L. is determined by using the consistency ratio (CR), which is the ratio of the index consistent with the random index value (RI) obtained from an experiment by the Oak Ridge National Laboratory, later developed by the Wharton School and shown as in the table.

This value depends on the order of the matrix n. Thus the consistency ratio can be

formulated as follows:

$$CR = \frac{CI}{RI}$$

Table 3.1. Random Inskes Value (RI)

N	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.580	0.900	1.120	1.240	1.320	1.410	1.450

N	10	11	12	13	14	15
RI	1.490	1.510	1.480	1.560	1.570	1.590

RESULTS AND DISCUSSION

The results and in this study are used as input for higher education on the ability of each prospective student. In this study, the interests and talents of each prospective student will be determined, to determine a suitable study program for students, so that competent graduates will be obtained. To research with the SAW method, it can be done with the following steps:

4.1. Data analysis

Determination of criteria and comparisons between criteria were obtained from interviews with prospective students and senior high school students who were in grade 12, so it can be seen in the table below

Table 3.2. Comparison Matrix between Criteria

	Skill	Academic	Language
Skill	1	3	5
Academic	1/3	1	3
Language	1/5	1/3	1
Total	**1.53**	**4.33**	**9**

4.2. SAW . Fuzzy System Design

As previously discussed in the introduction. Assessment of the selection of study programs is carried out by looking at the criteria that influence the assessment of the ability of each prospective student which includes skills, academics and language. Furthermore, these criteria will be used as a reference to determine the ability of each prospective student as input material which will later be implemented using the Fuzzy SAW method. From the data taken, the resulting normalized criterion weighting matrix is as follows:

Table 3.3. Normalized Criteria Weighting Matrix

	Skill	Academic	Language	**Bobot**
Skill	0.65	0.69	0.56	0.63
Academic	0.22	0.23	0.33	0.26
Language	0.13	0.08	0.11	0.11

From the comparison of interests between criteria, the weights obtained are calculated as follows:

- Weight of Expertise Criteria : (0.65 + 0.69 + 0.56) / 3
- Academic Criteria Weight : (0.22 + 0.23 + 0.33) / 3
- Weight of Nahasa Criteria : (0.13 + 0.08 + 0.11) / 3

After that the weight of each criterion is tested for consistency, so that it is obtained as follows:

max = (1.53 x 0.63) + (4.33 x 0.26) + (9 x 0.11)
= (0.96) + (1.13) + (0.99)
= 3.08
Because the matrix is of order 3 (that is, it consists of 3 criteria), the index of consistency obtained is:
CI =
For n = 3, RI = 0.58, then
CI = Because CR < 0.100, it can be interpreted that the respondent's preference is consistent.

4.3. Calculation Results with SAW After testing, the respondent then implements it to determine the appropriate study program, as follows:

No.	Respondent Name	Interest	SPK Results	**Ket.**
1	Respondent 01	Matematika	Matematika	Same
2	Respondent 02	Fisika	Fisika	Same
3	Respondent 03	Biologi	Biologi	Same
4	Respondent 04	Fisika	Fisika	Same
5	Respondent 05	Biologi	Biologi	Same
6	Respondent 06	Kimia	Kimia	Same
7	Respondent 07	Fisika	Fisika	Same
8	Respondent 08	Biologi	Biologi	Same
9	Respondent 09	Matematika	Biologi	Not the same
10	Respondent 10	Matematika	Matematika	Same
11	Respondent 11	Kimia	Biologi	Not the same
12	Respondent 12	Matematika	Matematika	Same
13	Respondent 13	Biologi	Biologi	Same
14	Respondent 14	Biologi	Biologi	Same

To find out how many percentage levels of inequality from the DSS are made, it is necessary to compare the results of decisions based on abilities that are built with student interests. Calculation of the percentage of error / inequality using the following formula:

$$\textbf{SPK} = \frac{\text{Number of field data} - \text{Amount of different data}}{\text{Number of field data}} \times 100$$

From the table above, it shows that there are 2 (two) numbers of students choosing different study programs with the results of the priority abilities that have been made. This is due to the ability test results are less than the predetermined value of 30, so that the percentage of inequality is 13.86%.

CONCLUSION

Based on the results of the discussion and research that has been stated in the previous chapter, it can be concluded that:

1. This decision support system is made by modeling the input of several factors that are used as assessment criteria and providing comparisons of the level of importance between criteria including academic scores, ability tests and language tests.
2. The use of information on value data, ability test results and students' language to select study programs can be further developed according to the needs of each study program.
3. Recommendations for the selection of study program priorities using the SPK method with the results of about 86.14% being in accordance with the specialization or choice and 13.86% not in accordance with the specialization or choice. So that the data is close to the truth.

REFERENCES

[1] Andy Rachman. Prosiding Seminar Nasional Teknoin 2008 Bidang Teknik Informatika
[2] Henry Wibowo S, 2010. "Jurnal Aplikasi Ujisensitivitas Untuk Model Madm Menggunakan Metode Saw Dan Topsis".
[3] Arifin, N. Y. (2020). Pemodelan Dan Simulasi Tata Letak Barang Menggunakan Algoritma Genetika. Engineering And Technology International Journal, 2(03), 45-54.
[4] Kaur P, Kumar S., 2013. Iosr Journal Of Business And Management (Iosr-Jbm) Volume 15.Issue 2.Nov – Dec 2013.
[5] Veza, O., & Arifin, N. Y. (2019). Sistem Pendukung Keputusan Calon Mahasiswa Non Aktif Dengan Metode Simple Additive Weighting. Jurnal Industri Kreatif (Jik), 3(02), 71-78.
[6] Kusrini, 2007. Konsep Dan Alikasi Sistem Pendukung Keputusan. Andi.Yogyakarta.
[7] Muhammad Rifqi M. 2012. Jurnal Ilmiah Ictech Vol. X No.1. 1 Januari