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A Web-Based Decision Support System for Determining High-Achieving Students Using The Simple Additive Weighting Method at SMK Kanisius Ungaran

Cesillia Ayu Kumala Sari[1], Yoannes Romando Sipayung[2]
[1,2] Informatics Engineering, Ngudi Waluyo University, Semarang, Indonesia
e-mail: acesillia@gmail.com[1], yoannesromando@unw.ac.id[2]
*Correspondence: *acesillia@gmail.com*

Abstract: *This study develops a web-based Decision Support System (DSS) to assist in determining academically high-achieving students at SMK Kanisius Ungaran. The current evaluation process in the school relies largely on manual assessment, which can make the management of multiple evaluation criteria time-consuming and difficult to organize systematically. To support a more structured evaluation process, this research applies the Simple Additive Weighting (SAW) method as a multi-criteria decision-making approach. Four assessment criteria were used in the system: report card average scores, school examination results, non-academic achievements, and attendance. Each criterion was assigned a weight based on institutional priorities. The system was implemented as a web application using Next.js and React.js for the front-end interface, while Supabase with PostgreSQL was used for data storage and management. The SAW procedure integrated into the system includes score normalization, weighted aggregation, and the generation of ranking results for students. A sample dataset consisting of five student alternatives was used to demonstrate the calculation process and system functionality. The results show that the system can process student evaluation data and generate ranking outputs based on the predefined criteria and weights. In the calculation example, the highest-ranked student obtained a final score of 0.9902. The developed system demonstrates how the SAW method can be operationalized within a web-based platform to support the organization and processing of multi-criteria student evaluation data. The study primarily contributes a practical implementation of a DSS for academic assessment in vocational secondary education contexts.*

Keywords: *Decision Support System, Simple Additive Weighting, Student Achievement, Web-Based System, Vocational High School.*

1. Introduction

The development of information technology has induced significant transformations across various sectors, including education, particularly in the optimization of academic assessment systems. Educational institutions are required to adopt evaluation mechanisms that are not only objective and transparent but also operationally efficient [1]. One of the crucial processes in academic management is the determination of high-achieving students, which directly affects reward mechanisms, learning motivation, and comprehensive evaluations of learning quality [2]. However, practical implementation shows that this process is still dominated by manual methods that are prone to subjectivity, resulting in decisions that do not accurately reflect students' actual competencies.

A fundamental issue faced by educational institutions, including SMK Kanisius Ungaran, is the multicriteria nature of the assessment process itself. Decisions must be based on various variables, including academic performance, attendance, discipline, and active participation in school activities. The absence of a structured decision-support framework increases the risk of inconsistency and bias in assessment outcomes [3]. As a solution, the implementation of a Decision Support System (DSS) becomes essential to systematically process data and generate accurate and objective outputs.

The evaluation of student achievement is an essential component of academic management in educational institutions because it influences reward systems, student motivation, and institutional performance assessment. In many schools, including vocational high schools, the identification of high-achieving students involves multiple evaluation criteria such as academic performance, attendance, and participation in extracurricular activities. Managing these criteria simultaneously can be challenging when the evaluation process is conducted manually, as it requires systematic comparison of multiple indicators for each student.

This study adopts the Simple Additive Weighting (SAW) method as the core of the DSS. SAW, which is part of the Multi-Criteria Decision Making (MCDM) framework, operates by calculating weighted sums of performance ratings for each predetermined criterion [4]. This method was selected due to its advantages in ease of implementation, computational efficiency, and its ability to generate consistent decision rankings [5]. Numerous previous studies have confirmed the validity of the SAW method in providing more transparent and measurable assessments in educational contexts, particularly in identifying high-achieving students [6].

However, many existing studies primarily focus on the calculation model of the method itself, while limited attention is given to the integration of the method into practical information systems that can be used directly by school administrators in daily evaluation activities. In addition, implementation contexts may vary across institutions, requiring system designs that are adaptable to specific evaluation criteria and institutional needs.

To enhance effectiveness and accessibility, the system is designed using a web-based architecture. A web platform allows stakeholders to access data flexibly and accelerates the calculation process and reporting of evaluation results [7]. Therefore, the combination of the SAW methodology and a web-based platform is identified as a strategic solution to support the decision-making process at SMK Kanisius Ungaran.

Based on these considerations, this study aims to design and implement a web-based Decision Support System that applies the Simple Additive Weighting method to assist in determining high-achieving students at SMK Kanisius Ungaran. The system integrates the SAW calculation process with a web-based interface to support the input, processing, and presentation of student evaluation data. The study contributes by providing a practical implementation of a DSS that organizes multi-criteria student assessment data within a web-based system suitable for vocational secondary education environments.

2.Methods

This study employed a system development approach to design and implement a web-based Decision Support System (DSS) for determining academically high-achieving students at SMK Kanisius Ungaran. The system integrates the Simple Additive Weighting (SAW) method to support multi-criteria evaluation of student performance.

Student assessment data used in this study were obtained from academic records maintained by the school. The data include four evaluation criteria commonly used by the institution: (1) report card average score, (2) school examination score, (3) non-academic achievements, and (4) attendance. For demonstration and testing of the system functionality, a sample dataset consisting of five student alternatives was used. Each student record contains scores for the four criteria with values ranging from 0 to 100. Data collection was conducted through documentation of school academic records and consultation with teachers responsible for student evaluation. The data represent student performance during one academic evaluation period in the 2025/2026 school year.

The Simple Additive Weighting (SAW) method comprises several stages that are applied in this study to determine academically high-achieving students:

a. Defining the Objective, the initial stage involves defining the objective of the system, namely to identify academically high-achieving students based on relevant evaluation criteria.
b. Determining Criteria and Alternatives, the assessment criteria are established in collaboration with the school and include academic scores, attendance, discipline, and participation in school activities. The alternatives refer to the students who are considered as candidates for academic achievement evaluation.
c. Assigning Criteria Weights, each criterion is assigned a weight according to its level of importance in determining student achievement. For example, academic scores are given a higher weight compared to attendance or participation, thereby reflecting their central relevance to the evaluation objective.
d. Normalization of Scores, each student's score for every criterion is normalized to ensure all values lie on a comparable scale. Normalization is performed using the following formula:

$$r_{ij} = \frac{x_{ij}}{x_j^{\max}}$$

   where x_{ij} represents the score of student *i* on criterion j, and $x_j^{\max}$ denotes the maximum score obtained for that criterion.
e. Final Score Calculation (Aggregation), the final score for each student is computed by summing the products of normalized scores and their respective criteria weights:

$$V_i = \sum_{j=1}^{n} (\omega_j \times r_{ij})$$

f. Web-Based System Implementation, all SAW computational processes are integrated into a web-based system developed using JavaScript. This system enables teachers or evaluators to input student data, assign criteria weights, and automatically generate student rankings, thereby enhancing the efficiency, accuracy, and transparency of the evaluation process [8].

Simple Additive Weighting (SAW) Algorithm

The SAW algorithm in this study is used to illustrate the decision-making workflow for determining academically high-achieving students at SMK Kanisius Ungaran. This algorithm operates through a systematic sequence of steps, beginning with data input and concluding with the generation of the final student ranking. In general, the process starts with entering student performance data and the assessment criteria, followed by assigning weights and normalizing the values to ensure that all data are represented on a common scale. Subsequently, the system calculates the final (aggregated) score for each student based on the assigned criterion weights.

The calculated scores are then sorted to produce the final ranking, in which the student with the highest score is designated as the academically high-achieving student [8].

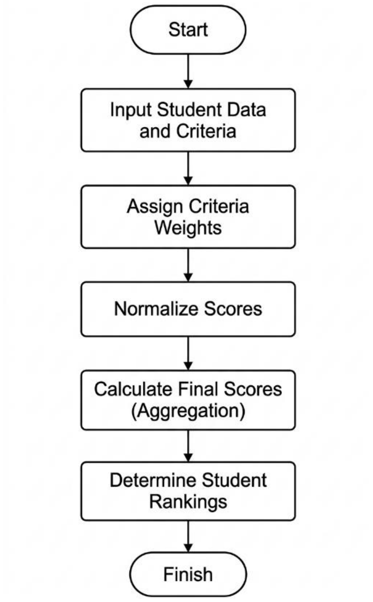

Figure 1. Flowchart of the SAW Usage Algorithm at Kanisius Ungaran Vocational School

Determination of Evaluation Criteria and Weights

The evaluation criteria were determined based on consultation with school administrators and teachers involved in the student assessment process. The selected criteria represent both academic and supporting indicators of student performance. The criteria used in the system are presented in Table 1.

Table 1. Assessment Criteria

Code	Criteria	Type	Weight
C1	Report Card Average Score	Benefit	0.40
C2	School Exam Scores	Benefit	0.30
C3	Non-Academic Achievements	Benefit	0.20
C4	Attendance	Benefit	0.10

The assigned weights reflect the relative importance of each criterion in determining student achievement according to the school's evaluation policy. Academic performance indicators are given higher weights because they represent the primary measure of student academic success.

System Implementation

The DSS was implemented as a web-based application to facilitate data input, processing, and visualization of student evaluation results. The system was developed using JavaScript with the Next.js framework and React.js library for the front-end interface. Supabase with PostgreSQL was used as the database platform to manage student data and store calculation results.

Through this system, teachers or administrators can input student data, assign assessment scores, perform SAW calculations automatically, and view the resulting rankings through tables and graphical visualizations.

3. Results and Discussion

Results

This decision-support system employs a web-based Simple Additive Weighting (SAW) method. It is designed to assist schools in selecting high-achieving students objectively, with assessments measured based on predetermined criteria. The system utilizes the SAW method as the underlying computational approach for evaluating student performance according to the established indicators.

The web application is developed using the Next.js and React.js frameworks, which provide high performance and streamlined system development. For student data storage and calculation results, the system integrates Supabase, a cloud-based Backend-as-a-Service (BaaS) platform built on PostgreSQL. The system performs SAW-based calculations to generate the total scores used to determine student rankings. The final output is presented in the form of bar charts and numerical scores.

System Objectives:

a. To assist the school in determining high-achieving students in an objective, measurable, and efficient manner.
b. To enhance transparency in the evaluation process through quantifiable methods.
c. To provide rapid and accurate calculation reports presented in clear and easily interpretable visual formats.

System Benefits

a. To facilitate the digital evaluation of student performance within the school environment.
b. To simplify the processing of student data without requiring time-consuming manual calculations.
c. To improve the efficiency of teachers and school staff in determining the final results of high-achieving students.

Table 2. Alternative Data

Alternative	Name
A1	Intan Kusuma
A2	Salsabila Nanda
A3	Vina Melinda
A4	Alif Nurhadi
A5	Xena Fitria
A6	Indah Permatasari
A7	Fitri Rahmawati
A8	Vera Susanti
A9	Zahra Amalia
A10	Dina Rosalia

The assigned weights reflect the relative importance of each criterion in determining student achievement according to the school's evaluation policy. Academic performance indicators are given higher weights because they represent the primary measure of student academic success.

Decision Matrix

The decision matrix presents the initial score of each student across the four criteria prior to normalization.

Table 3. Decision Matrix

Student Name	N1	N2	N3	N4
Intan Kusuma	0.978	1.000	1.000	0.990
Salsabila Nanda	0.989	0.967	1.000	0.980
Vina Melinda	1.000	0.978	0.955	0.990
Alif Nurhadi	0.989	0.978	0.966	1.000
Xena Fitria	0.989	0.978	0.966	0.990
Indah Permatasari	0.989	0.967	0.977	0.980
Fitri Rahmawati	0.967	0.946	0.909	0.969
Vera Susanti	0.967	0.946	0.898	0.969
Zahra Amalia	0.967	0.946	0.886	0.990
Dina Rosalia	0.946	0.924	0.830	0.990

SAW Normalization

All criteria used in this study are classified as *benefit criteria*, meaning that higher values indicate better performance. Normalization is carried out using the following formula:

a. x_{ij}= the score of student *i* on criterion *j*.

b. max (x_j)= the maximum score obtained for that criterion.

1. Alternative A1 with criteria C1 = 90, C2 = 92, C3 = 88, C4 = 97

$$R1 = \frac{90}{92} = 0.978 \quad R2 = \frac{92}{92} = 1.000 \quad R3 = \frac{88}{88} = 1.000 \quad R4 = \frac{97}{98} = 0.990$$

2. Alternative A2 with criteria C1 = 91, C2 = 89, C3 = 88, C4 = 96

$$R1 = \frac{91}{92} = 0.989 \quad R2 = \frac{89}{92} = 0.967 \quad R3 = \frac{88}{88} = 1.000 \quad R4 = \frac{96}{98} = 0.980$$

3. Alternative A3 with criteria C1 = 92, C2 = 90, C3 = 84, C4 = 97

$$R1 = \frac{91}{92} = 1.000 \quad R2 = \frac{89}{92} = 0.978 \quad R3 = \frac{88}{88} = 0.955 \quad R4 = \frac{96}{98} = 0.990$$

4. Alternative A4 with criteria C1 = 91, C2 = 90, C3 = 85, C4 = 98

$$R1 = \frac{91}{92} = 0.989 \quad R2 = \frac{90}{92} = 0.978 \quad R3 = \frac{85}{88} = 0.966 \quad R4 = \frac{98}{98} = 1.000$$

5. Alternative A5 with criteria C1= 91, C2 = 90, C3 = 85, C4 = 97

$$R1 = \frac{91}{92} = 0.989 \quad R2 = \frac{90}{92} = 0.978 \quad R3 = \frac{85}{88} = 0.966 \quad R4 = \frac{97}{98} = 0.990$$

6. Alternative A6 with criteria C1= 91, C2 = 89, C3 = 86, C4 = 96

$$R1 = \frac{91}{92} = 0{,}989 \quad R2 = \frac{89}{92} = 0{,}967 \quad R3 = \frac{86}{88} = 0{,}977 \quad R4 = \frac{96}{98} = 0{,}980$$

7. Alternative A7 with criteria C1 = 89, C2 = 87, C3 = 80, C4 = 95

$$R1 = \frac{89}{92} = 0{,}967 \quad R2 = \frac{87}{92} = 0{,}946 \quad R3 = \frac{80}{88} = 0{,}909 \quad R4 = \frac{95}{98} = 0{,}969$$

8. Alternative A8 with criteria C1 = 89, C2 = 87, C3 = 79, C4 = 95

$$R1 = \frac{89}{92} = 0{,}967 \quad R2 = \frac{87}{92} = 0{,}946 \quad R3 = \frac{79}{88} = 0{,}898 \quad R4 = \frac{95}{98} = 0{,}969$$

9. Alternative A9 with criteria C1 = 89, C2 = 87, C3 = 78, C4 = 97

$$R1 = \frac{89}{92} = 0{,}967 \quad R2 = \frac{87}{92} = 0{,}946 \quad R3 = \frac{78}{88} = 0{,}886 \quad R4 = \frac{97}{98} = 0{,}990$$

10. Alternative A10 with criteria C1 = 87, C2 = 85, C3 = 73, C4 = 93

$$R1 = \frac{87}{92} = 0{,}946 \quad R2 = \frac{85}{92} = 0{,}924 \quad R3 = \frac{73}{88} = 0{,}830 \quad R4 = \frac{93}{98} = 0{,}949$$

SAW Value Calculation

After normalization, the final value is calculated using the formula:

$$V_i = \sum(w_j \times r_{ij})$$

With weight C1= 0.40, C2 = 0.30, C3 = 0.20, C4 = 0.10

Example calculation for A1

V = (0.978 × 0.40) + (1.000 × 0.30) + (1.000 × 0.20) + (0.990 × 0.10)

V = 0.3912 + 0.30 + 0.20 + 0.099 = 0,9902

SAW Value Results

Table 4. SAW Value Results

Alternative	Students Name	SAW Value (Vi)	SAW Score (x100)
A1	Intan Kusuma	0.9902	99.03
A2	Salsabila Nanda	0.9837	98.38
A3	Vina Melinda	0.9834	98.34
A4	Alif Nurhadi	0.9822	98.23
A5	Xena Fitria	0.9812	98.13

Final Ranking

For this example, the top 5 data are used.

Table 5. Student Ranking

Rank	Name	Score
1	Intan Kusuma	99.03
2	Salsabila Nanda	98.38
3	Vina Melinda	98.34
4	Alif Nurhadi	98.23
5	Xena Fitria	98.13

DISCUSSION

This study demonstrates the application of the Simple Additive Weighting (SAW) method within a web-based Decision Support System to organize the evaluation of student achievement based on multiple criteria. The results show that the SAW approach can aggregate different performance indicators report card averages, examination scores, non-academic achievements, and attendance into a single preference value that allows students to be comparatively ranked.

The ranking results indicate relatively small differences among the final scores of several students. This outcome suggests that many students have comparable academic performance across the evaluated criteria. Such close score differences highlight an important aspect of multi-criteria decision-making methods: the final ranking is strongly influenced by the weighting scheme assigned to each criterion. In this study, report card scores were given the highest weight (0.40), reflecting the school's emphasis on academic performance. Consequently, students with slightly higher academic scores tend to obtain higher final preference values even when other criteria are similar.

From a methodological perspective, the SAW method provides a transparent calculation process because each stage normalization, weighting, and aggregation can be clearly traced. Previous studies have also shown that SAW is widely used in educational decision support systems due to its simplicity and ease of implementation. The findings of this study are consistent with prior research indicating that SAW can be used to structure the evaluation of student performance based on multiple indicators [9], [10].

In contrast, the results of this study should be interpreted with caution due to several limitations. First, the dataset used in the evaluation consists of a relatively small number of student records. Although the dataset was expanded for demonstration purposes, it does not necessarily represent the full diversity of student performance within a larger school population. As a result, the ranking outcomes should be viewed primarily as an illustration of the decision-support calculation process rather than a definitive measure of student achievement.

Second, the validity of the ranking results is influenced by the determination of criteria weights. In this study, the weights were defined based on institutional preferences rather than through a formal weighting method such as Analytic Hierarchy Process (AHP) or entropy weighting. Different weighting configurations could produce different ranking outcomes, particularly when the score differences among students are relatively small.

Another consideration relates to the scope of evaluation criteria. While the selected indicators capture key aspects of academic and supporting performance, other potentially relevant factors—such as behavioral assessments, project-based learning outcomes, or teacher evaluations—were not included in the current model. The inclusion of additional criteria may provide a more comprehensive representation of student performance.

Despite these limitations, the implementation of the SAW method within a web-based platform illustrates how multi-criteria evaluation processes can be organized in a structured and transparent manner. By automating normalization and ranking calculations, the system can assist teachers and administrators in managing student evaluation data more systematically. Nevertheless, the system should be considered as a supporting analytical tool rather than a replacement for professional judgment in educational decision-making.

Future research expand the dataset to include a larger number of students and multiple academic periods in order to evaluate the stability of ranking results over time. In addition, integrating alternative multi-criteria decision-making methods or combining SAW with other weighting approaches may provide further insights into how different evaluation models influence student ranking outcomes.

4. Conclusions

This study presented the design and implementation of a web-based Decision Support System that applies the Simple Additive Weighting (SAW) method to support the evaluation of high-achieving students at SMK Kanisius Ungaran. The system integrates several evaluation criteria report card average scores, school examination scores, non-academic achievements, and attendance into a structured calculation process that generates preference values and student rankings.

The implementation demonstrates how the SAW method can be operationalized within a web-based platform to organize and process multi-criteria student evaluation data. Through normalization, weighting, and aggregation procedures, the system produces ranking outputs that reflect the relative performance of students according to the predefined criteria and weights.

Despite the results of this study should be interpreted within the scope of its limitations. The evaluation dataset used in the study is relatively limited and was primarily intended to illustrate the operation of the SAW calculation process within the developed system. In addition, the study does not include a comparative evaluation with other multi-criteria decision-making methods, which limits the ability to assess the relative performance of the approach used.

Nevertheless these limitations, the system provides an example of how decision-support methods can be integrated into digital tools to assist the organization of student evaluation data in educational settings. Future research may involve applying the system to larger datasets, incorporating additional evaluation criteria, and comparing the SAW method with alternative decision-making approaches to further examine the robustness and applicability of the model.

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