MIKAILALSYS
Journal of Multidisciplinary Sciences

e-ISSN : 2987-2286
p-ISSN : 2987-3924
Index: Harvard, Boston, Sydney, Copernicus, Sinta 4, Scilit, Semantic, Google, etc

https://doi.org/10.58578/mikailalsys.v4i3.12206

Implementation of a Web-Based Decision Support System for Determining the Best Graduates Using the Simple Multi Attribute Rating Technique (SMART) Method at SMK Puspita Bangsa

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Submitted:	Revised:	Accepted:	Published:
Aug 16, 2026	Sep 13, 2026	Sep 25, 2026	Sep 30, 2026

Abstract

Manual processing of academic scores, attendance, achievements, extracurricular activities, and tardiness at SMK Puspita Bangsa creates risks of calculation errors, subjective assessment, and limited transparency in selecting the best graduates. This study aimed to design, develop, and test a web-based decision support system (DSS) using the Simple Multi Attribute Rating Technique (SMART) to automate graduate selection. Data were collected through observation, interviews, and a literature review. System development incorporated UML, ERD, and LRS modeling, with implementation using PHP, MySQL, and XAMPP. The SMART method calculated final scores based on five criteria, treating academic scores, attendance, achievements, and extracurricular activities as benefit criteria and tardiness as a cost criterion. System functionality and internal logic were evaluated through black-box and white-box testing. The results indicated that all five tested system functions were accepted and that the SMART method produced consistent graduate rankings. The system also enabled students to check their results using their student identification numbers, supporting transparency in the selection process. These findings indicate that the web-based DSS provides a practical application of SMART for automating graduate ranking and supporting efficient and transparent graduate selection at SMK Puspita Bangsa.

Keywords: Decision Support System; SMART Method; Graduate Selection; Web-Based System; Student Ranking

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INTRODUCTION

The rapid development of information technology has transformed various aspects of human life, including the education sector. Technology is no longer used merely as a medium for delivering information but has increasingly become an important instrument for managing data and supporting systematic decision-making processes. In educational institutions, the demand for fast, accurate, and integrated data management has become increasingly important because schools need to process various academic and non-academic information as a basis for student evaluation. Such developments have positioned information systems as an important component in improving the effectiveness of educational management (Setyani & Sipayung, 2023). One of the challenges encountered in vocational education is the determination of the best graduates by considering multiple indicators, including academic achievement, attendance, student accomplishments, and extracurricular involvement. When this process is conducted manually, the large volume of data that must be compared may increase the risk of calculation errors and affect the accuracy of the final decision (Ramadhoni et al., 2025).

This issue is particularly relevant to SMK Puspita Bangsa in Tangerang Selatan, where students are enrolled in several vocational programs with diverse academic and non-academic achievements. Selecting the best graduate requires an evaluation mechanism capable of simultaneously considering multiple criteria so that the final decision does not depend excessively on individual judgment. In decision-making environments, a decision support system can provide information and analytical models that assist decision makers in addressing semi-structured and unstructured problems (Sarwandi et al., 2023). Such systems can also facilitate a more systematic evaluation process by applying predetermined criteria and documenting the stages through which decisions are generated. Therefore, the digitalization of the best-graduate selection process should not be understood merely as an effort to accelerate calculations, but also as an approach to establishing a more structured, traceable, and accountable evaluation mechanism.

Previous studies have demonstrated the applicability of the Simple Multi Attribute Rating Technique (SMART) to various decision-making problems in education. Irianto et al. (2024) implemented SMART to support web-based student admission selection and reported that the method could automate ranking while maintaining consistency with manual calculations. In another educational context, Kartaputra et al. (2024) employed SMART to

recommend extracurricular activities based on students' interests and abilities. Purwanto et al. (2025), meanwhile, applied SMART to the selection of outstanding students by incorporating several assessment dimensions, including report-card scores, participation, attendance, attitude, and achievements. These studies indicate that SMART can effectively transform multiple assessment criteria into an aggregate score that can subsequently be used to rank decision alternatives.

The implementation of SMART has also been extended to web-based decision support applications. Prabowo & Toyib (2022) developed a PHP- and MySQL-based SMART system for student ranking by considering multiple assessment attributes. Their study demonstrated that criterion identification, weighting, normalization, utility calculation, and ranking could be integrated into a web application. Similarly, Muharto and Ratama (2024) demonstrated that SMART could support decision-making based on academic and non-academic criteria while reducing the possibility of human error during the selection process. Rizky & Aisyah (2025) further developed a web-based SMART system for identifying the best students using academic performance, attendance, attitude, and extracurricular activities as assessment criteria. These findings reinforce the relevance of SMART as a practical multi-criteria decision-making approach within educational institutions.

Nevertheless, previous studies leave a research opportunity that remains relevant to the present study. Existing research has largely addressed student admission, extracurricular recommendations, general student ranking, or the selection of outstanding students, whereas the specific determination of best graduates in a vocational high school through the integration of academic and disciplinary indicators has received comparatively limited attention. Furthermore, schools require more than a ranking mechanism; they also need a transparent evaluation process that can provide a rational basis for recognizing and rewarding selected students. Sitti et al. (2024) demonstrated the usefulness of web-based multi-attribute assessment systems in structuring student evaluation, while Azqia & Handayani (2025) reported that SMART-based systems can improve the effectiveness of evaluation through criterion-based data processing. However, these studies do not specifically address the selection of best graduates at SMK Puspita Bangsa according to the combination of criteria and institutional requirements examined in this research.

The research gap addressed in this study is therefore the absence of a decision support system specifically designed for determining the best graduates at SMK Puspita

Bangsa by integrating academic achievement, attendance, academic accomplishments, extracurricular participation, and lateness into a single ranking framework. This need is important because the selection of the best graduate has direct implications for the recognition and reward provided to students based on their achievements. Ardiyansyah & Ardiansyah (2026) demonstrated that SMART can accelerate student selection while supporting objective assessment through multiple criteria. Meanwhile, Agresma et al. (2026) examined SMART in comparison with another multi-criteria approach and highlighted its relatively straightforward computational mechanism for decision-making. These findings suggest the need for a more context-specific implementation that adapts SMART to the characteristics of graduate evaluation within the targeted vocational school.

The novelty of this study lies in the development of a web-based decision support system specifically designed to determine the best graduates at SMK Puspita Bangsa by integrating academic and non-academic indicators into a unified ranking mechanism. The proposed system is not limited to generating a final ranking; it is also designed to provide a structured calculation process in which the resulting scores can be traced to the criteria and weights applied. The methodological foundation is SMART, a multi-attribute decision-making technique that assigns weights according to the relative importance of each criterion (Lasarudin et al., 2022). The method subsequently transforms criterion values into utility scores and combines them with normalized criterion weights to obtain the final score for each alternative (Bagariang et al., 2025). These characteristics make SMART appropriate for the proposed application because its computational structure is relatively simple, transparent, and suitable for implementation within a web-based decision support environment.

From a technological perspective, the proposed system utilizes software components that support web application development and structured data management. PHP provides a server-side programming environment for developing dynamic web applications Bansal (2025), while HTML establishes the structural components of web pages and CSS supports their visual presentation (Alida et al., 2025). Data management is supported by a relational database system that enables information to be stored, organized, and processed systematically (Fadzar et al., 2024). During system design, Unified Modeling Language is employed to represent functional requirements and system structures through relevant modeling diagrams (Purwawijaya, 2024). The integration of these technological components enables student data management, SMART-based computation, and ranking presentation to operate within a unified web-based environment.

Based on the identified problem, research gap, and proposed novelty, this study focuses on the implementation of a web-based decision support system using the SMART method to determine the best graduates at SMK Puspita Bangsa. The system is designed to process predetermined criteria, normalize their weights, calculate utility values, generate aggregate scores, and automatically produce graduate rankings. The resulting system is subsequently evaluated through software testing to determine whether its functions operate according to the specified requirements. Black-box testing is applied to examine system functionality based on input and output without considering the internal program structure Alshamaa (2025), whereas white-box testing is employed to examine program logic and execution paths (Zen & Nuryasin, 2024). Through this approach, the study aims to provide a more structured, efficient, transparent, and accountable mechanism for determining the best graduates and supporting decision-making at SMK Puspita Bangsa.

METHODS

This study employed an applied research design with a quantitative approach to develop a web-based Decision Support System (DSS) for determining the best graduate at SMK Puspita Bangsa. The research was designed to transform the existing graduate-selection process into a structured decision-making procedure by applying the Simple Multi Attribute Rating Technique (SMART). SMART was selected because it supports multicriteria decision-making through systematic weighting, normalization, utility calculation, and alternative ranking, while maintaining relatively straightforward computational procedures for implementation in a web-based application (Herdiana et al., 2024). The research design comprised problem identification, data collection, determination of alternatives and assessment criteria, criterion weighting, SMART-based computation, web-system implementation, system testing, and evaluation (Cahyo, 2024). The assessment indicators consisted of academic achievement (C1), attendance (C2), lateness/disciplinary violations (C3), extracurricular activities (C4), and achievements (C5). These indicators represented the academic, attendance and disciplinary, extracurricular participation, and achievement-related aspects considered in determining the best graduate. C1, C2, C4, and C5 were categorized as benefit criteria, whereas C3 was categorized as a cost criterion. The initial weights assigned to C1 through C5 were 35, 15, 10, 15, and 25, respectively.

The research alternatives comprised 93 Grade 12 students at SMK Puspita Bangsa. All students were included as decision alternatives, allowing the ranking process to cover the entire group of prospective graduates assessed by the school. Research data were collected through observation, interviews, documentation, and a literature review. Observation was conducted to examine the existing procedure for determining the best graduate, while interviews with relevant school personnel were used to obtain information concerning the assessment process and system requirements. Documentation was used to obtain student assessment data, whereas the literature review provided the theoretical and methodological foundation for applying the SMART method. Information concerning the number of interview participants, sampling technique, and research period was based on the corresponding information contained in the thesis and is not supplemented with assumptions beyond the available research data.

Data analysis followed the SMART computational procedure. First, the initial weight of each criterion was normalized by dividing its weight by the total weight of all criteria, resulting in a relative weight for each criterion (Oktavyani et al., 2023). Second, the value of each alternative was transformed into a utility score for every criterion. For benefit criteria, utility was determined according to the position of an alternative's value relative to the minimum and maximum values, whereas the calculation for the cost criterion was adjusted so that a more favorable value produced a higher utility score. Third, the final score for each alternative was calculated by summing the products of normalized criterion weights and the corresponding utility values (Salsabila & Irawan. Muhammad Dedi, 2025) . The resulting scores were then used to rank all alternatives, with the highest preference value serving as the basis for identifying the best graduate. The resulting computational model was subsequently implemented as a web-based DSS and tested using Black Box Testing to verify that the implemented functions operated according to the specified requirements.

RESULTS

System Implementation

The Decision Support System (DSS) for determining the best graduates was successfully developed as a web-based application using PHP programming language and a MySQL database. The system was designed to assist the curriculum team in managing student data, determining criteria and weights, performing calculations using the Simple

Multi Attribute Rating Technique (SMART) method, and automatically displaying the ranking results. The development of a web-based system provides easier access, centralized data management, and greater efficiency in data processing, thereby supporting a more effective decision-making process (Muharto & Ratama, 2024). The implementation of a web-based decision support system can also facilitate data processing, improve user accessibility, and accelerate the decision-making process compared with manual procedures (Yulisda et al., 2024).

The system consists of several main modules, including the login page, student data management, criteria and weight management, SMART calculation, and ranking result pages. Each module is integrated into a single application, allowing the assessment and determination of the best graduates to be conducted systematically.

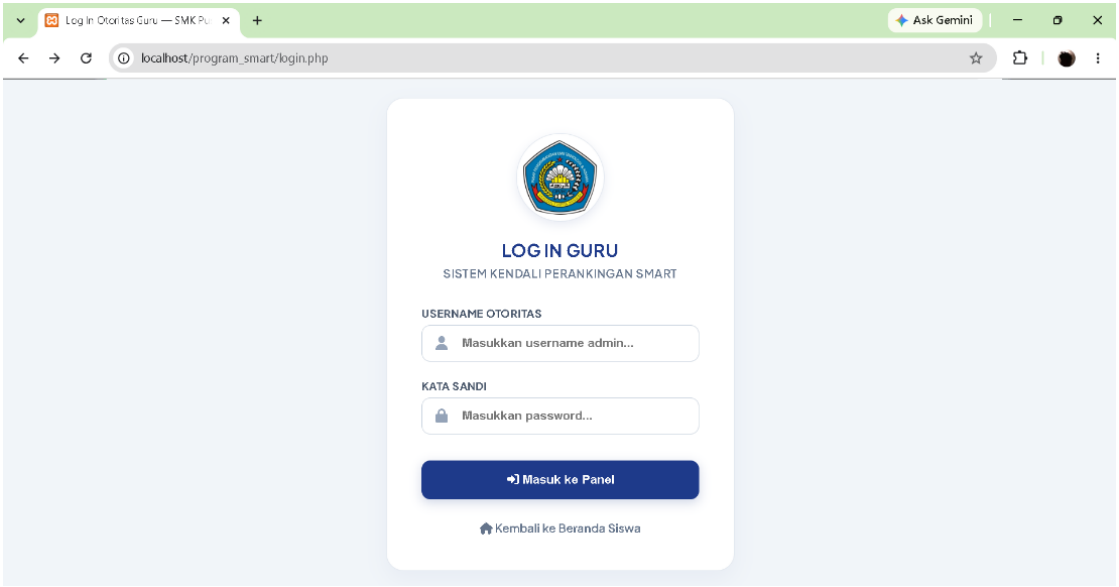


Figure 1. Login Page

Figure 1. Login Page shows that the login page serves as the authentication stage before teachers or administrators access the system. The page provides *username*, *password*, and login fields. The system validates the entered credentials and displays an error notification when the login information is incorrect.

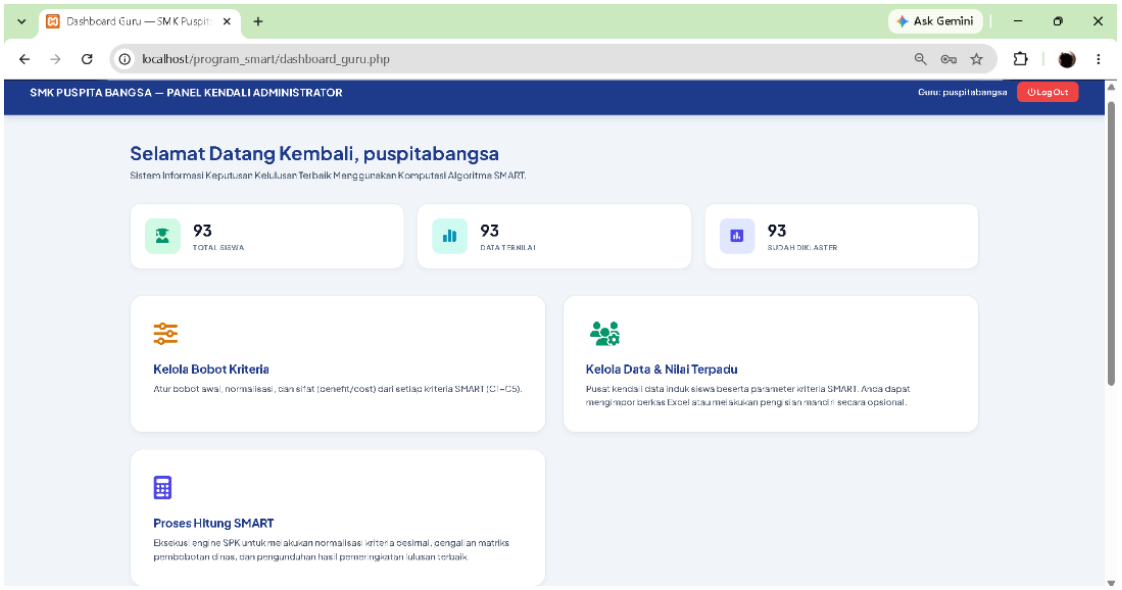


Figure 2. Teacher Dashboard

Figure 2. Teacher Dashboard shows that the dashboard serves as the main page after the teacher successfully logs into the system. The dashboard presents information on the five main criteria, namely C1 to C5, along with their weights and calculation information used in the SMART method. The page also provides navigation menus for accessing other system modules.

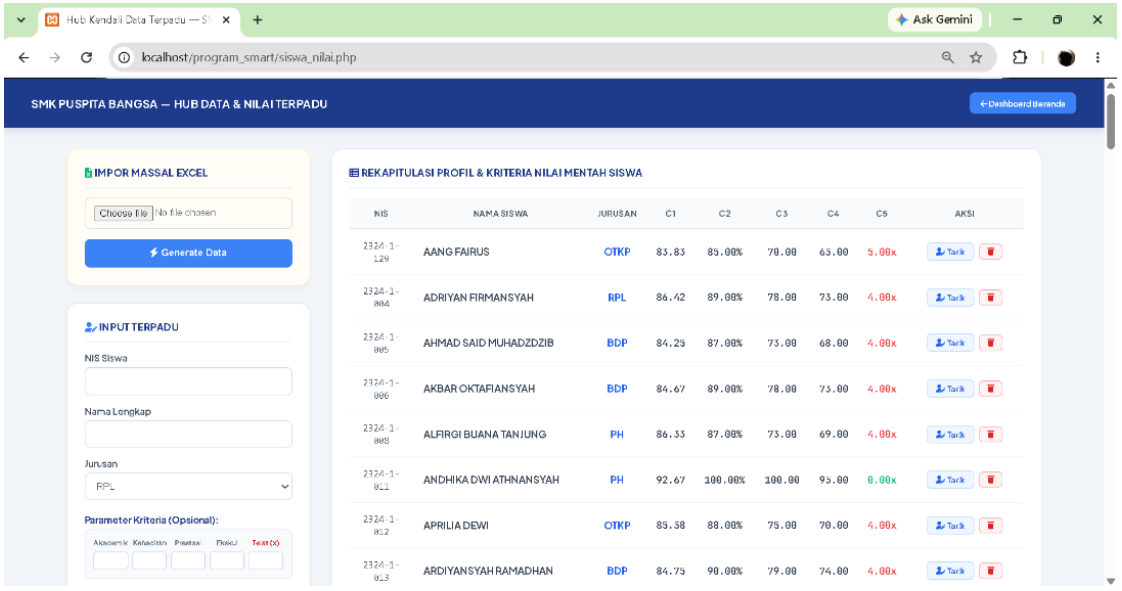


Figure 3. Student Data and Score Management Page

Figure 3. Student Data and Score Management Page shows that the integrated data and score management page is used to manage student data and scores for each criterion. The system provides a bulk data import feature using CSV files, data deletion, and data-clearing functions, allowing student data to be managed more efficiently.

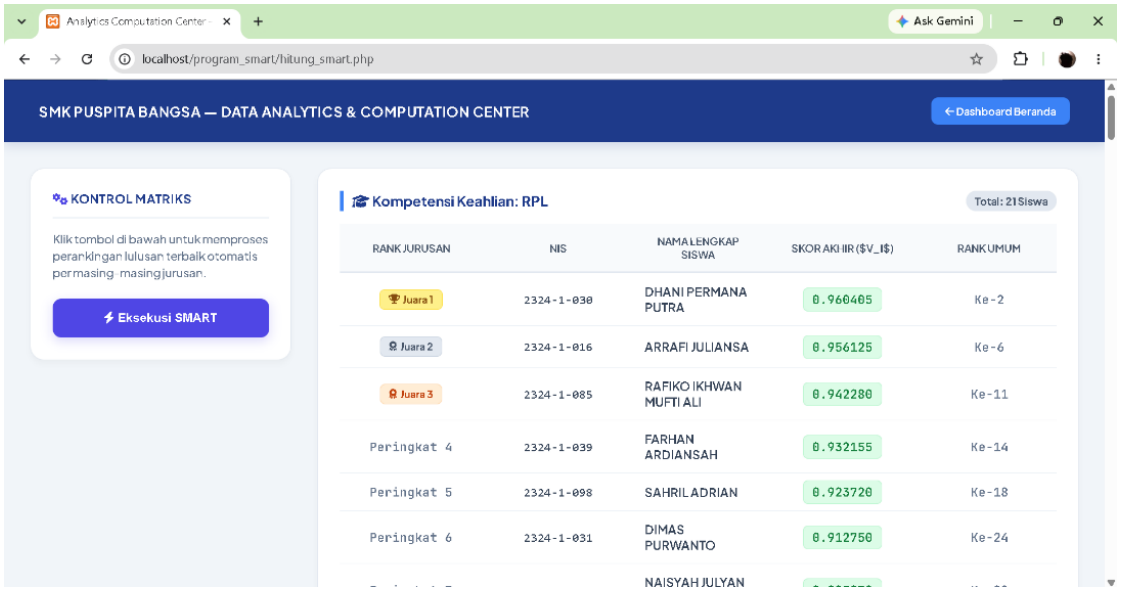


Figure 4. SMART Calculation Process Page

Figure 4. SMART Calculation Process Page shows that the SMART calculation page is used to perform the utility value and preference value calculations for each alternative. After the calculation process is executed, the system automatically generates the preference values and presents the ranking results based on the highest preference value.

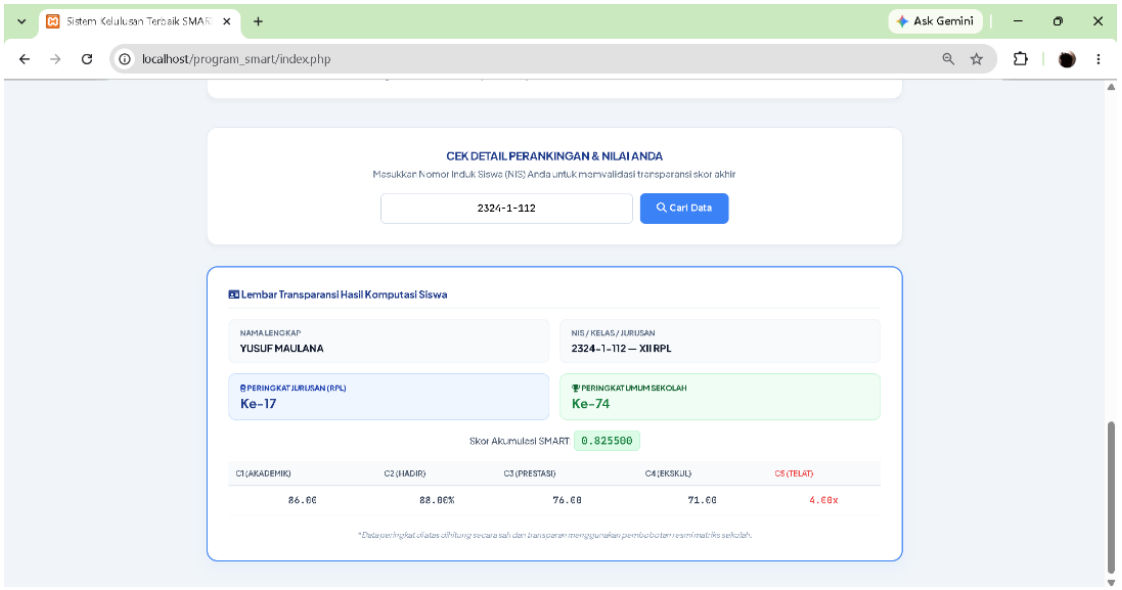


Figure 5. Personal Score Search Page

Figure 5. Personal Score Search Page shows that the system provides a personal score search feature based on the Student Identification Number (NIS). This feature allows students to obtain specific score information based on the entered NIS.

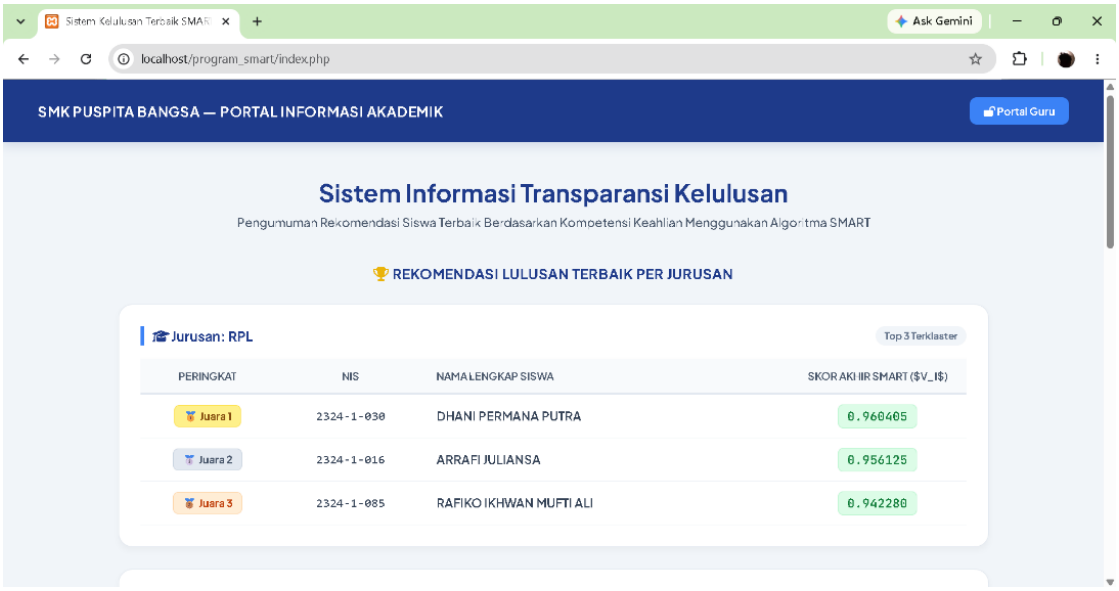


Figure 6. Student Access Page

Figure 6. Student Access Page shows that the student access page can be accessed without logging into the system. The page functions as an information interface for students by displaying information about the three highest-ranked graduates and providing a personal score search feature based on the NIS.

SMART Method Calculation Results

This study used 93 twelfth-grade students as assessment alternatives based on five criteria: academic achievement (C1), attendance (C2), lateness/violations (C3), extracurricular activities (C4), and achievements (C5). Each criterion was assigned a weight according to its level of importance before the normalization process was performed (Yulisda et al., 2024). This procedure is consistent with the SMART method, which includes weight normalization, utility value calculation, and preference value calculation for each alternative (Purwanto et al., 2025).

The SMART calculation produced a preference value for each alternative. These values were used as the basis for determining the ranking of graduates. A higher preference value resulted in a higher position in the ranking. The ranking results indicate that the SMART method can provide alternative recommendations based on the weights and values assigned to each criterion (Athaya et al., 2025).

Table 1. Results of SMART Method Calculation

Alternative	Preference Value	Ranking
AI	0.960405	1
A2	0.956125	2
A3	0.942280	3

Source: Compiled by the researcher (2026)

Table 1. Results of SMART Method Calculation shows that alternative A1 obtained a preference value of 0.960405 and ranked first. Alternative A2 obtained a value of 0.956125 and ranked second, while A3 obtained a value of 0.942280 and ranked third.

These results indicate that the system can automatically rank alternatives based on their preference values. This implementation is consistent with previous research Setyani & Sipayung (2023), which stated that the SMART method can support a selection process through alternative weighting and ranking. The application of the SMART method in a web-based system also supports decision-making efficiency because the calculation and presentation of results are performed computationally.

System Testing

System testing was conducted using the Black Box Testing method to ensure that all application functions operated according to user requirements (Abdillah et al., 2025). The testing covered the main features, including login, student data management, criteria management, SMART calculation, and ranking results.

Table 2. Black Box Testing Results

No	Criteria	Results
1	Login	Valid
2	Student Data Management	Valid
3	Criteria Management	Valid
4	SMART Calculation	Valid
5	Ranking Results	Valid

Source: Compiled by the researcher (2026)

Table 2. Black Box Testing Results shows that all tested main features obtained valid results. The login, student data management, criteria management, SMART calculation, and ranking result functions operated according to their designed functions.

Based on the testing results, all application functions operated according to the system design. Data input, criteria management, SMART calculation, and ranking result presentation could be performed properly. These results are consistent with the concept of Black Box Testing, which focuses on testing system functionality from the user's perspective (Alshamaa, 2025).

DISCUSSION

The findings demonstrate that implementing the Simple Multi Attribute Rating Technique (SMART) within a web-based Decision Support System (DSS) changed the mechanism used to determine the best graduate at SMK Puspita Bangsa, particularly by replacing a previously manual spreadsheet-based process with an integrated computational procedure. This change concerns not only the adoption of technology but also the structuring of the decision-making process itself. The system integrates five assessment criteria, academic achievement, attendance, achievements, extracurricular activities, and lateness—and processes each alternative through weighting, normalization, utility calculation, and ranking. Accordingly, the principal contribution of SMART lies in transforming assessment data into decision-oriented information that can be processed more consistently.

From a multicriteria decision-making perspective, the use of these five indicators demonstrates that determining the best graduate is not based exclusively on academic performance. Academic achievement carries the highest weight at 35%, followed by achievements at 25%, while attendance and extracurricular activities each account for 15% and lateness accounts for 10%. This weighting structure establishes explicit priorities within the assessment process. Although academic achievement remains the dominant factor, the final decision incorporates other dimensions related to discipline, participation, and student accomplishments. This is relevant because identifying the best graduate involves multiple dimensions of performance rather than a single measurable outcome. SMART enables these dimensions to be converted into comparable values, allowing the final decision to reflect several assessment aspects simultaneously.

The classification of criteria as benefit and cost criteria also has methodological implications for the resulting ranking. Academic achievement, attendance, achievements, and extracurricular activities are treated as benefit criteria, meaning that higher values contribute

positively to an alternative's final score. In contrast, lateness is treated as a cost criterion, whereby lower values represent a more favorable condition. This distinction indicates that the characteristics of each indicator are incorporated into the decision process rather than being subjected to an identical computational treatment. Normalization subsequently enables criteria with different value ranges to contribute proportionally to the final score. Consequently, the resulting preference value can be interpreted as a composite representation of student performance based on the predefined criteria and weighting structure.

Another important finding concerns the automation of the calculation process. The system automatically generates preference values and rankings, thereby reducing reliance on manual calculations. In the previous spreadsheet-based process, errors could potentially arise during data entry, formula application, or comparison of results. The DSS transfers these computational stages into a predefined system mechanism. Thus, the benefit of the system is not limited to faster processing; it also involves procedural standardization. Consistency is particularly important because every alternative is evaluated using the same criteria, weights, and computational procedures. This finding reinforces the results reported in Pebriyanti & Fauzi (2026), which indicate that web-based DSS implementation can support administrative efficiency while enhancing transparency in decision-making processes.

The findings are also consistent with previous research on the application of SMART. Study Rizky & Aisyah (2025) demonstrated that SMART can be employed to generate objective rankings of alternatives. The present findings support this application because the 93 students included as alternatives are processed using the same assessment structure, resulting in preference values and rankings through a systematic procedure. The commonality between the studies lies primarily in the function of SMART as a method for transforming multiple criteria into a single preference value that can subsequently be used for ranking. Therefore, this study reinforces the applicability of SMART to educational decision-making, particularly in the context of selecting the best graduate.

The findings are further aligned with study Prabowo & Toyib (2022), which reported that SMART implementation can improve the effectiveness of decision-making within a web-based system. The present study extends this application by integrating data management, computational processing, and result presentation within a single application in the context of SMK Puspita Bangsa. This contextual distinction is important because the

effectiveness of a decision-making method depends not only on its mathematical formulation but also on its alignment with organizational requirements and the characteristics of available data. In this study, SMART functions not as an isolated mathematical calculation but as an integral component of a system workflow that manages student data and produces ranking information.

Theoretically, this study reinforces the application of multicriteria decision-making approaches in educational settings. The implementation of SMART demonstrates how data representing different dimensions can be integrated through weighting and normalization to establish a more structured basis for decision-making. Practically, the system supports the school by accelerating data processing and providing results that can be examined more systematically. The self-checking feature based on the Student Identification Number also introduces a transparency dimension by enabling students to access their ranking, final score, and criterion-level assessment results. Therefore, the system functions not only as an internal data-processing instrument but also as a mechanism for communicating decision outcomes to relevant stakeholders.

Nevertheless, the objectivity provided by the system should be interpreted within the context of the predefined criteria and weighting structure. SMART can ensure computational consistency, but it does not independently establish that the selected criteria and weights represent the only possible definition of the "best graduate." For example, assigning 35% to academic achievement reflects the priority embedded in the current assessment structure; modifying the weights could potentially produce a different ranking. Thus, the system strengthens procedural objectivity through consistent computation, while the substantive basis of the decision remains dependent on the appropriateness of the selected criteria and weights. This distinction is important for the school when applying the system on a continuing basis.

Several limitations should also be acknowledged. First, the system relies on five assessment criteria, meaning that the range of student characteristics incorporated into the decision remains restricted to the predefined indicators. Second, the system does not yet provide an analytical dashboard capable of presenting data patterns through graphical or statistical visualizations, limiting its current functionality primarily to data processing and ranking presentation. Third, the implementation remains web-based and does not yet include a dedicated mobile application, leaving room for improvement in access flexibility across

devices. These limitations do not undermine the system's primary function but indicate opportunities for further development. Future studies may examine additional assessment criteria, develop analytical visualization features, and extend access through mobile applications. Further evaluation of the suitability of the weighting structure to the school's decision-making needs would also be valuable to ensure that the system is not only computationally consistent but increasingly representative of the institution's objectives in determining the best graduate.

CONCLUSION

This study achieved its objective of developing a web-based Decision Support System (DSS) for determining the best graduate at SMK Puspita Bangsa through the application of the Simple Multi Attribute Rating Technique (SMART). The developed system integrates five assessment criteria—academic achievement, attendance, achievements, extracurricular activities, and lateness—into a more structured decision-making process than the previously manual procedure. The implementation of SMART provides a consistent mechanism for criterion weighting, normalization, score calculation, and alternative ranking according to the relative importance of each assessment criterion. Accordingly, the study addresses its primary objective by providing the school with a systematic, efficient, and measurable mechanism for determining the best graduate. Beyond generating a ranking, the system incorporates a self-checking feature based on the Student Identification Number (NIS), enabling students to independently access their ranking, final score, and criterion-level assessment results.

From a practical perspective, this study contributes a digital alternative for reducing reliance on manual data processing while strengthening transparency in the assessment process. Its key contribution lies in integrating the SMART decision-making method into a web-based DSS that not only supports the determination of the best graduate but also facilitates direct access to assessment outcomes for students. This implementation provides a foundation for a more consistent and documented graduate-selection process within the school context. Future development should consider incorporating additional assessment criteria to provide a more comprehensive representation of student performance in the decision-making process. The system may also be extended through the integration of an analytical dashboard featuring graphical and statistical visualizations, as well as mobile

applications to provide more flexible access for school administrators, teachers, and students. Subsequent research may examine these developments while maintaining alignment between the computational method, institutional requirements, and the characteristics of the assessment process.

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