

# Application of the *Weighted Product Method* in Determining the Selection of Exemplary Students at Public Junior High School 67 Central Maluku

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## ABSTRACT

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To consider student learning outcomes each semester, the school usually selects exemplary students each year. It is done so that the enthusiasm for learning continues to increase. It is hoped that the selection of exemplary students can be a benchmark for students so that they continue to develop and deepen the knowledge they are learning. Some of the problems that occur in every school, especially at Public Junior High School 67 Central Maluku, in determining exemplary students are less effective and still require a lot of time to process and know the results of determining exemplary students. Based on the analysis that had been done, researchers used the Weighted Product method in processing data to produce exemplary students, which aimed to reduce the occurrence of errors in determining exemplary students and made it easier for schools to determine exemplary students. The Weighted Product method is one of the methods used to solve decision-making systems by considering criteria and weights. From the results of calculations using the Weighted Product method and manual calculations, it was found that Yunita D Firnanda was ranked first with the results of calculations using the Weighted Product method of 0.0149912 and manual calculations of 964, for the second rank using the Weighted Product method of 0.014292153 and manual calculations of 957 on behalf of Jordi Parinussa and the third rank on behalf of Sri Meilans Kinyari with the results of calculations using the Weighted Product method of 0.014146707 and manual calculations of 946.



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## 1. Introduction

Knowledge is constantly developing and evolving. Everyone has different abilities, and being an achiever is a very proud thing for you and others. Outstanding students are the nation's dream, and they are expected to become leaders or generations who can advance the Indonesian nation. However, to get outstanding students, schools must choose students who can master lessons and good self-ethics [1]. Students who excel are very worthy of being nominated as exemplary students to represent the school. People who excel usually follow the development of science so that they have an excellent opportunity to become model students. With the existence of technology, life has become a necessity and part of the human lifestyle. In human life, humans are faced with various fundamental problems in deciding. In the human decision-making process, humans are often faced with many alternatives to choose from, so for a problem, several decision-makers can make different decisions [2]. Decision support systems are part of computer-based information systems. The purpose of implementing a decision support system is to support decision-makers in choosing the best alternative through data processing using a decision-making model [3]. According to [4] and [5], decision support systems are systems that have problem-solving and communication capabilities for problems with semi-structured and unstructured conditions where no one knows precisely how decisions should be made.

Public Junior High School 67 Central Maluku is one of the teaching and learning facilities in the Central Maluku Regency with a total of 136 students, which are divided into 6 classes, including VII<sup>1</sup>, VII<sup>2</sup>, VIII<sup>1</sup>, VIII<sup>2</sup>, IX<sup>1</sup>, and IX<sup>2</sup>. Like schools in general, Public Junior High School 67 Central Maluku also participates in educating the nation's generation to become a devoted person, love and nation for the nation and state, and become an example for future generations.

As a form of participation in educating students to become superior generations, schools always try to encourage their students to continue to excel [6]. Generally, every school assesses outstanding students on academic scores. It can be interpreted that exemplary students have scores above the average of all other students in the school, and achievement itself can lead to a sense of competition among students in order to get the title of exemplary student in the school [7]. The assessment of exemplary students in a school is critical to motivating students to be better. Public Junior High School 67 Central Maluku is a school that implements a model student assessment system every year. The implementation of the exemplary student assessment system at Public Junior High School 67 Central Maluku is done manually by looking at student grades one by one and calculated using Microsoft Excel so that a problem arises, namely the lack of conducive work efficiency and inaccurate report results as well as frequent errors or loss of data. In addition, manual inputting can also cause the data to be changed so that exemplary student assessment reports are less objective. Therefore, Public Junior High School 67 Central Maluku needs a decision support system that can help the process of assessing exemplary students, especially for classes VII<sup>1</sup>, VII<sup>2</sup>, VIII<sup>1</sup>, and VIII<sup>2</sup>.

The method that can be used to assist decision-making in the process of assessing exemplary students is the Weighted Product method, which is a method for determining the values of each criterion based on weights and then ranking to select each existing alternative so as to obtain the best alternative [8]. Based on the research results [8], the Weighted Product method has a suitability level of 99.99857%, higher than the Moora method, with a value of 99.99779%, and the Promethee method, with a value of 99.99679%. Previous research on determining outstanding students at the Sejahtera Senior High School 1 Depok with the Weighted Product method also showed that the decision support system can rank well [9]. The Weighted Product method was chosen because it can determine the weight value of each attribute and then proceed with the ranking process that will determine exemplary students according to the criteria. The information generated from this system is the ranking of exemplary students based on criteria data (report card scores, attendance, attitudes and behavior, and extracurriculars) and weight data (excellent, good, sufficient, less, and less good). The resulting rankings can be used to assist teachers in making decisions on determining exemplary students.

## 2. Research Methods

The type of research used in writing this research is quantitative research, namely research that uses data processes in the form of numbers to solve a problem. This research was conducted at Public Junior High School 67 Central Maluku, and the beginning of this research was on January 17, 2023, and continued from June 13, 2023, to June 17, 2023.

### 2.1 Decision-Making System

The term Decision Support System was first initiated by P.G.W Keen, a British academic who later continued his career in the USA. In 1978, Keen and Scott Morton published a book with the title *Decision Support Systems: An Organizational Perspective*. Where in the book, they mention that computer systems have an impact on decisions to be

made because computers and analysis are essential factors to consider in determining a decision [10]. A decision support system is a system that has been designed and can be implemented to support agreed decisions in the selection of an object. Decision-making must be in accordance with the conditions of the problem that has occurred. The decision is determined in stages, and through a process, the decision is determined in four stages that are interconnected and sequenced [11]. Decision support systems can provide various benefits and advantages. The benefits that can be taken from a decision support system are [12]: 1) Can expand the ability of decision makers to process data/information for users. 2) It can help decision-makers solve problems, especially various problems that are very complex and unstructured. 3) Can produce solutions more quickly, and the results are reliable.

## 2.2 Weighted Product Method

The *Weighted Product Method* was first published by Bridgman in 1922 in his article, and then in 1969, Miller and Starr also published this *Weighted Product Method*. According to [13], *The Weighted Product method* is one of the methods used to solve problems. The *Weighted Product method* uses multiplication to connect attribute values (criteria), where the value of each attribute must first be multiplied by the weight of the attribute (criteria) concerned. According to Putra Jaya, the *Weighted Product method* requires a normalization process because this method transfers the results of the assessment of each attribute. The results of the multiplication are only meaningful if they have been compared (divided) with the standard value. The weight for the benefit attribute functions as a positive power in the multiplication process, while the cost weight functions as a negative power. The *Weighted Product method* uses multiplication as a way to connect attribute ratings, where the rating of each attribute must first be multiplied by the corresponding weight. This process is the same as the normalization process [14]. This method evaluates several alternatives against a set of attributes/criteria, where each attribute is independent of one another. According to Kusumadewi (2006), in the *Weighted Product Method*, several steps must be taken to solve the problem [15], including:

- a. Determining Alternative Criteria, which are criteria that will be used as a reference in making a decision.
- b. Determining Alternative Rating, which is the rating of the suitability of each alternative on each available criterion.
- c. Determining the weight of the data.
- d. Performing Weight Normalization. The value of the total weight must fulfill the equation:

$$W_j = \frac{w_j}{\sum w_j} \quad (1)$$

- e. Determining the S Vector Value by raising and multiplying the criterion value with the results of repairing the criterion weights.
- f. The formula for calculating the normalization value (S vector) is **Equation (1)** as follows:

$$S_i = \prod_{j=1}^n X_{ij}^{W_j} \quad (2)$$

Description:

$S$  : Alternative preferences analogized as a vector  $S$   
 $W$  : Weight of criteria  
 $X$  : Criterion value  
 $i$  : Alternatives  
 $j$  : Criteria  
 $n$  : Number of criteria

- g. Determining the *Vector Value V* by dividing the results of each Vector  $S$  by the overall average of Vector  $S$ . The relative preference value of each alternative can be calculated by the formula:

$$V_i = \frac{\prod_{j=1}^n X_{ij}^{W_j}}{\prod_{j=1}^n X_{ij}^{*W_j}} \quad (3)$$

Description:

$V$  : Alternative preferences analogized as a vector  $V$   
 $W_j$  : Weight of criteria  
 $x_{ij}$  : Alternative criteria value  
 $n$  : Number of criteria

- h. Ranking Vector Values

### 3. Results And Discussion

Based on the research that has been conducted in determining the selection of exemplary students at Public Junior High School 67 Central Maluku for classes VII<sup>1</sup>, VII<sup>2</sup>, VIII<sup>1</sup> and VIII<sup>2</sup>, the data analysis method carried out is to use the steps to complete the calculation using the Weighted Product Method. The following describes how to apply the Weighted Product method in determining decision making as follows.

#### 3.1. Determining Alternative Criteria

At this stage, the criteria data determined by Public Junior High School 67 Central Maluku is presented in **Table 1** as follows:

**Table 1.** Criteria Weights

Criteria	Description	Value
C1	Report Card Score	5
C2	Attendance	4
C3	Attitude and Behavior	3
C4	Extracurricular	2

The first criterion is the report card score, which has a weighting scale and can be seen in the **Table 2**, below:

**Table 2.** Report card score (C1)

Criteria for Report Card Score	Weight Value
$90 \leq X < 100$	5
$80 \leq x < 90$	4
$70 \leq x < 80$	3
$60 \leq x < 70$	2
$50 \leq x < 60$	1

The second criterion is Attendance, which has a weight scale and can be seen in the **Table 3**, below:

**Table 3.** Attendance (C2)

Attendance Criteria	Weight Value
0	5
1 - 2	4
3 - 4	3
5 - 7	2
$\geq 8$	1

The third criterion is Attitude and Behavior, which also has a weighting scale and can be seen in the **Table 4**, below:

**Table 4.** Attitude and Behavior (C3)

Attitude and Behavior Criteria	Weight Value
Excellent	5
Good	4
Sufficient	3
Insufficient	2
Poor	1

The fourth criterion is Extracurricular, which is taken from the number of activities participated in and has a weight scale which can be seen in the **Table 5**, below:

**Table 5.** Extracurricular (C4)

Extracurricular Criteria	Weight Value
3 activities	3
2 activities	2
1 activity	1

### 3.2. Determining Alternative Ratings

After determining the criteria data, it is also necessary to determine the alternative rating. The alternative rating determined in this study can be seen in **Table 6**.

**Table 6.** Alternative Rating

Score Weight	Value
Excellent	5
Good	4
Sufficient	3
Insufficient	2
Poor	1

### 3.3. Determining Weight Data

Furthermore, each student's data is converted into a weighting scale based on the criteria and rating data that has been determined. The results of the data weighting are presented in the following **Table 7**.

**Table 7.** Data Weighting

Alternative (Ai)	C1	C2	C3	C4
A1	4	4	3	3
A2	4	5	4	1
A3	3	4	5	1
⋮	⋮	⋮	⋮	⋮
A86	4	3	5	3

### 3.4. Perform Weight Normalization

After knowing the weight value of each criterion, the research continued by improving the weight of the criteria from the initial weight value or normalizing the weight which aims to change the initial weight value to get or produce more efficient criteria weights. To calculate the weight improvement, **Equation (3)** is used and the results obtained are as follows:

$$W_j = \frac{W_j}{\sum W_j}$$

$$W_1 = \frac{5}{5 + 4 + 3 + 2} = 0,357$$

$$W_2 = \frac{4}{5 + 4 + 3 + 2} = 0,286$$

$$W_3 = \frac{3}{5 + 4 + 3 + 2} = 0,214$$

$$W_4 = \frac{2}{5 + 4 + 3 + 2} = 0,143$$

The table below is a collection of results from the improvement of the weight of the criteria (W) as well as the total of the improvement of the weight of the criteria.

**Table 8.** Improvement of Criteria Weight

Criteria	Weight Value
C1	0.357
C2	0.286
C3	0.214
C4	0.143
Total	1

### 3.5. Determining Vector Values S

The next stage after improving the weight of the criteria was to calculate normalization (S vector) by raising and multiplying the value of the criteria with the results of the improvement of the criteria weights. To calculate the normalization (S vector), **Equation (2)** is used and the results obtained are as follows:

$$S_i = \prod_{j=1}^n X_{ij}^{W_j}$$

$$S_1 = (4^{0,357}) * (4^{0,286}) * (3^{0,214}) * (3^{0,143}) = 3.609581585$$

$$S_2 = (4^{0,357}) * (5^{0,286}) * (4^{0,214}) * (1^{0,143}) = 3.496887626$$

$$S_3 = (3^{0,357}) * (4^{0,286}) * (5^{0,214}) * (1^{0,143}) = 3.105281861$$

⋮

$$S_{86} = (4^{0,357}) * (3^{0,286}) * (5^{0,214}) * (3^{0,143}) = 3.708514796$$

### 3.6. Determining the Value of a Vector

The next stage is to calculate the preference value (Vector V) by dividing the results of each S vector with the total average of all S vectors.

To calculate the preference value (Vector V), the following **Equation (3)** can be used:

$$V_i = \frac{\prod_{j=1}^n X_{ij}^{W_j}}{\prod_{j=1}^n X_{ij} * W_j}$$

By using the calculation formula above, the results of the Vector V value of each alternative are obtained in **Table 9**, as follows:

**Table 9.** Vector V Value of Each Alternative

Alternative	Vector Value V
A1	0.011642537
A2	0.011279048
A3	0.010015942
⋮	⋮
A86	0.011961641

The determination of exemplary students was determined by the existence of a top 10 ranking, which is based on the results of 10 students among 86 students who got the most significant score. The **Table 10** below shows the ranking order 1 to 10 for classes VII<sup>1</sup>, VII<sup>2</sup>, VIII<sup>1</sup>, and VIII<sup>2</sup> at Public Junior High School 67 Central Maluku.

**Table 10.** Ranking of Exemplary Students

Alternative (Ai)	Vector Value V	Ranking
A22	0.0149912	1
A76	0.014292153	2
A62	0.014146707	3
A55	0.014064365	4
A17	0.013487039	5
A53	0.013408537	6
A67	0.013272083	7
A40	0.012953516	8
A15	0.012811738	9
A37	0.012653199	10

### 3.7. Comparative Analysis between Calculations Using the Weighted Product Method and Manual Calculations on Ranking Exemplary Students

To determine the accuracy of the calculation results using the Weighted Product Method, a comparison of the calculation results between the results of the Weighted Product method and manual calculations using Ms. Excel. Both calculation results can be seen in **Table 11**.

**Table 11.** Comparison of Calculation Results for 10 Students in the Exemplary Student Category

No.	Student Name	Weighted Method Product	Manual Calculations	Ranking
1.	Yunita D Firnanda	0.0149912	964	1
2.	Jordi Parinussa	0.014292153	957	2
3.	Sri M Kinyari	0.014146707	946	3

No.	Student Name	Weighted Method Product	Manual Calculations	Ranking
4.	Jovantka L Pooroe	0.014064365	939	4
5.	Peter Lohy	0.013487039	928	5
6.	Grevin Matitamolle	0.013408537	923	6
7.	Alga Wasilainy	0.013272083	917	7
8.	Salvius Titirloloby	0.012953516	911	8
9.	Novendry Lesaa	0.012811738	908	9
10.	Peter Maatoke	0.012653199	902	10

#### 4. Conclusions

Based on the results of research on decision-making systems for selecting exemplary students, conclusions can be drawn:

1. The application of the *Weighted Product* method can provide recommendations for selecting exemplary student candidates so that it can help Public Junior High School 67 Maluku Tengah in the process of determining exemplary students.
2. The application of the *Weighted Product* method in this model student recommendation system provides more efficient results because it reduces the risk of work efficiency problems, data inaccuracy, and data loss.
3. The results of calculations using the *Weighted Product* method and manual calculations produce the same exemplary student results so that this calculation can be used as an alternative to manual calculations used by Public Junior High School 67 Central Maluku.

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