 ISSN:2302-8149
e-ISSN:2540-9719

Implementation of Simple Additive Weighting and Profile Matching Methods to Determine Outstanding Students at Universitas Malikussaleh

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(***received*:** 23 May 2024, ***revised*:** 2 July 2024, ***accepted*:** 26 July 2024)

Abstract

Decision support system (DSS) is a computer-based system used to support data analysis and decision modeling, with the aim of increasing the effectiveness of decisions taken. In this research, SPK is needed to determine Outstanding Students. Through this research, it is hoped that the selection process for outstanding students can be optimized by choosing the evaluation method that best suits the student's characteristics and institutional goals. The results of this research also have the potential to improve the quality of graduates by providing fairer and more objective awards to those who excel. The aim of this research is to design and implement the concept of the Simple Additive Weighting (SAW) and Profile Matching methods in a system for determining outstanding students at Universitas Malikussaleh and to find out the ranking results of the two methods (SAW and Profile Matching) in selecting outstanding students at Universitas Malikussaleh. The research methodology used was literature study, data collection, Simple Additive Weighting and Profile Matching calculations, application design, testing and evaluation. The results obtained from this research are the application of the SAW and Profile Matching methods to determine outstanding students resulting in preferences with the highest score of 1 for the SAW method and the highest score of 5 for the Profile Matching method. These two methods can be applied in selecting outstanding students to help decision making because both this method produces the same best alternative.

Keywords: Decision Support Systems, Outstanding Students, Simple Additive Weighting, Profile Matching.

1 Introduction

Higher education is an important aspect in the formation of quality human resources [1]. In the tertiary environment, one way to prove that who can be an outstanding student is by measuring the extent of their level of success through student honors. Therefore, in every tertiary institution it is necessary to look for students who can do both and are given awards as students. who excel [2]. The process of selecting outstanding students which is carried out on the Universitas Malikussaleh campus still has obstacles such as the data processing process for selecting outstanding students which takes a long time, apart from that, the phenomenon where there are many outstanding students in the tertiary environment is an additional factor which makes it difficult to determine the most successful students. achievement. The significant number of outstanding students can create challenges in assessment and selection, especially when the evaluation methods used are not able to provide a clear and objective picture of their achievements [3]. In other words, the abundance of outstanding students can create obstacles in formulating fair and adequate criteria for determining who deserves to be awarded as an outstanding student.

To solve this problem, a decision support system for selecting outstanding students is needed. There are many methods used in implementing decision support systems [4], so it is necessary to apply two methods, including the Simple Additive Weighting (SAW) method with Profile Matching which

 ISSN:2302-8149
e-ISSN:2540-9719

aims to determine the differences in process results between the two. Apart from that, the application of these two methods aims to determine the level of accuracy of the information provided.

Simple Additive Weighting is a method that gives weight to each criterion and adds up the scores obtained by students [5]. In SAW, decisions are taken based on the highest value after a normalization process and criteria weighting. This method offers clarity in determining outstanding students through measurable mathematical calculations.

Profile Matching method is a method that evaluates the suitability of student profiles with predetermined achievement criteria [6]. A student profile involves various aspects, including academic achievements, extracurricular activities, and participation in research projects. This method focuses on the level of conformity between the student profile and the predetermined achievement standard.

This research aims to design and implement the concept of the Simple Additive Weighting and Profile Matching methods in a system for determining outstanding students at Universitas Malikussaleh and to find out the ranking results of the two methods (SAW and Profile Matching) in selecting outstanding students at Universitas Malikussaleh.

2 Literature Review

Previous related research became one of the author's references in conducting this research to get an overview or comparison that had been carried out by previous researchers, so that differences will be seen with this research. There are several studies that have become literature reviews, including those related to research conducted by [5]. The criteria used in this research are price, location, KPR, house type, facilities and initial payment. The results of the comparison of the SAW and Profile matching methods produce the same ranking as the 4th alternative, namely Sawangan Permai being the main choice in the calculation, for the SAW method with a value of 0.74 and profile matching 11.48. So that assessments using the SAW and Profile Matching methods can be used in decision making in selecting a house in the Depok city area using existing criteria.

The latest research was conducted by [7]. The criteria used in this research are information about incapacity, parents' income, number of parents' dependents, and average report card score. The sensitivity test results of this research show that the sensitivity percentage result of the SAW method is 5.9166% while the Profile Matching method is 27% which can be concluded that the superior method in this case is the Profile Matching method.

The latest research was conducted by [8]. The criteria used in this research are parental income, home ownership status, condition of the parents' house, number of dependents, and parental status. The results obtained are that the Profile Matching method can select scholarship recipients better than the Simple Additive Weighting method. The assessment criteria used consist of parents' income, homeowner status, condition of the parents' house, number of dependents and parental status. Comparison of the Profile Matching method produces the highest accuracy of 100% compared to the Simple Additive Weighing method which only produces 96% accuracy.

Apart from these studies, the author also takes references from other research with the aim of providing more references on related research including a decision support system for suitable soil types for food crops using SMARTER and SAW [9], a decision support system for determining disease in eggplant plants using the Simple Additive Weighting method [10], a decision support system for determining lecture recipients using the SMART method [11], and application of the Profile Matching Analysis method in a decision support system for study program recommendations [12].

From previous related research, there are differences with this research. This research focuses on designing and implementing the concept of the Simple Additive Weighting (SAW) and Profile Matching methods in a system for determining outstanding students and knowing the ranking results of both methods (SAW and Profile Matching) in selecting outstanding students and there are differences in the criteria used in selecting students achievement. Apart from this research, there are several studies that have been carried out by researchers regarding the application of methods in decision support systems and the creation of application systems, including the decision support system for selection of outstanding students using the fuzzy TOPSIS method [13], implementation of the moora method in selection of achievement students during the covid-19 pandemic [14], utilization of the laravel framework and bootstrap framework in developing a web-based hijab sales application [15], java

 ISSN:2302-8149
e-ISSN:2540-9719

application based decision support system in the production process of freshwater fish seed breeding in talang kemulun village [16], design and development of a data processing system for the toraja church, situru rante damai congregation based on client server [17]. Apart from this research, there are several studies that have been carried out by researchers regarding the application of methods in decision support systems and the creation of application systems, including research on the decision support system for determining PKH acceptance using the naïve bayes method [18], classification of student scientific work using the Naive Bayes Classifier method [19], the implementation of fuzzy c-means to determine the level of student satisfaction in online learning [20].

3 Research method

The method or stages carried out in this study are shown in Figure 1.

Figure 1. Research methods or stages

The following is an explanation of Figure 1. The methods or stages carried out in decision support system research using the Profile Matching and Simple Additive Weighting (SAW) methods are as follows:

a. Study of Literatture
This stage involves research and analysis of relevant literature related to the topic or problem that the decision support system wants to solve. It helps in understanding the theoretical basis, methodology, and technology used in the development of such systems.

b. Data Collection
In this research, the author collects data directly from the original source or location where this research was conducted. The basic data in this research is in the form of a questionnaire.

c. Calculation of Profile Matching and Simple Additive Weighting
The next step is to carry out calculations using the Profile Matching and Simple Additive Weighting (SAW) methods to evaluate the predetermined criteria and to calculate the total value of a series of existing alternatives.

d. Design and Manufacture of Decision Support Systems
This step involves the design and development of a decision support system based on an analysis of user needs and predetermined specifications. This includes creating system architecture, programming, and functional testing.

e. System Testing
After the decision support system is built, the next step is to carry out testing to ensure that the system functions well and meets user needs. This testing includes white-box testing and black-box testing.

f. Conclusions and Recommendations
After the decision support system has been developed and tested, the final step is to draw conclusions based on the results of development and testing. These conclusions include an evaluation of system performance, suitability to user needs, and impact on the decision-making process.

4 Results and Discussion

The results and discussion consist of data collection results, system flow diagram design results, application of the Profile Matching and Simple Additive Weighting (SAW) methods, calculation results of the Profile Matching and Simple Additive Weighting methods and system implementation results.

 ISSN:2302-8149
e-ISSN:2540-9719

4.1 Data Collection Results

The data obtained in this research is student data containing the student's name, student registration number, study program, GPA, english course grades, superior course grades, previous achievements, and organizational activity. These data can be seen in Table 1.

Table 1. Questionnaire result data

No	Name	Employee id Number	Study Program	GPA	English Values	Excellent Course Value	Achievement	Organizational Activeness
1	X1	220140055	Chemical Engineering	3,50 ≤ GPA < 4,00	A or A-	A or A-	Once won/received an award in a competition	Less active
2	X2	220170164	Informatics Engineering	3,50 ≤ GPA < 4,00	A or A-	A orA-	There isn't any	Not active
3	X3	220150032	Electrical Engineering	3,50 ≤ GPA < 4,00	A or A-	A or A-	Once won/received an award in a competition	Less active
4	X4	220140030	Chemical Engineering	3,50 ≤ GPA< 4,00	B- or C+	A or A-	There isn't any	Less active
5	X5	220160020	Architectural Engineering	3,50 ≤GPA < 4,00	A or A-	A or A-	Have won/received awards in competitions 2 times or more	Not active
6	X6	220120154	Mechanical Engineering	3,25 ≤GPA < 3,50	A atau A-	B+ or B	There isn't any	Not active
7	X7	220180132	Information Systems	3,50 ≤GPA < 4,00	B+ or B	A or A-	Once won/received an award in a competition	Active
8	X8	220180106	Sistem Informasi	3,50 ≤ IPK < 4,00	A or A-	B+ or B	There isn't any	Active
…	,,,,	,,,,	,,,,	,,,,	,,,	,,,,	,,,,,	,,,,,
65	X65	220120002	Mechanical Engineering	3,50 ≤ GPA < 4,00	A or A-	A or A-	Have won/received awards in competitions 2 times or more	Very active
…	….	……	…..	……	…..	….	….	……
251	X251	220170067	Mechanical Engineering	3,50 ≤ GPA < 4,00	B+ or B	A or A-	There isn't any	Not active

The data obtained in this research amounted to 251 data, all of this data was obtained from questionnaires obtained by the author directly from students

4.2 System Flowchart Design Results

The system scheme for implementing the Profile Matching and Simple Addtive Weighting methods can be seen in Figure 2.

ISSN:2302-8149
e-ISSN:2540-9719

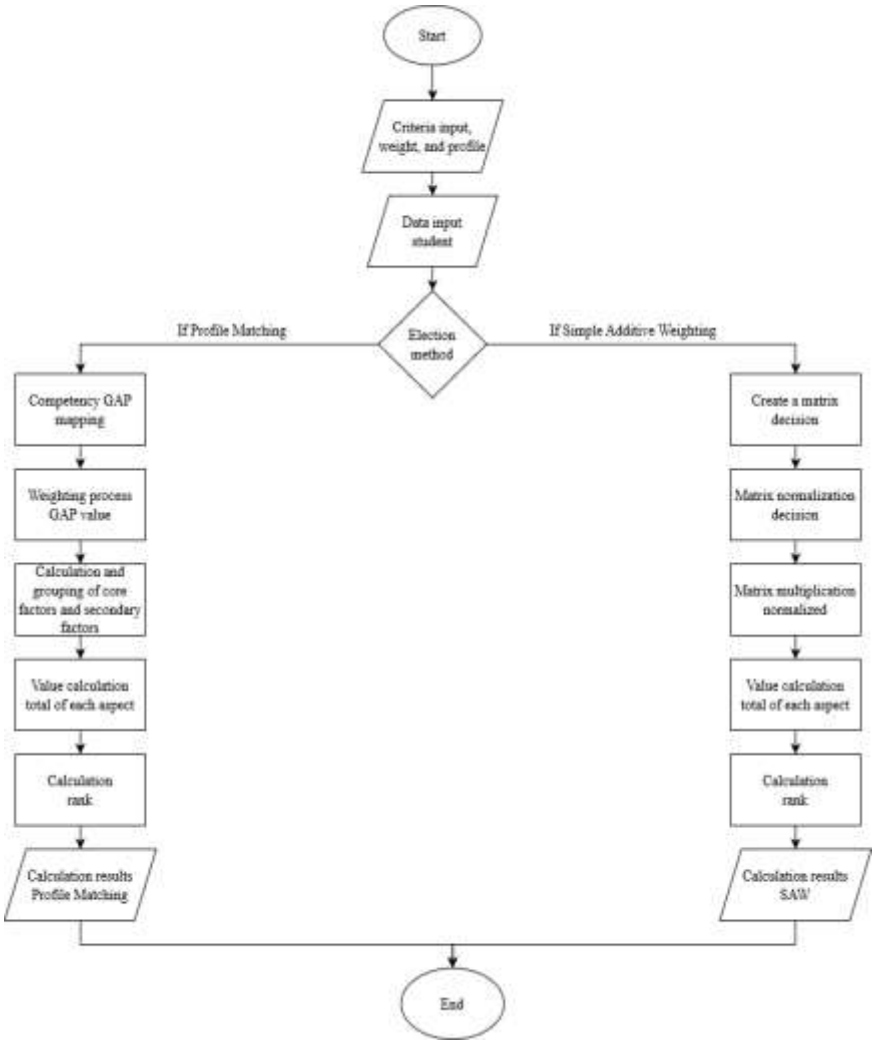

Figure 2. System scheme

4.3 Application of Simple Additive Weighting Methods

The manual calculation of the Simple Additive Weighting method is as follows.

1. Determine criteria and criteria weights
   The criteria and criteria weights that will be used in this calculation are can be seen in Table 2.

Table 2. Criteria and criteria weights

No	Criteria	Weight	Attribute
1	GPA	0.2	Benefit
2	English Values	0.2	Benefit
3	Excellent Course Value	0.15	Benefit
4	Achievement	0.3	Benefit
5	Organizational Activeness	0.15	Benefit

2. Assessment of each alternative
   In order to form a student assessment decision matrix, it can be done by taking 10 samples of student data which are shown in Table 3 below.

Table 3. Assessment of each alternative

No	Alternative name	Criteria

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		C1	C2	C3	C4	C5
1	X1	4	4	4	3	2
2	X2	4	4	4	1	1
3	X3	4	4	4	3	2
4	X4	4	2	4	4	2
5	X5	4	4	4	4	1
6	X6	3	4	3	1	1
7	X7	4	3	4	3	3
8	X8	4	4	3	1	3
…	……	….	….	…..	…..	……
65	X65	4	4	4	4	4
…	…….	….	….	….	…..	…..
251	X251	4	3	4	1	1

3. Decision Matrix Normalization

The values in the table are then normalized using the SAW method. An example of calculating matrix normalization is as follows:

$R(1,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$ $R(6,C1) = \frac{3}{MAX\{4;4;4;4;4;3;..;4\}} = 0.75$

$R(2,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$ $R(7,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$

$R(3,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$ $R(8,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$

$R(4,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$ $R(65,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$

$R(5,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$ $R(251,C1) = \frac{4}{MAX\{4;4;4;4;4;3;..;4\}} = 1.00$

The final results of the normalization form of the decision matrix above can be seen in Table 4 below.

Table 4. Final result normalized

No	Alternative Name	Criteria				
		C1	C2	C3	C4	C5
1	X1	1	1	1	0.75	0.5
2	X2	1	1	1	0.25	0.25
3	X3	1	1	1	0.75	0.5
4	X4	1	0.5	1	1	0.5
5	X5	1	1	1	1	0.25
6	X6	0.75	1	0.75	0.25	0.25
7	X7	1	0.75	1	0.75	0.75
8	X8	1	1	0.75	0.25	0.75
…	……	…..	…..	…..	…..	…..
65	X65	1	1	1	1	1
…	……..	….	…..	….	….	….
251	X251	1	0.75	1	0.25	0.25

4. Alternative Final Values and Rankings

The final step is to find the final value, an example of the final value is as follows:

V1 = (0.2*1) + (0.2*1) + (0.15*1) +(0.3*0,75) + (0.15*0.5) = 0.85

ISSN:2302-8149
e-ISSN:2540-9719

V2 = (0.2*1) + (0.2*1) + (0.15*1) +(0.3*0.25) + (0.15*0.25) = 0.6625
V251 = (0.2*1) + (0.2*0.75) + (0.15*1) + (0.3*0.25) + (0.15*0.25) = 0.6125
The final results of the final score calculation can be seen in Table 5 below.

Table 5. Alternative final values and rankings

No	Alternative	Criteria					Results	Rank
		C1	C2	C3	C4	C5		
1	X1	0.2	0.2	0.15	0.225	0.075	0.85	7
2	X2	0.2	0.2	0.15	0.075	0.0375	0.6625	79
3	X3	0.2	0.2	0.15	0.225	0.075	0.85	7
4	X4	0.2	0.1	0.15	0.3	0.075	0.825	11
5	X5	0.2	0.2	0.15	0.3	0.0375	0.8875	3
6	X6	0.15	0.2	0.1125	0.075	0.0375	0.575	205
7	X7	0.2	0.15	0.15	0.225	0.1125	0.8375	10
8	X8	0.2	0.2	0.1125	0.075	0.1125	0.7	58
…	……	….	….	….	….	….	…..	….
65	X65	0.2	0.2	0.15	0.3	0.15	1	1
…	…….	….	….	….	….	….	….	….
251	X251	0.2	0.15	0.15	0.075	0.0375	0.6125	183

The graph of the calculation results from the SAW method can be seen in Figure 3.

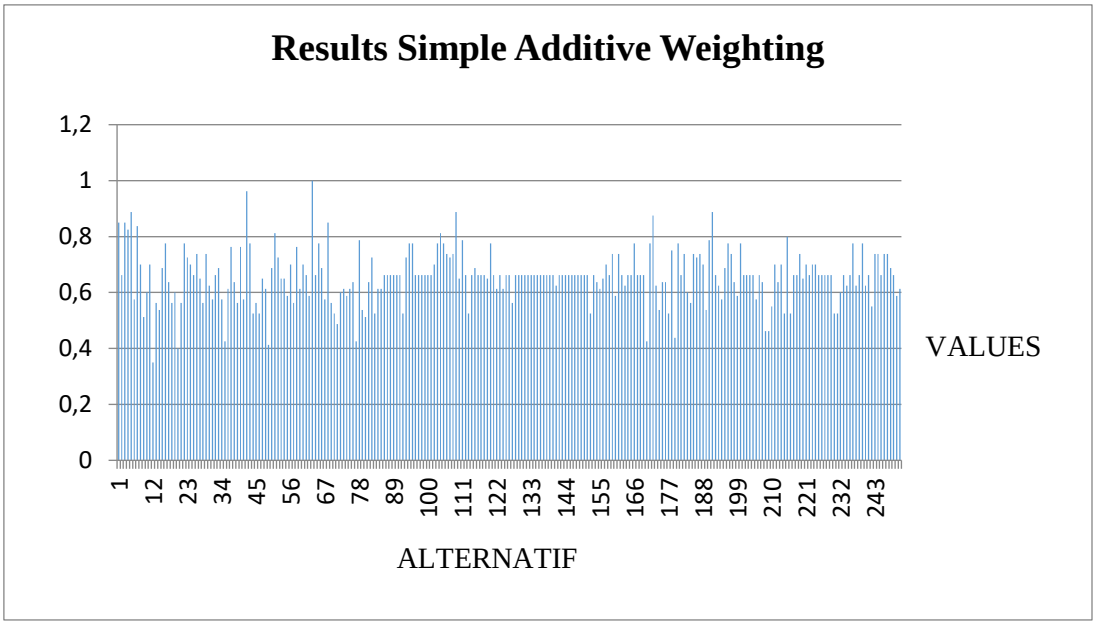

Figure 3. Graph of SAW calculation results

The conclusion from the results of manual score calculations using the SAW method is that it can be determined that the student with the highest score is X65 (Muharram Muhammad Arif) with a final score of 1.

4.4 Application of Profile Matching Methods

The manual calculation of the Profile Matching method is as follows.

1. Determine criteria and standard weight values

The criteria and standard weight values used can be seen in Table 6.

Table 6. Criteria and standard weight values

No	Criteria	Standard Weight Value

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e-ISSN:2540-9719

1	GPA	4
2	English Values	4
3	Excellent Course Value	4
4	Achievement	4
4	Organizational Activeness	4

2. Gap Mapping Process

The mapping process that occurs actually has one general formula that applies to calculating the weight of each criterion, namely as follows:

Gap = Ideal Profile – Individual Profile (1)

The results of the criteria mapping process can be seen in Table 7 below.

Table 7. Results of the gap charting process

No	Alternative	Criteria				
		C1	C2	C3	C4	C5
1	X1	4	4	4	3	2
2	X2	4	4	4	1	1
3	X3	4	4	4	3	2
4	X4	4	2	4	4	2
5	X5	4	4	4	4	1
6	X6	3	4	3	1	1
7	X7	4	3	4	3	3
8	X8	4	4	3	1	3
	……	….	….	….	….	….
65	X65	4	4	4	4	4
	……	….	….	….	….	….
251	X251	4	3	4	1	1
	Target value	4	4	4	4	4
1	X1	0	0	0	-1	-2
2	X2	0	0	0	-3	-3
3	X3	0	0	0	-1	-2
4	X4	0	-2	0	0	-2
5	X5	0	0	0	0	-3
6	X6	-1	0	-1	-3	-3
7	X7	0	-1	0	-1	-1
8	X8	0	0	-1	-3	-1
	…….	….	….	….	….	….
65	X65	0	0	0	0	0
	……..	….	….	….	….	….
251	X251	0	-1	0	-3	-3

3. GAP Mapping

The gap mapping can be seen in Table 8 below.

Table 8. GAP mapping

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No	GAP	Value Weight	Information
1	0	5	competencies as needed
2	1	4.5	one level of excess competency
3	-1	4	competency is one level short
4	2	3.5	2 levels of excess competency
5	-2	3	competency deficiency 2 levels
6	3	2.5	3 levels of excess competency
7	-3	2	competency deficiency 3 levels
8	4	1.5	4 levels of excess competency
9	-4	1	4 levels of competency deficiency

4. GAP value conversion

The results of the GAP value conversion can be seen in Table 9.

Table 9. GAP value conversion

No	Alternative	Criteria				
		C1	C2	C3	C4	C5
1	X1	5	5	5	4	3
2	X2	5	5	5	2	2
3	X3	5	5	5	4	3
4	X4	5	3	5	5	3
5	X5	5	5	5	5	2
6	X6	4	5	4	2	2
7	X7	5	4	5	4	4
8	X8	5	5	4	2	4
	……..	….	…..	…..	…..	…..
65	X65	5	5	5	5	5
	……..	….	….	….	….	….
251	X251	5	4	5	2	2

5. CF and SCF grouping

After the process of determining the weight of the gap value for each criterion, the criteria are then grouped again into two groups, namely core factors and secondary factors.
The core factor calculation can be seen in equation 2.

$$NCF = \frac{\sum NC}{\sum IC} \quad (2)$$

Where:

NCF = Average core factor value
NC = Total number of core factor values
IC = Number of core factor sub-criteria

And for secondary factor calculations, you can see equation 3.

$$NSF = \frac{\sum NS}{\sum IS} \quad (3)$$

Where:

NSF = Average secondary factor value
NS = Total number of secondary factor values

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IS = Number of secondary factor sub-criteria

The results of the core factor and secondary factor calculation process can be seen in Table 9 below.

Table 9. Results of the core factor and secondary factor calculation process

No	Alternative	NCF	NSF
1	X1	4.75	3
2	X2	4.25	2
3	X3	4.75	3
4	X4	4.5	3
5	X5	5	2
6	X6	3.75	2
7	X7	4.5	4
8	X8	4	4
…	……	…..	…..
65	X65	5	5
…	……..	….	….
251	X251	4	2

6. Calculation of Total Value and Ranking

From the results of each aspect above, the total value is then calculated based on the presentation of the core factor and secondary factor values which are estimated to influence the performance of each profile.

To calculate the total, a formula is used:

$$N = (X)\%\ NCF + (X)\%\ NSF \quad (4)$$

Where :

N = Total value for each aspect
NCF = Average core factor value
NSF = Average secondary factor value
(X)% = The percentage value entered

The final results and ranking of each alternative can be seen in Table 10 below.

Table 10. Alternative final results and ranking

No	Alternative	Total Value	Rank
1	X1	4.4	6
2	X2	3.8	64
3	X3	4.4	6
4	X4	4.2	14
5	X5	4.4	6
6	X6	3.4	191
7	X7	4.4	6
8	X8	4	38
….	……	….	…..
65	X65	5	1

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….	……..	….	….
251	X251	3.6	161

The graph of the calculation results of the Profile Matching method can be seen in Figure 4.

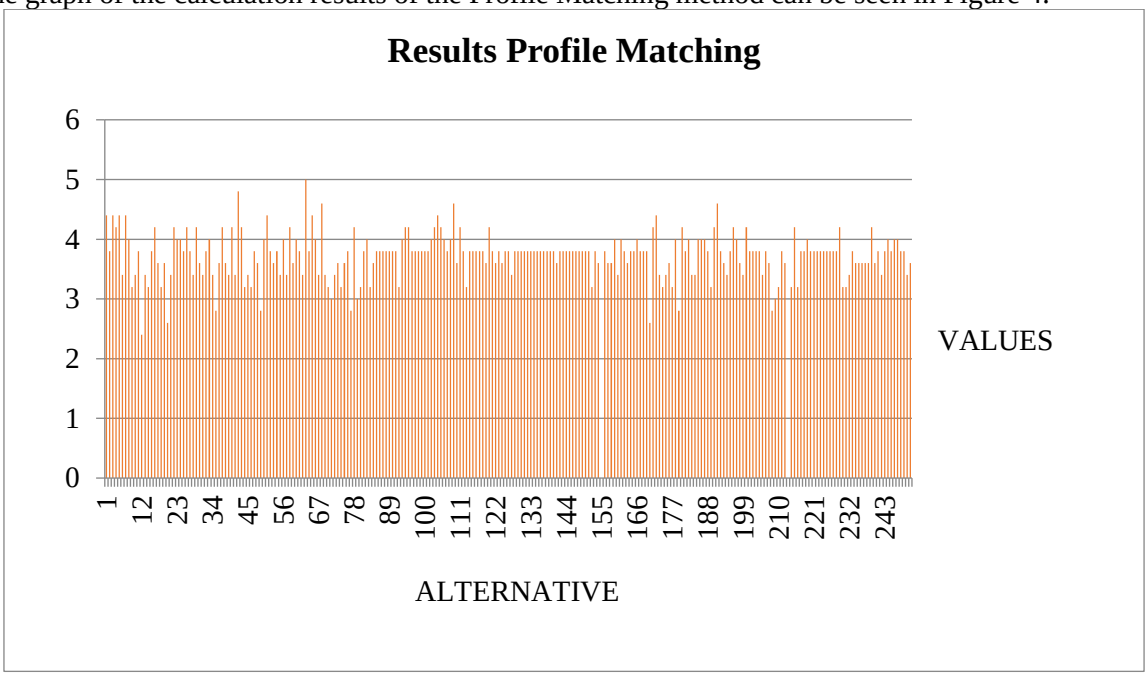

Figure 4. Graph of profile matching calculation results

The conclusion from the results of manual score calculations using the profile matching method is that it can be determined that the student with the highest score is X65 (Muharam Muhammad Arif) with a final score of 5.

4.5 System Implementation (System Output)

From the implementation of the system that the author has created, the output produced from the system is in the form of the final value of each alternative and the ranking of each alternative.

1. Criteria Data Page

The add data, CF and SF weights, search, edit and delete buttons can be found on the criteria data page, admins can add criteria data by pressing the add data button, the data that can be added are criteria names, attributes, types, weights, standard weights and methods. assessment, admins can also edit and delete the data using the edit and delete features can be seen in Figure 5.

ISSN:2302-8149
e-ISSN:2540-9719

Figure 5. Criteria data page

2. Alternative Data Page

On the alternative data page, the admin can add student data by pressing the add data button, then the user is asked to fill in the Employee id Number, name and study program, the admin can also change and delete data by using the edit and delete features can be seen in Figure 6.

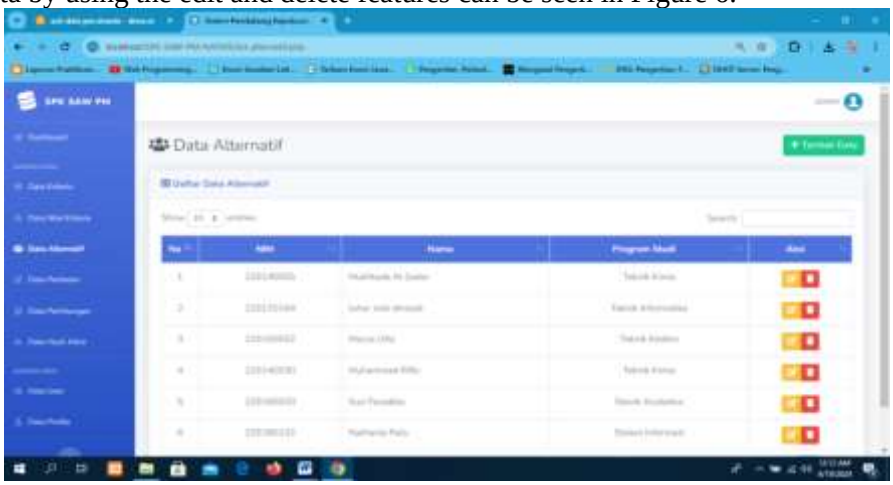

Figure 6. Alternative data page

3. Assessment Data Page

The Assessment Data Page is a page where the admin can add scores from students that have been added previously. The assessment is based on predetermined sub-criteria data can be seen in Figure 7.

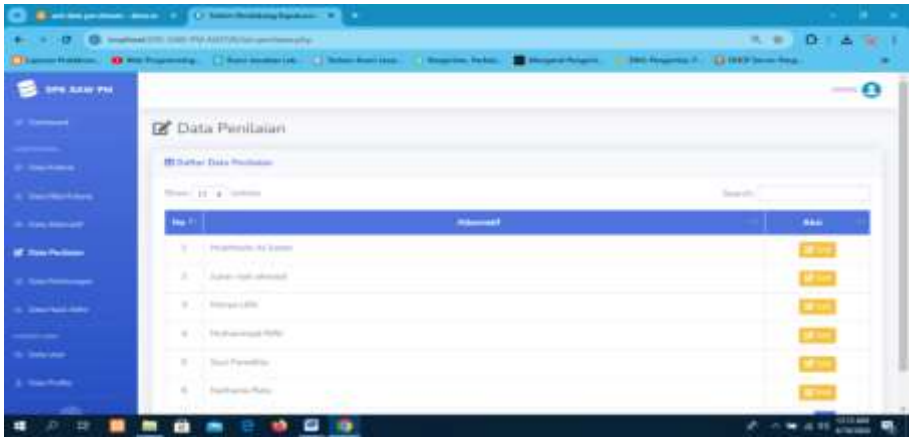

Figure 7. Assessment data page

4. Final Results Data Page

The final results data page is the page that the admin uses to see the results of calculations that have been carried out on this system. On this page the system will display the final ranking results from the Profile Matching and Simple Additive Weighting methods, the data displayed is in the form of alternative names, total scores and rankings, the admin can also print the final result data using the print data feature can be seen in Figure 8.

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e-ISSN:2540-9719

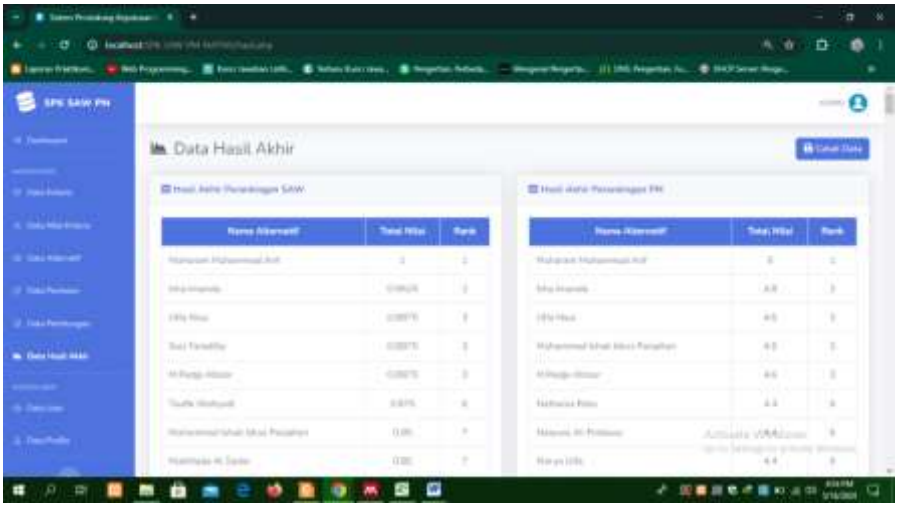

Figure 8. Final results data page

5 Conclusion

From the results of the research carried out in the research implementation of Simple Additive Weighting and Profile Matching Methods to determine outstanding students at Universitas Malikussaleh, the results obtained are that the decision support system can help streamline the time of Universitas Malikussaleh in making decisions to determine students achievement. By applying the SAW and Profile Matching methods to determine outstanding students, from the 251student data entered into the system it produces preferences with the highest score of 1 in the SAW method and the highest score of 5 in the Profile Matching method with the same best alternative, namely X65 (Muharam Muhammad Arif). So, these two methods can be applied in selecting outstanding students to help decision making, because these two methods produce the same best alternative.

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