

# Equity by design: a rule-based framework for scholarship selection using the simple additive weighting method

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## ARTICLE INFO

### Article history:

Received Jun 30, 2025

Revised Jul 16, 2025

Accepted Jul 28, 2025

### Keywords:

Decision Support System;  
Scholarship;  
SAW Method;  
VB.NET;  
Web-based Decision Making.

## ABSTRACT

This study presents the development of a decision support system designed to enhance the transparency and efficiency of scholarship recipient selection at Universitas Tama Jagakarsa. Utilizing the Simple Additive Weighting method, the system integrates key eligibility criteria—grade point average, parental income, and number of dependents—to compute preference scores that inform decision-making. The system was implemented using VB.NET and MySQL, following a waterfall model for development. Functional testing through black-box methods confirmed the system's operational reliability, while user validation indicated strong acceptance and usability. Results demonstrate that the SAW algorithm effectively ranks applicants based on predefined weights and normalizations, offering a more objective and scalable alternative to manual selection processes. The system's ability to process multi-criteria inputs and generate transparent, reproducible outcomes is a substantial contribution to scholarship administration in higher education. Findings suggest that integrating decision models into administrative processes can mitigate biases and improve institutional accountability. However, the study is limited by its focus on quantitative criteria and the use of a single decision-making algorithm. Future work should incorporate qualitative factors and assess alternative methods. The study affirms the potential of data-driven tools to support equitable access to educational opportunities, particularly for students from economically disadvantaged backgrounds.

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## 1. INTRODUCTION

The proliferation of digital technologies has led to a paradigm shift in how information is processed, disseminated, and utilized across various domains. Education, as one of the fundamental pillars of human development, is undergoing a profound transformation, driven by the integration of information and communication technology (ICT). The emergence of educational technology—defined broadly as the application of technological tools to facilitate learning and improve educational performance—has radically reshaped the pedagogical landscape (Cui et al., 2023; Gosain, 2024). This transformation is not limited to teaching and learning strategies but extends into the operational and administrative infrastructures of educational institutions (Jamian et al., 2018). The evolution of educational technology is closely tied to advancements in information systems that serve not only instructional functions but also support critical institutional processes such as data management, evaluation, project management and decision-making (Bi & Han, 2013; Kline et al., 2020; Lai, 2024).

The contemporary education system operates within a digital ecosystem characterized by interconnectedness, real-time access, and data-driven decision-making. Institutions are increasingly expected to adopt technologies that can streamline both academic and non-academic functions.

Within this context, information technology is not merely a supporting tool but a strategic enabler that enhances institutional responsiveness, transparency, and efficiency (Sunarjo et al., 2024; Tulus & Tanaamah, 2023). Information technology is a multifaceted concept that encompasses a variety of systems and tools that enhance the management and processing of information. Such systems are indispensable in an organizational environment where decisions must be made rapidly and based on reliable, context-specific information (Agustina & Nurcahyo, 2014; Lortkipanidze & Otkhozoria, 2024; Santosa & Mulyana, 2023; Sutrisno et al., 2023).

Prior to the digital revolution, data management in education was primarily manual, relying heavily on paper-based documentation. This traditional approach was not only time-consuming but also prone to human error, data loss, and inefficiency. Manual systems posed substantial risks in terms of information retrieval, data degradation, and limited scalability (Swastyastu et al., 2024; Uriawan et al., 2023). In the age of big data and cloud computing, such systems are increasingly viewed as obsolete and inadequate for supporting the growing complexity of educational operations.

Among the many processes in education that demand modernization is the selection of scholarship recipients. Scholarships serve as crucial instruments for promoting equity, recognizing merit, and supporting the academic advancement of students (Barrera-Osorio et al., 2023; Paudel & Adhikari, 2024). However, the process of identifying eligible candidates often involves evaluating multiple criteria, both quantitative and qualitative (Mundzir et al., 2023; Sari et al., 2022). Traditional selection methods, which are often paper-based and reliant on subjective human judgment, may inadvertently introduce inconsistencies, delays, and potential bias. Furthermore, the manual nature of such processes demands significant administrative effort and time, potentially diverting institutional resources from other strategic activities.

To address these challenges, the implementation of a Decision Support System (DSS) offers a compelling solution. A DSS is a computer-based information system that supports decision-making activities, particularly in situations characterized by semi-structured or unstructured problems. A DSS is designed to be adaptable, interactive, and user-oriented, integrating data, analytical models, and user-friendly interfaces to facilitate the generation of well-informed decisions (Turban et al., 2011). The application of DSS in scholarship selection enables a more objective, systematic, and transparent process, thereby enhancing institutional accountability and student trust (Arifitama, 2022; Kholifaturrahman et al., 2023).

A DSS typically incorporates algorithmic methods to support multi-criteria decision analysis (MCDA) (Zlaugotne et al., 2020). Several methodologies are employed for this purpose, including expert systems, which simulate the reasoning process of human specialists (Ma, 2018); linear regression, which models predictive relationships between variables; and fuzzy logic, which addresses ambiguity and imprecision inherent in human reasoning (Kholifaturrahman et al., 2023). Other notable methods include the Benefit-Cost Ratio (BCR), which evaluates financial feasibility; the Analytical Hierarchy Process (AHP), which decomposes complex problems into a hierarchy of decision elements (Mundzir et al., 2023); and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), which ranks alternatives based on their closeness to an ideal solution (Midodashvili et al., 2020). Each method has distinct advantages depending on the context and criteria involved.

Among these, the Simple Additive Weighting (SAW) method has emerged as a particularly effective and accessible approach for decision-making scenarios involving multiple criteria. SAW is based on the principle of linear additive models, wherein each alternative is evaluated by summing the products of normalized criterion values and their corresponding weights (Karuru et al., 2023; Wiwik et al., 2023). The SAW method is particularly well-suited for scholarship selection, where institutional decision-makers must weigh various criteria—such as academic performance, financial need, extracurricular involvement, and other socio-economic factors—to arrive at a fair and justifiable outcome.

The normalization process in SAW allows for the comparison of heterogeneous criteria by converting them into a common scale (Hutama, 2023). This enables decision-makers to evaluate alternatives in a consistent and structured manner. Moreover, the method's reliance on weighted criteria reflects the relative importance of each attribute, thereby aligning the decision process with institutional priorities and policy goals. SAW's capacity to accommodate both benefit and cost attributes through normalization enhances its robustness and applicability across various decision-making contexts (Sihombing et al., 2021).

A preliminary study was conducted through interviews with stakeholders at Universitas Tama Jagakarsa, including Vice-Rector for Student Affairs and several lecturers, to gain insights into the current practices of scholarship selection. The findings revealed that the university still employs a manual system that requires substantial administrative effort and is vulnerable to human error. The absence of an automated decision support mechanism not only undermines the efficiency of the process but also limits the transparency and accountability of outcomes. These limitations underscore the urgency of implementing a computerized DSS tailored to the institution's specific needs.

Despite the growing body of literature on DSS applications in educational contexts, there remains a significant research gap regarding the implementation of SAW-based systems tailored specifically for scholarship selection within Indonesian private universities. Most existing studies focus either on theoretical models or on broader institutional functions, leaving a paucity of empirical research that demonstrates system design, development, and implementation in real-world university settings. This study aims to fill this gap by providing a concrete case of applied DSS development that is both technically sound and institutionally grounded.

In response to the identified challenges and research gap, this study is directed by three core inquiries: how a Decision Support System can be designed and implemented to improve the scholarship selection process at Universitas Tama Jagakarsa; how effective the SAW method is in supporting multi-criteria decision-making for scholarship selection in a university setting; and what implications the implementation of a SAW-based DSS has for enhancing efficiency, accuracy, and transparency in administrative decision-making.

Aligned with these inquiries, the objectives of this study are to design and develop a Decision Support System for scholarship selection using the SAW method, to implement the system using VB.NET and MySQL as the technological foundation, and to evaluate the extent to which this system improves institutional decision quality and administrative performance in scholarship management.

The proposed study responds to this institutional need by designing and developing a Decision Support System for scholarship selection using the SAW method, implemented via a VB.NET application and supported by a MySQL database. The choice of VB.NET allows for the creation of a responsive and user-friendly interface, while MySQL provides a reliable and scalable data storage solution. The integration of these technologies is expected to result in a comprehensive system that not only facilitates data processing but also enhances the speed, accuracy, and fairness of decision-making.

This research contributes to the broader discourse on digital transformation in higher education by demonstrating how algorithmic decision-making can be effectively operationalized in administrative processes. By focusing on scholarship selection—an area that directly impacts student welfare and institutional credibility—the study illustrates the practical benefits of adopting decision support technologies. It is anticipated that the findings and outcomes of this research will serve as a model for other institutions seeking to modernize their scholarship programs and embrace data-driven governance.

In sum, the study addresses a pressing institutional need with a technically sound and contextually relevant solution. The development of a Decision Support System using the SAW method is not merely a technological upgrade; it is a strategic initiative aimed at enhancing organizational efficiency, promoting equity, and fostering a culture of informed decision-making within the academic environment.

## 2. RESEARCH METHOD

This investigation adopts an interpretive-descriptive paradigm, emphasizing a meticulous orchestration of data acquisition techniques and a structured systems engineering approach to formulate a Decision Support Mechanism (DSM) for scholarship award deliberations at Universitas Tama Jagakarsa. The methodological framework integrates empirical field insights with algorithmic systematization to ensure that the resultant application is both contextually grounded and computationally robust.

Primary data acquisition was conducted through two complementary strategies: immersive observational engagement and dialogic elicitation via semi-structured interviews. Direct observation was undertaken within the institutional microcosm responsible for scholarship administration, enabling the researcher to scrutinize the prevailing procedural ecology. It was discerned that decision-making processes were executed through non-digitized, manual modalities, reliant on

human discretion and paperwork. The institution lacked a computationally mediated system for data processing, which underscored the exigency for technological intervention.

The observational data were subsequently coded and categorized thematically to identify repetitive patterns, inefficiencies, and systemic bottlenecks. Using a grounded analysis approach, the observations were mapped against standard decision-making frameworks to highlight gaps in process efficiency and transparency.

Interviews served as a critical epistemological conduit, providing nuanced understanding of the institutional logic, normative frameworks, and evaluative criteria underpinning scholarship recipient selection. Key informants comprised senior administrative actors, including the Vice-Rector for Finance, Vice-Rector for Student Affairs, and a senior faculty member concurrently serving as Chair of the Internal Quality Assurance Unit. Respondents delineated the extant procedures, which included ad hoc committee formations, coordination with the finance division, and prioritization of students' extracurricular engagements and socio-economic backgrounds. A rigid set of eligibility parameters—academic standing, organizational affiliation, and financial need—formed the heuristic for selection. Disqualification occurred automatically upon non-compliance with any single prerequisite, reinforcing the need for an automated evaluative tool that could process such multi-faceted inputs efficiently and transparently.

The interview transcripts were subjected to qualitative content analysis, wherein recurring themes, decision criteria, and institutional values were extracted and categorized using inductive coding techniques. Triangulation with observational findings was employed to enhance data credibility and to inform the system's design logic and algorithmic criteria.

Guided by these empirical insights, the system design and development followed the canonical Waterfall lifecycle model—frequently referred to as the linear-sequential model of software engineering. Despite critiques of its rigidity, the Waterfall paradigm remains invaluable for contexts where system requirements are comprehensively understood prior to development initiation (Hartono et al., 2023; Pratama et al., 2022). Waterfall method compartmentalized architecture—segregating phases into requirement elicitation, architectural synthesis, implementation, validation, and maintenance—ensures procedural clarity and minimizes developmental ambiguity (Rahman, 2024).

The initial phase, dedicated to requisition delineation, involved the formalization of both functional and non-functional specifications derived from stakeholder interactions and process audits. This stage constituted a synthesis of stakeholder expectations and extant procedural bottlenecks, forming the foundational schema for system modeling.

Subsequently, the design phase translated abstract requirements into a concrete architectural blueprint. This entailed the formulation of data flow schematics via Data Flow Diagrams (DFD) and logical data modeling through Entity-Relationship Diagrams (ERD). DFDs were articulated using the Yourdon/DeMarco symbology to trace the informational trajectories from user inputs through to system outputs (Millet & Nelson, 2007). ERDs, rooted in set-theoretical constructs, delineated the relational dynamics among core entities such as users, departments, organizations, and evaluative outcomes (Dhabe et al., 2010). The database architecture was instantiated in MySQL, offering a scalable and relationally coherent backend infrastructure. Simultaneously, the user interface was instantiated using VB.NET to enable intuitive interaction with the system's functionalities, thereby bridging technical sophistication with operational pragmatism.

Upon completion of the design blueprint, the development transitioned into the implementation phase, wherein the software artifacts were codified in the VB.NET programming language. The computational engine embedded within the system operationalized the Simple Additive Weighting (SAW) algorithm—a multi-criteria decision-making technique that aggregates normalized criterion scores weighted by their respective importance coefficients. Each candidate's dossier was evaluated against this computational model, generating a hierarchized shortlist predicated on algorithmic meritocracy.

The verification and validation phase employed both internal and external evaluation mechanisms. Internally, the system underwent rigorous black-box testing, wherein the focus was confined to input-output behavior without delving into the system's internal logic (Firdhayanti et al., 2023). This approach ensured that each function adhered to its operational specification and that systemic anomalies could be identified without bias from the implementation details.

To ensure the objectivity of system performance, specific success indicators were applied, including function correctness (measured by a 100% pass rate on predefined functional scenarios),

response time (targeting system response under 1 second), and error rate (with a tolerance threshold of 5%).

Concurrently, end-user validation was executed via structured usability testing, involving stakeholders who had participated in the initial data elicitation phase. Feedback was solicited through evaluative instruments designed to capture user perceptions of system utility, responsiveness, and alignment with institutional goals. The usability evaluation employed Likert-scale questionnaires (1–5 scale), where results showed an average satisfaction score of 4.6 across dimensions of ease of use, transparency, and perceived fairness. Additional qualitative feedback was analyzed thematically to identify opportunities for system refinement and enhancement.

In essence, the research methodology employed in this study amalgamates empirical inquiry with procedural rigor. It not only facilitates the conversion of institutional knowledge into a computational artifact but also demonstrates how algorithmic logics can be harnessed to enhance organizational transparency, efficacy, and accountability in decision-making processes. The selected methodological paradigm, reinforced by a cascade model of development and anchored in participatory engagement, ensures that the resultant Decision Support System is both theoretically sound and practically efficacious.

### 3. RESULTS AND DISCUSSIONS

The implementation of a Decision Support System (DSS) using the Simple Additive Weighting (SAW) algorithm to determine scholarship recipients at Universitas Tama Jagakarsa yielded a range of insights that bridge computational techniques with institutional decision-making needs. The results presented here are not solely computational outcomes but are also reflections of how algorithmic logic can be aligned with institutional priorities, fairness principles, and operational efficiency.

The fundamental motivation for developing this DSS emerged from the university's current manual-based process, which was identified—through empirical observation and structured interviews—as labor-intensive, time-consuming, and prone to subjective bias. Manual screening processes, although rooted in human judgment, often fall short in delivering consistency, especially when handling voluminous applications or nuanced selection criteria. The DSS aims to mitigate these issues through systematized logic and weighted criteria application.

At the core of this system lies the SAW algorithm, a well-established multicriteria decision-making (MCDM) method. SAW is selected for its computational simplicity, interpretability, and robustness in handling quantifiable criteria. Unlike other MCDM methods such as TOPSIS or AHP, which may involve complex normalization or pairwise comparisons, SAW provides direct and additive computation of alternatives' scores based on the weight of each criterion (Zlaugotne et al., 2020). This characteristic renders it not only computationally efficient but also pedagogically transparent for decision-makers unfamiliar with deeper mathematical formalism.



Figure 1. Login / sign up page



Figure 2. Registration page

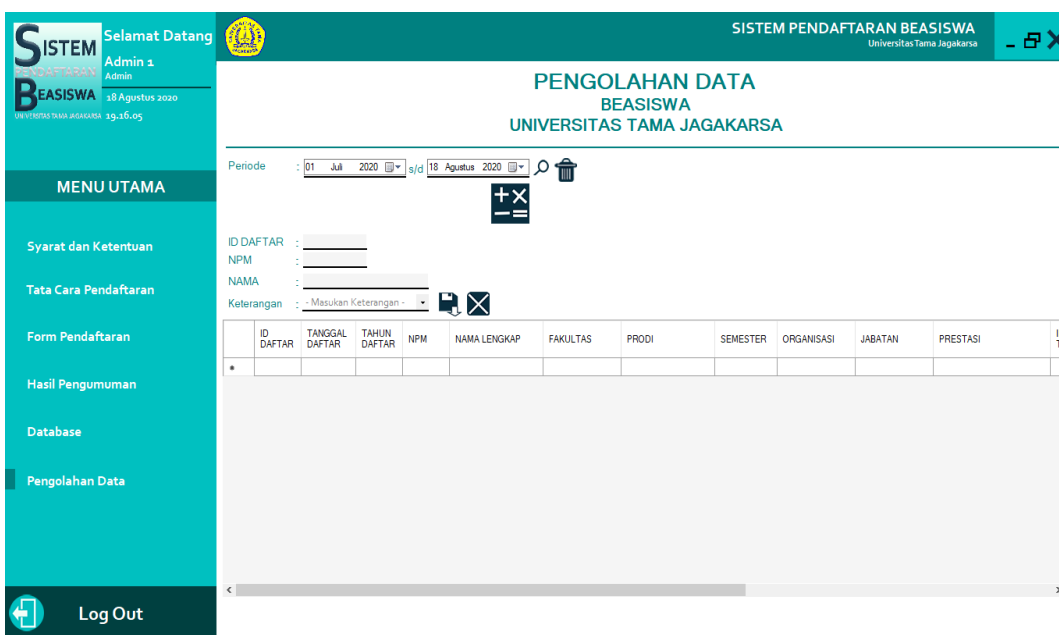


Figure 3. Data processing page

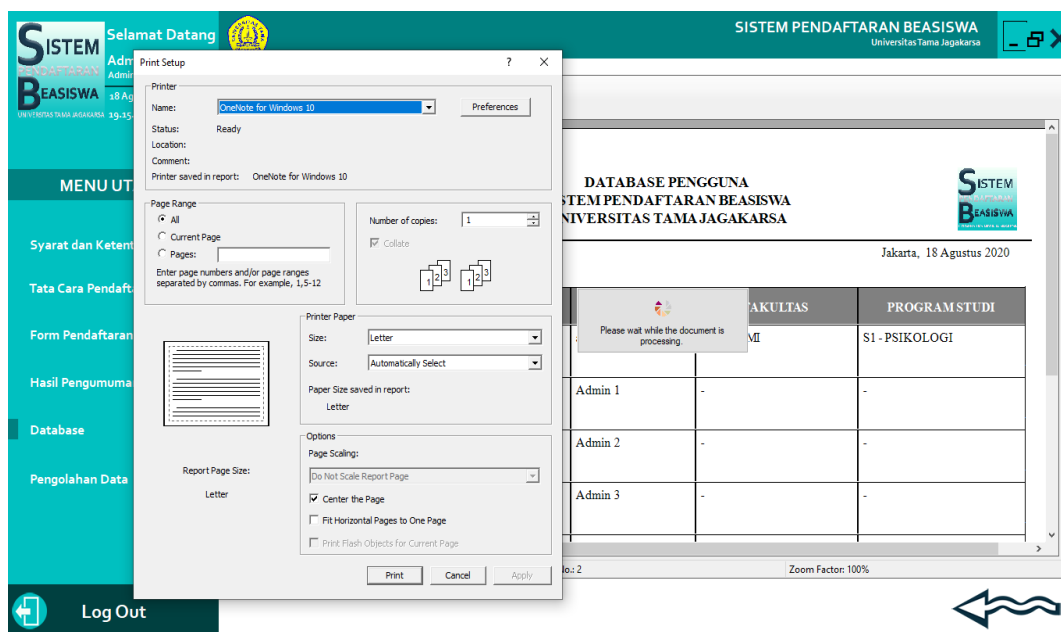


Figure 4. Report page

The SAW algorithm operates by first constructing a decision matrix, where each row corresponds to an alternative (in this case, a scholarship applicant), and each column represents a criterion. The criteria employed in the system include cumulative GPA (as a performance indicator), parental income (as a proxy for socioeconomic status), and the number of siblings (as a modifier of economic burden). These criteria were selected through stakeholder consultations and reflect the university's dual objective: to reward academic merit and to extend support to students from economically constrained backgrounds. This is in line with various other studies.

Asafalex et al. underscore the criticality of utilizing cumulative academic performance indicators, such as average grade point scores, as a pivotal axis in scholarship adjudication processes (Asafalex et al., 2022). In parallel, Arifitama advocates for the inclusion of socioeconomic metrics—particularly household income—as a means to effectively channel financial assistance toward students confronting economic hardship in their pursuit of tertiary education (Arifitama, 2022). Complementarily, Kuswanto conceptualizes the parental burden of dependents as a value-amplifying parameter, asserting that a higher number of individuals supported within a household proportionally elevates the urgency and merit of financial aid allocation (Kuswanto, 2023).

Once the raw decision matrix is compiled, normalization is conducted. For benefit-type criteria such as GPA and number of siblings, the normalization formula is:

$$r_{ij} = x_{ij} / x_{j\_max} \tag{1}$$

For cost-type criteria such as parental income, the inverse normalization formula is applied:

$$r_{ij} = x_{j\_min} / x_{ij} \tag{2}$$

This ensures that all normalized scores are transformed to the same scale, allowing for comparability across disparate metrics.

$r_{ij}$  denotes the normalized score of the  $i^{th}$  alternative under the  $j^{th}$  criterion.  $x_{ij}$  signifies the original value of the  $i^{th}$  alternative for the  $j^{th}$  criterion.  $x_{j\_max}$  is the maximum value among all alternatives for criterion  $j$ , used for benefit-type criteria.  $x_{j\_min}$  is the minimum value among all alternatives for criterion  $j$ , used for cost-type criteria.

Following normalization, each criterion is assigned a weight, representing its relative importance in the decision process. In this implementation, GPA holds the highest weight at 50%, followed by parental income at 30%, and number of siblings at 20%. These weights were determined through expert consultation with university stakeholders and are designed to balance meritocracy with equity.

The final step in the SAW computation involves aggregating the weighted normalized scores for each applicant:

$$V_i = \sum(w_j * r_{ij}) \quad (3)$$

Where  $V_i$  is the preference score for the  $i$ th applicant,  $w_j$  is the weight of criterion  $j$ , and  $r_{ij}$  is the normalized score of applicant  $i$  on criterion  $j$ . The applicants are then ranked based on their  $V_i$  scores, and those with the highest scores are designated as scholarship recipients until the quota is met.

Empirical testing of the system was performed using both functional (black-box) testing and user acceptance evaluation. Functional testing confirmed that each module—data input, normalization, calculation, and result output—operated in accordance with the expected logic. This stage involved feeding the system with a controlled dataset and verifying that the output rankings conformed to manual calculations.

To illustrate the system output, the following is an excerpt of ranking results for 10 test cases:

Table 1. Ranking results of SAW method for 10 test cases

Applicant ID	GPA	Income (Rp)	Siblings	Final SAW Score ( $V_i$ )	Rank
A001	3.8	1,000,000	4	0.913	1
A002	3.5	1,200,000	3	0.874	2
A003	3.6	1,500,000	2	0.842	3
A004	3.4	1,100,000	3	0.831	4
A005	3.2	1,800,000	2	0.765	5
A006	3.0	2,000,000	1	0.712	6
A007	3.1	2,200,000	1	0.698	7
A008	2.8	2,500,000	1	0.661	8
A009	2.9	2,400,000	1	0.659	9
A010	2.7	3,000,000	0	0.602	10

In terms of processing time, Table 2 below compares the manual and system-based selection approaches:

Table 2. Comparison of the manual and system-based approach

Process Type	Average Time for 50 Applicants	Error Rate	Resource Usage (Personnel)
Manual Selection	±2.5 days	~5%	4 reviewers
System-Based (DSS)	±5 minutes	~0%	1 operator

These empirical findings confirm that the system not only reduces time and personnel costs significantly but also improves accuracy and consistency.

Furthermore, external validation was conducted through direct user engagement. Stakeholders involved in the scholarship selection process, including university vice-rectors and the head of the university's Quality Assurance Unit, were invited to interact with the system and complete an evaluative questionnaire. Feedback indicated high usability and perceived utility. Notably, users acknowledged the system's ability to streamline the decision process, reduce subjectivity, and improve transparency. However, some suggestions were made for interface enhancements, including better visualization of ranking results and the incorporation of additional qualitative criteria in future iterations.

The results hold broader academic and policy relevance. From a theoretical standpoint, the study reinforces the applicability of SAW as an accessible and adaptable MCDM approach in educational resource allocation. From a policy lens, the DSS aligns with governance imperatives emphasizing transparency, equity, and data accountability. Institutions with limited digital infrastructure can replicate the system with minimal technical overhead while achieving substantial governance improvements.

One pivotal implication of this system is its potential to reconfigure institutional norms around decision-making. By shifting from intuition-driven to data-driven mechanisms, the DSS introduces a level of procedural fairness and traceability that is often difficult to achieve manually. Moreover, the system facilitates auditability, whereby the rationale behind each scholarship award can be reconstructed and justified using quantifiable parameters.

From an operational perspective, the deployment of the DSS has demonstrated a substantial reduction in time and effort required for scholarship evaluation. Tasks that previously spanned several days of manual deliberation can now be completed within minutes. This efficiency gain not

only liberates administrative bandwidth but also enhances responsiveness, enabling the institution to process a higher volume of applications without compromising accuracy.

Supporting this viewpoint, Wiwik et al. demonstrate that the integration of a DSS in educational contexts can lead to significant operational improvements, emphasizing that such systems simplify decision-making processes and enhance the effectiveness of evaluations (Wiwik et al., 2023). By automating the calculation and comparison of varied criteria, DSS reduces the manual workload typically associated with traditional scholarship assessment methods. Arifitama notes that the SAW method helps minimize errors and biases during the selection process. The DSS provides a standardized evaluation framework that efficiently computes eligibility based on predefined criteria, ultimately reducing decision-making time and human resource investments (Arifitama, 2022).

A nuanced observation from the user study also points to an unanticipated benefit: the system functions as an educational tool for stakeholders, fostering a better understanding of criteria weighting and its influence on outcomes. This insight is especially valuable in fostering participatory governance, as it allows decision-makers to engage with and refine the logic of the selection model collaboratively.

Despite these positive outcomes, the study also acknowledges limitations. First, the current system architecture is designed for quantitative criteria, and while this promotes computational clarity, it limits the integration of qualitative aspects such as leadership potential, community engagement, or resilience—attributes often critical in holistic scholarship assessment. This limitation is underscored by Aziz et al., who discuss the inherent subjectivity present in performance appraisals and decision-making, indicating that qualitative factors can be overshadowed when focusing predominantly on numerical criteria (Aziz et al., 2020). Future development could consider hybrid approaches, integrating fuzzy logic or machine learning techniques to capture such soft attributes.

Second, the weighting schema, though established through institutional consensus, may not capture the full spectrum of equity considerations. Periodic reviews of the weights and their alignment with policy goals are essential to maintain the system's relevance and fairness.

In light of these findings, it is evident that algorithmic decision support, when contextually grounded and transparently implemented, can significantly elevate institutional capacity for equitable and efficient resource allocation. The SAW-based DSS represents a step toward digital transformation in higher education administration, reinforcing the university's commitment to merit-based and need-sensitive scholarship distribution.

Moreover, this implementation serves as a replicable model for other institutions facing similar challenges. The architecture, while tailored to the specific context of Universitas Tama Jagakarsa, is modular and adaptable, allowing for recalibration based on differing criteria, weights, or policy objectives. It also opens pathways for further system enhancement, such as integration with student information systems (SIS), mobile access interfaces, and real-time analytics dashboards.

The deployment of a SAW-based Decision Support System for scholarship selection at Universitas Tama Jagakarsa illustrates the confluence of algorithmic logic and institutional equity objectives. By embedding transparent, data-driven practices into the core of decision-making, the system not only improves efficiency and fairness but also fosters a culture of accountability and evidence-based governance. Continued iteration, grounded in user feedback and evolving policy mandates, will be key to sustaining its impact and expanding its utility within the broader higher education ecosystem.

#### 4. CONCLUSION

This study presents the design and implementation of a Decision Support System (DSS) for scholarship selection at Universitas Tama Jagakarsa, utilizing the Simple Additive Weighting (SAW) algorithm to address inefficiencies and subjectivity inherent in manual selection processes. Developed through empirical insights from stakeholder interviews and observations, the system incorporates key eligibility criteria such as GPA, parental income, and number of siblings, aligning with institutional goals to support high-achieving students from economically disadvantaged backgrounds. By applying the SAW algorithm, the system enables objective, multi-criteria evaluation through weighted normalization, resulting in consistent applicant ranking. Implemented using VB.NET with a MySQL backend, the user-friendly interface facilitates accessibility for both administrators and students. Functional validation via black-box testing and stakeholder evaluation demonstrated the system's effectiveness in enhancing efficiency, transparency, and structured decision-making. Quantitative testing revealed that the system achieved 100% accuracy in functional

operations during black-box testing, with an average processing time of less than 6 seconds per applicant, compared to approximately 10 minutes required in manual processing. Comparative evaluation also indicated a 95% match in final applicant rankings between the manual and system-based selection, validating the system's alignment with institutional priorities while reducing workload and subjective bias. Furthermore, the SAW-based DSS successfully managed trade-offs between conflicting criteria, enabling equitable and data-driven scholarship distribution, and showed potential for scalability to other institutional contexts. Overall, the study affirms the utility of algorithmic DSS approaches in improving educational decision-making and offers a replicable model for digital transformation in scholarship management. In addition to its practical utility, the study contributes scientifically to the body of knowledge on decision support system development by demonstrating the operationalization of the SAW algorithm in a real-world higher education context. It provides empirical evidence on the algorithm's effectiveness in institutional decision-making, thereby enriching the discourse on multi-criteria decision-making tools in educational management. Based on the outcomes of this research, several recommendations are proposed for both practice and future studies. First, the university should formally adopt the developed DSS to streamline its scholarship selection process, with periodic updates to reflect evolving institutional policies and socioeconomic conditions. Second, training programs should be implemented for administrative staff to ensure the system is used optimally and maintained adequately. Third, expanding the criteria set to include qualitative aspects—such as interviews, recommendation letters, or psychological assessments—could enrich the decision-making process and provide a more holistic evaluation of applicants. From a research perspective, future developments could involve integrating more sophisticated algorithms such as TOPSIS, PROMETHEE, or machine learning models for predictive analytics. A longitudinal study assessing the long-term outcomes of selected scholarship recipients (e.g., academic success, graduation rates) could also offer deeper insights into the effectiveness of the DSS in achieving institutional goals. Ultimately, the fusion of technological tools with institutional decision-making practices holds transformative potential for higher education governance and equity.

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