Digitizing Recognition of Prior Learning: A Web-Based System for Enhanced Efficiency and Transparency

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Abstract

Recognition of Prior Learning (RPL) is an important mechanism in education for recognising learning outcomes from both formal and non-formal/informal pathways. However, the RPL process at Trunojoyo University Madura is still manual, resulting in lengthy processing times and the potential for administrative errors. This study aims to develop a web-based Cross-Level RPL Information System. The development method used is Rapid Application Development (RAD). The system is equipped with course conversion recommendation features using the Jaccard Similarity and Cosine Similarity methods. Blackbox testing on the implemented web system showed that all functionalities for the roles of Admin, RPL Students, and Assessors performed as expected (Met). The course conversion recommendation feature demonstrated a precision of 83.33 percent, recall of 46.88 percent, and an F1-Score of 60.00 percent, indicating good accuracy in recommendations but still room for improvement in the scope of identification. The development of this system successfully provides a digital solution with the potential to enhance efficiency, accuracy, and transparency in RPL management.

1. Introduction

The rapid advancement of information technology has fundamentally transformed various sectors, including education. One mechanism of growing importance is the Recognition of Prior Learning (RPL), which provides formal acknowledgment of an individual's learning achievements acquired through formal, non-formal, and informal pathways (Goggin & Sheridan, 2015; Ul-Islam & Gonzales, 2016). RPL plays a strategic role in expanding access to higher education and supporting continuous competency development. The effective implementation of RPL not only maintains academic standards but also ensures equal opportunities for all learners (Almadany, 2024).

At the University of Trunojoyo Madura, the annual RPL application process, including for students transitioning between educational levels, is still conducted manually without the support of a web-based application. This reliance on manual processes results in extended processing times and increases the risk of administrative errors. This situation underscores the urgent need to digitize the RPL system through an integrated platform to facilitate both students and university administrators.

In response to this need, this research focuses on the development of a web-based Information System for Cross-Level RPL. The Rapid Application Development (RAD) methodology was chosen for software development. RAD is prioritized for its agile and iterative development cycle, which intensively involves users in the design phase (Musvina et al., 2022). This user involvement is expected to produce a system that is well-aligned with specific user needs, making it highly relevant for an RPL system that demands high adaptability (Yanuardi et al., 2024).

The system is enhanced with a course conversion recommendation feature, which applies the Jaccard Similarity and Cosine Similarity methods. Jaccard Similarity was selected for its implementation simplicity and its intuitive interpretation when measuring similarity between data sets, such as course learning outcome descriptions (Hall, 2023). Meanwhile, Cosine

Similarity excels at measuring the similarity between text documents by representing them as vectors, unaffected by document length, and has proven efficient for high-dimensional data (Kesuma & Pribadi, 2016). The system's foundational structure is built using the Laravel framework, a PHP framework that employs the Model-View-Controller (MVC) architecture and is widely recognized for facilitating the creation of robust, efficient, and user-friendly web applications (Widyastuti et al., 2024).

The anticipated contributions of this research include streamlining RPL governance for the University of Trunojoyo Madura, simplifying the application process for students, supporting evaluation for assessors, and enhancing overall operational efficiency.

2. Method

This research adopts the Rapid Application Development (RAD) methodology, the workflow of which is visually illustrated in the diagram in Figure 1. This methodology was selected for its approach that emphasizes a rapid and iterative development cycle, allowing for the active involvement of users to ensure the final product aligns with their needs [4].

a. Requirements Analysis

This stage serves as the fundamental phase in the RAD methodology. The analysis process began with data collection through two primary techniques: a Literature Review to examine relevant theories and research , and Interviews with stakeholders to deeply understand the business processes and specific user requirements. The results from both techniques were synthesized to define the system's functional and non-functional requirements.

b. Rapid Design

Based on the requirements analysis, the next stage is rapid design. In this phase, a functional prototype and user interface (UI/UX) designs are created, in both low-fidelity and high-fidelity formats. The objective of this

stage is to visualize the system and gather initial user feedback as quickly as possible.
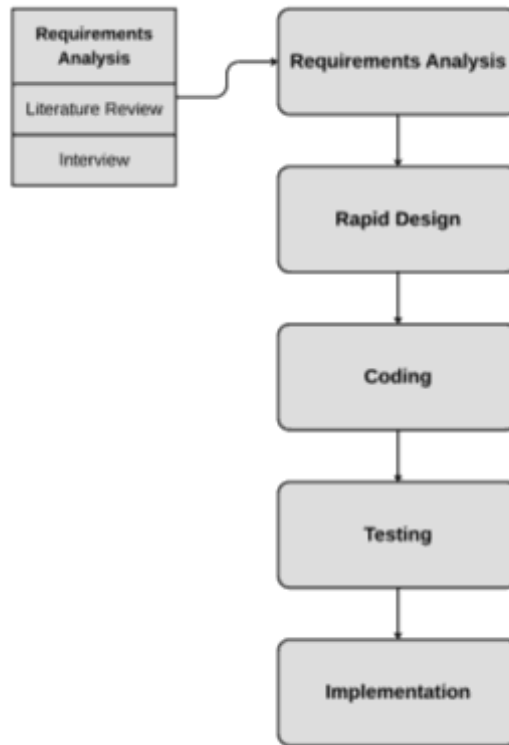

Figure 1. Workflow Diagram

c. Construction (Coding)

In this stage, the prototype and designs validated in the previous phase are implemented into a functional web application through the coding process. This involves translating the design specifications into program code using the designated technologies: the Laravel framework and a MySQL database.

d. Testing

The system that was built then underwent a series of trials, including Blackbox Trials, to verify its functionality. The diagram illustrates an iterative cycle, in which the results of the trial stage can be used as input to return to the Rapid Design stage. The input obtained from the trials is used

to make repeated improvements to the design and functionality of the system until the product meets user expectations.

e.   Implementation

After the system successfully passes all testing cycles and is confirmed to meet all established requirements, the final stage is implementation. In this phase, the completed system is deployed to the production environment, making it ready for use by its end-users (Admin, RPL Student, and Assessor).

3. Result and Discussion

This chapter comprehensively describes the results obtained from all stages of development and testing of the Cross-Level Prior Learning Recognition (RPL) Information System. The discussion will begin with a presentation of the development results, followed by details of the web system implementation along with findings from functional testing using the blackbox testing method. Next, the plan and results of the course conversion recommendation feature testing will be presented. This chapter concludes with an in-depth discussion that analyses and interprets the overall findings in the context of achieving the research objectives.

a.   *System Prototype Development and Testing Results*

As an initial step in the development cycle, a user interface (UI) and user experience (UX) prototype has been designed and built using Figma software. This prototype aims to visualise the system workflow design, page layout, and user interactions for the three main roles in the system, namely the Admin role, the RPL Student role, and the Assessor role.

Figure 2 Prototype Dashboard

Figure 2 shows the prototype interface for the RPL Student Dashboard page. This page serves as the main page after students successfully log in, displaying the main navigation menu on the left side, which includes Profile, Diploma, Course Conversion (with submenus Upload Proof, Input Transcript, Self-Assessment, and View Grades), and the Log Out button. The central part of the page displays a navigation breadcrumb, an illustrative image, and a summary of the system's main features relevant to students, such as course recommendations, conversion process assistance, and exporting conversion results.
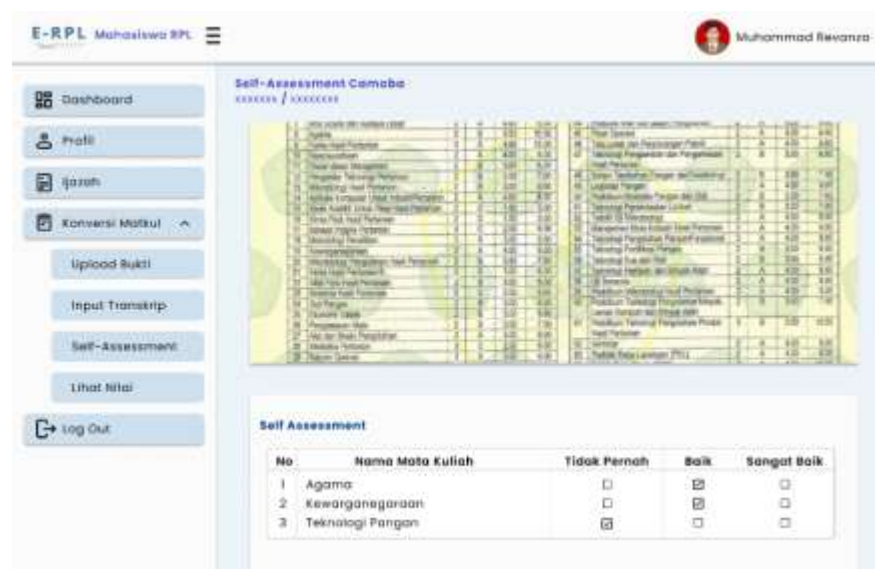

Figure 3 Prototype Self-Assessment

Figure 3 illustrates the prototype interface for the Self-Assessment page for prospective new students (Camaba) from the perspective of RPL students. At the top, a preview of the uploaded transcript document is displayed. Below that, there is a Self-Assessment table where students can indicate their status of taking or understanding each relevant course (e.g., with options such as "Never", "Good", "Very Good"). The left-side navigation menu remains available for easy access to other features.
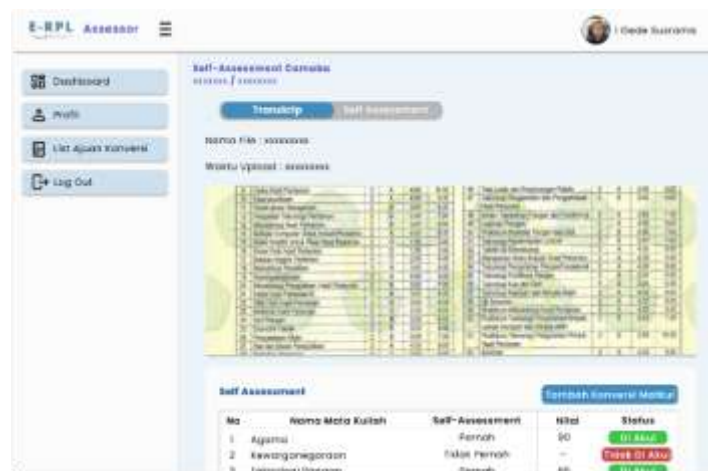

Figure 4 Prototype Conversion Assessment

Figure 4 shows a prototype of the Conversion Assessment page interface from the Assessor's perspective. This page allows assessors to view details of course conversion submissions by students. There are two main tabs, namely "Transcript" (displaying a preview of the student's transcript) and "Self Assessment" (displaying the results of the self-assessment completed by the student). Below that, there is a table where assessors can provide evaluations for each submitted course, input conversion grades, and determine the conversion status (e.g., "Approved" or "Not Approved"). The "Add Course Conversion" button is also available for further management.

The Admin can filter by department to facilitate management. There is an "Edit" button on each student data row, allowing the Admin to change or assign an assessor for that student. The main navigation menu for the Admin, such as

Dashboard, Profile, Add RPL Account, User Data, Courses, and Manage Assessors, is visible on the left side.

b. ***System Changes During the RAD Process***

The iterative Rapid Application Development (RAD) methodology allows the system to evolve dynamically through continuous feedback from users. During the development process, a series of discussions were held with partners, namely the Quality Assurance Centre (PJM) LPMPP Trunojoyo University Madura. Each discussion session resulted in a series of changes and adjustments aimed at refining the system to better align with real-world needs on the ground. Changes implemented during the development cycle are as follows:

1) Iteration 1: Adjustments to Reports and Output Formats

Initial discussions with partners focused on refining the final reports (outputs) generated by the system. Two major changes were implemented:

a) Report Template Changes: The report template was adjusted to align with the standard format used by the institution to meet administrative requirements.

b) Export Format Change: The export functionality was changed from PDF format to Microsoft Word (.docx) to provide users with flexibility in making final edits if necessary.

2) Iteration 2: Strengthening the Assessment Evaluation Foundation

In the second discussion, partners emphasised the importance of having valid comparative data for the assessment process. To respond to this need, several new features were added:

a) CPMK Management Feature: A feature was added for Admin to manage Course Learning Outcomes (CPMK). With CPMK data, assessors have a more objective and structured basis for comparison when conducting validation.

b) CPMK Information Access: To improve transparency and accuracy, Assessors and Students were given access to view CPMK details via a pop-up when conducting assessments or self-assessments.

3)   Iteration 3: System Flexibility Enhancements

The third iteration focuses on making the system more adaptive to existing field conditions and workflows. Changes include:

    a) Flexibility in Assessor Numbers: The previous rule requiring three assessors per student has been made more flexible to accommodate assessor availability in the field.

    b) Manage Period Feature: The "Manage Period" feature was added to allow administrators to manage RPL registration periods, so that student data displayed on the system can be filtered based on the active period.

4)   Iteration 4: Refining Structure and Workflow

In the final iteration, several significant adjustments were made to refine the structure and efficiency of the system:

    a) Addition of Super Admin Role: A new role with the highest authority was added to manage the entire system, including the management of Admin Prodi accounts.

    b) Simplification of Assessor Evaluation Process: The assessor workflow was optimised by integrating the assessment process and conversion value assignment into a single workflow to improve efficiency.

    c) User Interface (UI) Adjustments: The layout of several key pages, such as the evidence upload and conversion assessment pages, has been improved to make them more intuitive for users.

    d) Report Adjustments: The export feature has been improved by adding student programme information directly to the generated reports to facilitate data identification.

c.   ***Web System Implementation and Blackbox Testing Results***

Based on the design prototype, the Cross-Level RPL Information System was then fully implemented as a web-based application. After the web system development phase was completed, a series of functional tests were conducted using the blackbox testing method. These tests aimed to ensure that every feature and function in the developed system could run in accordance with the specified requirements for the three user roles (Admin, RPL Students, and Assessors). The

blackbox testing process did not consider the internal structure of the program code but focused on validating the input and output of each function.

1)   Blackbox Testing Results - Admin Role

Blackbox testing for the Admin role encompassed 11 distinct test cases, categorized under four main test scenarios (ADM_001 to ADM_004). These tests covered critical functionalities, including the login process, course data management (add, edit, delete), the assignment of assessors to students with departmental validation, and profile management. The results of these tests are summarized in Table 1.

Table 1 The Result of The Blackbox Testing Admin

ID Test	Function Tested	Test Scenario	Expected Result	Status
ADM_001	Login	Login with valid credentials	Successful login and redirected to admin dashboard	Completed
		Login with incorrect email	Display error message 'Email or password is incorrect'	Completed
		Login with incorrect password	Display error message 'Email or password is incorrect'	Completed
ADM_002	Manage Courses	Add new course	New course successfully added	Completed
		Add course with existing name	Display error message 'Course already exists'	Completed
		Edit course	Course data successfully updated	Completed
		Delete course	Course successfully deleted	Completed
ADM_003	Manage Student Assessors	Edit with three assessors	Student assessor management data successfully updated for all three	Completed
		Edit with two assessors	Student assessor management data successfully updated for all three	Completed
		Edit with assessors from different departments	Options for assessors from different departments than RPL students do not appear	Completed
ADM_004	Profile	Fill in the complete personal data form	Data saved and displayed in the profile	Completed

Based on the testing, all 11 test cases for the Admin role passed. This confirms that all functionalities designed for the Admin role were implemented correctly and performed as expected.

2)   Blackbox Testing Results - RPL Student Role

For the RPL Student role, blackbox testing was performed on 11 test cases distributed across five test scenarios (MHS_001 to MHS_005). These scenarios evaluated essential student functions, such as login, profile data management, diploma/certificate data entry, transcript uploads (including file format validation), and self-assessment form completion (including viewing of Course Learning Outcomes or CPMK). The test results are presented in Table 2.

Table 2 The Result of The Blackbox Testing RPL Student

ID Test	Function Tested	Test Scenario	Expected Result	Status
MHS_001	Login	Login with valid credentials	Successful login and redirected to the Student dashboard	Completed
		Login with incorrect email	Display error message "Email or password is incorrect"	Completed
MHS_002	Profile	Fill in complete personal data form	Data saved and displayed in profile	Completed
		Changing existing profile data	Profile data successfully updated	Completed
MHS_003	certificate of graduation	Filling out the complete certificate of graduation form	Diploma data saved and accessible	Completed
		Modifying existing certificate of graduation data	Diploma data successfully updated	Completed
MHS_004	Transcript	Uploading a valid transcript	Data saved and displayed on the transcript page	Completed
		Uploading an invalid transcript	Displaying the error message 'the selected file is not compatible'	Completed
MHS_005	Self-assessment	Filling out the self-assessment form completely	Data is stored and displayed in Assessor	Completed

	Filling out the self-assessment form incompletely	Data saved and displayed in Assessor	Completed
	Viewing CPMK from the course	Displaying CPMK in pop-up form	Completed

As detailed in Table 2, all 11 test cases for the RPL Student role were successful. This indicates that all student-centric functionalities are working as designed.

3)   Blackbox Testing Results - Assessor Role

Testing for the Assessor role involved 10 test cases under six test scenarios (ASR_001 to ASR_007, noting the absence of ASR_005). The tests focused on core assessor workflows: logging in, managing profile information, accessing the list of assigned students, viewing student details, and conducting assessments on student self-evaluations and conversion requests. The outcomes are documented in Table 3.

Table 3 The Result of The Blackbox Testing Assessor

ID Test	Function Tested	Test Scenario	Expected Result	Status
ASR_001	Login	Login with valid credentials	Successful login and redirected to the Assessor dashboard	Completed
		Login with incorrect email	Display error message 'Email or password is incorrect'	Completed
ASR_002	Profile	Fill in complete personal data form	Data saved and displayed in profile	Completed
		Changing existing profile data	Profile data successfully updated	Completed
ASR_003	Conversion Request List	Opening the conversion request form page	Displaying the list of students	Completed
ASR_004	Student Profile	Open the student profile page	Display student personal details	Completed
ASR_006	Student Self-Assessment	Assessing the student's self-assessment completely	Data is saved and can proceed to the next process	Completed
		Assessing the student's self-assessment incompletely	Data is saved and can proceed to the next process	Completed

ASR_007	Student Conversion Assessment	Filling out the assessment form with valid data	Data saved and sent to output	Completed
		Filling out the assessment form with invalid data	Displaying the error message 'The entered value is not valid'	Completed

As shown in Table 3, all 10 test cases for the Assessor role passed successfully. This confirms that functionalities related to the assessment process and data management by assessors have been implemented correctly.

The comprehensive blackbox testing results indicate that the developed RPL Information System meets the specified functional requirements for all three user roles (Admin, RPL Student, and Assessor). The system effectively handles a variety of scenarios, including valid and invalid data inputs, and provides appropriate feedback and outcomes, confirming its readiness for deployment.

d.   *Results of Course Conversion Recommendation Testing*

The course conversion recommendation feature, which implements the Cosine Similarity and Jaccard Similarity methods, is one of the core components aimed at assisting Assessors in the initial identification of courses that are potentially convertible. Testing of this feature was conducted by comparing the system's recommendation results with a sample of validated actual data (ground truth).

In this testing, a data sample was used where 32 courses had been manually identified as courses that should be convertible. The Cross-Level RPL Information System was then run to provide recommendations for the sample. The results are as follows:

1) Total number of courses recommended by the system: 18 courses.

2) Of the 18 courses recommended, 15 were correct recommendations (matching the ground truth). These are categorised as True Positives (TP).

3) The remaining 3 courses out of the 18 recommended were incorrect recommendations (not present in the ground truth list). These are categorised as False Positives (FP).

4) There are 17 courses that should be converted (based on the ground truth) but are not recommended by the system. These are categorised as False Negatives (FN).

Based on this data, the performance of the recommendation system is evaluated using the following standard metrics:

1) Precision: Measures how many of the courses recommended by the system are actually relevant.

2) Precision = TP / (TP + FP) = 15 / (15 + 3) = 15 / 18 = 0.8333 or 83.33%.

3) Recall (Sensitivity): Measures how many relevant courses (that should be converted) were successfully found or recommended by the system.

4) Recall = TP / (TP + FN) = 15 / (15 + 17) = 15 / 32 = 0.46875 or 46.88%.

5) F1-Score: The harmonic mean of Precision and Recall, providing a balance between the two metrics. F1-Score = 2 * (Precision * Recall) / (Precision + Recall) = 2 * (0.8333 * 0.46875) / (0.8333 + 0.46875) = 0.78121875 / 1.30205 ≈ 0.59998 or approximately 60.00%.

A Precision value of 83.33% indicates that of all the courses recommended by the system, the majority (more than 4 out of 5) are indeed relevant courses for conversion. This indicates that the system has a good level of accuracy in providing suggestions, so it does not give many 'wrong' or unnecessary recommendations.

On the other hand, the Recall value of 46.88% indicates that the system is only able to identify less than half of the total courses that should be convertible. This means there are still a significant number of relevant courses that are overlooked or not detected by the recommendation system.

The F1-Score value of 60.00% provides a moderate overall performance, balancing the system's ability to avoid incorrect recommendations (Precision) and its ability to find all relevant courses (Recall).

4. Conclusion

This study successfully developed a web-based Cross-Level Recognition of Prior Learning (RPL) Information System for LP3MP Trunojoyo University Madura. The system, built using the Laravel framework and MySQL, has been

functionally tested through blackbox testing for all three user roles (Admin, RPL Students, and Assessors) with a 'Completed' status across all scenarios, proving the system's ability to perform core tasks stably and accurately. The Rapid Application Development (RAD) methodology has proven effective in facilitating responsive development and reducing the risk of product mismatch.

The course conversion recommendation feature using Cosine Similarity and Jaccard Similarity shows promising performance with a Precision of 83.33%, indicating good accuracy in the suggestions provided, although the Recall (46.88%) and F1-Score (60.00%) values indicate room for improvement in identifying all potential courses. This feature serves as a valuable decision-support tool for assessors. Overall, this system provides a digital solution that addresses the challenges of the manual RPL process, with significant potential to enhance the efficiency, accuracy, and transparency of RPL management, while also facilitating access for all stakeholders and laying a strong foundation for the digital transformation of RPL services within the institution.

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