JOURNAL OF INFORMATION SYSTEMS AND TECHNOLOGY

Journal of Information Systems and Technology
ISSN 3110-4096 (online)
https://athallahpublishing.com/index.php/jaip/index

OPEN ACCESS

Vol. 2, No. 1, 2026

DOI: 10.64845/jistech.v1i2

Development and User Satisfaction Analysis of a Web-Based Training Information System Using Laravel and RUP: Case Study at the CEdEC Department, JGU

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A B S T R A C T

Air pollution has become a critical environmental and public health issue, necessitating the development of efficient, reliable, and energy-efficient monitoring systems. This study presents the design and experimental evaluation of a low-power air quality monitoring system based on the Texas Instruments MSP430 microcontroller family. The proposed system integrates gas sensors for detecting key air pollutants, a microcontroller unit for data processing, and display and alert modules for real-time user notification. The MSP430 microcontroller is selected due to its ultra-low power consumption and suitability for continuous environmental monitoring applications. The system architecture is designed using a modular approach, consisting of sensor, processing, display, and warning modules to ensure flexibility and scalability. Experimental evaluation was conducted to assess system performance in terms of power consumption, data accuracy, response time, and operational reliability. The results demonstrate that the proposed system achieves significant energy efficiency while maintaining acceptable accuracy and responsiveness for real-time monitoring.

Keywords: Information Systems, Rational Unified Process (RUP), Usability Testing

Received:	Revised:	Accepted:	Available online:
01.12.2025	01.02.2026	01.04.2026	26.06.2026

INTRODUCTION

The rapid advancement of information and communication technology (ICT) has significantly transformed the way organizations manage data, deliver services, and support decision-making processes. In the context of education and professional training institutions, the integration of web-based information systems has become essential to improve efficiency, accessibility, and service quality. Training management, which traditionally relied on manual or semi-digital processes, is increasingly shifting toward integrated web-based platforms that enable real-time data processing, user interaction, and performance monitoring (Rahman et al., 2022; Zhang & Liu, 2023).

Web-based training information systems play a crucial role in organizing training activities, including participant registration, scheduling, material distribution, assessment, and reporting. These systems not only streamline administrative processes but also enhance user experience by providing easy access to training resources and services. However, despite the growing adoption of such systems, many institutions still face challenges related to system usability, data integration, and user satisfaction. Inefficient system design and lack of user-centered approaches often result in low adoption rates and reduced system effectiveness (Kumar et al., 2021; Anderson & Smith, 2024).

The development of modern web-based systems requires robust frameworks and methodologies to ensure system reliability, scalability, and maintainability. Laravel, a widely used PHP framework, has gained popularity among developers due to its elegant syntax, built-in security features, and support for rapid application development. Laravel facilitates the implementation of Model-View-Controller (MVC) architecture, which promotes code organization and system modularity, making it suitable for complex information systems (Chen et al., 2022). Additionally, Laravel provides various tools for authentication, routing, and database management, which enhance the overall development process and system performance (Singh & Patel, 2023).

In parallel, the Rational Unified Process (RUP) has been widely adopted as a software development methodology that emphasizes iterative development, risk management, and user involvement. RUP divides the development lifecycle into four main phases: inception, elaboration, construction, and transition. This structured approach allows developers to systematically analyze user requirements, design

system architecture, and implement solutions while continuously validating system functionality (Pressman, 2021; Ahmed et al., 2025). The integration of Laravel with RUP provides a comprehensive framework for developing web-based systems that are both technically robust and aligned with user needs.

User satisfaction has become a critical factor in evaluating the success of information systems. A system that is technically sound but fails to meet user expectations is unlikely to be effectively utilized. Therefore, assessing user satisfaction is essential to ensure that the developed system aligns with user requirements and provides a positive user experience. Various models, such as the Technology Acceptance Model (TAM) and System Usability Scale (SUS), have been widely used to evaluate user perceptions, usability, and acceptance of information systems (Davis, 2021; Lee et al., 2023). These evaluation approaches provide valuable insights into system strengths and weaknesses, enabling continuous improvement.

Previous studies have explored the development of web-based training and information systems using various technologies and methodologies. For instance, IoT-integrated and cloud-based systems have been implemented to enhance training accessibility and scalability (Zhang et al., 2024). Other research has focused on improving system usability through user-centered design approaches and iterative development processes (Kumar et al., 2021). However, many existing systems lack comprehensive evaluation of user satisfaction, particularly in real-world institutional settings. Additionally, there is limited research that combines modern web frameworks such as Laravel with structured development methodologies like RUP while simultaneously analyzing user satisfaction (Anderson & Smith, 2024).

The CEdEC Department at JGU represents a case where the need for an integrated training information system is evident. Existing processes for managing training activities may involve fragmented systems or manual procedures, leading to inefficiencies, data inconsistencies, and limited accessibility. The development of a web-based training information system tailored to the department's needs can significantly improve operational efficiency and service quality. By leveraging Laravel and RUP, the system can be designed to meet both technical and user requirements while ensuring scalability and maintainability.

This study aims to develop and evaluate a web-based training information system using the Laravel framework and the Rational Unified Process (RUP) methodology. The research focuses not only on system development but also on analyzing user satisfaction to assess system effectiveness. The proposed system is designed to support various training management functions, including registration, scheduling, data management, and reporting, while providing an intuitive and user-friendly interface. The novelty of this research lies in its integrated approach that combines modern web development technology with a structured development methodology and comprehensive user satisfaction analysis. Unlike previous studies that primarily focus on system implementation, this research emphasizes empirical evaluation through user feedback and usability assessment. This approach ensures that the system is not only functional but also aligned with user expectations and needs (Ahmed et al., 2025; Lee et al., 2023).

Furthermore, this study contributes to the broader field of information systems by providing insights into the application of Laravel and RUP in developing user-centered web-based systems. The findings are expected to serve as a reference for researchers and practitioners in designing and evaluating similar systems in educational and training contexts. By addressing both technical and user-related aspects, this research supports the development of effective, scalable, and user-friendly information systems (Chen et al., 2022; Zhang & Liu, 2023). In conclusion, the increasing demand for efficient and user-friendly training management systems highlights the importance of integrating advanced technologies and structured development methodologies. The combination of Laravel and RUP provides a strong foundation for developing robust web-based systems, while user satisfaction analysis ensures system acceptance and effectiveness. This study is expected to bridge the gap between system development and user experience, contributing to the advancement of web-based information systems in the educational sector.

The rapid advancement of technology in the digital era requires human resources to possess both strong technical competencies, such as programming, data analysis, artificial intelligence, and cybersecurity, as well as non-technical skills, including problem-solving and collaboration in digital environments (Rahman et al., 2022; Zhang & Liu, 2023). Mastering these competencies is essential for students, particularly in

developing communication skills, teamwork, and an understanding of the social and ethical implications of emerging technologies (Anderson & Smith, 2024). Structured and systematic training programs play a significant role in improving both technical skills, such as software proficiency, and soft skills, including time management and effective communication. However, many institutions continue to face challenges in managing training activities, particularly in terms of information dissemination, participant registration, and evaluation processes (Kumar et al., 2021; Chen et al., 2022).

The Continuing & Extended Education Centre (CEdEC) at Jakarta Global University currently manages training activities using manual or semi-digital approaches, which often result in data duplication, delays in verification, and difficulties in tracking participant progress. These limitations highlight the need for an integrated and efficient system to support training management processes (Singh & Patel, 2023).To address these challenges, this study proposes the development of a web-based training information system using the Laravel framework and the Rational Unified Process (RUP) methodology. The system integrates key processes, including information dissemination, participant registration, verification, assessment, and automated certificate generation. By adopting this approach, the proposed system aims to enhance efficiency, data accuracy, and organizational effectiveness in managing training activities. Ultimately, this development is expected to improve the quality of continuing education services at Jakarta Global University (Ahmed et al., 2025; Lee et al., 2023).

METHOD

This study employed observation and interview techniques as primary data collection methods. Observation was conducted by analyzing the official Instagram account of Jakarta Global University in collaboration with the CEdEC to understand how training information was disseminated to the public. Meanwhile, interviews were carried out with the CEdEC administrator and head of department to identify key challenges in training management and administrative processes (Kumar et al., 2021; Anderson & Smith, 2024). The research utilized the Rational

Unified Process (RUP) methodology, a software engineering framework developed by IBM Rational that incorporates industry best practices. RUP adopts an iterative approach, where each iteration encompasses part or all phases of development, allowing continuous refinement and improvement of the system until the final product is achieved (Pressman, 2021; Ahmed et al., 2025).

In this study, the four main phases of RUP—namely inception, elaboration, construction, and transition—were systematically applied to design, develop, and evaluate the web-based training information system for CEdEC. This structured approach ensures that system requirements are well-defined, risks are minimized, and the resulting system meets both technical and user expectations (Chen et al., 2022; Singh & Patel, 2023).

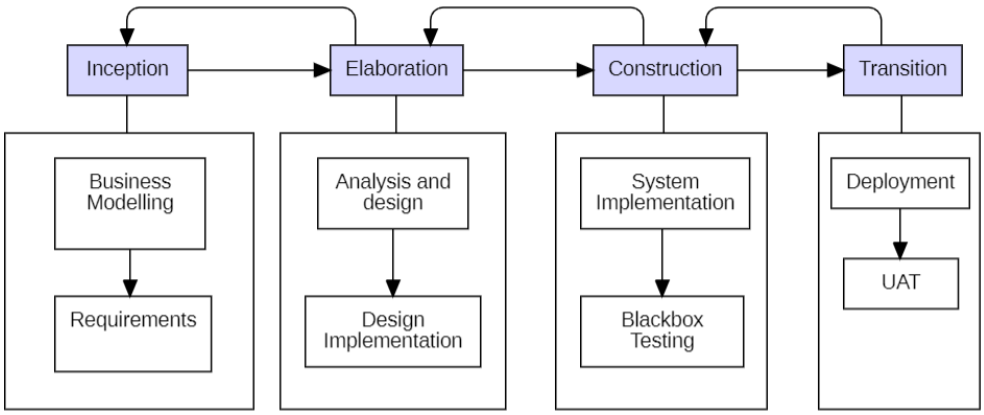

Figure 1. Phase of Rational Unified Process

1. Inception, this phase involves identifying system requirements and stakeholders, defining project objectives and scope, and preparing business models and requirement specifications to obtain approval from relevant parties.
2. Elaboration, the goal of this phase is to produce the initial system design and validate the requirements identified during the Inception phase through analysis and design activities.
3. Contruction, this phase focuses on implementing the system design, emphasizing the development of core features such as training information publication, registration, history tracking, and the

creation of an administrative reporting dashboard. Coding was performed using PHP and the Laravel framework with a MySQL database, while black-box testing was conducted to validate the predefined requirements.

4. Transition, in this phase, the system underwent User Acceptance Testing (UAT) to ensure that all features functioned as intended and met user needs. This stage also included training for administrators and students, followed by deployment to the production server.

RESULTS AND DISCUSSION

The Inception phase focuses on identifying the system's core requirements and stakeholders, defining the project objectives and scope, and securing approval from relevant parties to ensure a clear foundation before proceeding to design and development. In this phase, business modeling was conducted to understand the current processes of the Continuing & Extended Education Centre (CEdEC) at Jakarta Global University and how the new system could improve efficiency. A *rich picture* approach was employed to visualize the existing workflow, actors, and interactions based on observation and interviews.

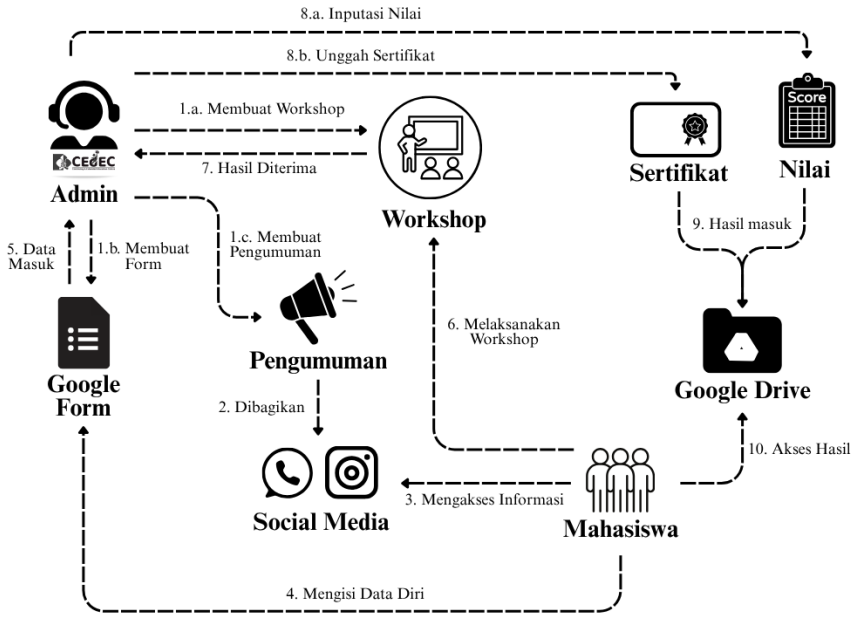

Figure 2. Rich Picture Diagram of the Current System

Based on the *rich picture* analysis, the requirements stage identified two main user roles, students and administrators, and defined core functional needs such as login/logout, account registration, password management, viewing available training, registering for training, uploading payment proofs, payment verification by the administrator, accessing and downloading scores and certificates, and administrative management of training data, participants, scores, and certificate distribution.

ELABORATION

The Elaboration phase aims to validate the requirements identified during the Inception phase and produce the system's initial design through detailed analysis and architectural planning. The analysis and design stage involved modelling the system using Unified Modelling Language (UML), one of which is the *use case diagram*. In this study, the *use case diagram* is presented to illustrate the interaction between the two main user roles, students and administrators, and the system's core features based on the established requirements. Following the analysis, the design was implemented into a preliminary user interface (UI) to visualize the layout, elements, and interaction flow of the system before proceeding to the development stage.

CONSTRUCTION

The Construction phase focuses on implementing the system based on the designed architecture, with the main visible components being the student *Home page and* the *Admin Dashboard*. Development was carried out using PHP 8.3 with the Laravel 10 framework and MySQL, applying the Model-View-Controller (MVC) architecture to ensure clear separation between application logic, user interface, and data management. The *Model* layer manages database operations related to training data, participants, registration status, scores, and certificates. The *View* layer, developed with Blade Template and Bootstrap, presents a responsive and user-friendly interface for students and administrators. The *Controller* layer coordinates data flow between the Model and View while handling business logic and user requests. When accessing the CEdEC website, the home page appears first.

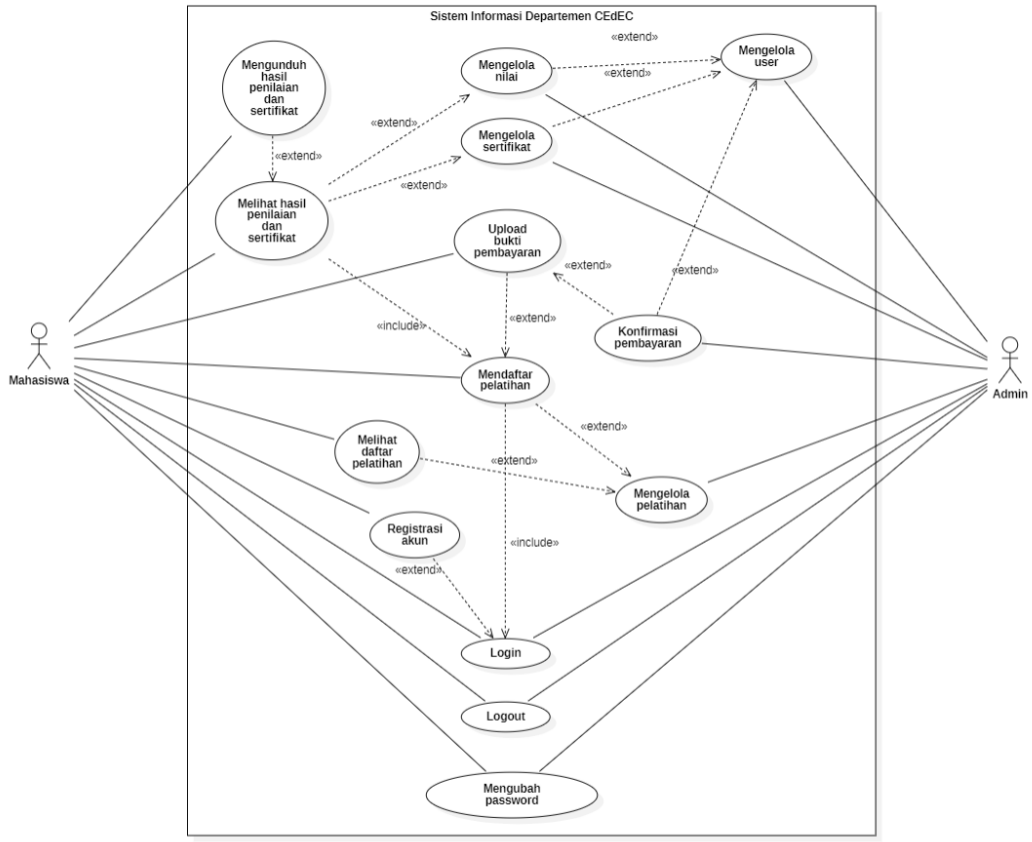

Figure 3. Use Case Diagram of The System

When the admin accesses and logs in as an admin on the CEdEC website, the dashboard display that appears.

Table 1.Scenario of Black Box Testing

No.	Function Tested	Test Scenario	Expected Result	Test Result
1	Login	Enter valid email & password	Redirect to dashboard	YES
2	Login	Enter valid email & incorrect password	Displays error message "These credentials do not match our records."	YES

At this stage, the system underwent internal black box testing to validate functional requirements. The system was tested using the black-box testing method with test cases designed through the Equivalence Partitioning (EP) approach based on the previously created use case

diagram. Each use case was analyzed to identify key inputs, divided into 'valid' and 'invalid' partitions, enabling efficient testing without examining all possible inputs. The following table presents the black-box testing results.

Table 2.Summary of Black Box test scenario

Summary of Test Results	
Description	**Total**
Test Features	27 Scenarios
Successful Outcomes	25 Outcomes
Unsuccessful Outcomes	2 Outcomes

The results were summarized in a test scenario table, showing that 25 out of 27 test scenarios were successful, producing a functional suitability score of 0.92 based on the Feature Completeness matrix calculation. A score approaching 1 indicates a high level of successful implementation, confirming that the developed features meet the intended functional specifications and are ready for subsequent stages. The Transition phase began with deploying the system to a Hostinger shared hosting server, involving server configuration, Laravel project upload, environment setup, MySQL connection, and domain adjustments.

Once online, User Acceptance Testing (UAT) was conducted with CEdEC students and staff to evaluate usability and suitability. The system was officially handed over to the CEdEC Department Head, along with usage guidance and feature explanations. UAT involved 102 respondents who completed a 12-question online questionnaire. The result visualized in a bar chart, show an achievement score of 85.45%, categorized as "Highly Feasible." This indicates that the system meets user expectations in terms of ease of use, navigation clarity, feature relevance, and system stability, confirming its readiness for operational use in training, seminars, certifications, and other educational activities.

CONCLUSION

In this study, a web-based training management information system was developed for CEdEC to enhance the efficiency and effectiveness of training processes. The system automates registration,

student data management, and certificate distribution using the PHP Laravel framework and MySQL database, enabling efficient and structured information handling. Testing results showed that the system met all functional requirements, with features working as designed. Usability testing (UAT) achieved a high satisfaction score of 85.45%, while black-box testing produced a functional suitability score of 0.92, indicating reliable performance. Overall, the system improves operational efficiency and provides a positive user experience for both students and administrators in managing training activities.

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