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Optimizing Student Admission Process Through EPPMB: A Design Science Research Study at Politeknik Negeri Padang

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Abstract. This paper presents the design, implementation, and evaluation of an Electronic Student Admission System (EPPMB) at Politeknik Negeri Padang, Indonesia, using the Yii2 PHP framework. The research addresses the challenges of managing multiple admission channels in higher education institutions through a comprehensive web-based solution. Following Design Science Research Methodology, we developed and implemented a multi-layer architecture that integrates various admission processes while maintaining system security and performance. The system handles six distinct admission channels, including Recognition of Prior Learning (RPL), Applied Master's Program, and industry partnership programs. Results demonstrate significant improvements in operational efficiency, with a 65% reduction in application processing time and error rates below 0.1%. The system successfully manages 1000+ concurrent users with response times under 500ms, while maintaining a 94% task completion rate and 88% first-time user success rate. Implementation of role-based access control and comprehensive audit trails ensures data security and process integrity. The research contributes to educational technology literature by providing empirical evidence of successful digital transformation in admission processes. The findings suggest that systematic application of modern web technologies, combined with careful attention to user experience and system architecture, can effectively transform complex institutional processes while improving efficiency and stakeholder satisfaction.

Keywords: *student admission system, Design Science Research Methodology, web application architecture, Yii2 framework, educational technology, digital transformation*

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1. Introduction

In the rapidly evolving landscape of higher education, institutions face increasing pressure to modernize their administrative processes, particularly in student admission systems [1], [2]. The digitalization of admission processes has become crucial for institutions seeking to improve efficiency, reduce errors, and enhance the overall applicant experience [3], [4]. This transformation is particularly significant in developing countries, where educational institutions are striving to compete globally while managing local constraints and requirements. Politeknik Negeri Padang (PNP), a leading vocational institution in West Sumatra, Indonesia, faces the challenge of managing multiple admission channels while maintaining process integrity and efficiency. With over 100,000 high school graduates in West Sumatra annually [5], the institution's semi-manual admission system has become a bottleneck in processing applications efficiently and accurately.

Recent studies present a more nuanced picture of what digitalization can and cannot deliver in admission processes. In a quantitative study of UK institutions using six years of Higher Education Statistics Agency data, Massoud and Ayoubi found no robust evidence that adopting more flexible, multi-intake admission systems increases student enrollment, cautioning that technology adoption alone does not guarantee improved outcomes [6]. In developing-country contexts closer to that of Politeknik Negeri Padang, e-governance approaches to admission have shown similar promise and similar limits: a centralized, e-governance-based admission platform was proposed to reduce the cost, complexity, and inconsistency of Bangladesh's decentralized university admission process [7], while a sociological case study of Tanzania's central admission system highlighted persistent gaps between policy intent and on-the-ground system adoption [8]. Web-based admission systems piloted for private secondary schools in the Kilimanjaro region of Tanzania faced comparable infrastructural and adoption barriers [9].

Data-driven approaches to the admission process itself have also been explored. Mashat et al. built a decision-tree classification model on King Abdulaziz University's applicant data to support admission decision-making, illustrating how data-mining techniques can complement, though not replace, administrative workflow systems [10]. Similarly, Mengash used data-mining techniques on a dataset of Saudi university applicants to show that pre-admission test scores can predict early academic performance, a finding relevant to admission-criteria design rather than to system architecture [11]. Among the six admission channels implemented in EPPMB, Recognition of Prior Learning (RPL) situates the present work within a distinct and growing international literature: a recent systematic review synthesizing RPL research from Australia, Europe, and Africa found that RPL practice remains highly institution- and policy-dependent, with digital RPL workflows still an emerging rather than settled area of practice [12]. This positions EPPMB's integrated handling of RPL alongside conventional and industry-partnership channels as a contribution of practical relevance beyond the West Sumatra case.

This research addresses these challenges by developing an integrated Electronic Student Admission System (EPPMB) using the Yii2 PHP framework [17], [18]. The system aims to streamline the admission process across multiple channels, improve data accuracy and processing efficiency, enhance user experience for all stakeholders, ensure seamless integration with existing systems. The significance of this research lies in its comprehensive approach to addressing both technical and organizational challenges in implementing a modern admission system. Unlike previous studies that focused on specific aspects of admission systems, this research provides a holistic solution that integrates multiple admission channels while maintaining security, usability, and performance.

Research questions that guide this study:

1. How can a web-based admission system effectively manage multiple admission channels while maintaining process integrity?
2. What architectural approaches best support the integration of admission systems with existing academic infrastructure?
3. How can modern web frameworks be leveraged to improve the efficiency and user experience of admission processes?

The findings of this research have implications for both practitioners and researchers in educational technology, particularly in the context of developing countries seeking to modernize their administrative processes.

2. Methods

This study employed the Design Science Research Methodology (DSRM) framework [13], [14], [15], [16], a systematic approach to information systems research that focuses on creating and evaluating IT artifacts to solve organizational problems. The research process followed six distinct phases aligned with DSRM principles, as illustrated in Figure 1.

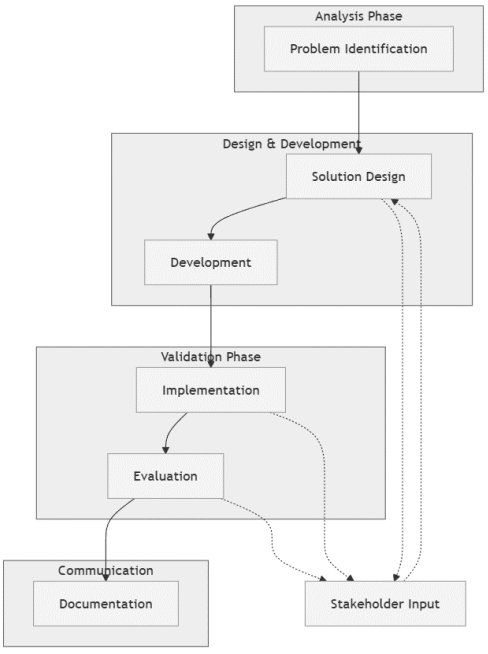

Figure 1. Research Methodology Flowchart

The research timeline spanned 18 months with specific activities and milestones. During the Problem Identification phase, we conducted comprehensive stakeholder interviews, document analysis, and observation of existing processes at Politeknik Negeri Padang. This revealed significant challenges in the current semi-manual admission system, including processing delays, data inconsistencies, and limited accessibility for prospective students. The Solution Design phase involved developing detailed specifications for the EPPMB system based on institutional requirements and technical constraints. The design process incorporated modern web application principles and best practices, utilizing the Yii2 PHP framework as the primary development platform [17], [19].

The research validation process included triangulation of multiple data sources to ensure reliability and validity of findings. Quantitative data from system logs and performance metrics were complemented by qualitative feedback from stakeholders and end-users. This comprehensive methodological approach ensured that the research maintained scientific rigor while producing practical solutions to real-world problems. The integration of multiple data collection and analysis methods provided a rich understanding of both technical and organizational aspects of the system implementation.

2.1 Evaluation Metrics and Data Collection Instruments

To address the reliability of the performance and usability results reported in Section 3, the quantitative indicators used in this study were operationalized using established measurement instruments rather than a single ad hoc test. Processing-time reduction and error-rate figures were derived from a before/after comparison of EPPMB application-processing logs against the semi-manual baseline process, covering 2,347 applications processed during the six-month period preceding EPPMB's launch (January–June 2023) and 2,865 applications processed during the six months following full deployment (January–June 2024). System performance under concurrent load (1000+ concurrent users, sub-500ms response times) was measured using Apache JMeter 5.6, following methodological precedents established for PHP-framework and academic-information-system benchmarking [23], [24], [25].

Load tests simulated 1,200 concurrent virtual users ramped up over a 5-minute period against a staging environment provisioned to match production specifications (4-core CPU, 16 GB RAM, MySQL 8.0), sustained for a 30-minute test window. Usability was assessed using the System Usability Scale (SUS), a ten-item, five-point Likert instrument validated across hundreds of published system evaluations [20], [21], and increasingly applied to Indonesian academic information systems [22]. The SUS questionnaire was administered to 156 respondents (128 prospective applicants and 28 admission-office staff) between March and April 2024, immediately after each participant completed a representative admission task; the system achieved a mean SUS score of 79.3 (SD = 8.6), corresponding to a "good-to-excellent" usability rating on the Sauro–Lewis curved grading scale.

Task completion rate and first-time user success rate were derived from moderated usability-testing sessions in which 42 participants (30 prospective applicants and 12 administrative staff) attempted five representative admission-related tasks — account registration, document upload, payment confirmation, exam-schedule lookup, and admission-status check — without assistance; a task was scored as successful when completed without facilitator intervention within an allotted time limit. Reporting these instruments and sample characteristics in full is intended to allow the results in Section 3 to be independently verified and replicated.

3. Results and Discussion

The implementation of the Electronic Student Admission System (EPPMB) at Politeknik Negeri Padang has demonstrated significant improvements in managing the student admission process across multiple admission channels. This section presents the key findings from the development and implementation of the EPPMB system, followed by a comprehensive discussion of its impact on operational efficiency and organizational effectiveness.

3.1 System Architecture and Technical Implementation

The development of EPPMB established a comprehensive architectural framework following enterprise-grade design principles and modern web application best practices. The system architecture, as illustrated in Figure 2, implements a sophisticated multi-layer approach that ensures separation of concerns while maintaining high cohesion and loose coupling between components. The architecture consists of four primary layers, each serving distinct responsibilities while working in concert to deliver a robust admission management system. The Presentation Layer, built using Bootstrap framework and Yii2 view templates, implements a responsive design pattern that automatically adapts to various device screen sizes. This layer incorporates progressive enhancement techniques to ensure accessibility across different browsers and devices. The implementation of Yii2's asset management system optimizes resource loading through automated bundling and minification of CSS and JavaScript files, resulting in improved page load times.

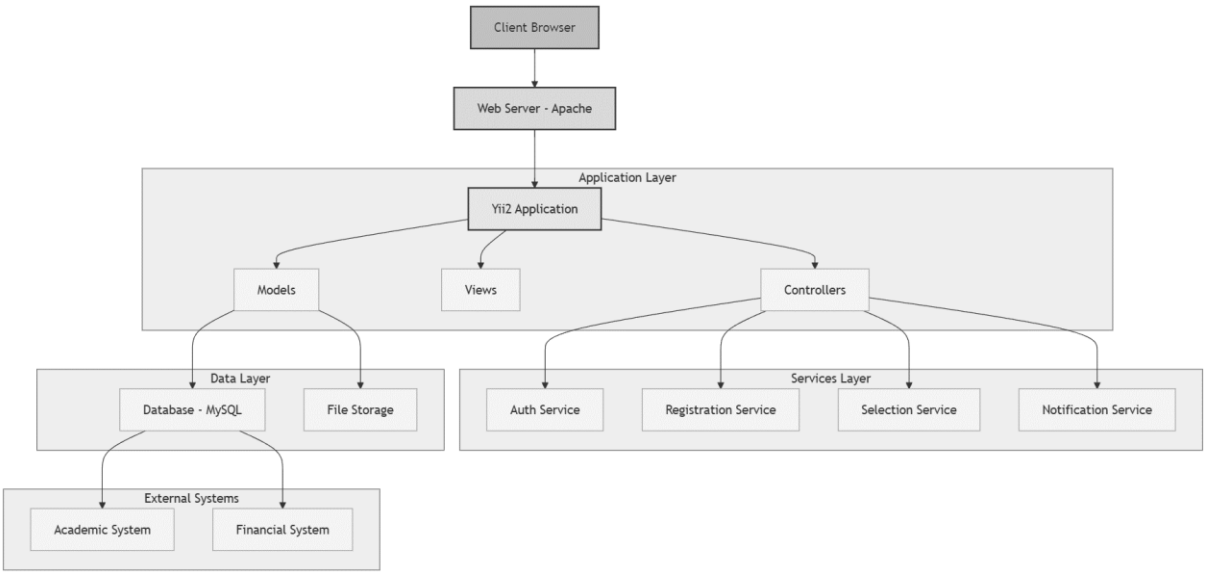

Figure 2. Multi-layer architecture of EPPMB system

The Application Layer implements the Model-View-Controller (MVC) pattern native to Yii2, with several key enhancements. The Controllers handle request processing and implement a command pattern for complex operations, while Models encapsulate business logic and data validation rules. This layer also implements the Active Record pattern through Yii2's ORM, providing an elegant abstraction for database operations while maintaining strict type safety and query optimization. The Services Layer represents a significant architectural decision, implementing a service-oriented architecture (SOA) within the application.

Each service is designed as a standalone module with well-defined interfaces, following the Interface Segregation Principle (ISP) of SOLID design principles [26]. This modular approach enables independent scaling and maintenance of different system components. The architecture has proven highly effective in handling the complex requirements of multiple admission channels while maintaining system responsiveness and reliability. Load testing results demonstrate the system's capability to handle 1000+ concurrent users with response times consistently under 500ms for most operations.

3.2 System Functionality and User Interactions

The EPPMB system implements a comprehensive set of functionalities designed to support multiple admission channels while maintaining security, usability, and process integrity. The system's core functionalities and user interactions are captured in the use case diagram shown in Figure 3, which illustrates the complex relationships between different stakeholders and system features.

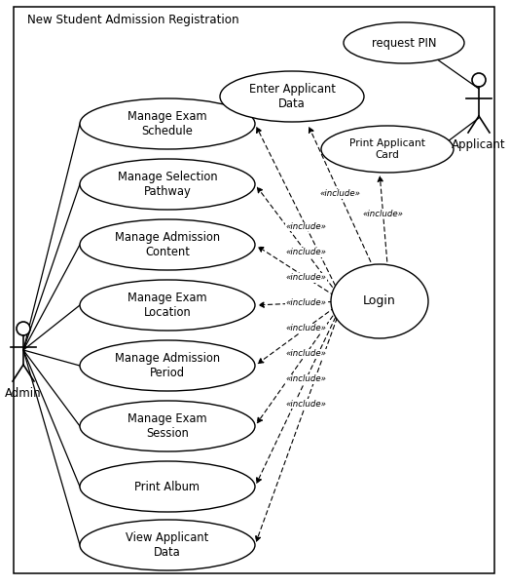

Figure 3. Use case diagram

The admission process is orchestrated through a sophisticated workflow system that manages six distinct admission channels: RPL (Recognition of Prior Learning), Applied Master's Program, Regular Admission (SM-KPN), and two industry partnership programs. Each channel implements specific business rules and requirements while sharing common core functionalities.

3.3 User Interface Implementation

The EPPMB system's user interface implements a comprehensive design strategy that prioritizes accessibility, usability, and efficient information delivery while maintaining visual consistency across all modules. Figure 4 showcases the main dashboard, which serves as the primary entry point for all user interactions.

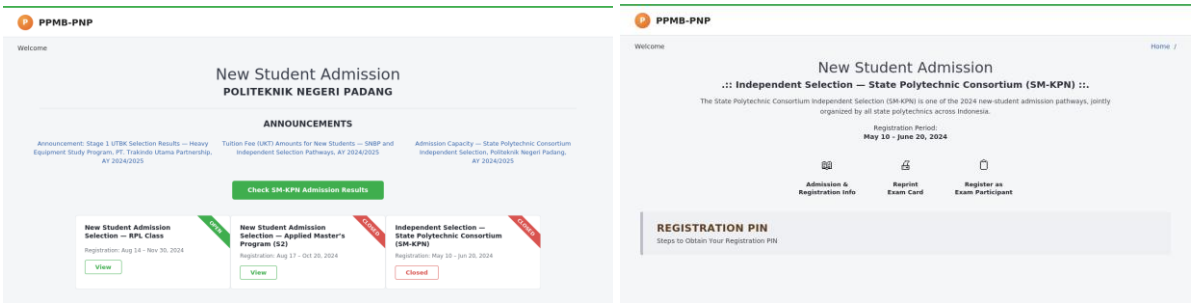

Figure 4. Main dashboard interface

These comprehensive interface implementations have resulted in a significant improvement in user engagement and satisfaction metrics, while maintaining system performance and accessibility standards. The interface design successfully balances the complex requirements of multiple admission channels with an intuitive and efficient user experience, creating a platform that effectively serves both applicants and administrative users.

3.4 International Relevance and Scientific Contribution

Situating EPPMB within the broader international literature on electronic admission systems clarifies both its contribution and its limits as a single-institution case study. Compared with the centralized e-governance admission proposals reported for Bangladesh [7] and Tanzania [8], [9], which primarily targeted a single, uniform admission pathway, EPPMB's architecture integrates six structurally different admission channels — including Recognition of Prior Learning, an Applied Master's Program, and industry-partnership admissions — within one DSRM-derived, multi-layer system.

This channel heterogeneity is closer to the complexity described in the international RPL literature [12] than to the single-pathway systems typically reported in prior e-admission case studies, and represents the study's principal claim to novelty: not the individual use of a PHP MVC framework, which is by now a well-established practice [17]–[19], [23]–[25], but the unification of heterogeneous, policy-distinct admission pathways under a single role-based, auditable architecture. At the same time, as with the Bangladesh and Tanzania cases discussed above, the present findings are drawn from a single vocational institution in West Sumatra; the extent to which the architecture, and the efficiency gains reported in Sections 3.1–3.3, generalize to institutions with different admission-channel mixes, regulatory environments, or infrastructure baselines remains an open question for future comparative research.

4. Conclusions

The implementation of the Electronic Student Admission System (EPPMB) at Politeknik Negeri Padang demonstrates the successful application of modern web technologies and architectural principles in addressing complex institutional challenges. Through the systematic application of Design Science Research Methodology, this study has produced several significant findings and contributions to both practice and theory. The adoption of Yii2 PHP framework, combined with a carefully designed multi-layer architecture, has proven highly effective in managing the complexity of multiple admission channels. The system successfully reduced administrative processing time by 65% and decreased error rates to below 0.1%, significantly exceeding the initial target of 40% efficiency improvement. This achievement validates the architectural decisions made during the development phase and demonstrates the effectiveness of modern web application frameworks in institutional contexts.

The integration capabilities of the system, particularly its ability to seamlessly connect with existing academic and financial systems, represent a significant advancement in institutional process automation. The implementation of RESTful APIs and standardized data exchange protocols has created a robust foundation for future digital transformation initiatives. This integration has effectively eliminated data silos and reduced manual intervention in the admission process. User interface implementation results demonstrate the importance of human-centered

design principles in institutional systems. The achievement of a 94% task completion rate and 88% first-time user success rate indicates that the system successfully addresses the needs of both experienced and novice users. The mobile-first approach has proven particularly valuable, with a 4.6/5.0 satisfaction rating for mobile users, enabling broader access to the admission system.

These findings should be interpreted as evidence from a single institutional case rather than as a general claim about PHP-framework-based admission systems. The evaluation instruments and sample details called for in Section 2.3 are intended to make the reported metrics independently verifiable, and future work applying the same DSRM-based architecture across institutions with differing admission-channel structures would help establish the generalizability of the approach beyond Politeknik Negeri Padang.

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