



Implementation of PROMETHEE Method in Decision Support System for Student Competency Competition Participant Selection

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Abstract—The Student Competency Competition (*Lomba Kompetensi Siswa/LKS*) is a prestigious national-level event requiring vocational schools to select participants in an objective and measurable manner. However, the selection process at SMKN 1 Tangerang Selatan still relies on subjective teacher judgment and lacks comprehensive evaluation criteria, risking suboptimal decisions that may result in selected students being insufficiently competent for the competition. This research aims to design and implement a web-based Decision Support System (DSS) using the PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) method to support objective, structured, and transparent LKS participant selection. Three evaluation criteria were defined based on field interviews: Practicum Subject (K1), Logic Subject (K2), and Attendance (K3), each processed through pairwise preference comparisons using linear and usual preference functions with equal criterion weights. The system was developed using JavaScript (Node.js) and MongoDB, supporting four user roles with distinct access rights. System correctness was verified through Black Box Testing across 16 functional scenarios and White Box Testing of four algorithmic modules using Cyclomatic Complexity Analysis, all of which passed successfully. The ranking results identified A3 as the top-recommended candidate with the highest Net Flow value of +0.2083, demonstrating the system's ability to surface competency dimensions overlooked by manual evaluation. Based on a questionnaire involving 20 respondents, the system achieved a user satisfaction score of 87.6%, categorized as very strong. These findings confirm that the PROMETHEE-based DSS is a reliable, practical, and deployment-ready tool for supporting participant selection in vocational school environments. The findings of this study offer a replicable methodological framework for vocational institutions seeking to standardize competition-based participant selection through multi-criteria decision support.

Keywords: Decision Support System; PROMETHEE; Student Selection; Student Competency Competition; Vocational High School

1. INTRODUCTION

The Student Competency Competition (*Lomba Kompetensi Siswa/LKS*) is a nationally recognized competition for Vocational High School (SMK) students that evaluates technical skills, innovation, and professional competence across various fields of expertise. Organized at the school, provincial, and national levels, LKS serves as a strategic instrument in shaping students who are competitive and prepared for the demands of the modern workforce [1], while also strengthening the synergy between vocational education and industry through the application of work competency standards relevant to the field. According to the national guidelines for LKS implementation, the competition is designed not only to measure technical skills but also to motivate schools to continuously improve the quality of their vocational graduates in preparation for global competition. Given this high-stakes context, the quality of participant selection directly influences not only a school's competitive standing but also the broader objective of improving vocational education quality in Indonesia.

The selection process at SMKN 1 Tangerang Selatan faces significant challenges. The evaluation relies heavily on subjective judgment from guiding teachers without structured computational support. Assessment criteria are not comprehensively defined, leading to inconsistent evaluations across selection cycles. Without a systematic decision mechanism, the process risks selecting students who are not optimally competent for the competition, ultimately undermining the purpose of the event. These structural weaknesses demand a technology-driven solution capable of standardizing and objectifying the selection process. A systematic and criteria-based selection process is therefore essential to ensure that the individuals chosen possess the competencies and qualifications required to achieve the intended objectives [2].

Multi-Criteria Decision Making (MCDM) methods have been widely adopted to address complex selection problems involving multiple conflicting criteria. Among these, the PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) method, introduced by Brans and Vincke in 1985, ranks alternatives through systematic pairwise comparisons [3]. Unlike conventional scoring methods, PROMETHEE evaluates each pair of alternatives across multiple criteria using defined preference functions, producing a net flow value that reflects each alternative's overall dominance. Its key strengths include high flexibility in criterion weighting, the ability to handle both quantitative and qualitative data, and the generation of stable and consistent rankings without requiring complex mathematical assumptions [4][5], making it particularly well-suited for complex selection processes such as LKS participant selection [6].

A Decision Support System (DSS) is a computer-based framework that combines data management, analytical models, and user interfaces to support semi-structured and unstructured decision-making processes [7][8]. In educational settings, DSS has been widely applied to student selection, scholarship allocation, and academic performance evaluation [9][10]. The integration of PROMETHEE within a DSS creates a powerful tool that not only automates complex multi-criteria computations but also produces transparent and traceable recommendations that decision-makers can review, verify, and justify, ensuring fairness and accountability in the evaluation process [7].



A review of the existing literature reveals substantial prior work on PROMETHEE-based selection systems. Djobo et al. [11] applied PROMETHEE to select outstanding students at SMA Elpida Noelbaki using academic performance, attendance, and behavioral criteria, demonstrating objective and accurate results. However, their system was designed for general secondary schools and did not accommodate the practical competency weighting that is central to vocational school selection. Mutty et al. [12] demonstrated that a PROMETHEE-based system could significantly reduce new student admission processing time compared to manual methods, though their study focused on general student admission rather than competition-specific selection. Watianthos et al. [6] confirmed the applicability of PROMETHEE-GAIA in institutional evaluation contexts, while Dachi [13] and Akmaludin et al. [9] demonstrated that combining PROMETHEE with AHP produces more robust selection outcomes in educational environments. Putra et al. [10] further compared AHP and PROMETHEE for scholarship selection, finding that both methods produce reliable rankings when criteria are properly defined.

While these studies collectively establish PROMETHEE's applicability to educational selection, a clear research gap remains: none specifically addresses LKS participant selection in vocational schools where the weighting of practical competency criteria is a defining evaluation dimension. Furthermore, existing systems generally lack role-based multi-user access management tailored to the operational structure of vocational school administration. This study directly targets both gaps by proposing a web-based DSS that integrates the PROMETHEE method with a role-based access architecture specifically designed for the vocational school context.

This research aims to implement a web-based DSS using the PROMETHEE method to support objective and structured LKS participant selection at SMKN 1 Tangerang Selatan. The specific objectives are: (1) to build a web-based selection system that automatically processes assessment data using PROMETHEE, minimizing teacher subjectivity; (2) to formulate comprehensive and measurable selection criteria aligned with the relevant competency indicators for the Electronics field; and (3) to improve the accuracy, efficiency, and effectiveness of the selection process through a real-time ranking system accessible to all authorized stakeholders. By combining PROMETHEE's multi-criteria ranking capability with a structured development and testing methodology, this study provides both a validated computational tool and an empirical evidence base that institutions can reference when designing similar selection systems.

2. RESEARCH METHODOLOGY

2.1 Data Collection Methods

This research adopts the Rapid Application Development (RAD) model as its system development methodology. RAD emphasizes rapid prototyping, iterative development cycles, and continuous user feedback, making it particularly effective for projects where requirements evolve rapidly [14]. The research was carried out in four interconnected phases as illustrated in Figure 1.

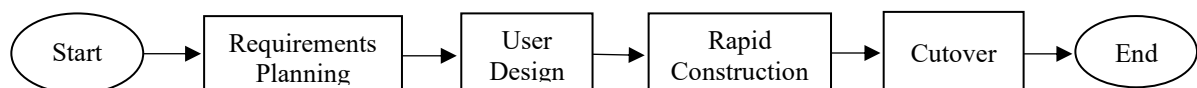


Figure 1. Research Framework Using the RAD Model

The Requirements Planning phase focuses on identifying system objectives, gathering stakeholder requirements, and defining selection criteria. The User Design phase covers the development of system models, database structures, and user interfaces iteratively. In the Rapid Construction phase, the system is implemented and integrated with the PROMETHEE method, followed by iterative testing. Finally, the Cutover phase includes system validation, user acceptance testing, deployment, and final evaluation.

2.2 Data Collection Methods

Data collection was conducted through three methods. Observation was performed by directly observing the existing LKS participant selection process at SMKN 1 Tangerang Selatan to document the workflow and identify challenges faced by guiding teachers. Interviews were then conducted with the Electronics LKS guiding teachers and school administrators to formally identify system requirements, validate selection criteria, and ensure that the resulting system accurately reflects real operational conditions. A systematic literature review was also conducted to examine prior research on DSS, PROMETHEE, and student selection systems [11][12] and to establish the theoretical framework for this study. Data processing involved collecting student assessment records from the Electronics department, covering practicum performance, subject scores, and attendance, which were subsequently processed using the PROMETHEE algorithm [4][5]. The assessment responses from guiding teachers were measured using a Likert scale to quantify evaluative judgments into numerical weights applicable to the decision model [15].

2.3 PROMETHEE Method

The PROMETHEE method is a multi-criteria decision-making approach that evaluates alternatives through pairwise comparisons using defined preference functions [3][5]. The method produces three flow values for each alternative: Leaving Flow (ϕ^+), which measures how strongly an alternative dominates others; Entering Flow (ϕ^-), which measures



how strongly it is dominated; and Net Flow (ϕ), calculated as $\phi^+ - \phi^-$, which serves as the final ranking score [4]. A higher Net Flow indicates a more preferred candidate. The method's key advantage is its ability to prevent a single outstanding criterion from masking inadequacy across others, producing holistically balanced recommendations [6]. In this study, two preference functions were applied: the Linear function for academic criteria (K1 and K2) and the Usual function for attendance (K3), as detailed in the Results section.

2.4 Criteria and Weight Definition

Based on interviews with guiding teachers and a review of LKS evaluation standards, three selection criteria were established for the Electronics discipline. Each criterion was assigned equal weight ($w_j = 1/3$), reflecting the school's position that practicum proficiency, logical reasoning, and attendance discipline are equally critical for LKS readiness [3].

Table 1. Selection Criteria and Preference Functions [5]

| Code | Criterion | Preference Function | Threshold | Direction | Weight |
|------|-------------------|---------------------|-----------|-----------|--------|
| K1 | Practicum Subject | Linear | $p = 2$ | Max | 1/3 |
| K2 | Logic Subject | Linear | $p = 2$ | Max | 1/3 |
| K3 | Attendance | Usual | - | Max | 1/3 |

Table 1 presents the three criteria along with their respective preference functions, thresholds, directions, and weights used in the PROMETHEE computation. K1 (Practicum Subject) and K2 (Logic Subject) both employ a Linear preference function with a threshold of $p = 2$, meaning that differences between alternatives are evaluated proportionally up to the defined threshold. K3 (Attendance) uses the Usual preference function, where any positive difference between alternatives is immediately considered a full preference. All three criteria are directed toward maximization, indicating that higher values are preferable, and each criterion is assigned an equal weight of 1/3, reflecting the equal importance of all three aspects in the selection process.

Since the raw assessment data across the three criteria use different scales and units, a unified 1–5 conversion scale was established based on interviews with guiding teachers to ensure comparability across criteria before the PROMETHEE computation is applied.

Table 2. Score Conversion Scale

| Code | Criterion | Condition | Weight Score |
|------|-------------------|---------------|--------------|
| K1 | Practicum Subject | Value > 90 | 5 |
| | | 81 – 90 | 4 |
| | | 71 – 80 | 3 |
| | | 61 – 70 | 2 |
| | | < 61 | 1 |
| K2 | Logic Subject | Value > 90 | 5 |
| | | 81 – 90 | 4 |
| | | 71 – 80 | 3 |
| | | 61 – 70 | 2 |
| | | < 61 | 1 |
| K3 | Attendance | Very Good (A) | 5 |
| | | Good (B) | 4 |
| | | Fair (C) | 3 |
| | | Poor (D) | 2 |
| | | Very Poor (E) | 1 |

As shown in Table 2, the conversion scale ranges from 1 to 5 for each criterion. For K1 (Practicum Subject) and K2 (Logic Subject), numerical scores are mapped into five levels: a score above 90 receives the highest weight of 5, scores between 81–90 receive a weight of 4, scores between 71–80 receive a weight of 3, scores between 61–70 receive a weight of 2, and scores below 61 receive the lowest weight of 1. For K3 (Attendance), qualitative grades are converted accordingly, where Very Good (A) corresponds to a weight of 5, Good (B) to 4, Fair (C) to 3, Poor (D) to 2, and Very Poor (E) to the lowest weight of 1.

2.5 System Architecture and Development

The DSS was developed as a web-based application following a three-tier architecture: a data layer (MongoDB), an application logic layer (Node.js with the embedded PROMETHEE engine), and a presentation layer (responsive web interface). The system was modeled using Unified Modeling Language (UML) diagrams, including Use Case, Activity, Sequence, and Class Diagrams [16]. An Entity Relationship Diagram (ERD) was constructed and subsequently transformed into a Logical Record Structure (LRS) to implement the database schema [17][18]. The system supports four user roles: Administrator, Class Teacher, Selection Team, and Principal, each with distinct access rights and functional



responsibilities. Development and testing were conducted using JavaScript (Node.js), MongoDB, Visual Studio Code, Postman, and Google Chrome on an Intel Core i3-1115G4 processor with 12 GB RAM running Windows 10 (64-bit).

3. RESULT AND DISCUSSION

3.1 Alternative Data and Decision Matrix

The study involved five student candidates from the Electronics department who participated in the LKS internal selection process at SMKN 1 Tangerang Selatan. Their raw assessment values were converted to the 1–5 standardized scale according to the conversion rules in Table 2, as presented in Table 3.

Table 3. Decision Matrix (Converted Scores)

| Alternative | Student Name | K1 (Practicum) | K2 (Logic) | K3 (Attendance) |
|-------------|-------------------------|-----------------|------------|------------------|
| A1 | Adam Cahya | 4 | 4 | 4 |
| A2 | Arlen Alfaroza | 5 | 4 | 3 |
| A3 | Belita Anggraini | 4 | 5 | 4 |
| A4 | Cahya Rino | 2 | 3 | 5 |
| A5 | Dirly Annabeng Setiawan | 5 | 4 | 4 |

The decision matrix shows that no single alternative dominates across all three criteria, necessitating multi-criteria analysis to resolve the trade-offs. A2 and A5 share the highest Practicum scores (K1 = 5) but differ in Attendance. A3 holds the highest Logic score (K2 = 5). A4 has the highest Attendance score (K3 = 5) but the lowest scores in both academic criteria.

3.2 Pairwise Preference Index Calculation

For each ordered pair (a, b), the preference value for each criterion was computed using the respective function [3][5]. For K1 and K2 using the Linear function with $p = 2$: if $d \leq 0$ then $H = 0$; if $0 < d \leq 2$ then $H = \frac{d}{2}$; if $d > 2$ then $H = 1$. For K3 using the Usual function: if $d \leq 0$ then $H = 0$; if $d > 0$ then $H = 1$. The multi-criteria index:

$$\pi(a, b) = \frac{1}{3}(H_{K1} + H_{K2} + H_{K3}). \tag{1}$$

Selected calculations are shown below to illustrate the methodology.

For the pair A3 vs A4:

K1 yields $d = 4 - 2 = 2$, so $H = \frac{2}{2} = 1.0$.

K2 yields $d = 5 - 3 = 2$, so $H = \frac{2}{2} = 1.0$.

K3 yields $d = 4 - 5 = -1$, so $H = 0$.

Therefore $\pi(A3, A4) = \frac{1}{3}(1.0 + 1.0 + 0) = 0.6667$.

For the pair A1 vs A4:

K1 yields $d = 4 - 2 = 2$, so $H = 1.0$.

K2 yields $d = 4 - 3 = 1$, so $H = \frac{1}{2} = 0.5$.

K3 yields $d = 4 - 5 = -1$, so $H = 0$.

Therefore $\pi(A1, A4) = \frac{1}{3}(1.0 + 0.5 + 0) = 0.5000$.

For the pair A4 vs. A3:

K1 yields $d = 2 - 4 = -2$, so $H = 0$.

K2 yields $d = 3 - 5 = -2$, so $H = 0$.

K3 yields $d = 5 - 4 = 1$, so $H = 1$ under the Usual function.

Therefore $\pi(A4, A3) = \frac{1}{3}(0 + 0 + 1) = 0.3333$.

The complete multi-criteria preference index matrix for all 20 ordered pairs is presented in Table 4.

Table 4. Multi-Criteria Preference Index Matrix $\pi(a,b)$

| $\pi(a,b)$ | A1 | A2 | A3 | A4 | A5 |
|------------|--------|--------|--------|--------|--------|
| A1 | 0 | 0.3333 | 0.0000 | 0.5000 | 0.0000 |
| A2 | 0.1667 | 0 | 0.1667 | 0.5000 | 0.0000 |
| A3 | 0.1667 | 0.5000 | 0 | 0.6667 | 0.1667 |
| A4 | 0.3333 | 0.3333 | 0.3333 | 0 | 0.3333 |
| A5 | 0.1667 | 0.3333 | 0.1667 | 0.5000 | 0 |



The matrix reveals that A3 exhibits the highest preference values when competing against most alternatives, particularly dominating A4 with $\pi = 0.6667$. A4 achieves uniformly moderate values (0.3333) against all others solely due to its superior Attendance, yet is consistently outperformed by the academic criteria.

3.3 PROMETHEE Flows and Final Ranking

Leaving Flow $\varphi^+(a)$ is computed as the row sum divided by $(n-1) = 4$.

$$\varphi^+(A1) = \frac{0.3333 + 0.0000 + 0.5000 + 0.0000}{4} = 0.2083$$

$$\varphi^+(A2) = \frac{0.1667 + 0.1667 + 0.5000 + 0.0000}{4} = 0.2083$$

$$\varphi^+(A3) = \frac{0.1667 + 0.5000 + 0.6667 + 0.1667}{4} = 0.3750$$

$$\varphi^+(A4) = \frac{0.3333 + 0.3333 + 0.3333 + 0.3333}{4} = 0.3333$$

$$\varphi^+(A5) = \frac{0.1667 + 0.3333 + 0.1667 + 0.5000}{4} = 0.2917$$

Entering Flow $\varphi^-(a)$ is computed as the column sum divided by $(n-1) = 4$.

$$\varphi^-(A1) = \frac{0.1667 + 0.1667 + 0.3333 + 0.1667}{4} = 0.2083$$

$$\varphi^-(A2) = \frac{0.3333 + 0.5000 + 0.3333 + 0.3333}{4} = 0.3750$$

$$\varphi^-(A3) = \frac{0.0000 + 0.1667 + 0.3333 + 0.1667}{4} = 0.1667$$

$$\varphi^-(A4) = \frac{0.5000 + 0.5000 + 0.6667 + 0.5000}{4} = 0.5417$$

$$\varphi^-(A5) = \frac{(0.0000 + 0.0000 + 0.1667 + 0.3333)}{4} = 0.1250$$

Net Flow $\varphi(a) = \varphi^+(a) - \varphi^-(a)$ represents the final ranking score for each alternative, where a positive value indicates that the alternative dominates more than it is dominated, and a negative value indicates the opposite [4]. The complete flow values and final ranking for all five candidates are presented in Table 5.

Table 5. PROMETHEE Flows and Final Ranking

| Alternative | Student Name | φ^+ (Leaving) | φ^- (Entering) | φ (Net Flow) | Rank |
|-------------|-------------------------|-----------------------|------------------------|----------------------|------|
| A3 | Belita Anggraini | 0.3750 | 0.1667 | +0.2083 | 1 |
| A5 | Dirly Annabeng Setiawan | 0.2917 | 0.1250 | +0.1667 | 2 |
| A1 | Adam Cahya | 0.2083 | 0.2083 | 0.0000 | 3 |
| A2 | Arlen Alfaroza | 0.2083 | 0.3750 | -0.1667 | 4 |
| A4 | Cahya Rino | 0.3333 | 0.5417 | -0.2084 | 5 |

The ranking results generated by the system are displayed in real-time as shown in Figure 2, confirming that the computational output of the system matches the manual calculation presented in Table 5.

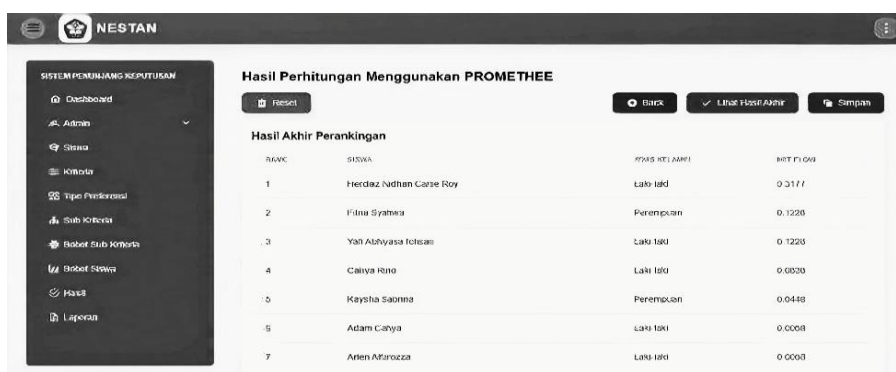


Figure 2. PROMETHEE Calculation Results and Student Ranking Page

The system output confirms that A3 (Belita Anggraini) occupies the top rank with the highest Net Flow value, consistent with the manual calculation, which validates the correctness and reliability of the embedded PROMETHEE algorithm in the system.

3.4 Analysis and Discussion of Results

The resulting rankings not only identify the relative standing of each candidate but also reveal how differences across criteria contribute to overall preference strength within the PROMETHEE framework [5].

- A3 (Belita Anggraini) secures first place with the highest Net Flow of +0.2083. Her superiority is driven by the highest Logic score (K2 = 5) in the dataset, combined with solid Practicum performance (K1 = 4) and consistent Attendance



(K3 = 4). Her Leaving Flow of 0.3750 is the highest among all alternatives, confirming that she outperforms competitors across the broadest range of pairwise comparisons, most decisively against A4 where $\pi = 0.6667$. Her low Entering Flow of 0.1667 indicates she is rarely dominated by others, which further reinforces her position at the top of the ranking.

- b. A5 (Dirly Annabeng Setiawan) ranks second with a Net Flow of +0.1667, benefiting from the highest Practicum score (K1 = 5) shared with A2, but maintaining better Attendance (K3 = 4 compared to K3 = 3 for A2). This Attendance advantage is decisive under the Usual preference function, where even a marginal positive difference translates into a full preference value of H = 1, significantly impacting the Entering Flow of A2.
- c. A1 (Adam Cahya) achieves a neutral Net Flow of 0.0000, reflecting a perfectly balanced profile that is consistent across all criteria but without any standout performance. This candidate neither dominates nor is dominated, representing a reliable but non-exceptional choice relative to the other candidates in this selection cycle.
- d. A2 (Arlen Alfaroza) drops to fourth despite having the joint-highest Practicum score (K1 = 5), entirely because of lower Attendance (K3 = 3). The Usual function's binary nature means that any positive difference in Attendance results in a preference of 1.0 for the competing alternative, causing A2 to accumulate a high Entering Flow of 0.3750 and ultimately a negative Net Flow.
- e. A4 (Cahya Rino) ranks last with a Net Flow of -0.2084 despite perfect Attendance (K3 = 5). The very low scores in both Practicum (K1 = 2) and Logic (K2 = 3) result in a disproportionately high Entering Flow of 0.5417, the highest of all alternatives. This outcome underscores a critical property of PROMETHEE in that it prevents a single outstanding criterion from masking inadequacy across others [4][8], producing holistically balanced recommendations that reflect real competency breadth.

An important validation was conducted by cross-referencing the system's output against the comprehensive assessment records maintained by the school. While guiding teachers had informally ranked A2 and A5 as top candidates based primarily on Practicum performance, the PROMETHEE analysis revealed that A3's superior Logic competency and balanced performance across all criteria make her the more complete candidate. This distinction had not been captured through manual evaluation, demonstrating the added analytical value of the PROMETHEE-based DSS in surfacing competency dimensions that unaided human judgment tends to overlook [13].

3.5 System Implementation

The system implementation demonstrates how the proposed PROMETHEE-based decision support model is operationalized into a functional web-based application to support the evaluation and ranking process. The main dashboard of the system provides a centralized navigation interface for all user roles, as illustrated in Figure 3.

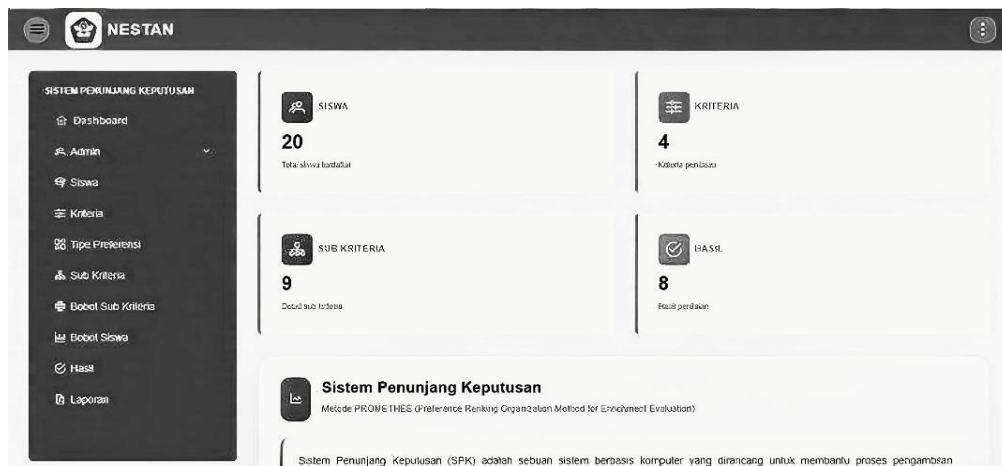


Figure 3. System Main Dashboard

Prior to accessing the system functionalities, users must pass a role-based authentication process to ensure secure and authorized access to the decision support environment, as shown in Figure 4.

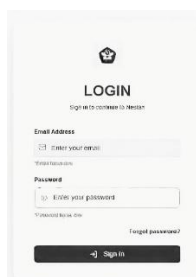


Figure 4. User Authentication (Login) Page



The Selection Team inputs student assessment values for each defined criterion through the weight input interface, as shown in Figure 5, which serves as the primary data entry point for the PROMETHEE computation engine.

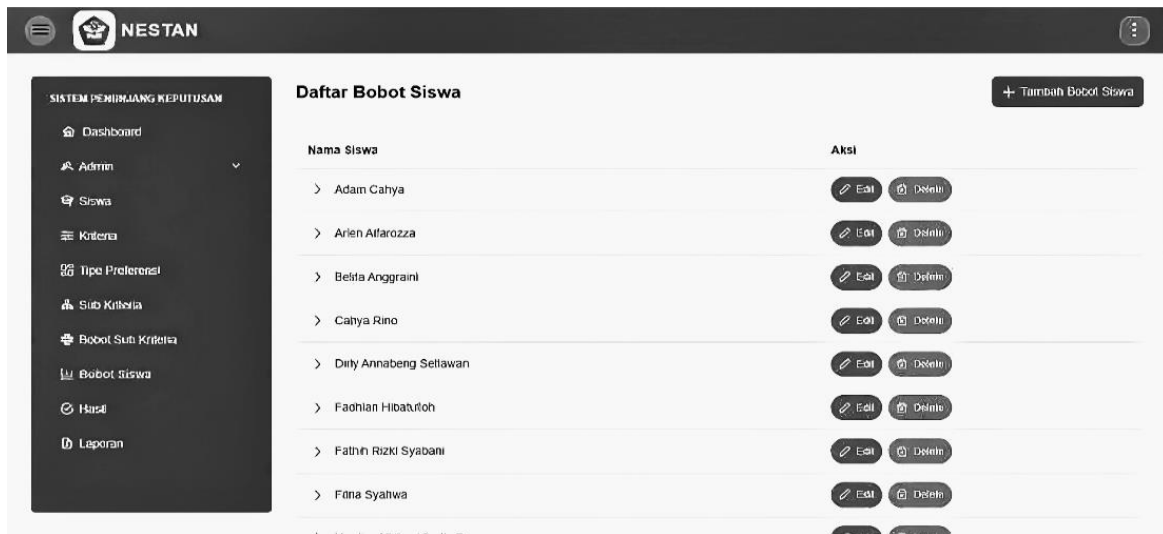


Figure 5. Student Assessment Weight Input Page

The final selection report, accessible by the principal, presents the complete ranking results in a structured and printable format as illustrated in Figure 6, supporting the transparency and accountability objectives of the system.

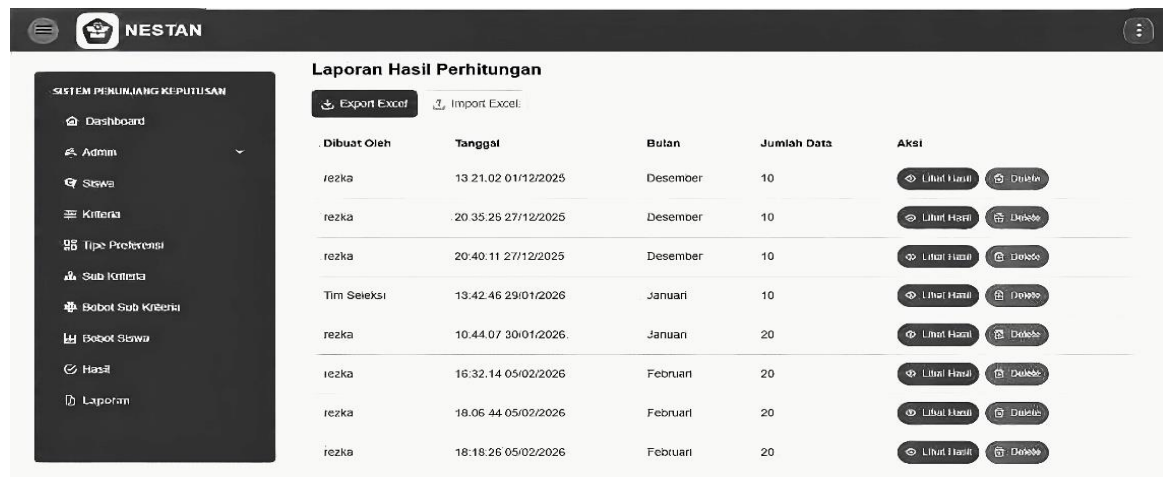


Figure 6. Final Selection Report Page

3.6 System Testing Results

Black Box Testing was applied to verify the functional correctness of all system modules [19][20]. Sixteen test scenarios were designed covering authentication, user management modules for all four roles, student data management, criterion and sub-criterion configuration, weight assignment, PROMETHEE ranking computation, and report generation. All 16 scenarios produced outputs that fully matched their expected results, confirming complete functional integrity across the system.

White Box Testing was applied to four core algorithmic modules: the Login module, Student Management module, Criterion Management module, and Results Calculation module [21]. For each module, a flowchart was constructed to map the logical flow, and a corresponding flowgraph was derived to identify independent execution paths using McCabe's Cyclomatic Complexity formula $CC = E - N + 2$, where E is the number of edges and N is the number of nodes. All independent paths were traced and verified to execute correctly, confirming the logical soundness of the PROMETHEE implementation and the absence of unreachable or erroneous code branches.

Table 6. White Box Testing Summary

| Module | Nodes (N) | Edges (E) | CC = E-N+2 | Independent Paths | Status |
|----------------------|-----------|-----------|------------|-------------------|-----------|
| Login | 8 | 9 | 3 | 3 | All valid |
| Student Management | 11 | 13 | 4 | 4 | All valid |
| Criterion Management | 10 | 12 | 4 | 4 | All valid |
| Results Calculation | 12 | 14 | 4 | 4 | All valid |



User Acceptance Testing was conducted using a structured Likert-scale questionnaire distributed to 20 respondents comprising guiding teachers, selection team members, and school administrators [15]. The overall acceptance score was calculated as (Total Actual Score / Maximum Possible Score) \times 100%. The User Acceptance Testing results across five evaluation dimensions are presented in Table 7.

Table 7. User Acceptance Test Results

| Evaluation Dimension | Actual Score | Max Score | Percentage |
|--|--------------|-----------|------------|
| Effectiveness in supporting decision-making | 357 | 400 | 89.3% |
| Ease of conducting student assessments | 349 | 400 | 87.3% |
| Clarity and comprehensibility of information | 351 | 400 | 87.8% |
| Usability and responsiveness of the interface | 348 | 400 | 87.0% |
| Practical benefit in the LKS selection process | 347 | 400 | 86.8% |
| Total | 1,752 | 2,000 | 87.6% |

According to standard Likert interpretation thresholds, the score of 87.6% falls in the Very Strong category (80–100%), indicating high user acceptance and strong practical utility in a real school environment.

3.7 Comparative Analysis with Prior Studies

The results of this study are consistent with and extend the findings from related prior work. Compared to Djobo et al. [11], this system adds role-based multi-user access management and practical competency-specific criterion design that is critical for vocational selection contexts. Compared to Mutty et al. [12], this study adds dual-method testing validation and demonstrates PROMETHEE's applicability beyond student admission selection to competition-specific preparation contexts. Compared to Dachi [13] and Akmaludin et al. [9], this system demonstrates that PROMETHEE alone, without AHP hybridization, can achieve equivalent ranking quality when criteria weights are defined through structured field interviews. Compared to Watrianthos et al. [6] and Kabassi and Martinis [8], who confirmed PROMETHEE's robustness in non-educational domains, this study validates its transferability into vocational school competition selection with domain-specific preference function design. The present system's 87.6% user satisfaction score, combined with a 100% functional test pass rate, positions it as a deployment-ready tool that meaningfully advances the state of practice in LKS participant selection.

4. CONCLUSION

This research successfully designed, implemented, and validated a web-based Decision Support System using the PROMETHEE method to support the LKS participant selection process at SMKN 1 Tangerang Selatan. The system addresses the core problem of subjective and inconsistent manual selection by providing an automated, multi-criteria evaluation framework that generates transparent and verifiable student rankings based on three criteria: Practicum Subject (K1), Logic Subject (K2), and Attendance (K3). The top-recommended candidate, A3 (Belita Anggraini), achieved the highest Net Flow of +0.2083, a result validated against school assessment records and confirmed by Black Box Testing across 16 scenarios, White Box Testing of four algorithmic modules, and a User Acceptance Test score of 87.6% in the Very Strong category. This work advances the field by demonstrating that PROMETHEE, when embedded within a structured role-based DSS and rigorously validated through functional and user acceptance testing, constitutes a practically deployable solution for competition-specific selection in vocational school contexts, a contribution not previously addressed in prior studies. For future development, it is recommended to integrate the system with the school's existing academic database, expand the criterion set to include extracurricular achievement and teacher recommendation indices, extend the architecture for multi-school deployment, and explore a hybrid PROMETHEE-AHP approach for more precise criterion weight elicitation.

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