GENERATION JOURNAL
Vol. 10 No. 1 2026
e-ISSN: 2549-2233 / p-ISSN: 2580-4952
DOI : https://doi.org/10.29407/gj.v10i1.26553

Decision Support System For Determining The Major Of New Students At SMKS Sunan Drajat Sugio Using The Method SAW *(Simple Additive Weighting)*

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Article Info

Received	2025-07-25
Revised	2026-01-10
Accepted	2026-01-12

Keywords **:** *Decision Support System; SAW; Major Selection; Vocational School; Accuracy.*

Abstract

Determining majors for new students at vocational schools is an important process that can affect student achievement and future prospects. However, this process is often still carried out manually and is not very objective, which can potentially lead to a mismatch between the chosen major and the potential and interests of the students. Therefore, a system is needed that can help schools determine majors more accurately, efficiently, and based on data. This study aims to design a Decision Support System (DSS) for determining the majors of new students at SMKS Sunan Drajat Sugio using the Simple Additive Weighting (SAW) method. The SAW method was chosen because of the ease of calculation and its ability to process multi-criteria data to produce systematic decisions. The criteria used in this system include report card averages, basic competency test results, and student interests. This system is web-based with a user-friendly interface. Testing was conducted using 65 new student data for the 2024/2025 academic year by comparing the system's calculation results with manual calculations using the SAW method that had been validated by the school. The test results showed a 100.0% match between the system results and manual calculations, indicating that the system is capable of implementing the SAW method accurately and consistently. Thus, the developed system can be used as a tool to assist

INTRODUCTION

Vocational high schools (SMK) are formal educational institutions that prepare students to enter the workforce with vocational skills. One important aspect of SMK education is the process of determining majors for new students, as this decision can influence students' future career paths and academic success [1]. However, in practice, the process of determining majors in various schools, including SMKS Sunan Drajat Sugio, is still done manually. This situation causes a number of problems, such as the length of the selection process and the potential mismatch between the chosen major and the students' abilities and interests. Mistakes in major placement can have a negative impact on students' motivation to learn and academic achievement [1].

To overcome these problems, an information technology-based system is needed to help schools make decisions more quickly, objectively, and accurately. A Decision Support System (DSS) is one appropriate solution. Decision support systems can help decision makers improve the effectiveness of their work [2], [3], [4]. DSS has several stages, including problem definition and collection of relevant data to be processed into information in the form of text or graphics to determine solutions [5], [6]. One method commonly used in DSS is the Simple Additive Weighting (SAW) method because of its ease in calculating preference values from a number of alternatives based on various criteria [7], [8].

Previous studies have shown that the SAW method has a good level of efficiency in various decision-making contexts. For example, the SAW method was used to help companies determine employee bonuses objectively and transparently [9]. Another study designed a web-based DSS system

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using the SAW method for selecting intern candidates at PT JIAEC, which proved to be able to increase the efficiency of the selection process and reduce human error [10]. In addition, the SAW method was also applied in the selection of extracurricular activities based on interests and talents at SMK Taruna Satria, with results showing an increase in efficiency and accuracy of decisions [11]. Research in the context of determining majors at the high school and vocational school levels also shows that the SAW method is capable of providing accurate recommendations that are easy for users to use [12], [13].

Based on these various studies, it can be concluded that the SAW method excels in terms of process speed and accuracy when compared to other methods, such as Weighted Product and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) [14]. These advantages are the main reasons for choosing the SAW method in this study. This study aims to design and implement a web-based decision support system for determining the majors of new students at SMKS Sunan Drajat Sugio using the SAW method. This system considers three main criteria, namely report card scores, basic competency test results, and student interests. With this system, it is hoped that the process of determining majors can be carried out more objectively, quickly, and accurately, as well as improve the overall quality of vocational education.

RESEARCH METHOD

This study uses a quantitative approach focused on developing a decision support system for determining the majors of new students at SMKS Sunan Drajat Sugio. This approach was chosen to measure and analyze numerical data objectively in order to produce major determination recommendations based on mathematical methods. The initial stage of the research began with a system requirements analysis through interviews with guidance and counseling teachers and school officials, accompanied by a theoretical review of previous research [7]. Based on the results of this analysis, three main criteria were identified for determining majors, namely average report card scores, basic skills test results, and students' interests in certain majors.

2.1 System Architecture

The system was designed using a web-based architecture so that it can be accessed flexibly by users, both from the school and students. The system was developed using the Next.js framework on the frontend and Prisma ORM for MySQL database management. Based on research [15], Next.js was chosen as the main framework because of its ability to provide server-side rendering (SSR) and deliver a fast and responsive user experience. Tailwind CSS was used to produce a modern and efficient interface design, making it easier for developers to apply styles consistently. This system was developed with two main interfaces, which are described in Figure 1.

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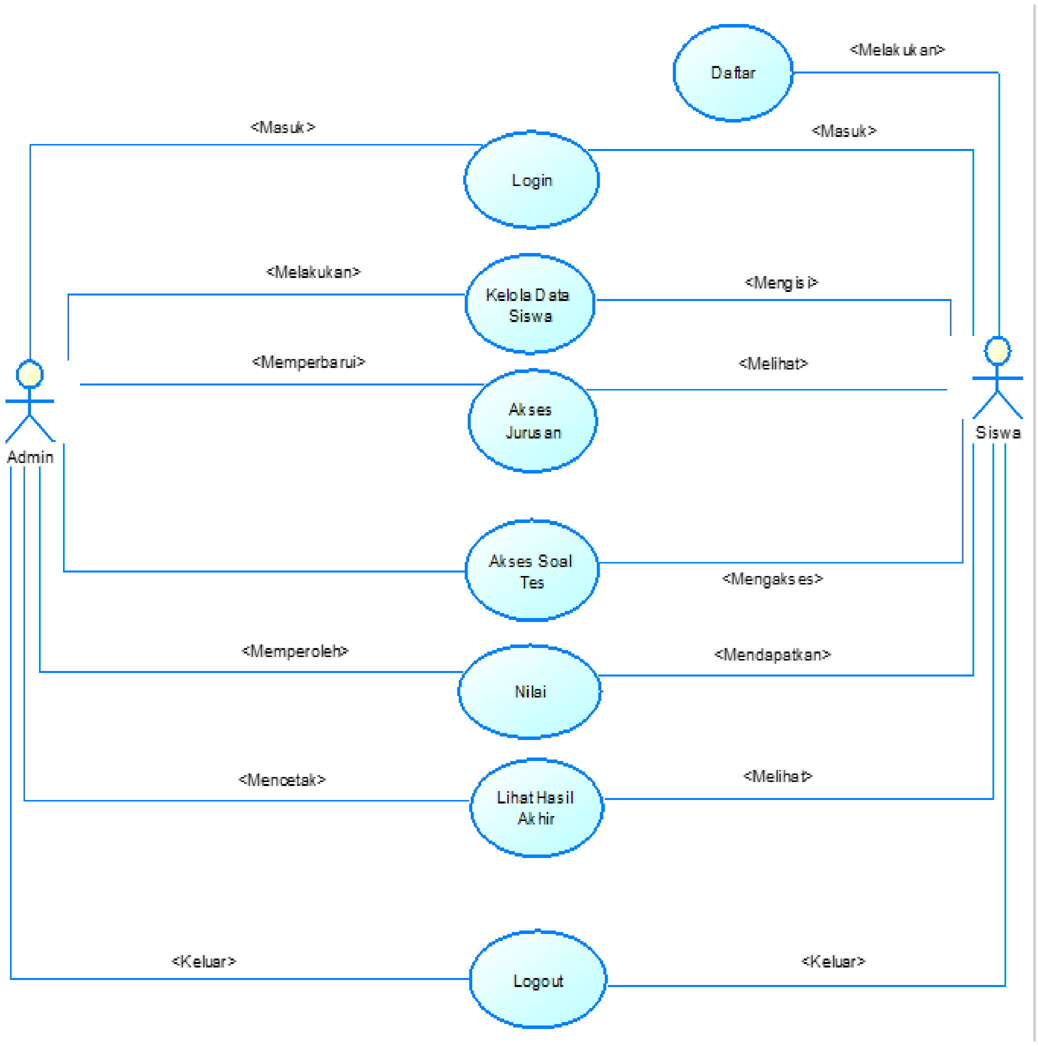

Figure 1. Use Case Diagram of the Decision Support System

Figure 1 illustrates the mapping of functionality between administrators and users. The figure illustrates the student data management system and the determination of results based on criteria involving two main actors, namely Admin and Students. Admin has primary responsibilities, including logging in, managing student data, editing and accessing department data, and viewing and printing final results. In addition, Admin can perform various data processing tasks that support decision making.

On the other hand, Students can register on the system, log in, access the list of majors, take tests, view final results, and log out of the system. The diagram shows the relationship between use cases to ensure that the system runs according to the needs of each actor. Meanwhile, the overall workflow of the system will be explained in Figure 2.

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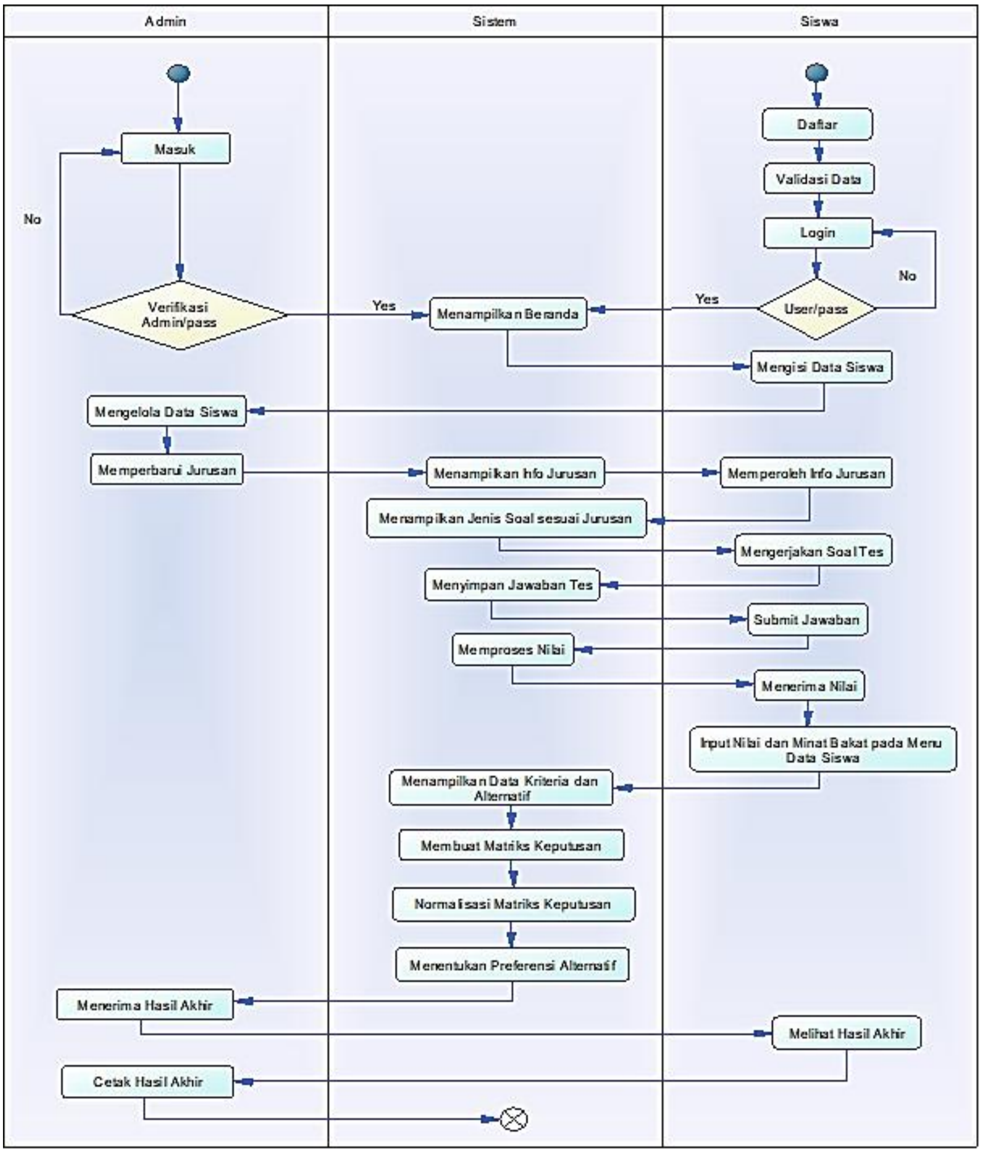

Figure 2. Decision Support System Activity Diagram

Figure 2 illustrates the process flow for determining the majors of new students, which involves three main components: students, administrators, and the system. Students begin the process by registering, validating their data, and then logging into the system. After successfully logging in, students fill in their personal data, grades, and interests, then complete a basic skills test. The answers submitted are processed by the system to generate scores.

On the other hand, administrators first go through a verification process, then manage student data and available major data. Once the data is complete, the system displays the criteria and alternatives, creates a decision matrix, performs normalization, and determines the preferences of each alternative based on the student's scores and interests. This process helps in selecting the most suitable major. The final results can be viewed by students and administrators. Administrators also have the option to print the final results as a report. This diagram illustrates a decision support system designed to help students choose a major objectively and based on data.

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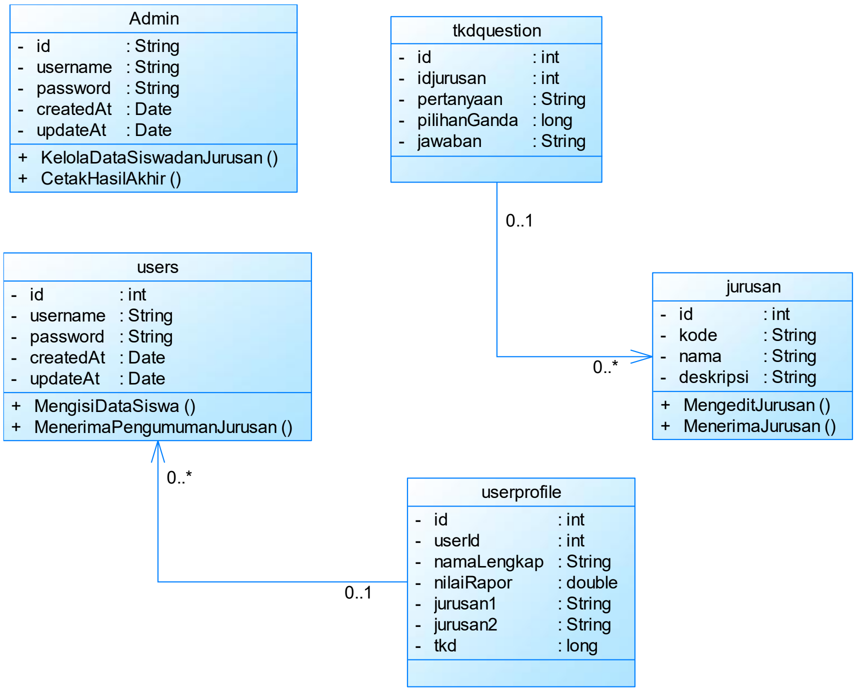

Figure 3. Decision Support System Class Diagram

Figure 3 illustrates the database structure modeling and interclass relationships in the SAW-based major determination system. This diagram consists of six main classes, namely Admin, Users, UserProfile, Major, TKDQuestion, and the interclass relationships. The Admin and Users classes each have attributes such as id, username, and password, as well as functions to manage data and print final results (Admin) or fill in data and receive announcements (Users). The UserProfile class stores students' personal data, including report card scores, chosen majors, and basic competency test results.

The relationships between classes show the functional links between entities. For example, one User has one UserProfile, while one Major can have many TKDQuestions. The Major class stores information such as the name and description of the major, while TKDQuestion stores basic competency test questions associated with a particular major. Each class uses data types according to its function, such as String for text, int for integers, and Date for timestamps. This diagram helps illustrate the database design and functional logic of the system in a structured manner.

Student data such as report card scores, test results, and interests are entered into the system, then processed using the Simple Additive Weighting (SAW) method to calculate the preference for each department based on predetermined weights. The highest score from the calculation becomes the top recommendation.

2.2. Simple Additive Weighting (SAW) Method

The Simple Additive Weighting (SAW) method is applied as the main algorithm in decision making. SAW is a decision support system method that calculates the preference score for each alternative by adding the results of multiplying the normalization value and the weight of each criterion. The process begins with the preparation of a decision matrix based on student data, followed by normalization according to the attribute type (benefit or cost), and then the final preference value is calculated to determine the most suitable major. Criteria weights were obtained through theories in previous studies [7], [14] and discussions between researchers and relevant parties at SMKS Sunan Drajat Sugio as a result of consideration of assessment priorities for academic grades and student interests.

The SAW steps in this study are:

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1. Determining alternatives

Table 1. Alternatives

Code	Alternative
A1	Computer Network and Telecommunications Engineering (TJKT)
A2	A2 Visual Communication Design (DKV)
A3	A3 Motorcycle Engineering (TSM)

Table 1 explains the possibilities of two or more choices that will become goals.

2. Determine the criteria that will be used as a reference in decision making and determine the weight of preference or level of importance of each criterion.

Table 2. Criteria Weights

Code	Criteria Name	Weight	Simplification	Attribute
C1	Student Interest	25%	0,25	Benefit
C2	Average Report Card Score	15%	0,15	Benefit
C3	TJKT Ability Test Results	20%	0,20	Benefit
C4	DKV Ability Test Results	20%	0,20	Benefit
C5	TSM Ability Test Results	20%	0,20	Benefit
	Total	100%	1,0	

Table 2 explains the weighting of each criterion, which was obtained through research theory (Juansen et al., 2020) and discussions between researchers and relevant parties at SMKS Sunan Drajat Sugio. In data processing, students who did not take the basic skills test were given a score of 0 for that criterion in accordance with school policy, so that the system could still perform calculations without estimating scores that could potentially lead to inaccurate results.

The criteria weights were determined through expert judgment based on discussions with guidance counselors and school officials, taking into account the level of importance of each criterion in determining majors. These weights were then used in the Simple Additive Weighting (SAW) method calculation.

3. Determining the Suitability Score for each criterion.
4. Creating a decision matrix (X) obtained from the suitability rating for each alternative (Ai) with each criterion (Cj).
5. The next stage in the Simple Additive Weighting (SAW) method is to normalize the decision matrix X. Normalization is done to equalize the value scale between criteria so that they can be compared fairly. The normalized performance rating value r_ij of alternative A_i on criterion C_j is calculated using the following equation.

$$r_{ij} = \frac{x_{ij}}{\max(x_{ij})}, if\ C_j \text{ is an attribute of benefit} \qquad \text{.................. (1)}$$

6. The results of calculating the r_ij values then form a normalized matrix R, which can be expressed as follows:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1j} \\ r_{21} & r_{22} & \cdots & r_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ r_{i1} & r_{i2} & \cdots & r_{ij} \end{bmatrix} \qquad \text{............... (2)}$$

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7. After the normalized matrix is obtained, the final preference value V_i for each alternative is calculated by summing the results of multiplying the normalized values and the weights of each criterion. The preference value equation is shown in the following equation:

$$V_i = \sum_{j=1}^{n} w_j \times r_{ij} \quad \text{.......................... (3)}$$

Explanation:
x_ij : the i-th alternative value in the j-th criterion
r_ij : normalized value
w_j : weight of the j-th criterion
n : number of criteria
i : alternative (major)
j : assessment criterion

8. The alternative with the highest preference value V_i is selected as the best solution and recommended as the most suitable major.

2.3 Implementation

The system was implemented using data from 65 tenth-grade students from the 2024/2025 academic year. The data entered included report card averages, major test results (based on weighted questions), and students' chosen interests.

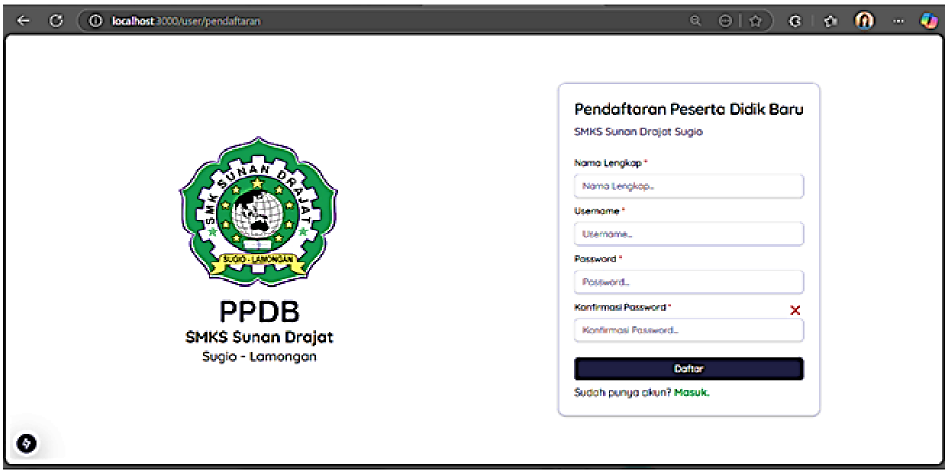

Figure 4. Account Registration and User Login Page

Figure 4 shows the account registration page for prospective new students in the SMKS Sunan Drajat Sugio PPDB system. This form is used to create a new account before continuing with the registration process.

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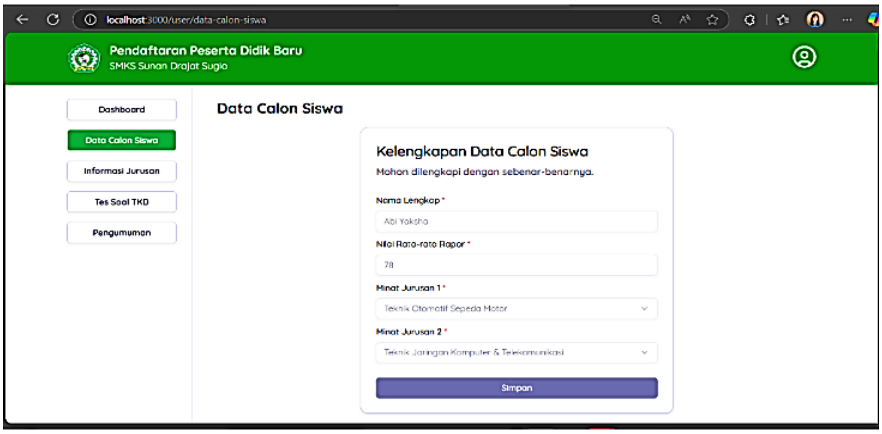

Figure 5. Prospective Student Data Page

Figure 5 illustrates the data entry page for prospective students of SMKS Sunan Drajat Sugio, which contains forms for filling in names, report card averages, and first and second choice majors.

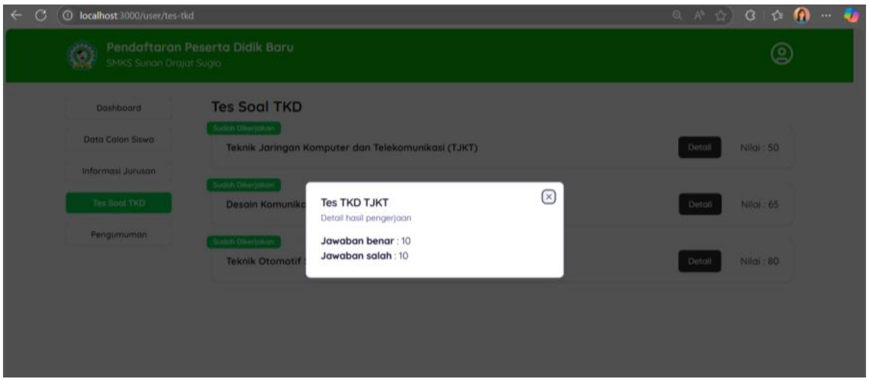

Figure 6. Basic User Competency Test Questions

Figure 6 shows the Basic Competency Test page at SMKS Sunan Drajat Sugio that prospective students will complete. After completing the test, the system automatically displays a summary of the number of correct and incorrect answers, so that students can immediately see the preliminary results of the test. This feature facilitates self-evaluation and increases transparency in the selection process.

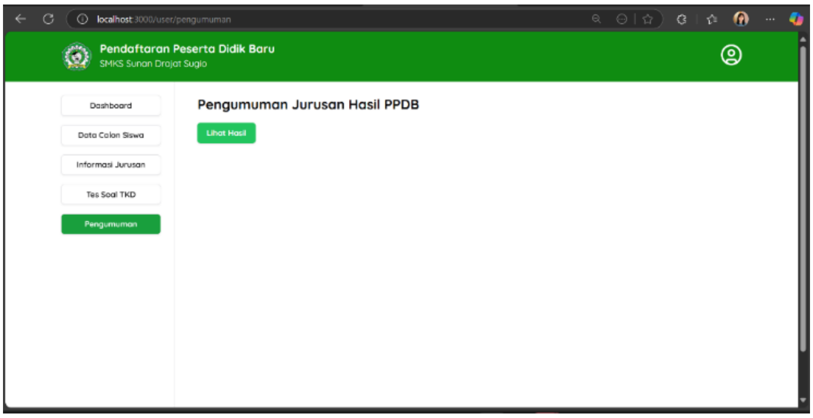

Figure 7. User Department Announcement Results Page

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Figure 7 shows the PPDB results announcement page at SMKS Sunan Drajat Sugio with a "See Results" button to view the accepted departments. This page is the result of system calculations using the SAW method.

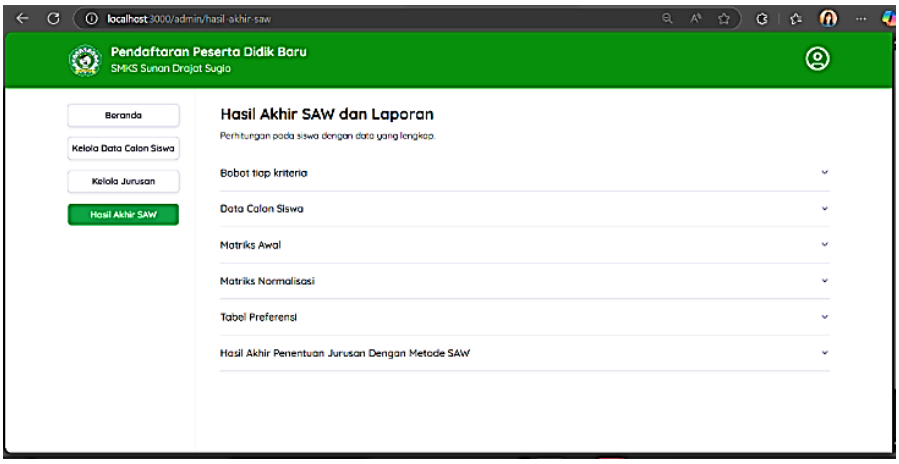

Figure 8. SAW Final Results and Admin Report Page

Figure 8 is the "Final SAW Results and Report" page on the SMKS Sunan Drajat Sugio PPDB system. This page contains a dropdown menu that includes important components in the SAW method calculation process, such as criteria weights, prospective student data, initial matrix, normalization matrix, preference table, and final department determination results. This display shows that the system uses a structured approach in determining the majors of new students.

RESULTS AND DISCUSSION

System testing was conducted to evaluate the performance of the Simple Additive Weighting (SAW) method in determining the majors of new students at SMKS Sunan Drajat Sugio. The data used consisted of 65 new students for the 2024/2025 academic year. For the purposes of explaining the calculations, five sample student data sets were calculated manually using the SAW method.

Table 3. Manual Calculation Sample Data for Prospective Students

No	Student Name	Average Report Card Score	Student Interests		Basic Ability Test		
			Choice 1	Choice 2	TJKT	DKV	TSM
1	Abi Yaksha	78	TSM	TJKT	50	65	80
2	Abi Yamcha	80	TSM	TJKT	50	70	80
3	Achmad Aditya F.	74	TSM	TJKT	35	60	75
4	Aditya Vicky A.	88	TJKT	DKV	80	80	70
5	Salman Al Farizi	79	TSM	TJKT	95	60	0

Table 3 presents five sample data of prospective students used in manual calculations, including report card averages, major preferences (first and second choices), and basic competency test results for each major (TJKT, DKV, and TSM). This data is used to verify the accuracy of the system's calculations with manual calculations.

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Table 4. Student Interest Criteria Matching Values

No	Student Interests	Score
1	Choice 1	5
2	Choice 2	3
3	Not choosing	1

The assessment of student interest criteria is shown in Table 4, where the first choice is given the highest weight (value 5), the second choice is given a value of 3, and not choosing is given a value of 1. This scheme represents the priority level of student interests in the major selection process.

Table 5. Average Report Card Score Criteria Matching Values

No	Average Report Card Score	Value
1	≥ 90	5
2	80-89	4
3	70-79	3
4	<70	2
5	Null/0	1

Table 5 shows the compatibility values for the report card average score criterion, where the highest value is given to students with an average score of ≥ 90 (value 5), and the lowest value (1) is given to students who do not have score data or have a score of 0, thus reflecting the academic weight in determining majors. This approach aims to simplify the normalization process and ensure consistency between criteria.

Table 6. Compatibility Values for TJKT Ability Test Results Criteria

No	TJKT Ability Test Scores	Value
1	≥ 90	5
2	80-89	4
3	70-79	3
4	<70	2
5	tidak ada/0	1

Table 6 shows the compatibility scores for the TJKT ability test results criteria, where scores ≥ 90 receive the highest score (5), while no score or a score of 0 receives the lowest score (1), reflecting the level of mastery of Computer Network and Telecommunications Technology material by students.

Table 7. Compatibility Scores for DKV Ability Test Results Criteria

No	DKV Ability Test Scores	Value
1	≥ 90	5
2	80-89	4
3	70-79	3
4	<70	2
5	none/0	1

Table 7 shows the compatibility scores for the DKV competency test result criteria, where the highest score (5) is given for scores ≥ 90 and the lowest score (1) is given for scores of 0 or no score, which is used to assess the extent of students' abilities in the field of Visual Communication Design.

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Table 8. Compatibility Scores for TSM Competency Test Result Criteria

No	TSM Ability Test Scores	Nilai
1	≥ 90	5
2	80-89	4
3	70-79	3
4	<70	2
5	tidak ada/0	1

Table 8 shows the compatibility scores for the TSM test result criteria, where scores ≥ 90 receive the highest score (5) and scores of 0 or none receive the lowest score (1), as the basis for assessing students' abilities in the field of Motorcycle Engineering. Figure 2. Standards, Quality, and Rankings.

Create a decision matrix obtained from the suitability rating for each alternative with each criterion by creating a 3x5 matrix:

a. Abi Yaksha

$$X = \begin{pmatrix} 3 & 3 & 2 & 1 & 1 \\ 1 & 3 & 1 & 2 & 1 \\ 5 & 3 & 1 & 1 & 4 \end{pmatrix}$$

b. Abi Yamcha

$$X = \begin{pmatrix} 3 & 4 & 2 & 1 & 1 \\ 1 & 4 & 1 & 3 & 1 \\ 5 & 4 & 1 & 1 & 4 \end{pmatrix}$$

c. Achmad Aditya F.

$$X = \begin{pmatrix} 3 & 3 & 2 & 1 & 1 \\ 1 & 3 & 1 & 2 & 1 \\ 5 & 3 & 1 & 1 & 3 \end{pmatrix}$$

d. Aditya Vicky A.

$$X = \begin{pmatrix} 5 & 4 & 4 & 1 & 1 \\ 3 & 4 & 1 & 4 & 1 \\ 1 & 4 & 1 & 1 & 3 \end{pmatrix}$$

e. Salman Al Farizi

$$X = \begin{pmatrix} 3 & 3 & 5 & 1 & 1 \\ 1 & 3 & 1 & 2 & 1 \\ 5 & 3 & 1 & 1 & 1 \end{pmatrix}$$

Normalization Matrix based on equations adjusted to the type of attributes that have been determined Based on the suitability value of each criterion, a decision matrix is formed for each alternative major. The matrix is then normalized using the benefit attribute, where a higher value indicates a higher level of suitability.

a. Abi Yaksha

$$R = \begin{pmatrix} 0{,}6 & 1 & 1 & 0{,}5 & 0{,}25 \\ 0{,}2 & 1 & 0{,}5 & 1 & 0{,}25 \\ 1 & 1 & 0{,}5 & 0{,}5 & 1 \end{pmatrix}$$

b. Abi Yamcha

$$R = \begin{pmatrix} 0{,}6 & 1 & 1 & 0{,}33 & 0{,}25 \\ 0{,}2 & 1 & 0{,}5 & 1 & 0{,}25 \\ 1 & 1 & 0{,}5 & 0{,}33 & 1 \end{pmatrix}$$

c. Achmad Aditya F.

$$R = \begin{pmatrix} 0{,}6 & 1 & 1 & 0{,}5 & 0{,}33 \\ 0{,}2 & 1 & 0{,}5 & 1 & 0{,}33 \\ 1 & 1 & 0{,}5 & 0{,}5 & 1 \end{pmatrix}$$

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d. Aditya Vicky A.

$$R = \begin{pmatrix} 1 & 1 & 1 & 0{,}25 & 0{,}33 \\ 0{,}6 & 1 & 0{,}25 & 1 & 0{,}33 \\ 0{,}2 & 1 & 0{,}25 & 0{,}25 & 1 \end{pmatrix}$$

e. Salman Al Farizi

$$R = \begin{pmatrix} 0{,}6 & 1 & 1 & 0{,}5 & 1 \\ 0{,}2 & 1 & 0{,}2 & 1 & 1 \\ 1 & 1 & 0{,}2 & 0{,}5 & 1 \end{pmatrix}$$

The final preference results obtained from the summation of the normalized matrix multiplication:

a. Abi Yaksha
A1: (0,25*0,6) +(0,15*1) +(0,20*1) +(0,20*0,5) +(0,20*0,25) = 0,65
A2: (0,25*0,2) +(0,15*1) +(0,20*0,5) +(0,20*1) +(0,20*0,25) = 0,55
A3: (0,25*1) +(0,15*1) +(0,20*0,5) +(0,20*0,5) +(0,20*1) = 0,8

b. Abi Yamcha
A1: (0,25*0,6) +(0,15*1) +(0,20*1) +(0,20*0,33) +(0,20*0,25) = 0,616
A2: (0,25*0,2) +(0,15*1) +(0,20*0,5) +(0,20*1) +(0,20*0,25) = 0,55
A3: (0,25*1) +(0,15*1) +(0,20*0,5) +(0,20*0,33) +(0,20*1) = 0,766

c. Achmad Aditya F.
A1: (0,25*0,6) +(0,15*1) +(0,20*1) +(0,20*0,5) +(0,20*0,33) = 0,666
A2: (0,25*0,2) +(0,15*1) +(0,20*0,5) +(0,20*1) +(0,20*0,33) = 0,566
A3: (0,25*1) +(0,15*1) +(0,20*0,5) +(0,20*0,5) +(0,20*1) = 0,8

d. Aditya Vicky A.
A1: (0,25*1) +(0,15*1) +(0,20*1) +(0,20*0,25) +(0,20*0,33) = 0,716
A2: (0,25*0,6) +(0,15*1) +(0,20*0,25) +(0,20*1) +(0,20*0,33) = 0,616
A3: (0,25*0,2) +(0,15*1) +(0,20*0,25) +(0,20*0,25) +(0,20*1) = 0,5

e. Salman Al Farizi
A1: (0,25*0,6) +(0,15*1) +(0,20*1) +(0,20*0,5) +(0,20*1) = 0,8
A2: (0,25*0,2) +(0,15*1) +(0,20*0,2) +(0,20*1) +(0,20*1) = 0,64
A3: (0,25*1) +(0,15*1) +(0,20*0,2) +(0,20*0,5) +(0,20*1) = 0,74

Table 9. Ranking of the highest final results

No.	Student Name	Selected Major	Alternative Code	Choice Number	Remarks
1	Abi Yaksha	TSM	A3	1	As per Option 1
2	Abi Yamcha	TSM	A3	1	As per Option 1
3	Achmad Aditya F.	TSM	A3	1	As per Option 1
4	Aditya Vicky A.	TJKT	A1	1	As per Option 1
5	Salman Al Farizi	TJKT	A1	2	As per Option 2

The final ranking results are shown in Table 9. Of the five student samples, four students were recommended to enter the major according to their first choice, while one student was recommended to enter their second choice major. This shows that the SAW method not only considers student preferences but also prioritizes objective assessment results based on all the criteria used. The following is a visualization of preference values and major rankings based on SAW results for 5 students:

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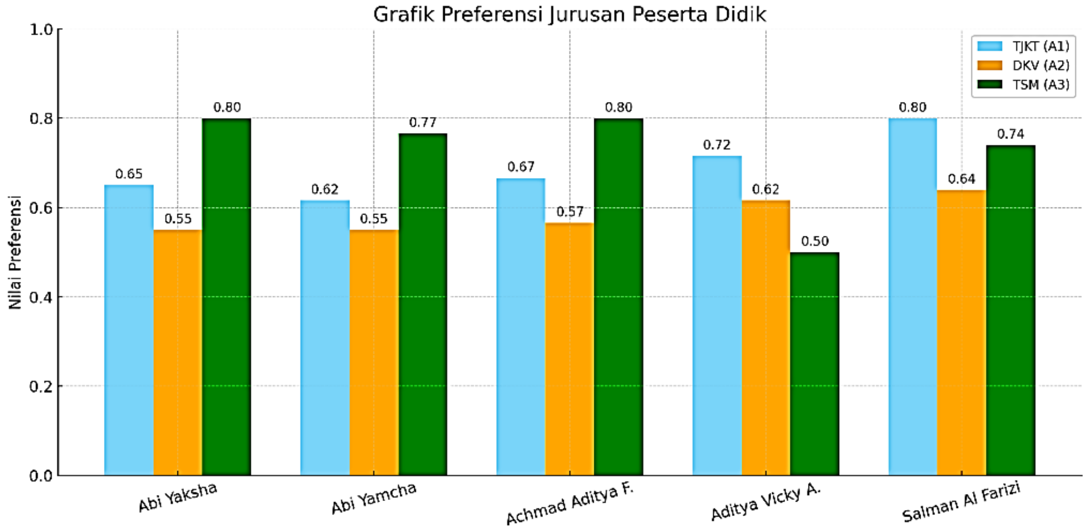

Figure 9. Bar Chart of Major Preference Values

The visualization of preference values and major rankings for the five sample students is shown in Figure 9. The graph shows a comparison of preference scores between majors (TJKT, DKV, and TSM) for each student, facilitating analysis of the ranking results.

System performance evaluation was conducted by comparing the system's calculation results with the manual SAW method calculation results for all student data. This comparison aimed to validate the suitability of the algorithm implementation in the system.

The test results show that all system calculation results are fully consistent with the manual SAW calculations, so that the calculation consistency rate reaches 100% (65 out of 65 data). Thus, this test can be categorized as functional validation and algorithm calculation validation, not as a measurement of predictive accuracy against external data.

To determine the quantitative performance of the system, accuracy testing was carried out based on the following formula:

$$Accuracy = \frac{Valid\ Data}{Number\ of\ Sample\ Data} X\ 100\% \qquad \text{.................... (4)}$$

Therefore, the accuracy value obtained is:

$$Accuracy = \frac{65}{65} X\ 100\% = 100{,}0\%$$

CONCLUSION

From the results of the research conducted, the following conclusions can be drawn:

1. The implementation of the Simple Additive Weighting (SAW) method in a web-based decision support system can assist in the process of determining the majors of new students at SMKS Sunan Drajat Sugio in an objective and systematic manner. The system can process multi-criteria data in the form of report card averages, basic competency test results, and student interests to produce major recommendations based on the data entered.
2. Testing the system using 65 student data for the 2024/2025 academic year showed a 100.0% level of conformity between the system's calculation results and manual calculations using the SAW method. These results indicate that the system successfully implemented the SAW method accurately and consistently in the context of the research data used.

Vol. 10 No. 1 2026
e-ISSN: 2549-2233 / p-ISSN: 2580-4952
DOI : https://doi.org/10.29407/gj.v10i1.26553

3. The advantages of the developed system lie in its ease of use, flexibility in setting criteria weights, and consistency of calculation results. However, the system still has limitations in the number of criteria used and does not consider qualitative factors such as student personality and motivation.
4. For further development, the system can be improved by adding a variety of criteria, automatically integrating school databases, and developing more adaptive analysis methods to support more comprehensive decision making.

SUGGESTIONS

Based on the results of the study, the following recommendations can be made:

1. Future studies should add qualitative assessment criteria, such as personality aspects, deep interests, and student motivation to learn, in order to produce more comprehensive major recommendations.
2. It is necessary to develop a system with other supporting methods, such as fuzzy logic or machine learning, to handle data uncertainty and improve accuracy in the decision-making process.
3. Future research is advised to conduct a long-term evaluation of the results of major determination to measure the success rate of the system in placing students in majors that match their academic achievements and interests.
4. For further development, it is recommended that a usability test be conducted using the System Usability Scale (SUS) method to assess the ease of use of the system from the perspective of school users. For example, the system is expected to obtain a SUS score above 70, which indicates a "good" category, so that the evaluation results can be used as a basis for improving the interface and functions of the system.

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