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Original Article

Implementation of Multi-Objective Optimization on The Basis of Ratio Analysis (MOORA) in a Decision Support System to Determine the Choice of Schools, Case Study of SMAN Depok Region

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Abstract - *A decision support system (DSS) is a system that can help someone in making decisions from various types of choices that are made accurately and in accordance with desired goals. Many problems can be solved by using the DSS, one of which is selecting schools. In this study, the DSS was used to help Junior High School (SMP) students in making choices to continue their education at Public Senior High School (SMAN) based on the criteria they had for consideration, such as report cards, distance from home to school, championship achievements, and age. The method used in this study is the Multi-Objective Optimization on The Basis Of Ratio Analysis (MOORA) method because this method is widely used in solving multi-criteria problems and has a level of flexibility and ease of understanding in separating the subjective part of an evaluation process into decision weight criteria with several decision-making attributes. In this study, calculation of the optimal value in the selection of schools was carried out using four criteria, namely the average value of report card, championship achievement, distance and age, and has 15 alternative solutions, which are 15 SMAN in Depok, namely SMAN 1 to SMAN 15. The study's results using the MOORA method produced Yi with the highest weight of 0.3949 as the best alternative in making school selection decisions. The lowest Yi weight is 0.2101 as a less-than-optimal alternative.*

Keywords - *Implementation, Decision support system, Moora method, Senior high school, Depok.*

1. Introduction

Choosing a school is a routine activity for parents when it is time for the children to start or continue their education at a certain level. School is a place to gain knowledge. This is where children get to know various fields of science and socialize with the environment, namely the teachers and school friends. School can be a comfortable place when children feel excited to be able to achieve something the children want and aspire to. To get a comfortable place when children study, parents must be able to place the child according to the child's abilities or talents and in a supportive environment so that the child can grow and develop optimally. Selection of a good education place in accordance with a child's ability is a combined necessity to support a child's developmental abilities. For example, when choosing a school after graduating from Junior High School (SMP), this is something that really needs to be considered in connection with the decision to continue to public schools or vocational schools. The choice must be made to continue to Senior High School, Vocational High School (SMK) or another form. In the selection of secondary schools, several assessment criteria are considered, such as student report cards, the academic achievement of students, and the distance between student's home and school; the assessment of these criteria which will later be processed using a method that is in the Decision Support System (DSS) with the Multi-Attribute Decision Making (MADM) model to be able to provide alternative choices that can be measured in the form of modelling and ranking so that the order of which schools can be selected by students based on the criteria the student have [1]. In the previous study entitled Smart Zoning Application to Measured School Distance Using the Haversine Method, the haversine method measures the straight-line distance between the location of a student's home and school, making it easier for students to obtain information on the nearest distance to school [2]. Distance in school selection is one of the determining factors, especially in the admission system using the zoning system [3].

Decision Support System (DSS) is a computer-based interactive system that can help decision-makers use data and models to solve unstructured problems [4]. Many problems can be solved by using a decision support system, one of which is in selecting schools. Santri W Pasaribu's research with the title Implementation of Multi-Objective Optimization on The Basis of Ratio Analysis (MOORA) to Determine the Best Quality of Mango Fruit is a form of research that determines mango seeds based on size, taste, fruit aroma, colour, and skin structure by applying the MOORA method [5]. Another related research that forms the basis of this research is research conducted by Ni Wayan Ari Ulandari, 2020 which determined the outstanding students on Bidikmisi scholarship to study at STIKOM Bali Institute of Technology and Business based on potential academic value, father's income, mother's income, achievement, ranking, through ranking and implementation of MOORA method [6]. Research related to decision support systems has several other methods that can be used, including the electre method used in research in recommending outstanding lecturers in the field of computer science case studies at AMIK & STIKOM Tunas Bangsa by Siti Sundari and Anjar Wanto [7].

In this study, a decision support system was used to help Junior High School (SMP) students in making choices to continue their student education at Public Senior High School (SMAN) based on the criteria they had for consideration, such as report cards, distance from home to school, and championship achievements. One of the methods in decision selection is the Multi-Objective Optimization by Ratio Analysis method or the MOORA method [8]. MOORA method is a method that has a minimum and very simple calculation. The use of this method is a good choice in providing alternative solution stages in solving problems [9]. The approach taken by MOORA is defined as a concurrent process to optimize two or more conflicting situations on several constraints [10].

Public Senior High School (SMAN) in Depok consists of fifteen schools spread over eleven sub-districts [11]. In the previous study, a mapping visualization of the SMAN was carried out, which can show the location on a digital map and the location of the student's home location to the school [12]. Realizing the importance of choosing the right school, it is necessary to design a mechanism to assist in school selection. In this study, a decision-making-based application will be made that can be used to provide school recommendation solutions that students can choose based on the criteria needed by performing calculations using the MOORA method.

2. Literature Review

2.1. Administration of New Students' Admission

Based on Permendikbud No. 44 of 2019 describes the implementation of new students' admission at Kindergarten, Elementary, Junior School, High School and Vocational Schools, stating that one of the educational programs to improve quality and equitable competitiveness is through the implementation of New Student Admissions (PPDB) based on several things, are as follows [24] :

- The Principle of New Students Admission, several principles in the new student admissions system that programs in the Republic of Indonesia do not differentiate all aspects of it unless the agency serves students with a certain gender or religion is called the principle of non-discriminatory admission. The implementation must be done objectively in accordance with rules that have been determined and must be open so that all parents of students or the community can find out information conveyed by the authorities called the principle of transparent, accountable new student admissions where the authorities can account for the process of implementing new student admissions. The admission process is fair that does not favor any interests.
- In this case, the implementation of New Student Admissions is held by each educational unit of High School, Vocational School in West Java Province based on management-based schools that coordinated with West Java Education Office [3]. In the admission of new students held by the government, it is mandatory to provide information or public announcement regarding the implementation of new student admission (PPDB). So that the community and parents of students know the registration requirements, selection of new students, information on the available capacity at each school and the results of the new student's admission.

As for the mechanism in the process of the implementation of new student admission using online and offline, the first stage is the registration of new students by using the network online by opening PPDB official website that each region school has determined. The second stage is offline registration by, carried out directly to the intended school. The Minister of Education and Culture has arranged it regarding the new student admission in kindergarten, elementary, junior high, senior high, vocational school, or other equivalent forms. In facilitating new students' access to the school, then the zoning system is enforced

2.2. Definition of Zoning System in New Student Admission

According to Nasihin and Sururi, "the success of organizing educational institutions will depend heavily on the management of students. The management of these students makes a high contribution and provides strong support for other components in educational institutions in achieving school goals"[14]. The system referred is in the admission of new students focuses on methods. There are two events in the new student admission system: first, using a promotion system, where this promotion system is the admission of students who previously did not use selection.

Registered students in school are accepted without any prior selection, so registering as a student, not a participant, is rejected. This promotion system generally applies to schools whose enrolment is less than the specified capacity. Second, using a selection system, where this selection system can be divided into three types, namely: selection based on the list of values, selection based on interest and ability searches, and selection based on results of the entrance test. According to Big Indonesian Dictionary (KBBI), zoning is a division or breaking of an area into several parts according to function and management objectives. The zoning system policy in accepting new students seemed to cause an uproar in the community as well as among the student's parents. Many parties feel aggrieved by the system; in fact, the implementation of this zoning system gives priority to new students who will go to school within a near distance of where they live.

According to Sukemi 2018, in the Zoning Policy book, Accelerate Equitable Access, and Quality of Education explains that the PPDB zoning system is a policy that has been running since 2017 because the equal distribution of education quality is the aim of the zoning policy [15]. The local government implemented the zoning policy in 2018, whereas in 2017, the zoning policy was still an adjustment step, so not all schools implementing new student admissions implemented the zoning policy. The 2018 PPDB has implemented a zoning system that is comprehensive, integrated, and composed of efforts for those who will carry out arrangements in the education sector. According to Andina, 2017, implementing a zoning system can benefit students who live near the schools, which means it can reduce travel time to school [16]. Meanwhile, according to Abidin and Asrori 2018, the zoning system is part of a school reform effort to improve the quality of education in Indonesia. The existence of this zoning system can create equity. High-achieving students do not just gather at their favorite schools because, like it or not, they have to register at the nearest school and cannot register at schools far away even though they have favorite status [17].

2.3. Decision Support System (DSS)

2.3.1. Decision Support System Concept

Decision Support System can be defined as an information system that is used to help management in decisions related to semi-structured issues. This system has facilities that produce a variety of alternatives that are interactively used by the user [18]. A well-designed decision support system is an interactive software-based system that aims to help decision-makers compile important information from various raw data, documents, individual knowledge, or a business process model to identify problem-solving and decision-making [25].

2.3.2. Decision Support System Architecture

In their book Decision Support of Management, Sprague and Watson (1996) explain that one of the DSS principles is to have a DDM (Dialogue, Data, and Models) component.

- Dialogue, or in other terms called interactive, means that there is a relationship between the system and the user.
- Data is a variety of information, either in the form of numbers, characteristics that identify something, or other information as a support system.
- Models are the process of data analysis carried out in the system.

According to Turban, the components of a decision support system broadly consist of Data Management, Model Base, User Interface, and Knowledge Management [20]. Data management includes data in a database managed by other software, often called Database Management System (DBMS). A component base model is a model that represents a problem in the form of quantitative, statistical, financial, or other forms that can be analysed. The user interface is a component of the decision support system used for users to communicate with the software. In contrast, the knowledge management component is a decision support system that stores or manages knowledge from an expert to solve existing problems. The components of the Decision Support System Model are illustrated in Figure 1.

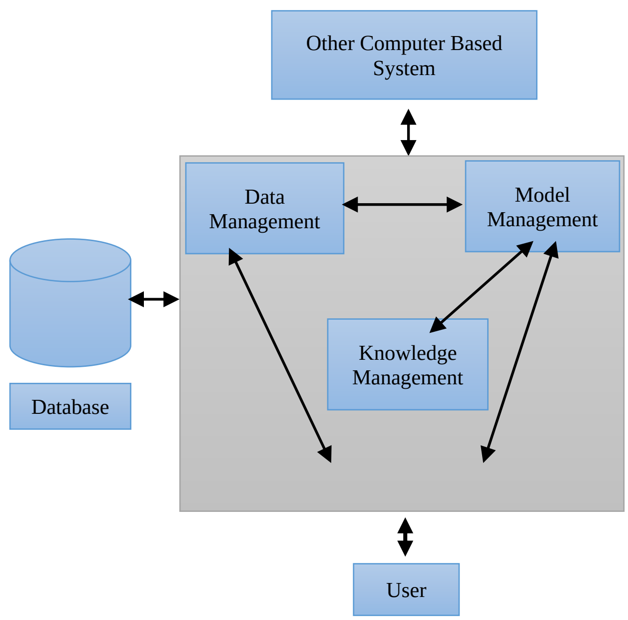

Fig. 1 Conceptual Model of DSS [20]

2.4. Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) Method

The Multi-Objective Optimization on the basis of the Ratio Analysis method, known as MOORA, is a multi-objective system that optimizes two or more conflicting attributes simultaneously. This method is used to solve problems with complex mathematical calculations. MOORA was introduced by Brauers and Zavadskas in 2006 [8]. Initially, this method was introduced as “Multi-Objective Optimization”, which can be used to solve various complex decision-making problems in a factory environment. The MOORA method is applied to solve many economic, managerial, and construction problems in a company or project [18]. The steps taken in solving problems using the MOORA method are shown in Figure 2. The first order is to input the defined criteria values, followed by changing the criteria values into a decision matrix. It then normalised the matrix, reducing the maxmax and minmax values by calculating the weighted normalized matrix, which can finally determine the preference value to determine the ranking of the results of the MOORA calculation.

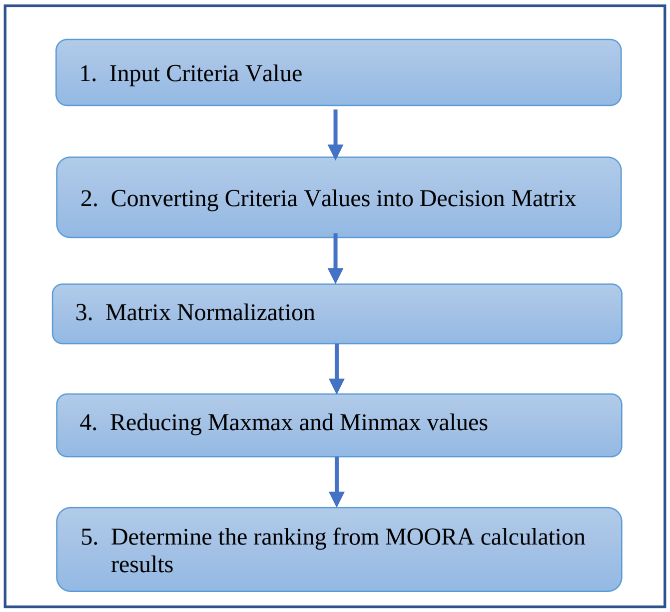

Fig. 2 Stages of using MOORA [18]

2.4.1. Input Criteria Value

This is done to define or enter a criterion value in an alternative where the value will be processed, and the result will be a decision matrix.

2.4.2. Change The Value of The Criteria into a Decision Matrix

Following is the change in the value of the criteria in a decision matrix :

$$X = \begin{bmatrix} X_{11} & X_{12} & X_{1n} \\ X_{21} & X_{22} & X_{2n} \\ X_{m1} & X_{m2} & X_{mn} \end{bmatrix} \quad (1)$$

The matrix represents an X which is the criterion value of each criterion [21]

n = sequence number of attributes or criteria
m = alternative sequence number

2.4.3. Matrix Normalization

Normalization aims to unify each element of the matrix so that the elements in the matrix have a uniform value. Normalization in MOORA can be calculated using the following equation :

$$X^*_{ij} = X_{ij} \Big/ \sqrt{\left[\sum_{i=1}^{m} X^2_{ij} \right]} \quad (2)$$

Description :
Xij = Other option of matrix j on criterion i
i = 1, 2, 3, 4,...,n is the sequence number of attributes or criteria
j = 1, 2, 3, 4, ...,m are alternative sequence numbers
X*ij = Alternative Normalization Matrix i on criterion j

2.4.4. Reducing Maximax and Minmax Values

To indicate that an attribute is more important, it can be multiplied by the appropriate weight (coefficient of significance). The weight attribute is considered for calculation using the following equation :

$$Y_i = \sum_{j=1}^{0} W_j X^*_{ij} - \sum_{j=g+1}^{n} W_j W^*_{ij} \quad (3)$$

i = 1,2, ..., g-criteria/attribute with maximized status;
i = g+ 1, g+ 2, ..., n- criteria/attribute with minimized status;
W_j = weight to j
Y_i = the normalized value of the alternative I th for all attributes

2.4.5. Determining the Ranking of MOORA Calculation Results

This stage ranks the result values sorted from large to small based on the weighted normalized matrix calculation results.

3. Research Methodology

This section describes the research methods used and the concept of calculation to obtain ranking results as a form of recommendation for the selected school.

3.1. Research Concept Framework

This section describes the research methods used and the concept of calculation to obtain ranking results as a form of recommendation for the selected school.

3.2. Data Model Formation

In this section, we will discuss making a decision support system in selecting SMAN in Depok using the MOORA method. Before the calculation is carried out, it is necessary to create a data model that describes the relationship between the criteria and the alternatives that are the solutions to the problems encountered. The data modelling in this DSS is shown in Figure 4.

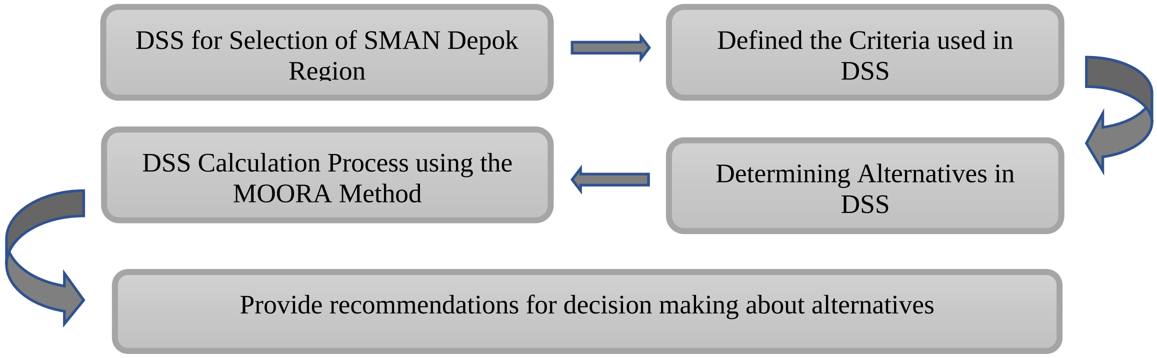

Fig. 3 Research Concept Framework

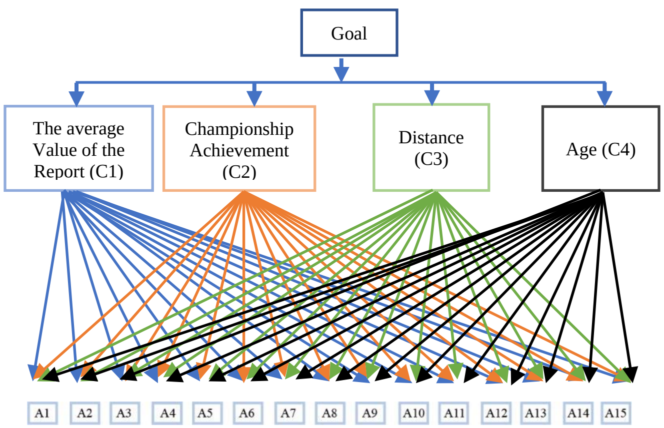

Fig. 4 Data Model of DSS

Figure 4 explains how the criteria used to achieve the goal, which is to get alternative schools that can be selected; in this case, there are four criteria used, namely the average value of the report card, championship achievement, distance from home location of the student to the school location, and student's age. The alternative chosen is fifteen SMAN in Depok, in this case, represented by A1 to A15, which defines the name of the school, namely SMAN 1, SMAN 2 to SMAN 15. This model data will be used to map the calculation process carried out to the alternatives provided as solutions based on the criteria that become the input data.

Table 1. Definition of Criteria

Criteria	Description	Weight of Value	Type
C1	The Average Value of The Report Card	20%	Benefit
C2	Championship Achievement	10%	Benefit
C3	Distance	50%	Benefit
C4	Age	20%	Benefit

3.3. Establishment of Table of Criteria and Weights

The criteria used in establishing a decision support system in selecting SMAN in Depok consist of four criteria, each of which has a different weight value based on assessment needs [20]. The definition of the criteria is shown in table 1.

The following is a rating scale for each criterion used for calculating the DSS selection for SMAN so that a calculation matrix can be made between the criteria and the alternatives provided. Tables 2 to 5 explain the weight of the criteria in the assessment.

Table 2. The weight of the criteria for the average value of the report card

Qualification	Scale
100-91	5
90-81	4
80-71	3
70-61	2
< 61	1

Table 2 explains the value of the criteria for the average score of report cards starting from semester one to semester five while in Junior High School.

Table 3. The weight of championship criteria [22]

Qualification	Score	Scale
Int/World Champion	425-455	5
Int/Asia Champion	380-410	4
National	320-365	3
Province	260-305	2
City/District	200-245	1

Table 3 explains the weight of the championship criteria obtained in international, Asian, and city scope with a predetermined weight.

Table 4 explains the weight of the criteria for the distance of a student's home to school in meters, where the distance is calculated using the straight-line method that has been carried out in previous studies [2].

Table 4. The weight of distance criteria [22]

Qualification (Meters)	Score	Scale
0-2000	400	5
2001-4000	390	4
4001-6000	380	3
6001-8000	370	2
>8000	360	1

Table 5. The weight of age criteria [22]

Qualification (Years)	Score	Scale
20-21	400	5
18-19	390	4
16-17	380	3
14-15	370	2
< 14	360	1

Table 5 explains the weight of the age criteria for students who register and is one of the supporting factors that have a weight value that should be considered.

3.4. MOORA Method Calculation Flowchart

The steps taken in calculating the DSS to determine recommendations for the selected school can be seen in Figure 5.

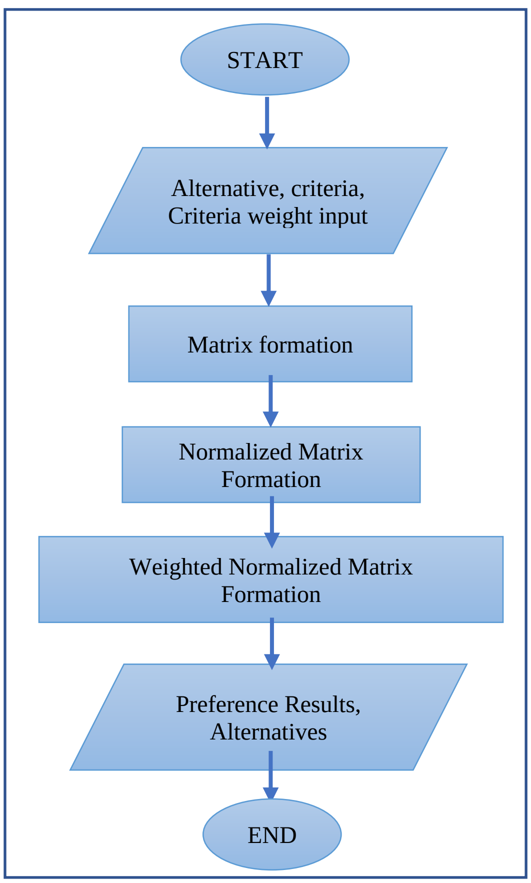

Fig. 5 Flowchart of MOORA Method

Figure 5 explains that the steps taken to select schools using the DSS with the MOORA method begin with input or identification of criteria, alternatives, and weights of each criterion and alternatives needed. The next stage is to form a matrix based on the weights of the alternatives and criteria used. The matrix formed through the matrix normalization process attempts to unify each matrix element so that the elements in the matrix have a uniform value scale. The normalized matrix is continued by multiplying with the weighted value, resulting in a weighted normalized matrix. In the end, it will give preference results, producing a ranking as the output of the decision support system carried out [23].

4. Results and Discussion

4.1. Case of Scenario

A student with an address at GKM housing number 27 RT03 RW09 Bhineka IV Street, Pasir Gunung Selatan, Cimanggis, Depok. Place of birth date January 7, 2006. Calculating the average report card is obtained from the accumulated calculation of the average score from semesters 1-5, as shown in Table 6. Has the achievement of 1st place in poetry writing at the provincial level. Calculations will be made to get the best alternative to choose a school.

Table 6. List of Scores for Semester 1 – 5 Report Card

Subject	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5
Group A					
Pend Agama & Budi Pekerti	94	96	94	96	96
PPKn	91	88	98	99	95
Bahasa Indonesia	92	92	85	90	96
Matematika	87	93	91	91	90
IPA	90	93	93	92	96
IPS	96	99	91	93	98
Bahasa Inggris	96	93	93	93	96
Group B					
Seni Budaya	87	88	85	90	91
PJOK	86	86	89	88	96
Prakarya	90	96	91	91	94
Mulok	91	93	87	96	98
Avg of Semester	90,91	92,45	90,64	92,64	95,09
Semester Report Score Average 1-5	**92,35**				

4.2. Calculation Simulation Using the MOORA Method

Based on information in the case scenario, the process of mapping the value of each alternative is based on the criteria table, namely tables 2 to 5. Determining the distance based on the address has been converted to latitude and longitude and produces distances in kilometres for 15 alternative schools spread across Depok [12], as shown in Table 7.

Table 7. Distance from home to school location [8]

NO	User Coordinates		School Name	School Coordinates		Distance (KM)
	Latitude	Longitude		Latitude	Longitude	
1	-6,34474	106,845,745	SMA Negeri 1	-6,395047	106,814458	6,58
2			SMA Negeri 2	-6,3946006	106,8491576	5,55
3			SMA Negeri 3	-6,4075209	106,8409172	6,99
4			SMA Negeri 4	-6,394434	106,8823928	6,85
5			SMA Negeri 5	-6,4011561	106,7666284	10,77
6			SMA Negeri 6	-6,3706803	106,7733785	8,52
7			SMA Negeri 7	-6,3975893	106,9100008	9,22
8			SMA Negeri 8	-6,424844	106,8468016	8,90
9			SMA Negeri 9	-6,3472217	106,7801344	7,28
10			SMA Negeri 10	-6,3932982	106,7327226	13,63
11			SMA Negeri 11	-6,3868742	106,8303999	8,64
12			SMA Negeri 12	-6,4200047	106,794943	10,07
13			SMA Negeri 13	-6,376502	106,873379	4,67
14			SMA Negeri 14	-6,378766	106,822401	4,63
15			SMA Negeri 15	-6,396705	106,843364	3,20

The steps carried out based on the MOORA method can be carried out as follows :

1. Input of criteria value for each alternative
   Input of criteria values is carried out based on a predetermined scale in tables 2 to 5 for the criteria average report cards, championships, distance and age, shown in table 8.

Table 8. Input Criteria Value to Alternative

Alternate	Criteria			
	C1	C2	C3	C4
A1	5	2	2	2
A2	5	2	3	2
A3	5	2	2	2
A4	5	2	2	2
A5	5	2	1	2
A6	5	2	1	2
A7	5	2	1	2
A8	5	2	1	2
A9	5	2	2	2
A10	5	2	1	2
A11	5	2	1	2
A12	5	2	1	2
A13	5	2	3	2
A14	5	2	3	2
A15	5	2	4	2

2. Converting Criteria Values to Decision Matrix
   The value of the criteria obtained based on the scale defined in the table of criteria weights, namely table 2 to 5 in table 8, is converted into a decision matrix, as shown in Table 9.

Table 9. Decision Matrix

5	2	2	2
5	2	3	2
5	2	2	2
5	2	2	2
5	2	1	2
5	2	1	2
5	2	1	2
5	2	1	2
5	2	2	2
5	2	1	2
5	2	1	2
5	2	1	2
5	2	3	2
5	2	3	2
5	2	4	2

3. Normalizing the Decision Matrix
   Calculation of the normalization decision matrix is carried out on each criterion used by each alternative, as follows :

C1: : $\sqrt{5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2 + 5^2}$: 19,36

A_{11} : 5/19,36
: 0,3056
A_{21} : 5/19,36
: 0,3056
A_{31} : 5/19,36
: 0,3056
A_{41} : 5/19,36
: 0,3056
A_{51} : 5/19,36

: 0,3056
A_{61} : 5/19,36
: 0,3056
A_{71} : 5/19,36
: 0,3056
A_{81} : 5/19,36
: 0,3056
A_{91} : 5/19,36
: 0,3056
A_{101} : 5/19,36
: 0,3056
A_{111} : 5/19,36
: 0,3056
A_{121} : 5/19,36
: 0,3056
A_{131} : 5/19,36
: 0,3056
A_{141} : 5/19,36
: 0,3056
A_{151} : 5/19,36
: 0,3056

C2: : $\sqrt{2^2 +} 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2$
: 7,75
A_{11} : 2/7,75
: 0,2580
A_{21} : 2/7,75
: 0,2580
A_{31} : 2/7,75
: 0,2580
A_{41} : 2/7,75
: 0,2580
A_{51} : 2/7,75
: 0,2580
A_{61} : 2/7,75
: 0,2580
A_{71} : 2/7,75
: 0,2580
A_{81} : 2/7,75
: 0,2580
A_{91} : 2/7,75
: 0,2580
A_{101} : 2/7,75
: 0,2580
A_{111} : 2/7,75
: 0,2580
A_{121} : 2/7,75
: 0,2580
A_{131} : 2/7,75
: 0,2580
A_{141} : 2/7,75
: 0,2580
A_{151} : 2/7,75
: 0,2580

C3: : $\sqrt{2^2 +} 3^2 + 2^2 + 2^2 + 1^2 + 1^2 + 1^2 + 1^2 + 2^2 + 1^2 + 1^2 + 1^2 + 3^2 + 3^2 + 4^2$: 8,12
A_{11} : 2/8,12
: 0,2460
A_{21} : 3/8,12
: 0,3694
A_{31} : 2/8,12
: 0,2460
A_{41} : 2/8,12
: 0,2460
A_{51} : 1/8,12
: 0,1231
A_{61} : 1/8,12
: 0,1231
A_{71} : 1/8,12
: 0,1231
A_{81} : 1/8,12
: 0,1231
A_{91} : 2/8,12
: 0,2460
A_{101} : 1/8,12
: 0,1231
A_{111} : 1/8,12
: 0,1231
A_{121} : 1/8,12
: 0,1231
A_{131} : 3/8,12
: 0,3694
A_{141} : 3/8,12
: 0,3694
A_{151} : 4/8,12
: 0,4926

C4 : $\sqrt{2^2 +} 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2 + 2^2$
: 7,75
A_{11} : 2/7,75
: 0,2580
A_{21} : 2/7,75
: 0,2580
A_{31} : 2/7,75
: 0,2580
A_{41} : 2/7,75
: 0,2580
A_{51} : 2/7,75
: 0,2580
A_{61} : 2/7,75
: 0,2580
A_{71} : 2/7,75
: 0,2580
A_{81} : 2/7,75
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A_{91} : 2/7,75
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A_{101} : 2/7,75
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A_{121} : 2/7,75
: 0,2580
A_{131} : 2/7,75
: 0,2580
A_{141} : 2/7,75
: 0,2580
A_{151} : 2/7,75
: 0,2580

Based on the normalization calculation of the alternatives based on the criteria used, the normalization matrix is generated, as shown in Table 10.

Table 10. Normalization Matrix

0,3056	0,2580	0,2460	0,2580
0,3056	0,2580	0,3694	0,2580
0,3056	0,2580	0,2460	0,2580
0,3056	0,2580	0,2460	0,2580
0,3056	0,2580	0,1231	0,2580
0,3056	0,2580	0,1231	0,2580
0,3056	0,2580	0,1231	0,2580
0,3056	0,2580	0,1231	0,2580
0,3056	0,2580	0,2460	0,2580
0,3056	0,2580	0,1231	0,2580
0,3056	0,2580	0,1231	0,2580
0,3056	0,2580	0,1231	0,2580
0,3056	0,2580	0,3694	0,2580
0,3056	0,2580	0,3694	0,2580
0,3056	0,2580	0,4926	0,2580

4. Calculating Weighted Normalized Matrix

In this process, the calculation is carried out by multiplying the normalized matrix in the table with the weights for each criterion that has been formed in table 11.

C1 = A_{11} : 0,2 x 0,3056 = 0,0712
A_{21} : 0,2 x 0,3056 = 0,0712
A_{31} : 0,2 x 0,3056 = 0,0712
A_{41} : 0,2 x 0,3056 = 0,0712
A_{51} : 0,2 x 0,3056 = 0,0712
A_{61} : 0,2 x 0,3056 = 0,0712
A_{71} : 0,2 x 0,3056 = 0,0712
A_{81} : 0,2 x 0,3056 = 0,0712
A_{91} : 0,2 x 0,3056 = 0,0712
A_{101} : 0,2 x 0,3056 = 0,0712
A_{111} : 0,2 x 0,3056 = 0,0712
A_{121} : 0,2 x 0,3056 = 0,0712
A_{131} : 0,2 x 0,3056 = 0,0712
A_{141} : 0,2 x 0,3056 = 0,0712
A_{151} : 0,2 x 0,3056 = 0,0712

C2 = A_{11} : 0,1 x 0,2580 = 0,0258
A_{21} : 0,1 x 0,2580 = 0,0258
A_{31} : 0,1 x 0,2580 = 0,0258
A_{41} : 0,1 x 0,2580 = 0,0258
A_{51} : 0,1 x 0,2580 = 0,0258
A_{61} : 0,1 x 0,2580 = 0,0258
A_{71} : 0,1 x 0,2580 = 0,0258
A_{81} : 0,1 x 0,2580 = 0,0258
A_{91} : 0,1 x 0,2580 = 0,0258
A_{101} : 0,1 x 0,2580 = 0,0258
A_{111} : 0,1 x 0,2580 = 0,0258
A_{121} : 0,1 x 0,2580 = 0,0258
A_{131} : 0,1 x 0,2580 = 0,0258
A_{141} : 0,1 x 0,2580 = 0,0258
A_{151} : 0,1 x 0,2580 = 0,0258

C3 = A_{11} : 0,5 x 0,2460 = 0,1230
A_{21} : 0,5 x 0,3694 = 0,1846
A_{31} : 0,5 x 0,2460 = 0,1230
A_{41} : 0,5 x 0,2460 = 0,1230
A_{51} : 0,5 x 0,1231 = 0,0615
A_{61} : 0,5 x 0,1231 = 0,0615
A_{71} : 0,5 x 0,1231 = 0,0615
A_{81} : 0,5 x 0,1231 = 0,0615
A_{91} : 0,5 x 0,2460 = 0,1230
A_{101} : 0,5 x 0,1231 = 0,0615
A_{111} : 0,5 x 0,1231 = 0,0615
A_{121} : 0,5 x 0,1231= 0,0615
A_{131} : 0,5 x 0,3694 = 0,1846
A_{141} : 0,5 x 0,3694 = 0,1846
A_{151} : 0,5 x 0,4926 = 0,2463

C4 = A_{11} : 0,2 x 0,2580 = 0,0516
A_{21} : 0,2 x 0,2580 = 0,0516
A_{31} : 0,2 x 0,2580 = 0,0516
A_{41} : 0,2 x 0,2580 = 0,0516
A_{51} : 0,2 x 0,2580 = 0,0516
A_{61} : 0,2 x 0,2580 = 0,0516
A_{71} : 0,2 x 0,2580 = 0,0516
A_{81} : 0,2 x 0,2580 = 0,0516
A_{91} : 0,2 x 0,2580 = 0,0516
A_{101} : 0,2 x 0,2580 = 0,0516
A_{111} : 0,2 x 0,2580 = 0,0516
A_{121} : 0,2 x 0,2580 = 0,0516
A_{131} : 0,2 x 0,2580 = 0,0516
A_{141} : 0,2 x 0,2580 = 0,0516
A_{151} : 0,2 x 0,2580 = 0,0516

Based on the process of multiplying the normalized matrix with the criterion weights, the weighted normalized matrix results are obtained, as shown in Table 11.

Table 11. Weighted Normalized Matrix

0,0712	0,0258	0,1230	0,0516
0,0712	0,0258	0,1846	0,0516
0,0712	0,0258	0,1230	0,0516
0,0712	0,0258	0,1230	0,0516
0,0712	0,0258	0,0615	0,0516
0,0712	0,0258	0,0615	0,0516
0,0712	0,0258	0,0615	0,0516
0,0712	0,0258	0,0615	0,0516
0,0712	0,0258	0,1230	0,0516
0,0712	0,0258	0,0615	0,0516
0,0712	0,0258	0,0615	0,0516
0,0712	0,0258	0,0615	0,0516
0,0712	0,0258	0,1846	0,0516
0,0712	0,0258	0,1846	0,0516
0,0712	0,0258	0,2463	0,0516

5. Reducing Maxmax and Minmax Values

In this process, the search for the maximum value is carried out by adding up the values for each criterion, then looking for the value of Y_i by reducing the maximum with a value of Min = 0; results can be seen in table 12.

Table 12. Y_i Value Search

Alternate	Max(C1+C2+C3+C4)	Min (0)	Y_i= Max-Min
A1	(0,0712+0,0258+0,1230+0,0516)	0	0,2716
A2	(0,0712+0,0258+0,1846+0,0516)	0	0,3332
A3	(0,0712+0,0258+0,1230+0,0516)	0	0,2716
A4	(0,0712+0,0258+0,1230+0,0516)	0	0,2716
A5	(0,0712+0,0258+0,0615+0,0516)	0	0,2101
A6	(0,0712+0,0258+0,0615+0,0516)	0	0,2101
A7	(0,0712+0,0258+0,0615+0,0516)	0	0,2101
A8	(0,0712+0,0258+0,0615+0,0516)	0	0,2101
A9	(0,0712+0,0258+0,1230+0,0516)	0	0,2716
A10	(0,0712+0,0258+0,0615+0,0516)	0	0,2101
A11	(0,0712+0,0258+0,0615+0,0516)	0	0,2101
A12	(0,0712+0,0258+0,0615+0,0516)	0	0,2101
A13	(0,0712+0,0258+0,1846+0,0516)	0	0,3332
A14	(0,0712+0,0258+0,1846+0,0516)	0	0,3332
A15	(0,0712+0,0258+0,2463+0,0516)	0	0,3949

6. Determine the ranking of each alternative

Ranking of each alternative is determined based on the Y_i value, where the best alternative is one with the highest Y_i value, while the worst alternative has the lowest Y_i value; this is done by sorting or ranking the Y_i values in descending order, ranking result are shown in table 13.

Table 13. Rank of Result

Alternate	Y_i= Max-Min)	Rank
A1	0,2716	5
A2	0,3332	4
A3	0,2716	7
A4	0,2716	6
A5	0,2101	14
A6	0,2101	9
A7	0,2101	12
A8	0,2101	11
A9	0,2716	8
A10	0,2101	15
A11	0,2101	10
A12	0,2101	13
A13	0,3332	3
A14	0,3332	2
A15	0,3949	1

Based on the results of value ranking preferences, it is found that the highest Y_i value is found in alternative A15, which is the most optimal form of solution for decision-making, which sees weight and distance as the biggest calculation factors for the zoning system.

5. Conclusion

Based on research conducted on the decision support system in selecting Public Senior High School (SMAN) in Depok using the MOORA method. It can be concluded that based on the assessment criteria required in the process of determining the selection of SMAN, namely four criteria such as the average value of semester 1 to 5 report cards, championship achievement, distance from home to school, and age. The Yi value is obtained with the highest weight of 0.3949 as the best alternative in making school selection decisions and the lowest Yi weight of 0.2101 as a less-than-optimal alternative.

Results of the weighting calculations are expected to help carry out analysis and decision-making for students in determining which SMAN to choose so that the risk of failure or not being accepted in 1 school because it does not meet the criteria can be minimized. In the case study in this study, based on report cards, distance, championship achievements, and age, the recommended school is an alternative, namely SMAN 15.

Conflicts of Interest

This research is part of a research grant from the Ministry of Education and Research Technology, and there is no conflict of interest related to the publication of this paper.

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