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ORIGINAL

Implementation of the Analytical Hierarchy Process (AHP) Method for Choosing Majors in the Web-Based New Student Admission Information System (PPDB)

Implementación del Método de Proceso de Jerarquía Analítica (AHP) para la Elección de Especialidades en el Sistema de Información de Admisión de Nuevos Estudiantes Basado en Web (PPDB)

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ABSTRACT

Introduction: student major placement in vocational schools often lacks a standardized, data-driven decision-making process.
Objective: this study aims to develop a web-based New Student Admission Information System (PPDB) that integrates the Analytical Hierarchy Process (AHP) for accurate and transparent major recommendations.
Method: a structured waterfall software development life cycle (SDLC) was applied. The system was built using PHP, CodeIgniter, and MySQL, adopting the MVC architectural pattern. AHP was implemented on the server side to calculate priority weights and consistency ratios based on student data and selection criteria.
Results: the system accommodates four user roles (students, admin, committee, principal). It enables real-time registration, document uploads, major selection, and automated recommendation using AHP. Interfaces are responsive, and data flow is traceable. AHP processing improves objectivity and consistency in decision-making, replacing traditional subjective assessments.
Conclusions: this system transforms vocational school admissions by integrating technology and structured decision-making. It supports transparency, fairness, and scalable implementation for broader educational environments.

Keywords: PPDB; SDLC; Waterfall Method; AHP; Website.

RESUMEN

Introducción: la asignación de especialidades en escuelas vocacionales carece a menudo de un proceso de decisión estandarizado y basado en datos.
Objetivo: desarrollar un sistema web para la admisión de nuevos estudiantes (PPDB) que integre el Proceso Analítico Jerárquico (AHP) para recomendar especialidades con precisión y transparencia.
Método: se utilizó el ciclo de vida de desarrollo de software en cascada. El sistema fue construido con PHP, CodeIgniter y MySQL, empleando la arquitectura MVC. AHP se implementó en el servidor para calcular ponderaciones y razones de consistencia basadas en datos de los estudiantes y criterios de selección.
Resultados: el sistema atiende a cuatro tipos de usuario (estudiantes, administración, comité, dirección). Permite registro, carga de documentos, elección de especialidad y recomendaciones automáticas con AHP.

La interfaz es adaptable y los datos son rastreables. AHP mejora la objetividad y coherencia en la toma de decisiones.
Conclusiones: el sistema moderniza el proceso de admisión escolar al integrar tecnología con métodos de decisión estructurados, promoviendo la equidad, la transparencia y una aplicación escalable.

Palabras clave: PPDB; SDLC; Método Waterfall; AHP; Sitio Web.

INTRODUCTION

The admission of new students is a fundamental process in every educational institution, serving as an initial screening mechanism for human resources to ensure academic quality and institutional alignment.[1,2] Vocational High Schools (SMK) play a crucial role in Indonesia's educational system, specifically designed to produce skilled graduates ready for the workforce. According to the Ministry of Education and Culture of Indonesia, there are approximately 14 000 vocational schools serving over 5 million students nationwide as of 2023, making the efficiency of student admission processes critically important for educational management.[3,4]

The student admission process traditionally involves two critical stages: initial student selection and major determination. However, current practices in many Indonesian vocational schools, including SMK N 11 Merangin, rely heavily on manual, offline processes that present significant challenges. These manual systems are characterized by paper-based documentation, physical presence requirements for registration, and limited analytical tools for major selection decisions. The problem of inappropriate major selection has become increasingly prevalent in vocational education.[5,6] Research indicates that approximately 30-40 % of vocational students in Indonesia experience academic difficulties and reduced motivation due to mismatched major selection. This mismatch leads to various academic and behavioral issues, including increased absenteeism, classroom disruption, and ultimately, reduced learning outcomes.[7,8]

The guidance counselor data from SMK N 11 Merangin (July-December 2022) confirmed these trends, revealing that many students felt unsuitable for their chosen majors, resulting in frequent absences during final class periods and disruptive classroom behavior.[9] Students were often found in the cafeteria and behind the school, leading to noisy classrooms where teachers' explanations were disregarded, and some students even fell asleep during class. The transition from manual to digital admission systems has proven beneficial in educational institutions worldwide.[10,11] Digital systems offer improved efficiency, reduced processing time, enhanced data security, and better accessibility for stakeholders. Furthermore, the integration of decision support systems in educational contexts has shown promising results in improving decision-making quality and student satisfaction.[12]

The Analytical Hierarchy Process (AHP), developed by Thomas Saaty in 1980, is a structured technique for organizing and analyzing complex decisions based on mathematics and psychology.[13,14] AHP helps decision-makers find the alternative that best suits their goal and their understanding of the problem by providing a comprehensive and rational framework for structuring decision problems, measuring and synthesizing priorities. In educational contexts, AHP has been successfully applied for various decision-making scenarios, including program evaluation, resource allocation, and student placement. The method utilizes pairwise comparison principles to allow stakeholders to assign weights or relative values to each criterion and alternative, thus breaking down the complexity of problems by detailing decision elements into smaller, more manageable levels.[15]

This study aims to develop and implement a web-based New Student Admission Information System that integrates the Analytical Hierarchy Process (AHP) method to improve the accuracy of major placement decisions and enhance the overall efficiency of the admission process at SMK N 11 Merangin.[16] The research questions focus on how the AHP method can be effectively integrated into a web-based PPDB system for major selection, what the key system requirements are for implementing an efficient online admission process, and how the proposed system improves upon the current manual admission procedure. The research hypothesis states that the implementation of the AHP method in a web-based PPDB system will significantly enhance the accuracy of major selection decisions and improve the overall efficiency of the student admission process at SMK N 11 Merangin.

METHOD

Type of Investigation

This research employs a developmental research approach using system development methodology, specifically focusing on the design, development, and implementation of a web-based information system with decision support capabilities.[17]

Methodological Definitions

- PPDB (Penerimaan Peserta Didik Baru): new Student Admission Information System.
- AHP (Analytical Hierarchy Process): a multi-criteria decision-making method using pairwise comparisons to determine relative importance of alternatives.[18]
- SDLC (System Development Life Cycle): a structured approach to software development consisting of sequential phases.[19]
- Waterfall Model: a linear sequential design approach where each phase must be completed before the next begins.

Research Variables

- Input Variables: student academic records, personal data, interest assessments, aptitude test results, major preferences.
- Process Variables: AHP criteria weights, pairwise comparison matrices, consistency ratios, system algorithms.
- Output Variables: major recommendations, ranking scores, admission decisions, system reports.

Requirement Analysis

In this stage, system analysis is conducted based on the results of observations of the current process and interviews with guidance counselors at SMKN 11 Merangin. This comprises the analysis of the existing system and the proposed system.

Running System Flowmap

Describing a diagram or system procedure chart that is currently running can be seen in figure 1.

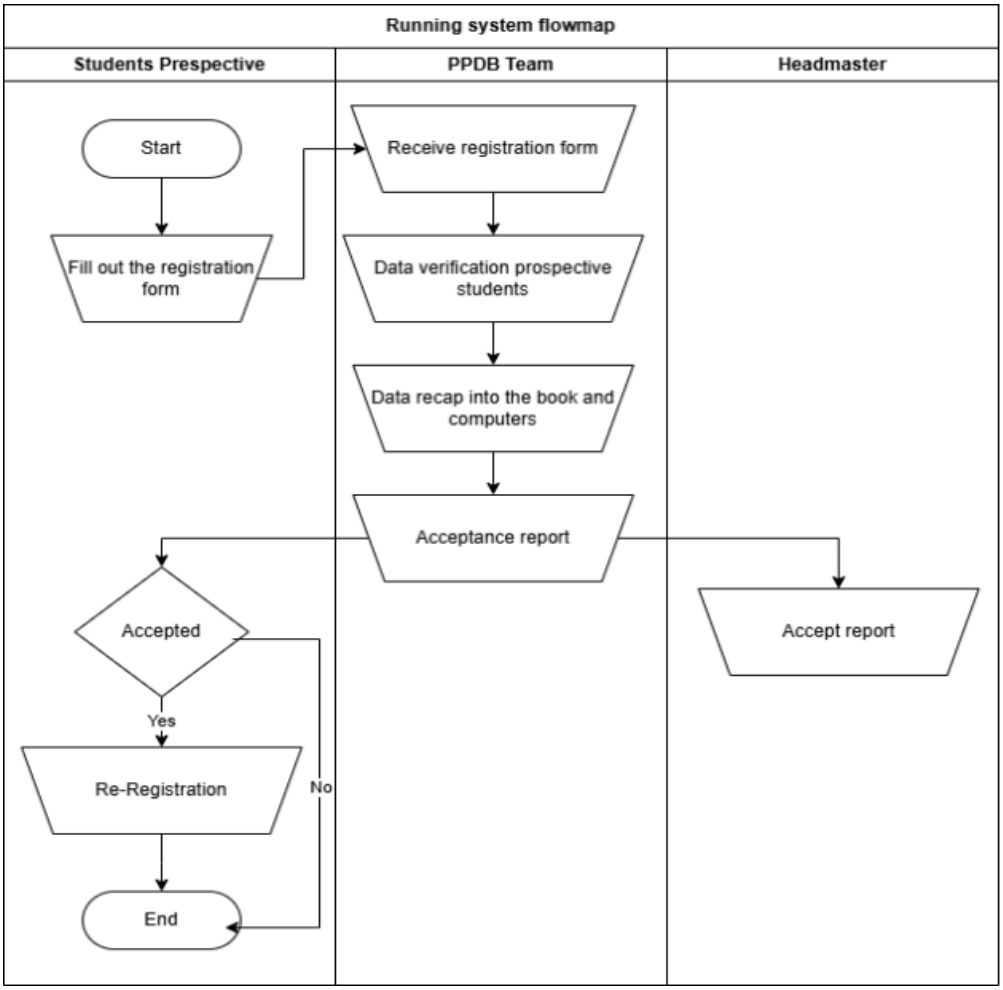


Figure 1. Current system flowmap for admission of new students

Proposed System Flowmap

Describing the diagram or flowchart of the proposed system can be seen in figure 2.

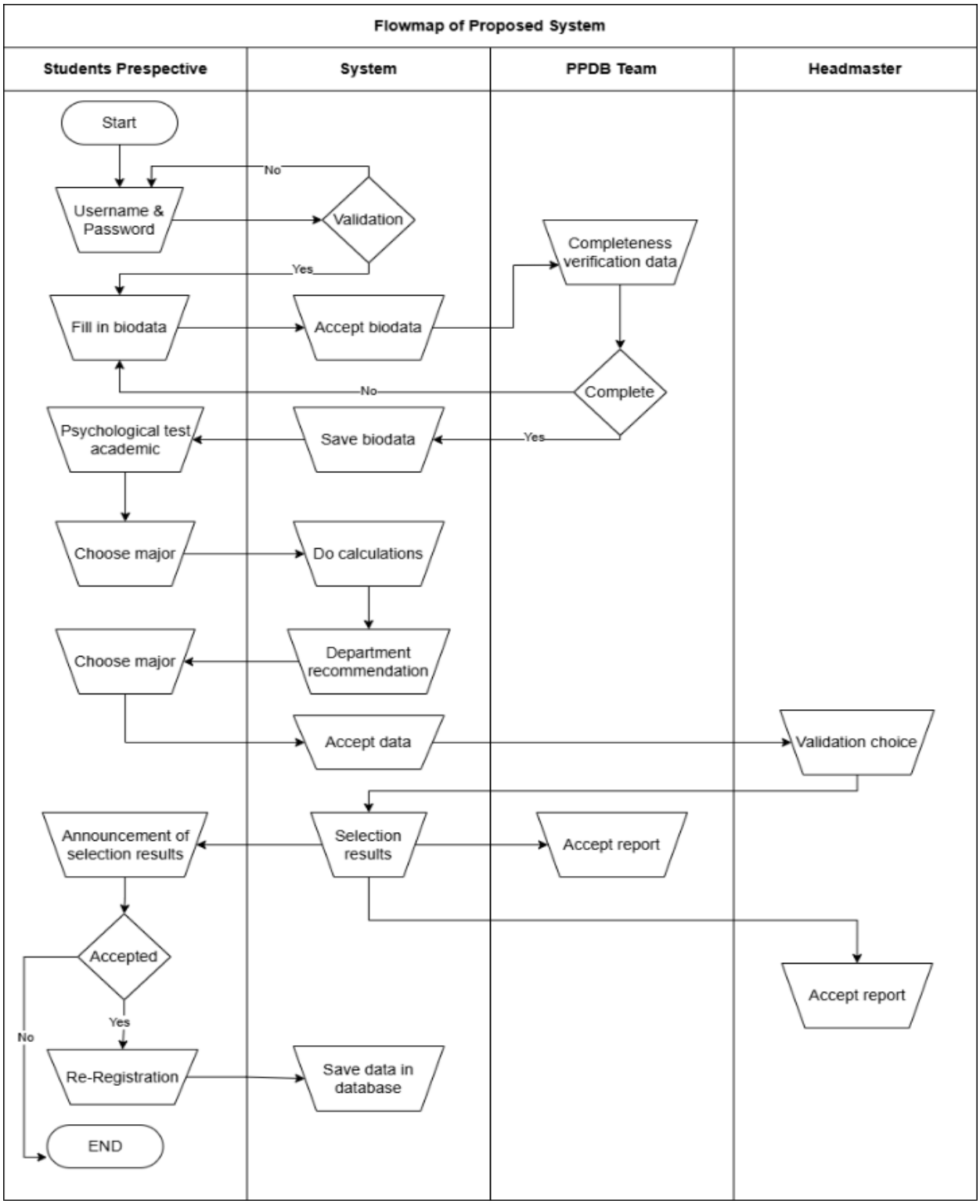


Figure 2. Flowmap of the roposed system for the application of the AHP method for selecting majors whenaccepting new students

System and Software Design

After the analysis of all defined system requirements, the process continues to the system design phase to obtain an overview of how the information will be implemented in the system. Modeling will be done using Unified Modeling Language (UML).[20] The parts of UML that will be used in system design are as follows.

Use Case Diagram

The use case diagram depicts the activities and interactions that occur between actors and the system to be built, as seen in figure 3.

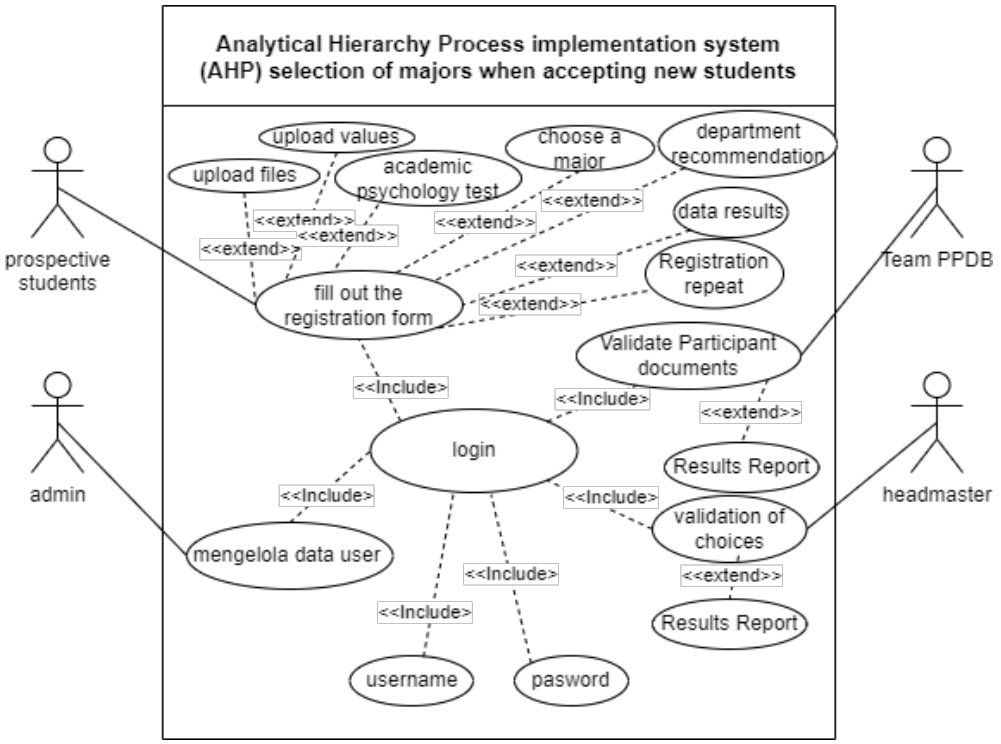


Figure 3. Analytical Hierarchy Process implementation system (AHP) selection of majors when accepting new students

Class Diagram

The class diagram is a collection of object classes. Classes depict the state (attributes) of a system, while also offering services to manipulate these states (functions), as seen in figure 4.[21]

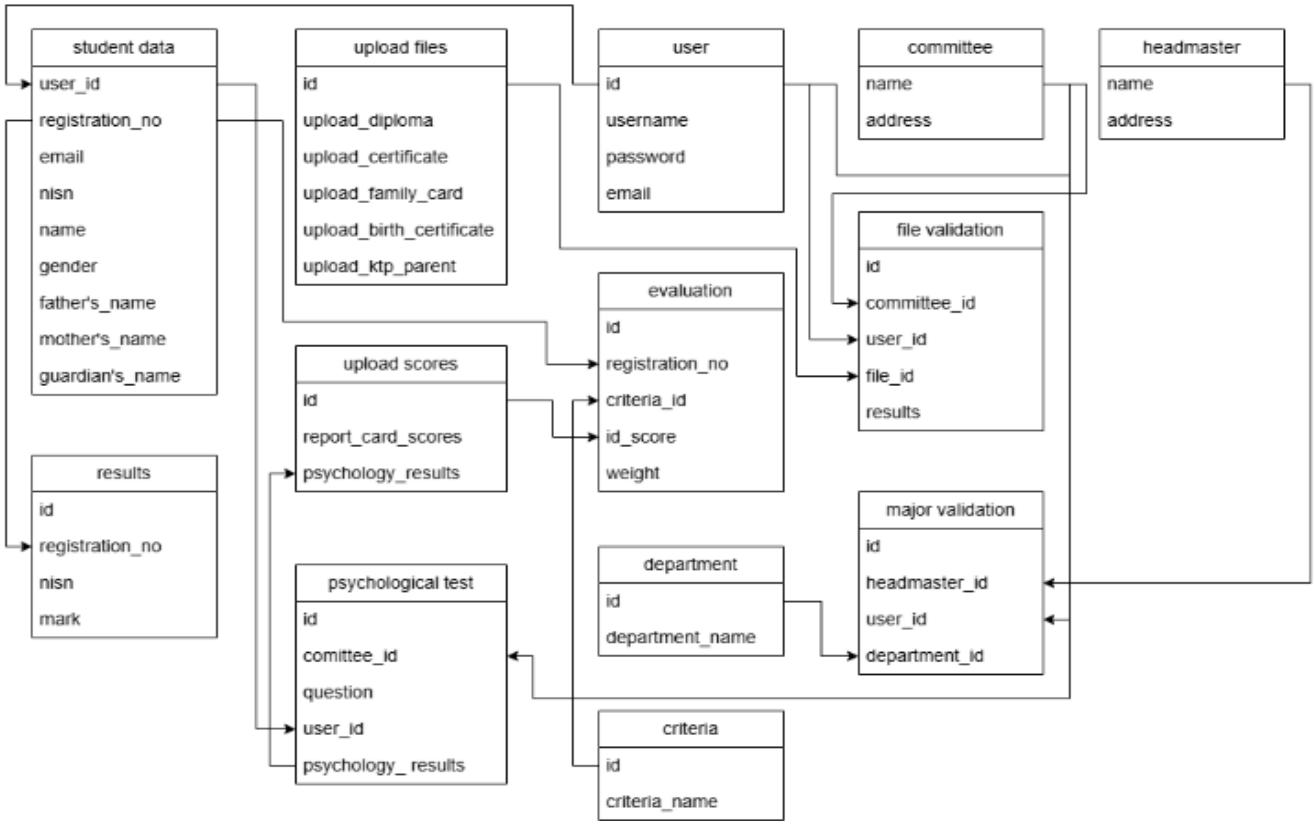


Figure 4. The class diagram for the implementation of AHP in selecting majors for new student admissions

Activity Diagram

Depicting the workflow or activities of a system or business process.

1. Activity Diagram Admin: the activity diagram for administrators illustrates the workflow that can be performed by admin users, as depicted in figure 5.

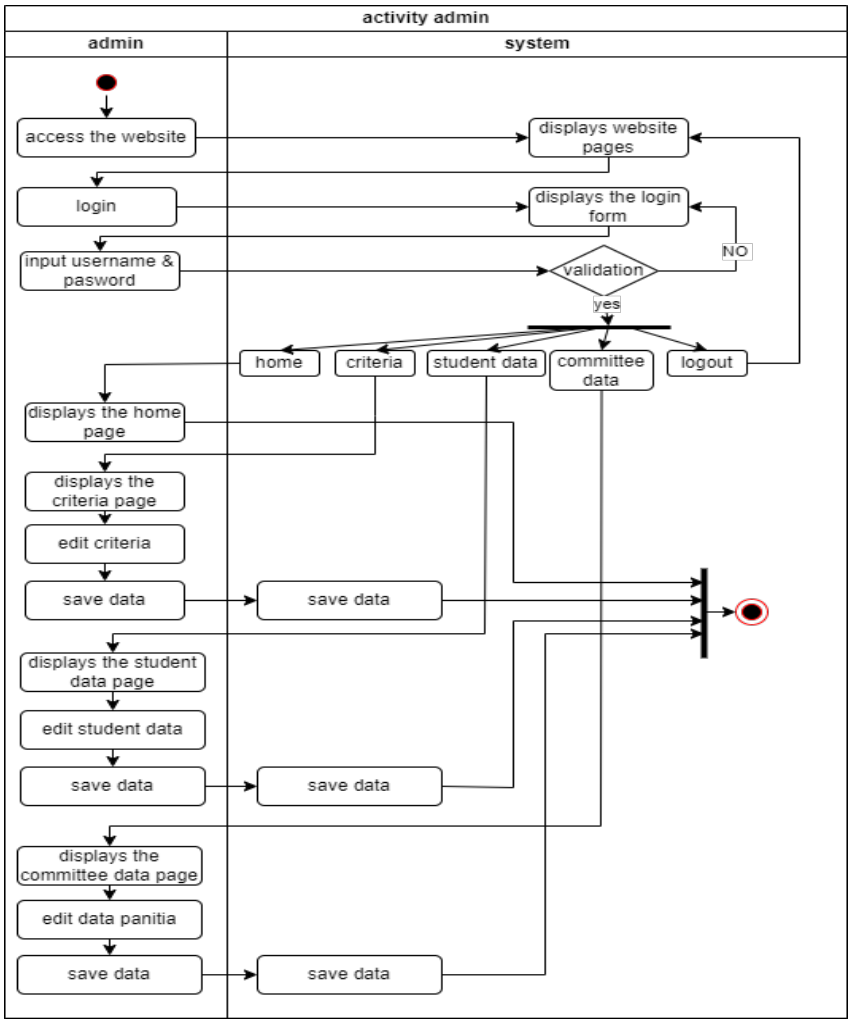


Figure 5. Activity diagram admin

2. Activity Diagram for Prospective Student Account Registration: the activity diagram for student registration portrays the workflow that can be carried out during registration by prospective student users, as depicted in figure 6.

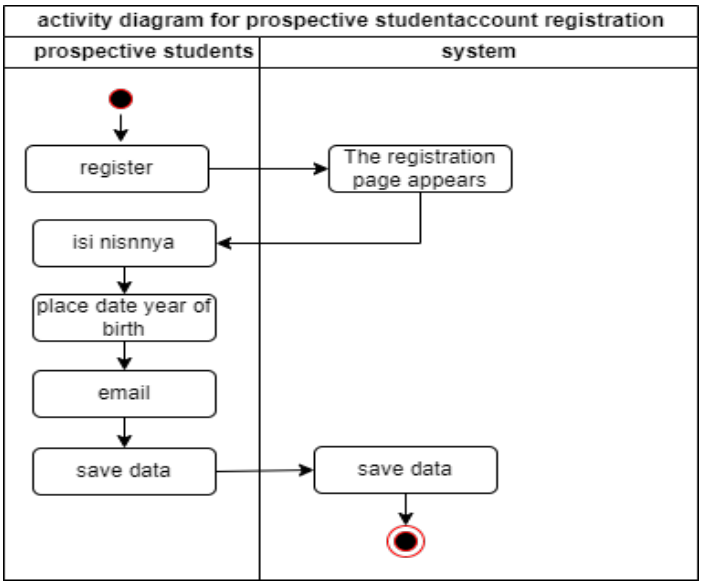


Figure 6. Activity diagram for prospective student account registration

3. Activity Diagram for Prospective Student: the activity diagram for prospective students illustrates the workflow that can be performed by prospective student users, as shown in figure 7.

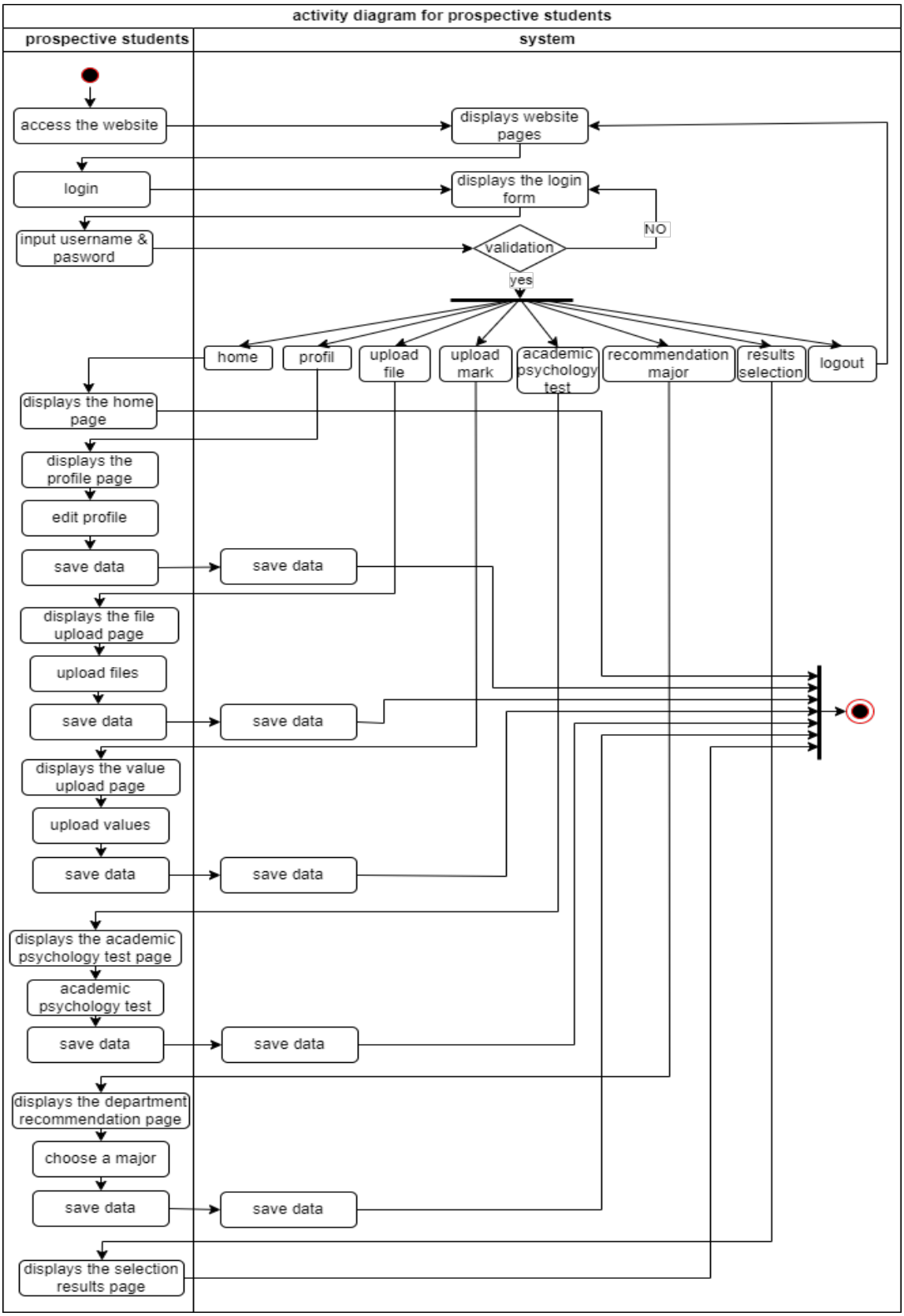


Figure 7. Prospective student activity diagram

4. PPDB Team Acitivity Diagram: the activity diagram for PPDB team depicts the workflow that can be performed by the PPDB team users, as shown in figure 8.

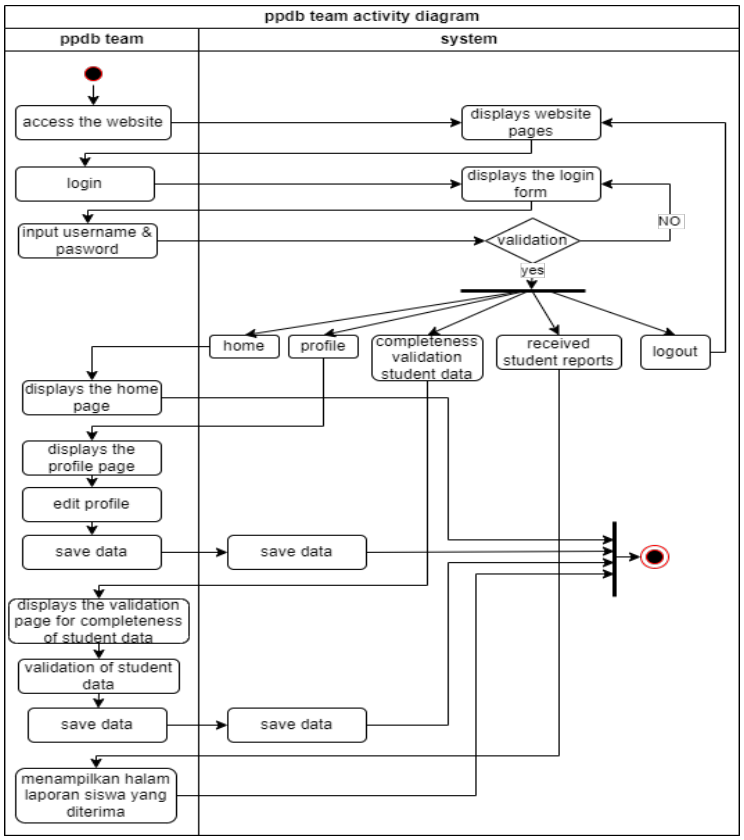


Figure 8. PPDB team activity diagram

5. Principal Activity Diagram: the activity diagram for school principal illustrates the workflow that can be performed by the user acting as the school principal, as depicted in figure 9.

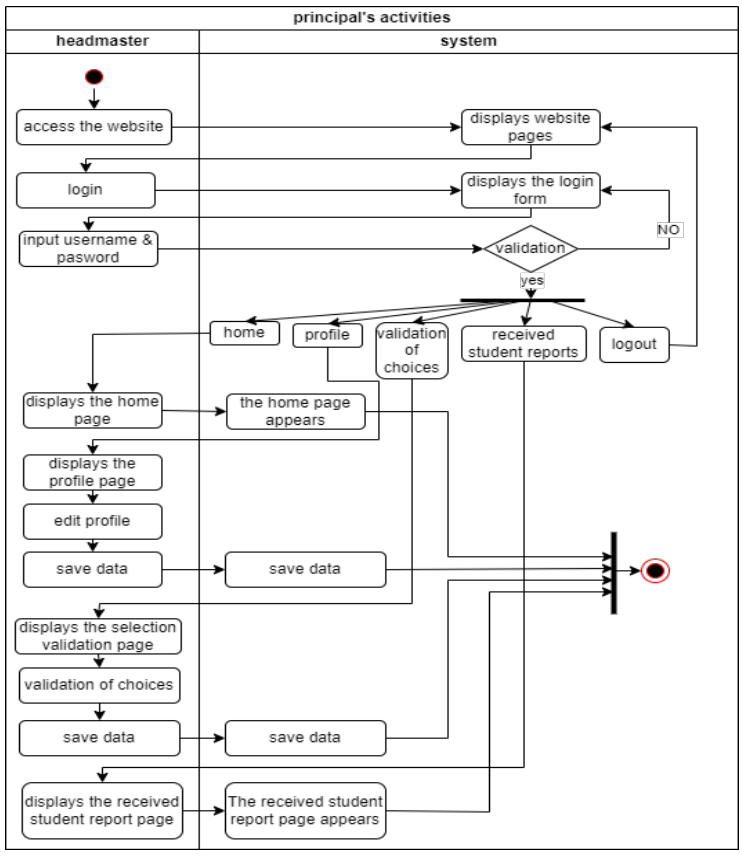


Figure 9. Principal activity diagram

Data Collection and Processing

Student data collection involves gathering academic transcripts, personal information forms, and assessment results through the web interface. The system processes this information using MySQL database storage with secure encryption protocols. AHP calculations are performed server-side using PHP algorithms that compute pairwise comparisons, generate consistency ratios, and produce weighted rankings for major selection recommendations.[22]

System Reproducibility

The development process is documented through comprehensive system documentation, including database schemas, API specifications, and user manuals. The waterfall methodology ensures each phase is thoroughly documented, enabling replication in different educational contexts. All source code follows MVC architecture principles using CodeIgniter framework standards.[23]

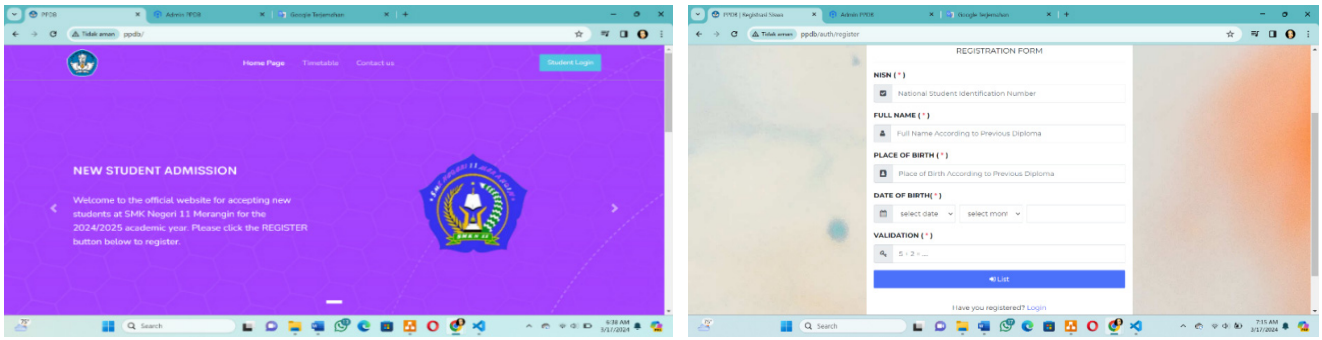
Ethical Considerations

This research adheres to Indonesian data protection regulations and educational ethics standards. Student data privacy is protected through secure authentication systems, encrypted data transmission, and role-based access controls. Informed consent procedures are implemented for data collection, and students maintain the right to access and modify their personal information. The AHP decision-making process maintains transparency, allowing students to understand the criteria and weights used in major selection recommendations.[24]

RESULTS

The implementation of a web-based New Student Admission Information System (PPDB) integrated with the Analytical Hierarchy Process (AHP) methodology at SMK N 11 Merangin was successfully completed. This system was developed using the PHP programming language and the CodeIgniter framework, following the Model-View-Controller (MVC) architecture, with MySQL serving as the database management system. The system supports four different user roles, namely students, administrators, committee members, and school principals, each with a customized interface and specific functionalities tailored to their roles in the admission process.

From the user interface perspective, the system was designed to be intuitive and responsive. The use of Bootstrap CSS ensures compatibility across various devices, enabling users to access and navigate the system efficiently whether through desktop or mobile platforms. The student interface allows prospective students to register, complete their personal and academic data, and upload required documents. Once the registration is completed, the system automatically sends email confirmations, enhancing communication and transparency. This process is illustrated in figure 10, which shows the student dashboard and registration interface.



(a) (b)

Figure 10. Student Dashboard & Registration Page

The administrator interface includes tools to manage institutional settings and user data, facilitating backend control of the admission system. The committee interface is responsible for validating student documents, scheduling admission activities, and publishing the results of the selection process. The school principal's interface provides access to the verification of major selections, thereby offering an authoritative role in validating and finalizing student placements. A consolidated view of these functionalities is shown in figure 11, representing the admin, committee, and principal dashboards.

The core functionality of the system lies in its integration of the AHP method for decision support in major selection. Students provide academic records, interest assessments, and major preferences through the platform.

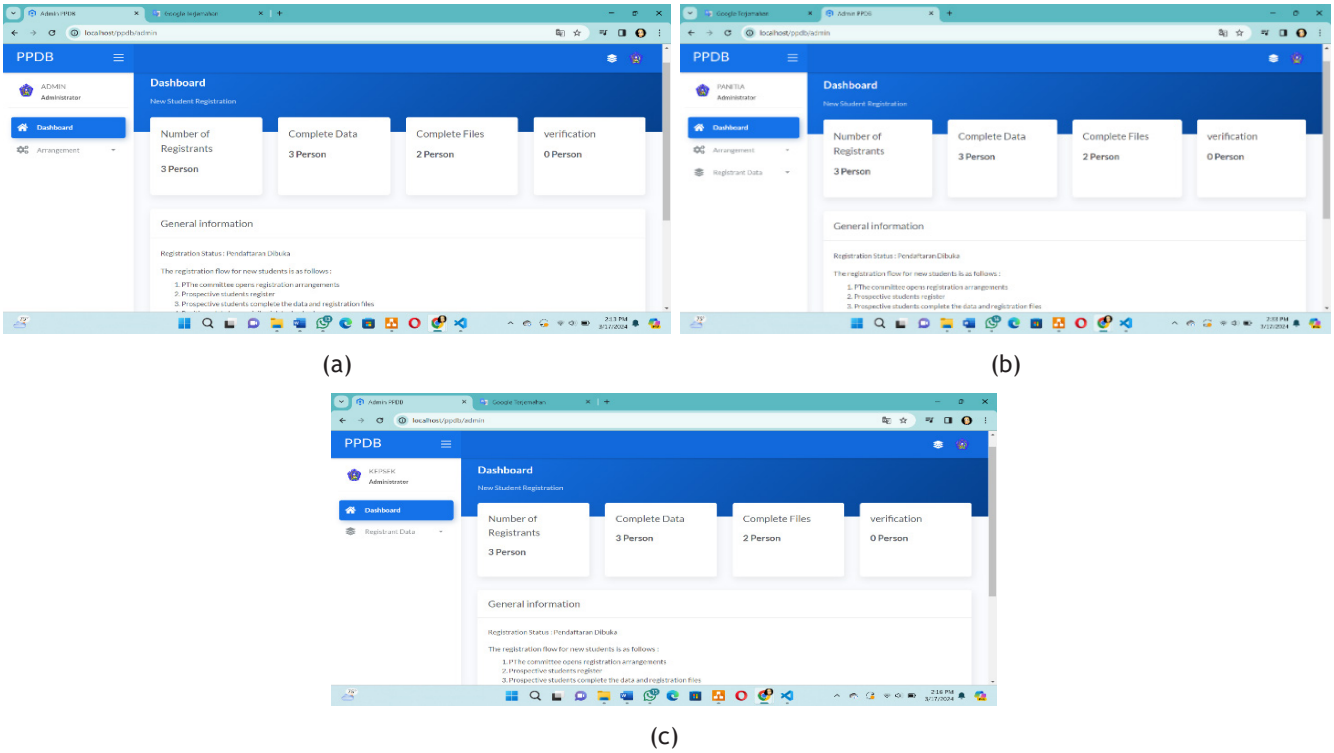


Figure 11. Admin (a), Committee (b), and Principal Dashboards (c)

This data is processed server-side using the AHP algorithm, which performs pairwise comparisons and calculates consistency ratios to generate weighted rankings of available majors. The system then produces personalized recommendations for each student based on these calculations. These results are reviewed by the PPDB team and school principal to determine the most appropriate major for each applicant.

Through these functionalities, the web-based system not only automates the admission process but also introduces a data-driven approach to guide students in choosing majors that align with their strengths and interests.

DISCUSSION

The development and implementation of this web-based PPDB system with AHP integration represent a significant advancement over the traditional manual admission procedures at SMK N 11 Merangin. The manual process was often time-consuming, paper-based, and subjective, with decisions relying heavily on human judgment without analytical support. In contrast, the AHP-based system introduces a structured, objective, and transparent approach to major selection, which helps reduce mismatches between students and their chosen fields.

When compared to previous works such as Herdiansah[7] and Ilham et al.[9], this study offers a more practical and scalable solution by embedding the AHP model within an interactive web platform. The decision-making process is now traceable and reproducible, enabling school stakeholders to review the rationale behind each placement. This increases trust in the system and supports more equitable outcomes, as every student is evaluated based on consistent criteria.

Moreover, the MVC-based system architecture ensures modularity and ease of maintenance. The use of open-source technologies like PHP, MySQL, and Bootstrap significantly reduces development costs while providing sufficient flexibility for future enhancements. Real-time data access and notifications improve user engagement and reduce information delays, which are common issues in manual systems.

Despite these improvements, there are still areas for further enhancement. One limitation is the system's current dependence on the accuracy and completeness of the data provided by students. If students provide inaccurate or incomplete information, the quality of the AHP recommendations may be compromised. To address this, future versions of the system could integrate data validation mechanisms and incorporate verification steps using historical academic performance records.

Additionally, the current version of the system does not incorporate post-placement feedback or learning analytics to track the success of the recommendations. Implementing a feedback loop that collects performance data after students are placed in their respective majors could help refine the AHP criteria weights over time. Incorporating adaptive algorithms or machine learning components could further enhance the system's

intelligence and personalization capabilities.

The inclusion of additional variables such as psychological assessments, socio-economic background, and parental preferences could also make the recommendation process more holistic. This would align with modern educational paradigms that emphasize personalized learning pathways and student well-being. Moreover, the use of digital dashboards for administrators and principals allows for real-time monitoring, which supports proactive interventions when necessary.

In conclusion, this study demonstrates the feasibility and effectiveness of combining web-based technologies with structured decision-making methods like AHP in educational settings. It provides a replicable model for other institutions seeking to modernize their admission processes and highlights the importance of integrating data-driven approaches in supporting students' academic and career pathways.

CONCLUSIONS

Decision-making in student major placement can be systematized through structured methodologies and accessible technologies. Abstracting student profiles into computable preferences facilitates fairer academic planning. The integration of AHP in web-based educational systems reflects a shift toward transparent, evidence-based selection processes within institutional decision ecosystems. In educational settings where choice influences long-term outcomes, the application of algorithmic frameworks strengthens consistency, accountability, and personalized direction. These systems are not merely technical implementations but conceptual bridges between student potential and institutional vision, enabling education to move from assumption-based decisions to informed and equitable guidance frameworks.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Project management: Siti Ramah.
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