Journal of Computing Innovations and Emerging Technology

Volume 1 | Issue 2 | December (2025)

Published by **Novamind Press**

JCIET

Journal of Computing Innovations and Emerging Technology

Web-Based Decision Support System for Major Selection Using the SAW Method at Efata Ombarade Vocational School

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Abstract —Efata Ombarade Vocational High School is located in West Sumba Regency, East Wewewa District, East Nusa Tenggara Province. It is a vocational high school offering two majors: tourism and hospitality services business. Every new school year, this school routinely accepts new students, where each applicant chooses a major according to their preferences, which may not be in line with their abilities. To improve the quality of the school and its students, each new student admission involves a selection process based on criteria set by the school, such as National Examination Scores, Report Card Scores, written tests, interviews, and health checks. The current student registration and selection process has several weaknesses, including the time-consuming process of entering data into Microsoft Excel and the delay in obtaining results due to the lack of a specific application to support the calculations. In view of these issues, a system is needed to assist in the process of making faster, more accurate, and more objective decisions regarding student majors. One solution offered is the implementation of a Decision Support System (DSS) using the Simple Additive Weighting (SAW) method. This method works by assigning weights to each criterion used in the assessment, then calculating preference scores to determine the best alternative. The data used includes students' academic scores, particularly their National Examination results, as well as data on their interests. The use of the SAW method in the major selection decision support system is expected to reduce unfairness in assessment, as small differences in scores can be processed proportionally. With this system in place, schools can more easily determine the majors that suit students' abilities and interests. Additionally, this system can also speed up the major selection process, reduce the potential for manual errors, and provide more accurate and fair recommendations for each student.

Keywords— Decision Support System; Major Selection; Simple Additive Weighting

Manuscript received 18 Sep. 2025; revised 01 Oct. 2025; accepted 01 Oct. 2025. Date of publication 15 Des. 2025.

I. INTRODUCTION

In this era of globalization, many developments have taken place, including in the field of information technology. Current developments in information technology cannot be separated from the rapid development of computer technology, because computers are a medium that can make it easier for humans to complete their work. Information technology greatly assists companies or institutions in processing work data to obtain accurate information for decision making [1]-[2].

Decision support systems (DSS) are part of the development of information technology today. Many government agencies and private sectors utilize this technology to help simplify and speed up decision-making. In this case, DSS is needed in decision making for major selection. Because major selection by students is too risky, its implementation must consider the principle of prudence and the principles of major selection must be appropriate so that in the future it does not cause problems that make it difficult for students [3]-[4]. A Decision Support System (DSS) is a system capable of providing problem-solving and communication capabilities for problems with semi-structured and unstructured conditions. This system is used to assist decision-making in semi-structured and unstructured situations, where no one knows for sure how decisions should be made[5]-[6].

Vocational high school students are assigned to specific fields of study in the odd semester of their 11th grade. This assignment is introduced as a measure to guide students according to their talents, interests, and academic abilities. This career guidance is intended to make it easier for students to choose a major in college that will lead to their future careers. However, career guidance for vocational high school students does not always reflect their abilities, talents, interests, and academic achievements. This may be due to the confusion students experience when given a choice of majors. Many of them choose one major.

In vocational schools, the majority of major decisions are determined by three factors. First, based on the parents' preferences. Second, the choice of study program is based on peer influence and following current major trends. The third factor is the student's own academic achievement. Career choices based on these three factors will inevitably lead to regret for students whose chosen career path is not in line with their talents, interests, and preferences. Therefore, computer technology is needed to support career decision-making in vocational high schools.

The MCDM (Multiple Criteria Decision Making) method used is Simple Additive Weighting (SAW). Multiple criteria decision making (MCDM) is used when a decision maker wants to find the best alternative or rank a list of alternatives rationally and efficiently when there are several decision criteria involved[7]-[10]. Several researchers who have conducted previous studies using the same Simple Additive Weighting (SAW) method include Elda Ranisa et al.[11] Suhendra Rawal Dewa, et al. [12], Nurhikma Arifin, et al. [13], and Muhammad Wahyu Pratama, et al. [14]. The results of these studies concluded that Simple Additive Weighting (SAW) can improve the efficiency of the committee in the process of selecting new students for major determination and is superior to the manual system. In addition, it also concludes that the more samples there are, the higher the validity level tends to be, and the final result of this study is an alternative that has the best value comared to other alternatives, also known as the weighted sum method, which is one of the algorithms often used in the development of decision support systems. The weighted sum of performance values for each alternative in the criteria is the main concept of Simple Additive Weighting SAW [15].

This system is expected to support Efata vocational school students in choosing their majors. The majors are tailored to the students' abilities, interests, and academic achievements. The Decision Support System (DSS) that applies the Simple Additive Weighting (SAW) method in this system will be able to perform paired comparison tests.

This study makes a unique contribution by presenting a high school student major selection decision support system using the Simple Additive Weighting (SAW) method, which is more objective than manual methods. Its uniqueness lies in its ability to simplify various criteria values into a uniform scale, thereby facilitating comparison and producing a transparent final score. This system not only takes academic grades into account but also student interests, resulting in fairer decisions that are more in line with individual potential. Additionally, the use of SAW speeds up the placement process, minimizes human error, and provides flexibility in setting criterion weights according to school policies. Thus, this research makes a tangible contribution to creating a fast, accurate, and transparent placement mechanism to support the quality of education at the high school level.

II. METHODOLOGY

The purpose of the research at SMK Efata is to produce a decision support system to help prospective new students determine their majors according to their competencies and interests. This research began gradually from the identification process to the conclusion.

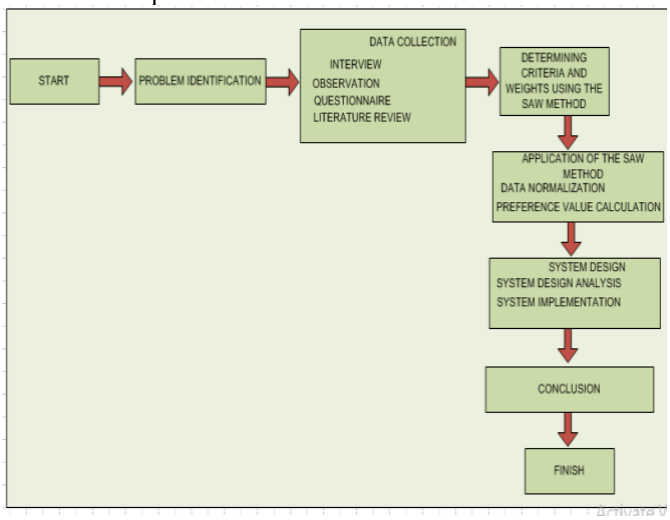

Fig. 1. Research Method

a. Problem Identification
The researchers determined the research problem, namely the choice of major at Efata Vocational School.

b. Data Collection
Data collection was carried out in three stages, namely: Interviews: Conducting interviews with teachers and school officials regarding the criteria used in determining majors. Observation: Directly observing the selection of majors at Efata Vocational School.
Questionnaire: Distributing questionnaires in the form of questions to prospective new students to determine their competencies according to their interests and talents. Literature Study: Reviewing theories related to SPK, the SAW method, and relevant previous research.

c. Determination of criteria and weights using the SAW method
In the vocational school major selection process, criteria serve as the basis for determining the major that best suits the student's potential and interests. Criteria can be determined based on school policy, major competency requirements, and the student's psychological and academic factors.

d. Application of the SAW Method
The process of determining majors using the Simple Additive Weighting (SAW) method is carried out in several stages, beginning with determining the relevant criteria and weights to form a decision matrix based on student data. Next, the matrix is normalized so that all values are on a uniform scale. The normalization results are then multiplied by the weight of each criterion to obtain preference values. The preference values of each student are added up to produce a final ranking, which forms the basis for providing recommendations on the majors that best suit the student's profile[16]-[17].

e. System Design

The decision support system in this study was designed using the Waterfall method, which includes several sequential stages, starting from system requirements analysis to identify user needs and assessment criteria, followed by system design in the form of database design, interface, and process flow using use case diagrams, activity diagrams, and Data Flow Diagrams. Next, implementation was carried out by applying the design to the DSS application, followed by testing using data from Efata Vocational School students to ensure that the system ran according to requirements, and finally evaluation to assess the accuracy and effectiveness of the system in providing appropriate major recommendations.

III. RESULT AND DISCUSSION

3.1 Result

Criteria and Weighting

This study analyzes data using the SAW (Simple Additive Weighting) method for new students determining their majors at Efata Vocational School with the criteria used being national exams, written tests, interviews, health tests, and report card scores. Criteria weighting is assigned a weight value to each criterion by the decision maker, which represents the level of importance of each criterion.

TABLE I. CRITERIA AND TYPES OF CRITERIA

No	Name Criteria	Criteria Type
1	National Examination Scores	Benefit
2	Written examination	Benefit
3	Interview	Benefit
4	health test	Benefit
5	Report card scores	Cost

Weight Value of Each Criterion

Criteria weighting is the weighting of the value of each criterion. Criteria values are determined based on the interests of Efata Vocational School.

TABLE II. WEIGHT VALUE OF EACH CRITERION

No	Name Criteria	Weight Value
1	National Examination Scores	30
2	Written examination	25
3	Interview	15
4	health test	10
5	Report card scores	20

Value of Each Criterion

Filling in the scores for each criterion, scores based on the data obtained, filling in the weighting from 0-1.

TABLE III. VALUES FOR EACH CRITERION

Alternative	Criteria				
	C1	C2	C3	C4	C5
Agustinus	40	20	70	80	100
Samuel	30	40	50	80	80
Marselinus	40	100	40	70	50
Santika	50	50	20	70	50
Linustri	50	100	100	40	70
Agustina	70	100	50	100	20
Diana Pote	100	80	40	100	40
Liana	70	20	70	100	60
Andika	80	100	80	90	100
Agus Zaza	90	100	40	90	50

Criteria C1

$$r11 = \frac{40}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{40}{100} = 0,4$$

$$r21 = \frac{30}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{30}{100} = 0,3$$

$$r31 = \frac{40}{Max\{0.4:0,3;0,4;0,5;0,5;0,7;1;0.7;0,8,0,8,0\}} = \frac{40}{100} = 0,4$$

$$r41 = \frac{50}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{50}{100} = 0,5$$

$$r51 = \frac{50}{Max\{40,30;\ 0,4;\ 0,5;\ 0,5;\ 0,7;\ 1;\ 0.7;\ 0,8,0,8,0\}} = \frac{50}{100} = 0,5$$

$$r61 = \frac{70}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{70}{100} = 0,7$$

$$r71 = \frac{100}{Max\{40:30;40;50;50;70;100;70;80,8,0\}} = \frac{100}{100} = 1$$

$$r81 = \frac{70}{Max\{70:30;40;50;50;70;100;70;80,8,0\}} = \frac{0,7}{1} = 0,7$$

$$r91 = \frac{80}{Max\{40:30;40;50;50;70;100.70;80,80\}} = \frac{80}{100} = 0,8$$

$$r101 = \frac{90}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{90}{100} = 0,9$$

Criteria C2

$$r12 = \frac{20}{Max\{20;40;100;50;100;60;80;20,100,100\}} = \frac{20}{100} = 0,2$$

$$r22 = \frac{40}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{40}{100} = 0,4$$

$$r32 = \frac{100}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{100}{100} = 1$$

$$r42 = \frac{50}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{50}{100} = 0,5$$

$$r52 = \frac{100}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{100}{100} = 1$$

$$r62 = \frac{60}{Max\{40:30;40;50;50;70;100;70;80,80} = \frac{60}{100} = 0,6$$

$$r72 = \frac{80}{Max\{40:30;40;50;50;70;100;70;80,80\}} = \frac{80}{100} = 0,8$$

$$r82 = \frac{30}{Max\{30;20;100;50;20;50;90;30,100,70\}} = \frac{30}{100} = 0,3$$

$$r92 = \frac{100}{Max\{30;20;100;50;20;50;90;30,100,70\}} = \frac{100}{100} = 1$$

$$r102 = \frac{100}{Max\{30;20;100;50;20;50;90;30,100,70\}} = \frac{100}{100} = 1$$

Criteria C3

$$r13 = \frac{70}{Max\{,70;50;40;20;100;50;40;70;80;40\}} = \frac{70}{100} = 0,7$$

$$r23 = \frac{50}{Max\{70;50;40;20;100;50;40;70;80;40\}} = \frac{50}{100} = 0,5$$

$$r33 = \frac{40}{Max\{70;50;40;20;100;50;40;70;80;40\}} = \frac{40,}{100} = 0,4$$

$$r43 = \frac{20}{Max\{70;50;40;20;100;50;40;70;80;40\}} = \frac{20}{100} = 0,2$$

$$r53 = \frac{100}{Max\{70;50;40;20;100;50;40;70;80;40\}} = \frac{100}{100} = 1$$

$$r63 = \frac{50}{Max\{70;50;40;20;100;50;40;70;80;40\}} = \frac{50}{100} = 0,5$$

$$r73 = \frac{40}{Max\{70;50;40;20;100;50;40;70;80;40\}} = \frac{40}{100} = 0,4$$

$$r83 = \frac{70}{Max\{70;50;40;20;100;50;40;70;80;40\}} = \frac{70}{100} = 0,7$$

$$r93 = \frac{80}{Max\{70;50;40;20;100;50;40;70;80;40\}} = \frac{80}{100} = 0,8$$

$$r103 = \frac{40}{Max,70;50;40;20;100;50;40;70;80;40\}} = \frac{40}{100} = 0,4$$

Criteria Cost (C4,C5)

Criteria C4

$$r14 = \frac{min\{80;80;70;70;40;100;100;100;90;90\}}{80} = \frac{40}{80} = 0,5$$

$$r24 = \frac{min\{80;80;70,70;40;100;100;100;90;90\}}{80} = \frac{40}{80} = 0,5$$

$$r34 = \frac{min\{80;80;70;70;40;100;100;100;90;90\}}{0,7} = \frac{40}{70} = 0,57$$

$$r44 = \frac{min\{80;80;70;70;40;100;100;100;90;90\}}{70} = \frac{40}{70} = 0,57$$

$$r54 = \frac{min\{80;80;70;70;40;100;100;100;90;90\}}{40} = \frac{40}{4} = 1$$

$$r64 = \frac{min\{80;80;70;70;40;100;100;100;90;90\}}{70} = \frac{40}{100} = 0,4$$

$$r74 = \frac{min\{80;80;70;70;40;100;100;100;90;90\}}{100} = \frac{40}{100} = 0,4$$

$$r84 = \frac{\min\{80;80;70;70;40;100;100;100;90;90\}}{0,4} = \frac{40}{100} = 0,4$$

$$r94 = \frac{min\{80;80;70;70;40;100;100;100;90;90\}}{0,9} = \frac{40}{90} = 0,44$$

$$r104 = \frac{min\{80;80;70;70;40;100;100;100;90;90\}}{90} = \frac{40}{90} = 0,44$$

Criteria C5

$$r15 = \frac{min\{10;80;50;50;70;20;40;60;100;50\}}{1} = \frac{20}{100} = 0,2$$

$$r25 = \frac{min\{100;80;50;50;70;20;40;60;100;50\}}{80} = \frac{20}{80} = 0,25$$

$$r35 = \frac{min\{100;80;50;50;70;20;40;60;100;50\}}{50} = \frac{20}{0,5} = 0,4$$

$$r45 = \frac{min\{100;80;50;50;70;20;40;60;100;50\}}{50} = \frac{20}{50} = 0,4$$

$$r55 = \frac{min\{100;80;50;50;70;20;40;60;100;50\}}{70} = \frac{0,2}{0,7} = 0,28$$

$$r65 = \frac{min\{100; 80; 50; 50; 70; 20; 40; 60; 100; 50\}}{20} = \frac{0,2}{0,2} = 1$$

$$r75 = \frac{min\{100; 80; 50; 50; 70; 20; 40; 60; 100; 50\}}{0,4} = \frac{20}{40} = 0,5$$

$$r85 = \frac{min\{100; 80; 50; 50; 70; 20; 40; 60; 100; 50\}}{0,6} = \frac{20}{60} = 0,33$$

$$r95 = \frac{min\{100; 80; 50; 50; 70; 20; 40; 60; 100; 50\}}{1} = \frac{20}{100} = 0,2$$

$$r105 = \frac{min\{100; 80; 50; 50; 70; 20; 40; 60; 100; 50\}}{50} = \frac{0,2}{0,5} = 0,4$$

Normalization

Normalization is the result of calculations based on criteria C1-C5.

TABLE IV. NORMALIZATION

CI(30)	C2(20)	C3(20)	C4(15)	C5(15)
0,4	0,2	0,7	0,5	0,2
0,3	0,4	0,5	0,5	0,25
0,4	1	0,4	0,57	0,4
0,5	0,5	0,2	0,57	0,4
0,5	1	1	1	0,28
0,7	0,6	0,5	0,4	1
1	0,8	0,4	0,4	0,5
0,7	0.3	0,7	0,4	0,33
0,8	1	0,8	0,44	0,2
0,9	1	0,4	0,44	0,4

Ranking Process

The ranking process is a process of ranking using weights for each criterion given by the decision maker, namely

.

A1=(0,4)(30)+(0,2)(20)+(0,7)(20)+(0,5)(15)+(0,2)(15)=0,00675

A2=(0,3)((30)+(0,2)(20)+(0,5)(20)+(0,5)15)+(0,25)(15)=0,00992

A3=(0,4)(30)+(1)(20)+(0,4)(20)+(0,57)(15)+(0,4)(15)=0,0832

A4=(0,5)(30)+(0,5)(20)+(0,2)(20)+(0,285)(15)+(0,6)(15)=0,0146

A5(0,5)(30)+(1)(20)+(1)(20)+(1)(15)+(0,28)(15)=0,01125

A6=(0,7)(30)+(0,6)(20)+(0,5)(20)+(0,4)(15)+(1)(15)=0,0235

A7=(1)(30)+(0,8)(20)+(0,4)(20)+(0,4)(15)+(0,5)(15)=0,0173

A8=(0,7)(30)+(0,3)(20)+(0,7)(20)+(0,4)(15)+(0,33)(15)=0,0236

A9=(0,7)(30)+(0,3)(20)+(0,8)(20)+(0,44)(15)+(0,.2)(15)=0,0140

A10=(0,9)(30)+(1)(20)+(0,4)(20)+(0,44)(15)+(0,4)(15)=0,0467

Based on the ranking results, alternative A2 achieved the highest ranking score of 0.00992.

Discussion

System Design

The design of this system aims to describe the structure, behavior, and interaction of the system running on the new student admission system at SMK Efata that will be built, where the tool used for modeling is a UML diagram.

a. Use Case Diagram User

Use Case Diagram is a visual representation that shows the relationship between actors (parties using the system) and the functions (use cases) available in the system. In the context of this decision support system, the main actors are administrators, who can be students or teachers.

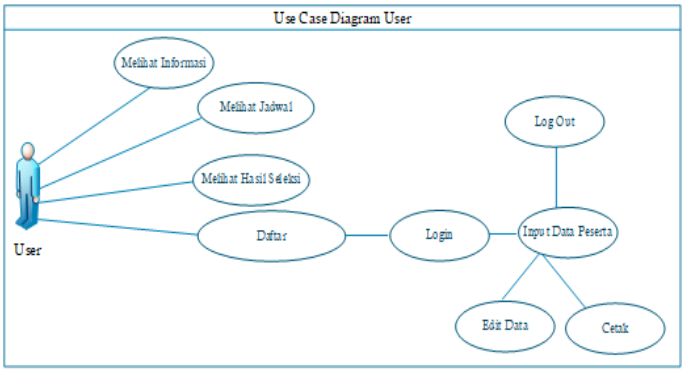

Fig. 2. Use Case Diagram User

b. Use Case Diagram Admin

The Admin role functions as the main administrator of the system, responsible for managing data and users, as well as ensuring that the system runs smoothly. The following are use cases typically performed by admins.

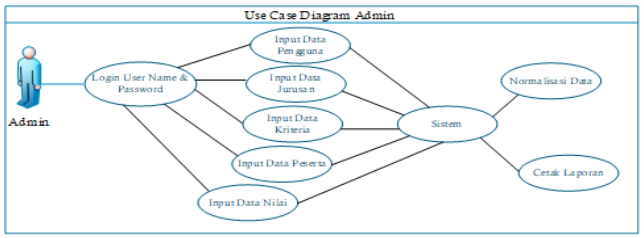

Fig. 3. Use Case Diagram Admin

System Display

Login Page

The home page used by all admin users and users to log into the system. Users are asked to enter their username and password. At this stage, the system will recognize the user's role so that after logging in, the dashboard display will differ according to each user's access rights.

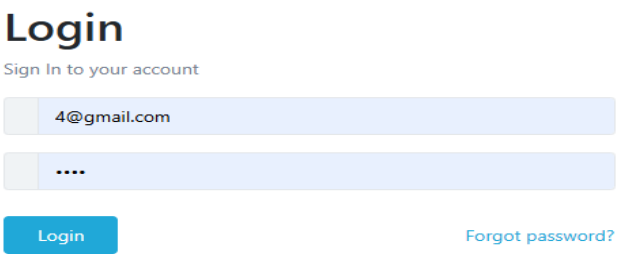

Fig. 4. Login Admin

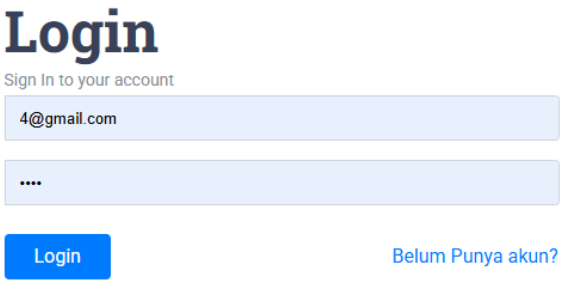

Fig. 5. Login User

User Data Input Form

In the SAW method Major Selection Decision Support System, the user input form is an interface used to enter student data before the system performs calculations. This form is the initial stage for the system to build a decision matrix.

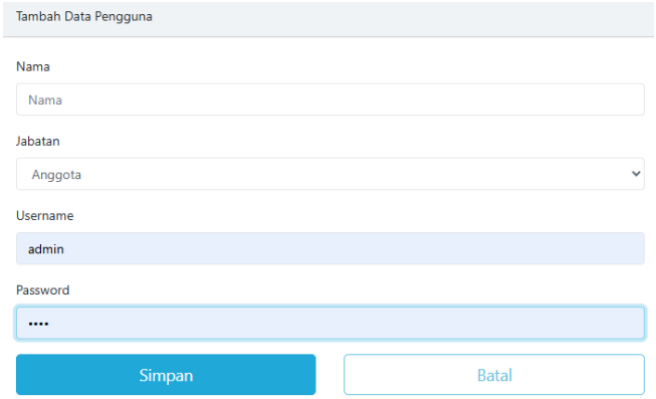

Fig. 6. User Data Input Form

Department Registration Form
This form is used by administrators or teachers to enter and manage data on the majors available at vocational schools, so that the system can recognize alternative choices to be calculated using the SAW method.

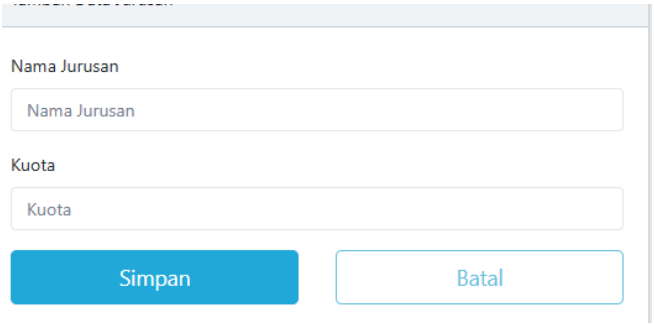

Fig. 7. Department Registration Form

Criteria Input Form
This form is used by administrators or system managers to enter and set the criteria that will be used in departmental assessments. Since the SAW method is based on criteria and weights, the criteria data must be available before the system can perform calculations.

Fig. 8. Criteria Input Form

Participant data input form
This form is used to enter student data that will be processed by the system. Participant data forms the basis for creating a decision matrix, as it contains student identities along with their academic grades and interests.

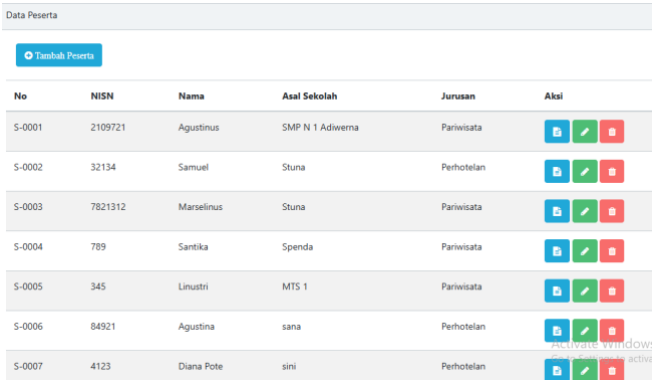

Fig. 9. Participant Data Input Form

Participant Score Input Form
This form is used by teachers or administrators to enter participants'/students' academic scores. This data is very important because it forms one of the bases for SAW calculations, along with interest data.

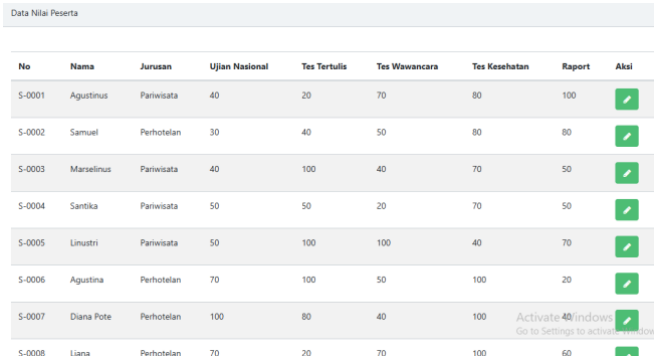

Fig. 10. Participant Score Input Form

Normalization by Department

Normalization in the SAW method is the process of converting alternative values for each criterion to a scale of 0–1 so that the values of benefits and costs can be compared.

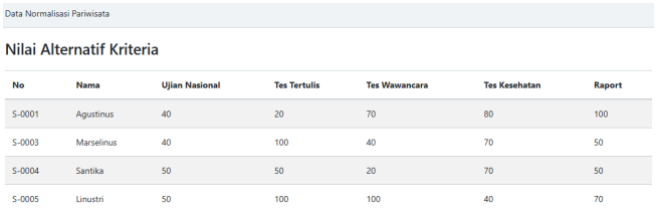

Fig. 11. Normalization by Department

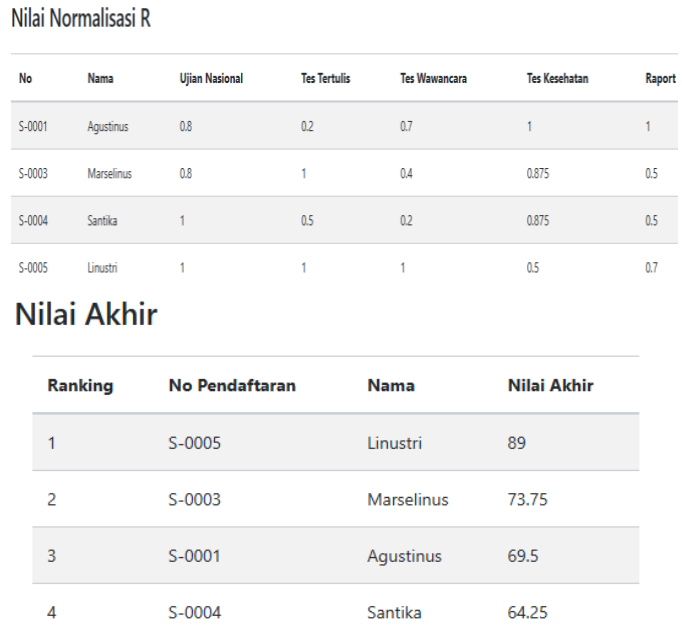

Fig. 12. Normalization by Department

Test Scenario

To ensure that the system can calculate, normalize, and provide accurate, fast, and objective recommendations for students' majors based on their academic grades and interests.

TABLE V. TEST SCENARIO

Testing	Hope
Users (admin/teachers) input participant data, department data, criteria, weightings, and student scores.	The data is stored correctly, there are no errors, and it can be used in SAW calculations.
The system calculates normalization for each criterion (benefit/cost).	The normalized result values are on a scale of 0–1 according to the SAW formula.
The system multiplies the normalization results by the criteria weights.	Weights are applied according to the provisions, and the total Vi score is accurate.
The system determines majors based on the highest SAW scores.	Recommended majors based on manual calculations (cross-check).
The user entered blank data or an incorrect format (for example, a value > 100).	The system rejects the input and displays an error message.

IV. CONCLUSION

The following are the conclusions of the major selection decision support system using the SAW method.

1. The selection of majors in high school, which is usually still done manually, risks causing errors, delays, and a lack of objectivity.
2. The SAW (Simple Additive Weighting) method can be used to determine the best major because it calculates academic grades and interests in a measurable way.
3. Normalization is necessary so that the values of each criterion are on the same scale (0–1), making them fair to compare.
4. The final result is obtained by multiplying the normalized values by the criterion weights and then adding them together.
5. The major with the highest score is the best recommendation for students, resulting in faster, more accurate, and more objective decisions.

ACKNOWLEDGMENT

The author would like to express his gratitude to God Almighty for His blessings and grace, which enabled him to complete this report. The author would also like to express his deepest gratitude to all those who have provided support, assistance, and prayers during the preparation of this report. The author would like to express special thanks to the school, the supervising lecturer, colleagues, and family who have always provided encouragement and motivation. May all the help and support that has been given be rewarded by God Almighty.

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