# **CHAPTER III RESULTS AND DISCUSSIONS**

This chapter focuses on the resulting system created throughout this research. The LMS should be capable of all the functions of the usual LMS alongside the implementation of convolutional neural network and data visualization. While this LMS is capable of handling learning-related functionalities (i.e. class management, assignments, etc.) for any course or subject, the LMS will be used for providing TLE-based education for high school students.

**4.1 Project Capabilities and Testing Process Details**

This project follows the Rapid Application Development (RAD) methodology, a model that emphasizes iterative prototyping, active user participation, and modular implementation. The system is divided into several core capabilities, each of which is tested and refined in continuouscollaboration with its intended users. The features were developed incrementally, allowingfeedback from early builds to shape the final system.

**a. User Management**

The system supports a robust user management module with secure authentication mechanisms. Users can register, log in, and gain access to features based on predefined roles: student, professor, or administrator. These roles are enforced through a role-based access control system that restricts certain actions to authorized users only. A password reset mechanism is implemented through a “Forgot Password” component, which allows users to reset their credentials securely via email-based token verification. Additionally, each user has access to a profile page where they can view and update personal information, including their name, profile picture, and contact details.

**b. Course Management**

Professors are given the ability to create, edit, and delete courses. When creating a course, they can upload a banner and assign descriptive metadata to help organize content. Enrollment features allow professors to manually add or remove students from their courses, while students can access a list of their enrolled subjects. A course dashboard is available for professors, providing them with data visualizations and analytics related to student participation, lesson completion, and overall course engagement. This empowers educators to make informed instructional decisions.

**c. Lesson and Learning Materials**

The platform allows professors to build structured lesson content composed of multiple steps or learning segments. These lessons may include instructional text, external resources, files, videos, or quizzes. Student progress is tracked automatically, including which steps have been completed, how long each step was viewed, and current lesson streaks. Students are able to mark steps as completed manually, resume incomplete lessons, and monitor their own progress via a dashboard interface designed to promote self-regulated learning.

**d. Assignment and Submission Management**

The assignment module allows professors to create a range of assessment types such as written assignments, multiple-choice quizzes, group projects, and exams. Professors may upload files, set submission deadlines, and include detailed instructions for students. Students, in turn, are able to upload submissions directly to the system. In cases where modifications are needed before the deadline, the system permits un-submission if enabled by the professor. Professors can view student submissions, assign grades, and provide feedback, which is then made visible to the student in their grade overview section.

**e. Discussion Forum**

To facilitate collaboration and discussion, a dedicated discussion board allows users to create, edit, and delete discussion threads. Users can also engage with threads by commenting, liking or disliking content, and replying to other users. File attachments are supported in both discussions and comments, allowing the exchange of additional resources and materials relevant to the topic.

**f. Convolutional Neural Network Tools**

The system integrates an image search tool that integrates Convolutional Neural Network (CNN) to provide information retrieval and automated feedback features. This includes the ability to analyze uploaded images and retrieve related educational content from sources like Wikipedia and Wikidata. The CNN tool enhances learning by offering contextualized information and image-based data classification aligned with academic topics.

**g. Analytics and Reporting**

Professors are provided with course analytics that include student performance trends, grade distributions, attendance rates, and lesson progress statistics. This supports data-driven instruction and early intervention. Students also benefit from a personal dashboard that displays their academic metrics such as grades, attendance records, lesson completion rates, and submission statuses.

**h. Expected or Planned Features**

The development team has identified several enhancements planned for future iterations. These include bulk upload functionalities for courses or student lists, real-time notification systems for new submissions, grades, or discussion replies, and a more comprehensive administrative panel for managing users and content. Additionally, improvements to mobile responsiveness are planned to ensure a seamless experience across different devices. Automated testing tools will also be integrated to increase the reliability and efficiency of future development.

**i. Testing Process**

The testing approach employed is multi-layered and consistent with RAD principles of iterative refinement. Unit testing is conducted during development to verify the smallest testable units of the application, such as utility functions, controllers, and React components. These tests are expected to be written using Jest for frontend components and Mocha or Chai for backend logic, although formal unit test files have not yet been integrated. The architecture supports future inclusion of these tests with minimal refactoring.

**j. Integration Testing**

Integration testing focuses on verifying that different modules of the system—such as the frontend interface, backend APIs, and database operations—work together seamlessly. Tools like Supertest for API validation and React Testing Library for user interface flows are expected to be implemented. Although integration tests are currently not present, the system architecture is structured to support them efficiently.

**k. Manual Testing**

End-to-end user flows have been manually tested throughout development. These tests include registering users under different roles, confirming that access controls behave as expected, creating and managing courses and lessons, enrolling students, and verifying perspectives from both student and professor views. Additional manual tests involve file submission and grading, discussion forum interaction, AI tool usage, and error handling for various edge cases. API endpoints are manually validated through Postman, and the user interface is tested in browsers to ensure usability and responsiveness.

**l. System Testing and User Acceptance Testing (UAT)**

System testing is performed by the development team to ensure that the entire system meets functional and non-functional requirements. This involves exploratory testing to uncover issues not caught during unit or integration testing. Planned UAT (User Acceptance Testing) will involve actual users—such as students and professors—interacting with the system to validate its functionality in real-world academic scenarios. Their feedback will guide final adjustments before full deployment.

**m. Validation of System Behavior**

System validation is conducted by testing API responses via Postman to ensure they return the correct data and status codes. User interface validation includes walkthroughs of all core user activities such as registration, login, course access, and assignment submission. Error-handling is manually tested through intentional input of invalid data, missing fields, or permission violations. While automation is not yet fully implemented, the system is prepared for future integration of testing tools such as Jest, React Testing Library, and Supertest to support ongoing system reliability.

**4.2 Project Testing Results**

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| **Test Scenario ID** | | Login-1 | | **Test Case ID** | | Login-1-a | |
| **Test Case Description** | | Login Registration (Student) | | **Test Priority** | | High | |
| **Pre-requisite** | | N/A | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Login Page with Login and Register Open | Login Page with Login, Register and Forget Password open. | Firefox | Pass |  |
| 2. | Enter a valid name, email, password and designation (student, professor, admin) | Valid name: Juan dela Cruz  Email:  Personal Email  Password: \*\*\*\*\*\*\*\*\*\*\*\*  Designation: Student | Account Creation Success  (as Student) | Account Creation Success (as Student) | Firefox | Pass | Validation for whether an account with the same information is present to which it will give a warning that an account with the same information already exists |

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| **Test Scenario ID** | | Login-1 | | **Test Case ID** | | Login-1-b | |
| **Test Case Description** | | Login Registration (Teacher) | | **Test Priority** | | High | |
| **Pre-requisite** | | N/A | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Login Page with Login and Register Open | Login Page with Login, Register and Forget Password open. | Firefox | Pass |  |
| 2. | Enter a valid name, email, password and designation (student, professor, admin) | Valid name: Anne Perez  Email:  Test123@gmail.com  Password: \*\*\*\*\*\*\*\*\*\*\*\*  Designation: Professor | Account Creation Success  (as Professor) | Account Creation Success (as Professor) | Firefox | Pass | Validation for whether an account with the same information is present to which it will give a warning that an account with the same information already exists |

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| **Test Scenario ID** | | Login-1 | | **Test Case ID** | | Login-1-c | |
| **Test Case Description** | | Login Registration (Admin) | | **Test Priority** | | High | |
| **Pre-requisite** | | N/A | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Login Page with Login and Register Open | Login Page with Login, Register and Forget Password open. | Firefox | Pass |  |
| 2. | Enter a valid name, email, password and designation (student, professor, admin) | Valid name: John Dizon  Email:  Test456@gmail.com  Password: \*\*\*\*\*\*\*\*\*\*\*\*  Designation: Admin | Account Creation Success  (as Admin) | Account Creation Success (as Admin) | Firefox | Pass | Validation for whether an account with the same information is present to which it will give a warning that an account with the same information already exists |

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| **Test Scenario ID** | | Login-2 | | **Test Case ID** | | Login-2-a | |
| **Test Case Description** | | Login | | **Test Priority** | | High | |
| **Pre-requisite** | | Registered Account | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Login Page with Login and Register Open. | Login Page with Login, Register and Forget Password open. | Firefox | Pass |  |
| 2. | Enter a valid email and password | Email:  Personal Email  Password: \*\*\*\*\*\*\*\*\*\*\*\* | Redirect to Dashboard | Redirect to Dashboard. | Firefox | Pass | Validation for incorrect username or password exists. |

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| **Test Scenario ID** | | Login-3 | | **Test Case ID** | | Login-3-a | |
| **Test Case Description** | | Login Forget Password | | **Test Priority** | | High | |
| **Pre-requisite** | | Registered Account | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Login Page with Login and Register Open | Login Page with Login, Register and Forget Password open. | Firefox | Pass |  |
| 2. | Enter a valid email | Email:  Personal Email  (Juan dela Cruz’s email) | Enter Change User Password. | Enter Change User Password. | Firefox | Pass |  |
| 3 | Change user password | New Password: \*\*\*\*\*\*\*\*\*\*\*\*  Verify Password: (Same as new password for verification) | Password change successful, new password is usable for the account. | Password change successful, new password is usable. | Firefox | Pass | Password verification is also present if you don’t put the same password for verification. |

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| **Test Scenario ID** | | Dashboard-1 | | **Test Case ID** | | Dashboard-1 | |
| **Test Case Description** | | Discussions | | **Test Priority** | | Medium | |
| **Pre-requisite** | | Account Logged In | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Dashboard containing the main LMS functions. | Dashboard containing tabs for Discussions, CNN Ai, Course, Settings, and Account Profile. | Firefox | Pass |  |
| 2. | Enter Discussions tab |  | Open Discussions | Open Discussions | Firefox | Pass |  |
| 3. | Create a discussion | Title: “Test Discussion” Text (optional): Description  With additional image (optional): | Create a new discussion board | Created a new discussion board with title, text and an image attached | Firefox | Pass |  |
| 4. | Write a comment on the discussion page | Comment: “this is a comment” | Posted a comment on discussion page. | JSON.parse: unexpected character at line 1 column 1 of the JSON data. | Firefox | Fail | \*Pa-recheck nito sa system mo para mas accurate, patanggal ng message pag na-edit mo na.\* |
| 5. | Like or Dislike a Discussion |  | Add one like on the discussion. | Added one like on the discussion page. | Firefox | Pass |  |

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| **Test Scenario ID** | | Dashboard-2 | | **Test Case ID** | | Dashboard-2 | |
| **Test Case Description** | | Convolutional Neural Network Testing | | **Test Priority** | | Medium | |
| **Pre-requisite** | | Account Logged In | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Dashboard containing the main LMS functions. | Dashboard containing tabs for Discussions, CNN AI, Course, Settings, and Account Profile | Firefox | Pass |  |
| 2. | Enter CNN AI tab |  | Open CNN AI | Open CNN AI | Firefox | Pass |  |
| 3. | Upload an image | Image: | Upload image successful. | Created a new discussion board with title, text and an image attached | Firefox | Pass |  |
| 4. | Predict the image | Image uploaded in Step 3 | Show prediction result that is accurate to the posted image. | Error: Prediction Fail | Firefox | Fail | \*Pa-recheck nito sa system mo para mas accurate, patanggal ng message pag na-edit mo na.\* |

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| **Test Scenario ID** | | Dashboard-3 | | **Test Case ID** | | Dashboard-3 | |
| **Test Case Description** | | Settings | | **Test Priority** | | Low | |
| **Pre-requisite** | | Account Logged In | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Dashboard containing the main LMS functions. | Dashboard containing tabs for Discussions, CNN Ai, Course, Settings, and Account Profile | Firefox | Pass |  |
| 2. | Enter Settings tab |  | Open Settings and load all settings needed. | Opened settings but no settings are loaded, only a message saying, “This is a placeholder for the settings page content.” Is present. | Firefox | Fail | Settings for the account is still to be made. |

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| **Test Scenario ID** | | Dashboard-4 | | **Test Case ID** | | Dashboard-4 | |
| **Test Case Description** | | Profile Editing | | **Test Priority** | | Medium | |
| **Pre-requisite** | | Account Logged In | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Dashboard containing the main LMS functions | Dashboard containing tabs for Discussions, CNN Ai, Course, Settings, and Account Profile | Firefox | Pass |  |
| 2. | Enter Profile tab |  | Open the Profile tab and load the name, profile picture and email of the user. | Opened the Profile tab and loaded the name, profile picture and email of the user. | Firefox | Pass |  |
| 3. | Edit Profile | New Name: Juan dela Cruz II  New Profile Picture: | Changes the name and profile picture of the account. | Changed the name and profile picture of the account. | Firefox | Pass | Only the name and profile picture is editable. Edits on the account now loads on the profile page and to the other functions that shows the account’s name. |

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| **Test Scenario ID** | | Dashboard-5 | | **Test Case ID** | | Dashboard-5 | |
| **Test Case Description** | | Logout Account | | **Test Priority** | | High | |
| **Pre-requisite** | | Account Logged In | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Login Page with Login and Register Open. | Login Page with Login, Register and Forget Password open. | Firefox | Pass |  |
| 2. | Log-out |  | Redirect to Dashboard, account logged out. | Redirect to Dashboard, account logged out. | Firefox | Pass |  |

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| **Test Scenario ID** | | PrDashboard-1 | | **Test Case ID** | | Pr-Dashboard1 | |
| **Test Case Description** | | Course Management | | **Test Priority** | | High | |
| **Pre-requisite** | | Professor Account Logged In | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Dashboard containing the main LMS functions. | Login Page with Login, Register and Forget Password open. An additional “Course Management” tab is present for the professor’s only. | Firefox | Pass |  |
| 2. | Create A New Course | Course Name: Test Course 1  Course Details: Test Course 1 Description  Banner: | Create a new course with a name, description and an optional banner image. | Created a new course with name, description and banner image set. Course now appears on the Course List of the Professor. | Firefox | Pass | Needs all forms (except image) to be filled out. |
| 3. | Load Course Page |  | Loads Course page containing the dashboard, assignments, and grading. | Loads Course page. The dashboard contains course analytics and reports to track student performance alongside a list of students and email input to enroll a student. Lessons tab with add lesson, submission management, and grading. | Firefox | Pass | Needs all forms (except image) to be filled out. |
| 4. | Add student on course | Student email | Adds the student on the course. | Adds the student on the course, but the student can’t be removed on the course due to server error. \*Parecheck sa system mo if true to, tas modify if needed.\* | Firefox | Pass | Validation for a valid email address and detecting a nonexistent email address is also present by giving a warning. |
| 5. | Add Lesson on course | Lesson Title: Test Lesson  Lesson Description: Lesson Description  Step 1 Title: Test Step 1.  Step 1 Description: Description of Step 1.  Step 1 Resource URL (optional): <https://www.wikipedia.org/>  Step 2 Title: Test Step 2.  Step 2 Description: Description of Step 2.  Step 2 Youtube Links: <https://www.youtube.com/watch?v=TKfS5zVfGBc>  <https://www.youtube.com/watch?v=tCO4i2t-Aso>  Uploaded File for Step 2: | Creates a new lesson containing a title, description and additional related information for the lesson. | Creates a new lesson with a title and description alongside steps that contain individual resources each step. The lessons can’t be opened by the professor but are editable by the professor. | Firefox | Pass |  |
| 6. | Submission management | Title: Test Submission 1  Type: Assignment  Due Date:2025-05-31  Title: Invisible Submission 1  Type: Quiz  Due Date:2025-5-24  Visible: Hidden  Title: Late Submission 1  Type: Project  Due Date: 2025-5-3  Status: Closed | Create a submission with a title, and due date. Make the submission close when the due date comes. | Created a submission with a title, type and due date. The information for this is editable. Submission can be set when a status is closed or open, and whether the submission will be visible to students or not. Submission can be deleted. | Firefox | Pass |  |
| 7. | Grade Student |  | Give the student a grade on the submission | \*Gawin mo to sa system mo na lang\* | Firefox | \*Pass kung gumagana, fail kung hindi\* | “No submissions found” will be outputted if no one submitted in an assignment. |

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| **Test Scenario ID** | | StDashboard-1 | | **Test Case ID** | | St-Dashboard1 | |
| **Test Case Description** | | Student Course View | | **Test Priority** | | High | |
| **Pre-requisite** | | Student Account Logged In, Enrolled Courses of the Student | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Dashboard containing the main LMS functions. | Dashboard containing tabs for Discussions, CNN AI, Course, Settings, and Account Profile | Firefox | Pass |  |
| 2. | View Course | Enrolled Course: Test Course 1 | Gets onto the course page, load all course information in it. | Loads the course page, it contains the dashboard which has the attendance and lesson completion information of the student. Lessons containing the lessons uploaded by the professor in the course. And submissions. |  |  | Will display “No enrolled courses” if a student isn’t enrolled on a course. |
| 3. | View lesson as student. |  | View lesson as student, go through the lesson step-by-step indicated based on what the professor inputted. | The lesson has a progression bar to mark where the student is in the lesson. For each step, there’s a resource and a button you can click mark as complete to fill the progression (Gives an error that says “Could not save progress, try again”) | Firefox | Pass | \*Recheck sa system at modify mo yung sa part na nag-error kung nag-error siya\* |
| 4. | Submit on a submission |  | Submit a submission, only on open submissions can the student submit. | Submission only displays a white screen. \*Paggawa na lang sa system mo tas imodify mo tong part na to if needed.\* | Firefox | \*Pass kung gumagana, fail kung hindi\* |  |

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| **Test Scenario ID** | | AdDashboard-1 | | **Test Case ID** | | AdDashboard-1 | |
| **Test Case Description** | | Admin Panel | | **Test Priority** | | Medium | |
| **Pre-requisite** | | Admin Account Logged In | | **Post-requisite** | | N/A | |
| **TEST EXECUTION STEPS** | | | | | | | |
| **S No.** | **Actions** | **Inputs** | **Expected Output** | **Actual Output** | **Test Browser** | **Test Result** | **Test Comments** |
| 1. | Launch Website |  | Dashboard containing the main LMS functions. | Dashboard containing tabs for Discussions, Admin Panel, Settings, and Account Profile. | Firefox | Pass |  |
| 2. | Access Admin Panel |  | Access Admin Panel | Accessed Admin Panel, only a placeholder for admin panel page exists. | Firefox | Fail | Admin panel page is to be made. |