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LearnLink: Artificial Intelligence-Based E-Learning Companion for High School Students

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Abstract

The lack of engagement, personalization, real-time assessment, and adequate resources are common challenges in traditional high school coding education. To address these issues, this study presents LearnLink, an AI-powered e-learning platform specifically designed for ICT club students at SMK Puchong Batu 14. By integrating technologies such as Visual Studio and ChatGPT API, LearnLink provides a comprehensive, interactive learning experience that fosters student engagement and enhances programming skills. The prototype model is employed to develop the platform, allowing for extensive user interaction and iterative refinement. Preliminary findings indicate that the platform effectively addresses the identified challenges, demonstrating potential to bridge gaps in digital education through tailored content delivery and real-time feedback.

1. Introduction

LearnLink, an AI-infused e-learning platform for ICT club students at SMK Puchong Batu 14, transforms coding education. By integrating artificial intelligence, particularly an AI quiz Bot, the platform offers an interactive environment for learning coding and programming. E-learning, facilitated by digital technology, is complemented by AI, a branch of computer science enhancing tasks requiring human intelligence. Coding, crucial in software development, is empowered by AI advancements. LEARNLINK addresses challenges in traditional education, providing tailored resources for students and revolutionizing high school coding education through engagement, personalization, and real-time assessment. This project aims to empower students with enjoyable and relevant digital skills for the future.

High school students in the ICT Club at SMK Puchong Batu 14 face challenges in coding education, including low engagement, limited personalization, delayed feedback, and a scarcity of tailored resources. These issues lead to underdeveloped skills, reduced interest in ICT, and inequalities in learning opportunities. In response, the ICT club and its teacher are taking the initiative by developing LearnLink, an AI-powered e-learning platform. LearnLink aims to address these challenges, offering personalized learning experiences, real-time assessment, and comprehensive resources. The project is driven by the goal of empowering students for success in the digital era and eliminating barriers to quality ICT education.

The objectives of this project are to design and implement a user-friendly e-learning platform tailored to the curriculum and skill development needs of high school students in the ICT club at SMK Puchong Batu 14, to develop an AI-powered tutor chatbot that provides real-time interaction and enhances understanding of coding concepts, and to implement testing functionality to evaluate the effectiveness of the developed web application. The system includes several modules: User Management allows admins to add or delete students, educators, and

other admins. Roles Management enables admins to create, read, and delete roles. A Login Form permits all users to access the system. Account Settings let users update certain details. Educators can manage course pages and lessons, including creating, reading, updating, and deleting them, and uploading lesson materials. Students can view courses, lessons, and download materials. An AI-based tutor botassists students by answering course-related questions through natural language processing. The system aims to streamline educational management and enhance learning experiences.

The LearnLink project is instrumental in addressing challenges faced by high school students in the ICT Club at SMK Puchong Batu 14. By providing an engaging e-learning platform with AI-driven features, it aims to reignite students' interest in coding. Personalized learning experiences cater to diverse learning styles, while real-time assessment tools offer immediate feedback for skill refinement. The project overcomes resource scarcity by delivering updated content, bridging gaps in coding and programming skills. Ultimately, LearnLink's significance lies in creating an inclusive learning environment, ensuring equal access to quality education, and preparing students for success in the digital era, fostering a transformative impact on their academic and professional journeys.

2. Related Work

Established in 1975, SMK Puchong Batu 14, or "esempi," has evolved from two buildings to five, currently accommodating 1,700 students under the leadership of Principal Ms. Noor Hiakmah. With a mission to enhance education quality through modern approaches, the school has introduced initiatives to revitalize interest in digital learning, particularly in its ICT club. To support this objective, the development of LearnLink leverages key technologies such as Visual Studio for the coding environment and the ChatGPT API for AI-based interactions. Artificial Intelligence, the core technology behind the system, simulates human-like problem-solving and decision-making capabilities, enabling more interactive and adaptive learning experiences. Additionally, the platform incorporates e-learning technologies, encompassing online courses, digital resources, and interactive multimedia content to facilitate effective learning beyond traditional classroom settings.

2.1 Literature Preview

Kahoot! is a game-based learning platform renowned for its interactive and collaborative approach to education. Educators craft engaging quizzes, or "Kahoot," covering diverse topics, employing multiple-choice questions, true/false statements, and polls. Participants, termed "players," use smartphones, tablets, or computers to join sessions via unique game PINs. The competitive, time-based structure awards points for accuracy and speed, fostering friendly competition and active engagement. Kahoot! has proven effective in traditional and virtual classrooms, enhancing comprehension, reinforcing concepts, and facilitating team building in professional settings [1]. Its transformative impact on education lies in combining playfulness with learning, creating an interactive and inclusive environment.

Quizizz, a game-based learning platform akin to Kahoot, diverges in its emphasis on self-assessment and asynchronous learning. While Kahoot is restricted to multiplayer mode, Quizizz offers a unique Homework Mode for individual, self-paced participation [2]. The platform incorporates game-like elements, awarding points for correct answers and providing detailed feedback and performance reports for both educators and participants. Distinct from Kahoot's synchronous play, Quizizz's self-paced mode allows participants to answer questions at their own speed, fostering a more relaxed and enjoyable experience. Quizizz's comprehensive performance reports, emphasizing its adaptability and effectiveness in diverse educational settings [3].

Edmodo, established in 2008 by Nic Borg and Jeff O'Hara, is a teacher-centered e-learning platform facilitating communication, collaboration, and learning among educators, students, and parents. Teachers wield administrative control over virtual classrooms, with students and parents requiring invitations for access. The platform serves as a secure online space, enabling the dissemination of assignments, quizzes, and educational resources. Edmodo's messaging system ensures secure interactions, while features for creating and distributing digital assessments streamline the grading process [4]. Parental engagement is prioritized, granting access to announcements, assignments, and grades. Edmodo's commitment to security and privacy underscores its role as a versatile and integrated tool for enhancing educational communication and collaboration [5]

Table 1 presents a comparative analysis of key modules across four educational platforms: Kahoot, Quizizz, Edmodo, and the proposed system, LearnLink. While all platforms support core functionalities such as login, quizzes, and data management, LearnLink distinguishes itself by integrating an AI-Tutor Bot for interactive learning support. Unlike Kahoot and Quizizz, LearnLink does not include a live quiz module but offers a teaching material module similar to Edmodo. Additionally, it incorporates a score and assessment module but lacks a report and event calendar module, highlighting its focus on interactive learning rather than administrative features.

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Table 1 *Modules comparison*

No	Module	Kahoot	Quizizz	Edmondo	LearnLink
1.	System Type	Web and mobile based	Web and mobile based	Web and mobile based	Web based
2.	Login Module	Yes	Yes	Yes	Yes
3.	Quiz Module	Yes	Yes	Yes	Yes
4.	Live quiz module	Yes	Yes	Yes	No
5.	Teaching material module	No	No	Yes	Yes
6.	Data Management module	Yes	Yes	Yes	Yes
7.	AI-Tutor Bot	No	Yes	No	Yes
8.	Score and assessment module	Yes	Yes	No	Yes
9.	Report module	Yes	Yes	Yes	No
10.	Event calendar module	No	No	No	No

3. Methodology/Framework

The prototyping model facilitates simultaneous analysis, design, and implementation, iterating until the final system is realized [6]. Software prototypes, highlighting core functionalities, are developed iteratively, collecting user and management feedback for refinement. This iterative process ensures stakeholder consensus on deployment readiness. The planning phase establishes the foundation for software development, defining project objectives, requirements, and resource allocation [7]. A Gantt chart guides project management, offering a systematic task sequence. This stage scrutinizes data from interviews and existing systems, informing the generation of Entity Relationship Diagrams (ERD) and Data Flow Diagrams (DFD) [8]. The design phase translates planning and analysis insights into a structured blueprint, detailing system architecture and functionalities [9]. This phase involves program development, with iterative prototype cycles and end-user feedback guiding system enhancements [10]. The testing phase ensures thorough system evaluation, identifying and rectifying errors through user acceptance testing [11].

The planning phase establishes the groundwork for the software application's development. It involves defining project requirements, problem statements, and objectives. Additionally, a Gantt chart is created to outline tasks and manage the project systematically [12]. Furthermore, a project schedule is formulated and illustrated in the Gantt chart, outlining the tasks to be executed during the development of the proposed project within the specified timeframe. The Gantt chart is accessible in Appendix A. This chart serves as a guide for managing and steering the project from the planning phase through the implementation and maintenance phases, offering a systematic and clearly defined sequence of tasks.

In the analysis phase, data collected in the planning stage is scrutinized to determine project requirements. This includes assessing features for an E-Learning system and understanding existing systems' features and workflows. Additionally, an analysis of features and the workflow of existing systems will be carried out to understand how they implement quiz systems, what elements contribute to the enjoyment of their games, and the essential content and features needed for the e-learning system. Context Diagram, Data Flow Diagrams (DFD) and Entity Relationship Diagrams (ERD) are then generated for the subsequent design phase shown in figure 1 figure 2 and figure 3 subsequently.

Table 2 *Methodology Phases*

No	Phase	Output
1	Planning	Project Requirements Document, Gantt Chart (Appendix A), Project Schedule
2	Analysis	Context Diagram (Figure 1), Data Flow Diagram (DFD - Figure 2), Entity Relationship Diagram (ERD - Figure 3)
3	Design	System Architecture Diagram, User Interface Design, Database Schema
4	Implementation	Developed System/Prototype, Testing Plan
5	Testing and Maintenance	Test Results, Bug Report, User Feedback, Maintenance Log, User Manual, Update Schedule

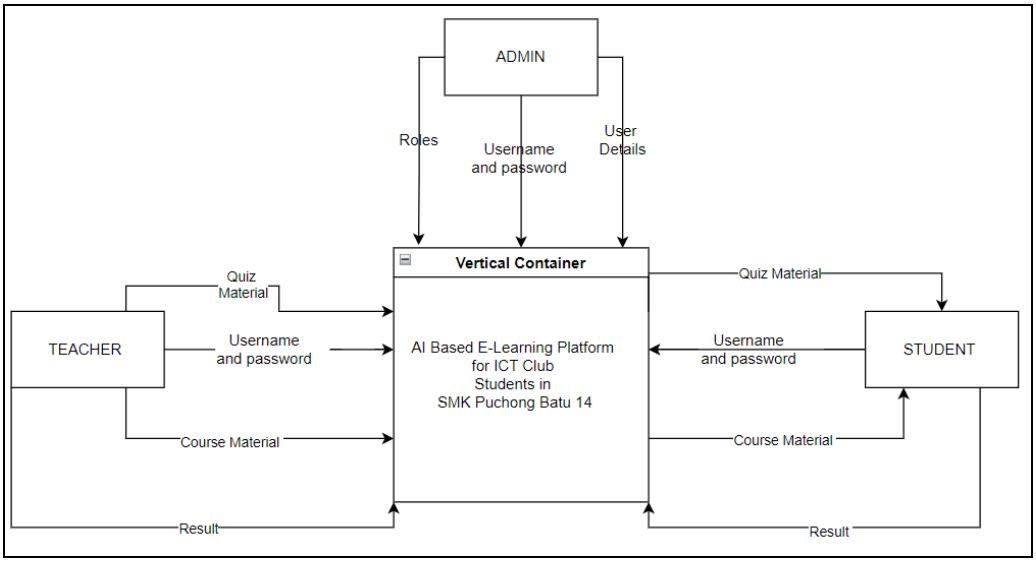

Fig 1 *Context Diagram*

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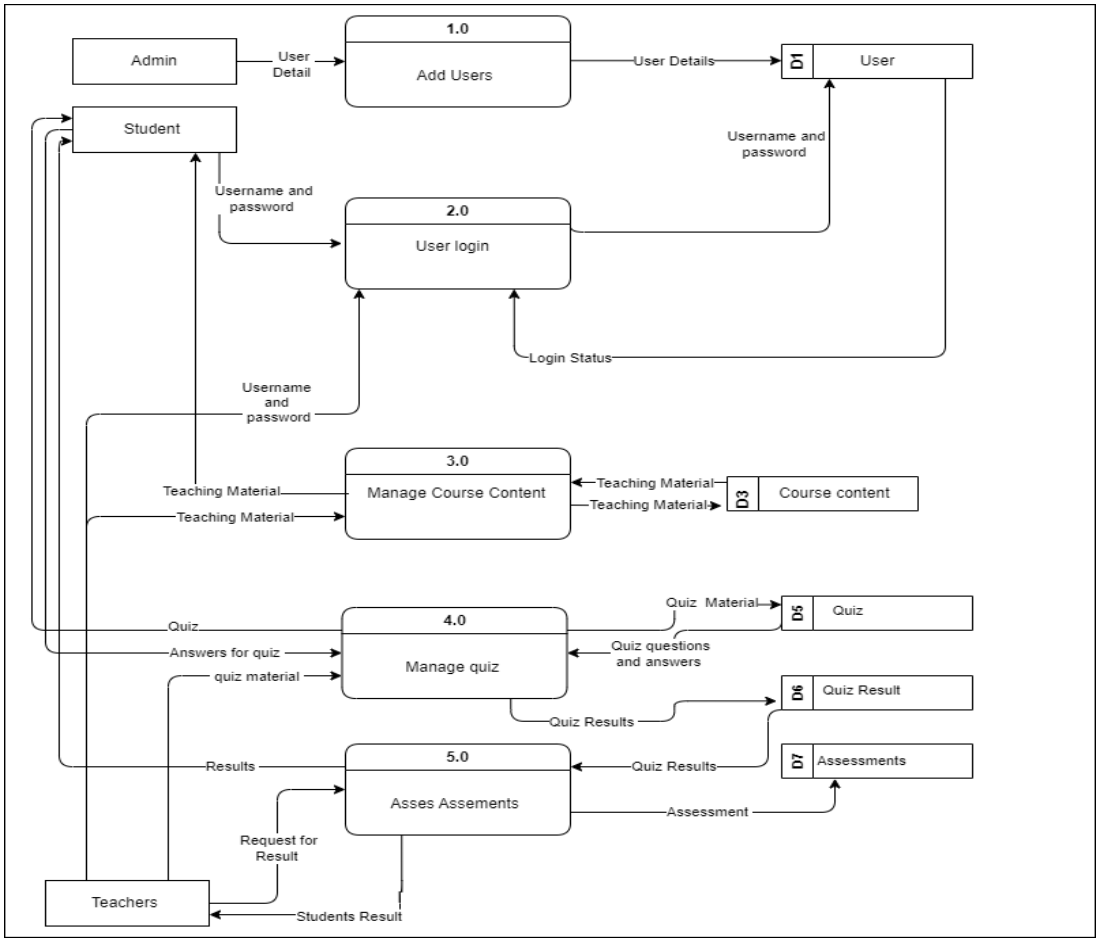

Fig 2 *Level 0 Data Flow Diagram*

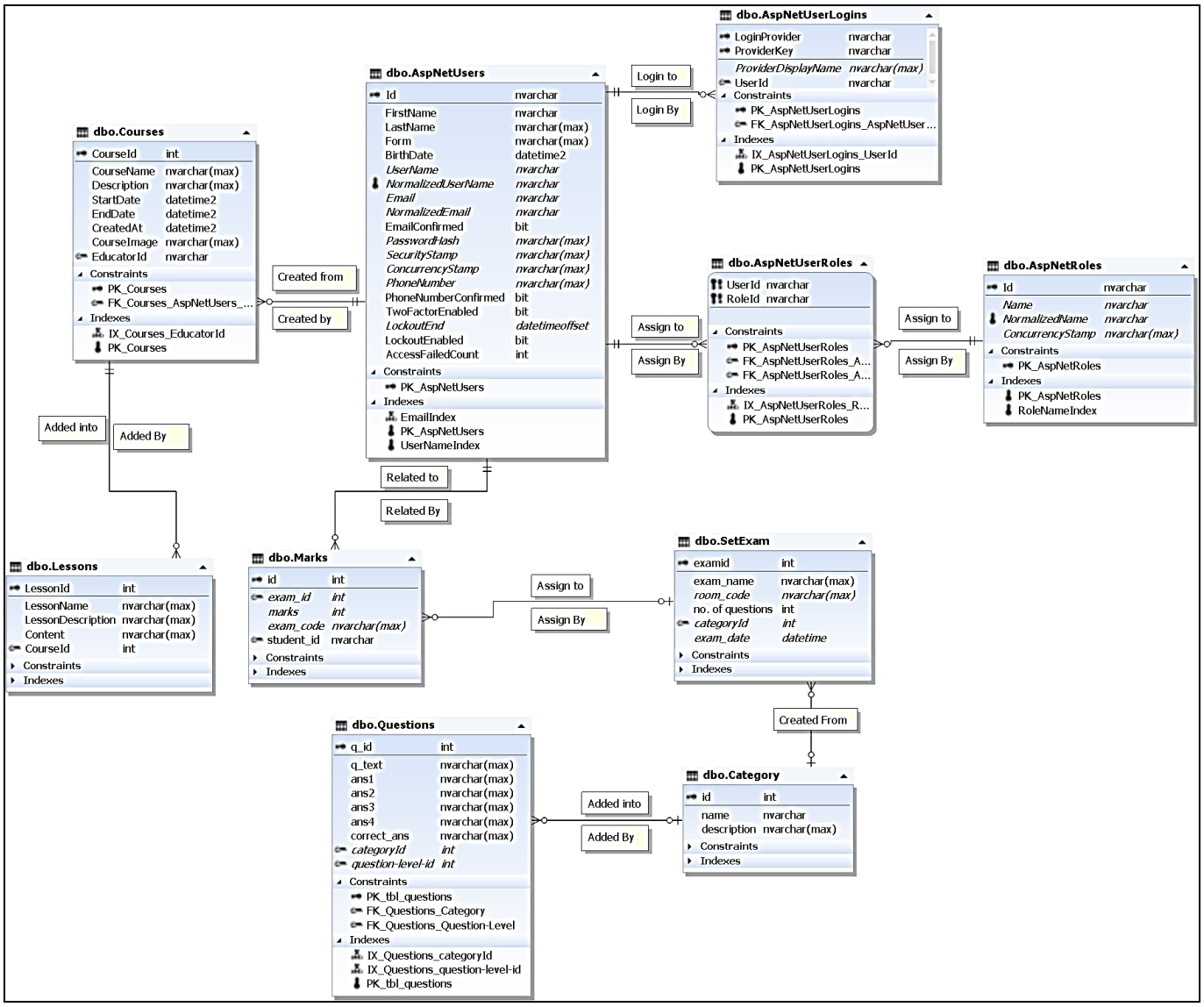

Fig 3 *Entity Relationship Digram*

In qualitative research, the utilization of in-depth interviews serves as a versatile and valuable method for data collection, allowing individuals to express their unique perspectives and interpretations of the world. Despite the apparent informality of interviews, they are meticulously guided conversations designed to achieve specific research objectives. This dynamic presents methodological, analytical, and ethical challenges, particularly for novice researchers. An illustrative example is an interview conducted via a phone call meeting with Puan Shamala A/P Mariappan, the teacher in charge of the ICT club at SMK Puchong Batu 14, on 27th November 2023. The recorded interview, detailed in Appendix C, highlights key insights from Puan Shamala, emphasizing the absence of an E-learning system at SMK Puchong Batu 14. Puan Shamala supports the proposed application, emphasizing its need for user-friendliness and easy comprehension for students. The envisioned system aims for ubiquity, ensuring seamless access to teacher-uploaded notes for students and straightforward note uploading for teachers. Puan Shamala also advocates for the integration of an AI tutor bot, promoting a personalized learning experience for students within the proposed educational application. The design phase transforms insights from planning and analysis into a structured blueprint. It involves creating a detailed system architecture, specifying functionalities, and defining the overall software structure. This phase encompasses entity relationship diagram, database design, and user interface design. Figure 4, figure 5 and figure 6 displays the flowchart.

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Table 3 *Database Design*

No	table_name	Attributes	Primary_keys	foreign_keys
1	AspNetRoleClaims	Id, RoleId, ClaimType, ClaimValue	Id	RoleId
2	AspNetRoles	Id, Name, NormalizedName, ConcurrencyStamp	Id	
3	AspNetUserClaims	Id, UserId, ClaimType, ClaimValue	Id	UserId
4	AspNetUserLogins	LoginProvider, ProviderKey, ProviderDisplayName, UserId	LoginProvider, ProviderKey	UserId
5	AspNetUserRoles	UserId, RoleId	UserId, RoleId	UserId, RoleId
6	AspNetUsers	Id, FirstName, LastName, Form, BirthDate, UserName, NormalizedUserName, Email, NormalizedEmail, EmailConfirmed, PasswordHash, SecurityStamp, ConcurrencyStamp,PhoneNumber, PhoneNumberConfirmed,TwoFactorEnabled, LockoutEnd, LockoutEnabled, AccessFailedCount	Id	
7	AspNetUserTokens	UserId, LoginProvider, Name, Value	UserId, LoginProvider, Name	UserId
8	Category	id, name, description	id	
9	Courses	CourseId, CourseName, Description, StartDate, EndDate, CreatedAt, CourseImage, EducatorId	CourseId	EducatorId
10	Lessons	LessonId, LessonName, LessonDescription, Content, CourseId	LessonId	CourseId
11	Marks	id, exam_id, marks, exam_code, student_id	id	exam_id, student_id
12	Question-Level	id, questionLevel	id	
13	Questions	q_id, q_text, ans1, ans2, ans3, ans4, correct_ans, categoryId, question-level-id	q_id	categoryId, question-level-id
14	SetExam	examid, exam_name, room_code, no. of questions, categoryId, exam_date	examid	categoryId

Table 2 depicts the database table. This database design creates a cohesive structure, fostering relationships between key entities within the education platform. Table 3 depicts the hardware and software requirements used to develop the proposed system.

Table 4 *Harware and Software Requirements*

No	Hardware	Model
1	Laptop Model	DELL G15
2	Operating System	Windows 11 Home Single Language
3	processor	intel(R) core(TM) i7-10870H CPU@2.20 GHz
4	Memory (RAM)	16.00 GB Ram
5	Graphic Processing Unit (GPU)	GeForce RTX® 3050
No	Software	Features
1	Visual Studio	Environment to develop the entire project
2	MS SQL	Develop and store the database
3	ChatGPT API	ChatGPT API is an interface used to create quiz bot
4	Figma	To draw wireframe
5	Microsoft Project 2019	To draw the Gantt Chart
6	Amazon S3	Cloud object storage

The implementation phase translates analysis and design outcomes into a tangible system through program development. The initial prototype focuses on quizzes, scores, assessments, and data management modules. User feedback guides modifications, leading to a comprehensive system with additional modules like teaching material and reports. In the initial prototype cycle, the focus lies on creating a system prototype that emphasizes quiz, score, assessment, and data management modules. After crafting the first prototype, teachers, and users, who are the end users, will test it, providing valuable feedback on the quiz, score, assessment, and data management modules. Subsequently, system modifications based on end-user feedback conclude the prototype cycle. The second cycle introduces the development of additional modules, specifically a teaching material module and a report module. Upon completing the second prototype, it undergoes reevaluation by end users, and their feedback guides further system adjustments, culminating in the creation of a comprehensive system. The testing phase ensures the finalized system undergoes thorough evaluation, including bug resolution and usability enhancements [14]. Rigorous checks confirm operational effectiveness, aligning with functional and non-functional requirements outlined in the analysis phase. User acceptance testing allows assessment before the official launch, and periodic maintenance prevents major failures following the SDLC Prototype Model.

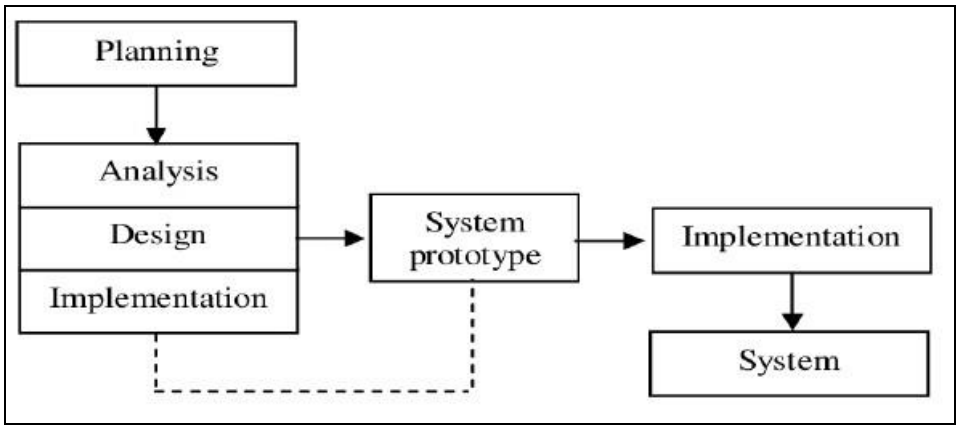

Fig 4 *Prototyping Model*

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4. Result and Discussion

4.1 Implementations

The Admin Controller manages several views for handling administrative tasks related to user management. Figure 2 views the roles in the system. The AddUser in figure 4 view includes a form for entering user details and selecting roles, facilitating the addition of new students. The UserList in Figure 3 view displays a list of all users with their usernames, emails, and roles, providing options for editing or deleting users. The EditUser view in figure 5 presents a pre-filled form for updating user information and roles, ensuring user details can be modified accurately. After a user is deleted via the DeleteUser action, the UserList view is updated to reflect the changes. The UserDetails view in figure 6 offers a read-only display of individual user details, including personal information and roles, allowing administrators to review user data. These views collectively support comprehensive user management, enabling the creation, modification, deletion, and viewing of user information within the application.

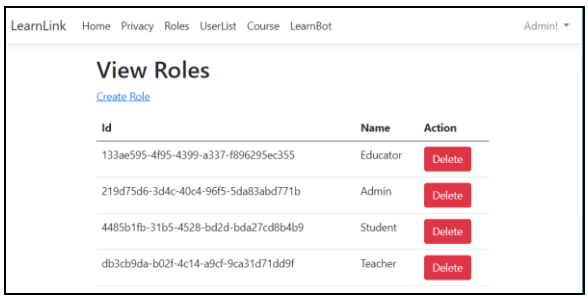

Fig 5 *View Roles*

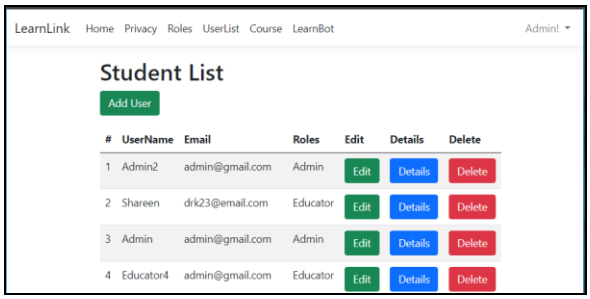

Fig 6 *User List*

Fig 7 *Add Users*

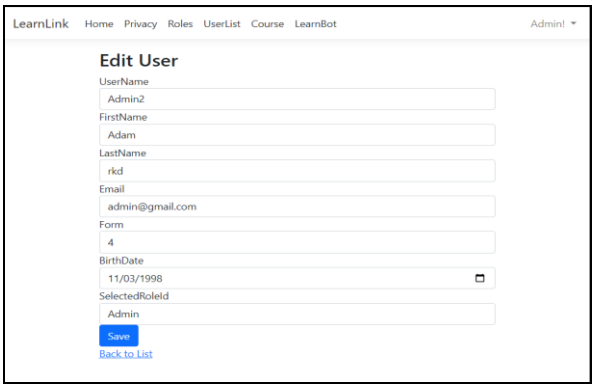

Fig 8 *Edit Users*

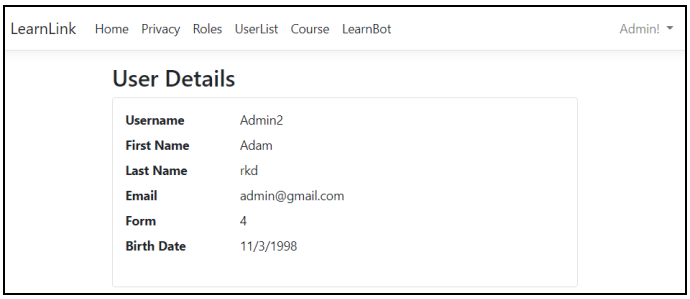

Fig 9 *User Details*

Account Views include login page and Edit Account Details page.Login page as shown in figure 6 is for user to login. Once user's login their details will be stored in the session according to their roles. Users can only access pages that are authorized according to their roles. Edit Account details page in figure 7 is for users to view and change their password.

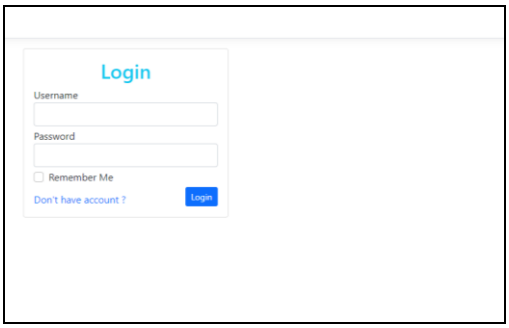

Fig 10 *User Login*

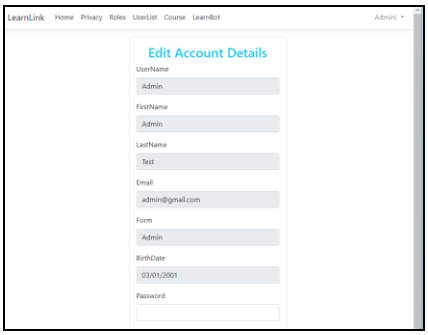

Fig 11 *Edit User Details*

The EducatorController manages course views for users with the "Teacher" role. The Index view lists all available courses as shown in figure 12 The CreateCourse view in figure 13 provides a form to add new courses, including details and an optional image. The UpdateCourse view in figure 14 allows editing existing course details, pre-filling current information. The Details view offers a read-only display of course information. The DeleteCourse action removes a course with confirmation typically via JavaScript or AJAX.

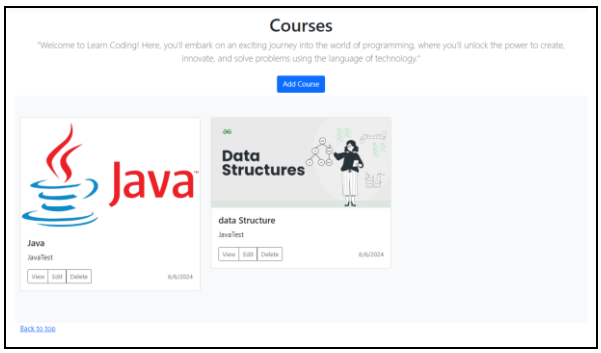

Fig 12 *Courses page*

Fig 13 *Create CoursePage*

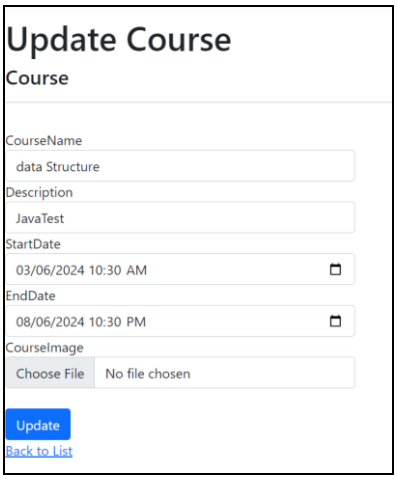

Fig 14 *Update Course Page*

The LessonController handles lesson views within a course. The Index view lists lessons and offers options to create, edit, delete, and download lessons. The CreateLesson view in figure 15 provides a form for adding new lessons, including file uploads to AWS S3. The DeleteLesson in figure 16 action updates the Index view to reflect lesson removal. The DownloadFile action streams lesson content from AWS S3 directly to the user.

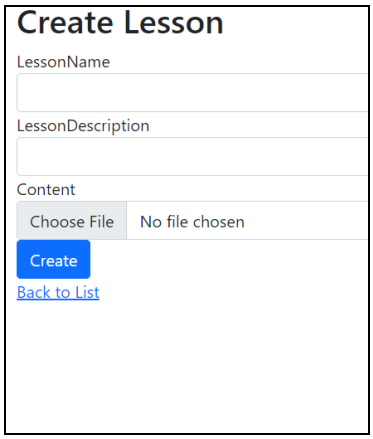

Fig 15 *Create Lesson Page*

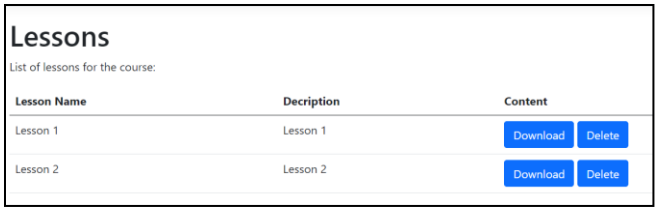

Fig 16 *Lesson List*

The LearnBot or tutorbot in Figure 17 is a GPT model. It includes a textarea for the query and a dropdown for language selection, populated from ViewBag.Languages. Upon submission, it sends a POST request to the GetGPTResponse action. If ViewBag.Result is not null, the response is displayed in an alert box below the form. This setup allows users to submit queries in a selected language and view the GPT model's response in a user-friendly, responsive design.

Fig 17 *Learn Bot*

The CategoryController views in the LearnLink app offer a user-friendly interface for managing categories and their questions. The Categories view in figure 18 lists categories with pagination and options to create, update, or delete. CategoryCreate and CategoryUpdate figure 19 and figure 20 respectively views provide forms for adding and editing categories, respectively. CategoryDelete and CategoryQuestionDelete perform deletions and redirect appropriately. The CategoryQuestions view lists questions for a specific category, with options to delete questions or return to the category list. These views streamline category and question management, enhancing user experience.

Fig 18 *Quiz Category*

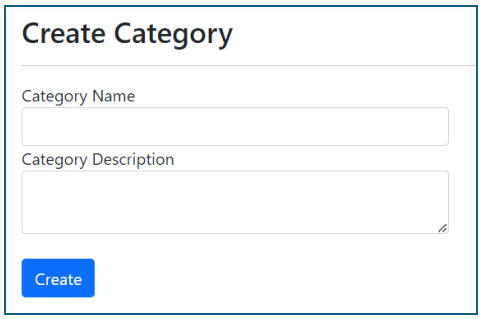

Fig 19 *Create Category*

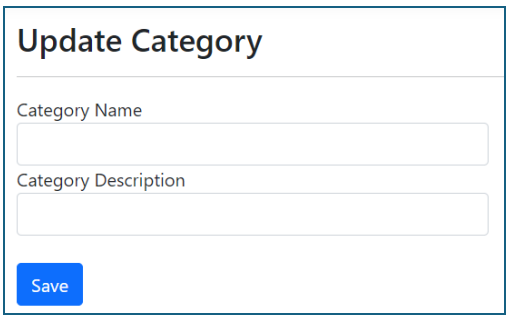

Fig 20 *Update Category*

The QuestionController views in LearnLink streamline question management. The Questions view in figure 21 lists questions with pagination for easy navigation. QuestionCreate figure 22 provides a form for adding questions, featuring category dropdowns and validation feedback. QuestionUpdate figure 23 pre-fills forms for editing questions, showing current details and categories. QuestionDelete redirects users to the question list with success or error messages via TempData. These views offer an intuitive interface for managing questions efficiently.

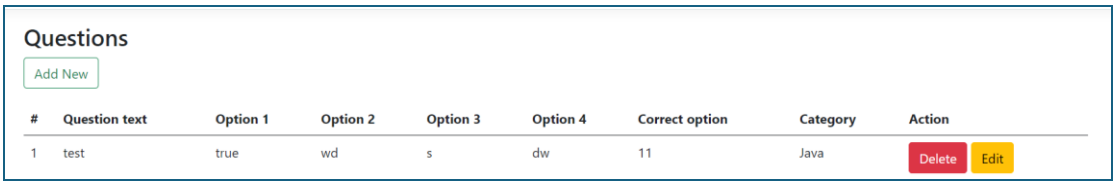

Fig 21 *Questions List*

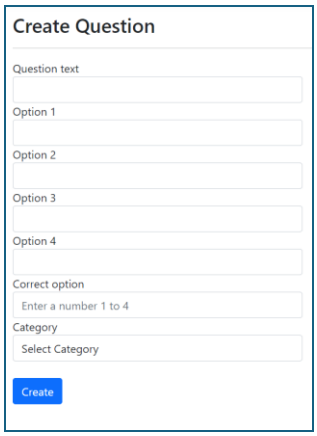

Fig 22 *Create Question*

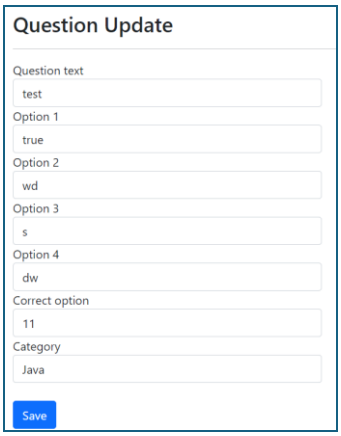

Fig 23 *Question Update*

Users can view exams via SetExamList as shown in figure 24 and create new ones through SetExam Figure 25, which includes category selection. On form submission, validation is handled, redirecting to the exam list or displaying errors if needed. ExamDelete facilitates exam removal and redirects to the list. Educators can access overall exam results via Results and view specific quiz details through ShowResults as shown in figure 26. Error handling ensures smooth management by addressing missing quiz names or retrieval issues. These actions provide a streamlined user experience for exam management. The StartExam view Figure 27 presents the interface for initiating an exam, where students input a room code to begin. If the room code is valid and the student hasn't attempted the quiz before, they proceed to the AttemptQuiz view in Figure 28, displaying the questions retrieved from the session. After submitting their answers, the SubmitQuiz view Figure 29 processes the responses, calculates marks, and presents the result to the student.

Fig 25 *Quiz List*

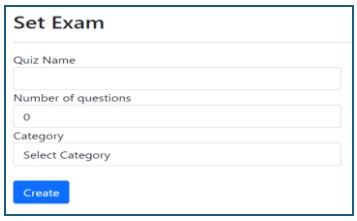

Fig 26 *Set exam*

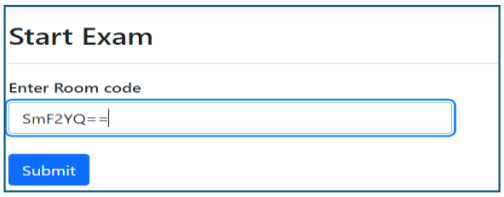

Fig 27 *Start exam*

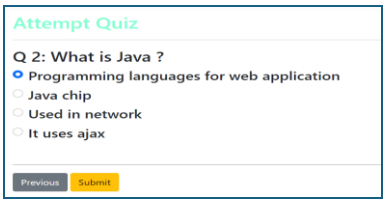

Fig 28 *Attempt Quiz*

Fig 29 *Exam results*

4.2 User Acceptance Test

To evaluate the admin functionalities of the LearnLink system, including login, role management, user management, navigation, usability, design, and performance. This test plan aims to ensure that the system meets the requirements and provides a smooth experience for administrators.

Table 5 Test Plan for Admin

No	Description	Expected Result	Actual Result
1.	Test login functionality	User should be successfully logged in and redirected to the dashboard	Pass
2.	Test invalid login functionality	User should receive an error message indicating invalid credentials	Pass
3.	Test role creation process	New role should be created and listed in the roles list	Pass
4.	Test user creation process	New user should be created and listed in the users list	Pass
5.	Test user edit process	User details should be updated and reflected in the users list	Pass
6.	Test user deletion process	Selected user should be deleted and no longer listed	Pass
7.	Test navigation ease through the LearnLink system	User should be able to navigate to various sections without difficulty	Pass
8.	Test feature discovery ease	User should be able to find required features without difficulty	Pass
9.	Test overall design and layout satisfaction	User should find the design and layout aesthetically pleasing and easy to use	Pass
10.	Test intuitiveness of forms and buttons	Forms and buttons should be intuitive and easy to use	Pass
11.	Test system performance (delays/issues)	System should perform tasks without significant delays or issues	Pass

To evaluate the teacher functionalities of the LearnLink system, focusing on login, course management, content and assignment management, quiz and exam management, tutor bot interactions, navigation, usability, design, and performance. This test plan aims to ensure that the system meets the requirements and provides a smooth experience for teachers.

Table 6 Test Plan for Teacher

No	Description	Expected Result	Actual Result
12.	Test login functionality	Teacher should be successfully logged in and redirected to the dashboard	Pass
13.	Test invalid login functionality	Teacher should receive an error message indicating invalid credentials	Pass
14.	Test course creation process	New course should be created and listed in the courses list	Pass
15.	Test course update process	Course details should be updated and reflected in the courses list	Pass
16.	Test course deletion process	Selected course should be deleted and no longer listed	Pass
17.	Test course content and assignment management	Course content and assignments should be managed seamlessly	Pass
18.	Test quiz content management	Quiz content should be managed efficiently	Pass
19.	Test exam setting and student result viewing	Exams should be set and student results viewed efficiently	Pass
20.	Test tutor bot accuracy	Tutor bot should provide accurate and timely responses	Pass
21.	Test tutor bot assistance	Tutor bot should be helpful in assisting with queries	Pass
22.	Test navigation ease through the LearnLink system	User should be able to navigate to various sections without difficulty	Pass
23.	Test feature discovery ease	User should be able to find required features without difficulty	Pass
24.	Test overall design and layout satisfaction	User should find the design and layout aesthetically pleasing and easy to use	Pass
25.	Test intuitiveness of forms and buttons	Forms and buttons should be intuitive and easy to use	Pass
26.	Test system performance (delays/issues)	System should perform tasks without significant delays or issues	Pass

This test plan ensures a comprehensive evaluation of the LearnLink system from a student's perspective, aiming to enhance functionality, usability, and performance.

Table 7 Test Plan for Student

No.	Description	Expected Results	Actual Result
27.	Test login functionality	Student should be successfully logged in and redirected to the dashboard	Pass
28.	Test invalid login functionality	Student should receive an error message indicating invalid credentials	Pass
29.	Test view course process	Course details should be displayed correctly	Pass
30.	Test lesson viewing and downloading	Lesson content should be displayed, and downloading should work seamlessly	Pass
31.	Test quiz participation	Student should be able to join the quiz using the provided code	Pass
32.	Test quiz answering efficiency	Questions should be answered efficiently without technical issues	Pass
33.	Test quiz submission and result viewing	Quiz should be submitted successfully, and results should be displayed	Pass
34.	Test tutor bot accuracy	Tutor bot should provide accurate and timely responses	Pass
35.	Test tutor bot assistance	Tutor bot should be helpful in assisting with queries	Pass
36.	Test tutor bot accuracy	Tutor bot should provide accurate and timely responses	Pass

Table 7 Test Plan for Student (cont.)

No.	Description	Expected Results	Actual Result
1.	Test tutor bot assistance	Tutor bot should be helpful in assisting with queries	Pass
2.	Test navigation ease through the LearnLink system	User should be able to navigate to various sections without difficulty	Pass
3.	Test feature discovery ease	User should be able to find required features without difficulty	Pass

LearnLink system is highly satisfactory for admins, especially in key areas such as login functionality, role management, and system design. There are opportunities for slight improvement in user management processes to enhance efficiency. However, the positive ratings across all categories suggest that the system effectively supports admins in their administrative tasks as shown in figure 30.

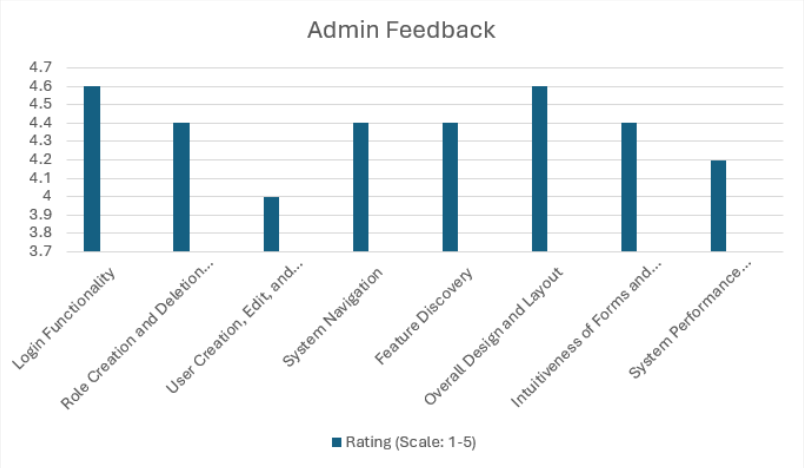

Fig 30 *Admin Feedback*

LearnLink system is highly satisfactory for teachers, especially in key areas such as login functionality, tutor bot accuracy, and system navigation. There are opportunities for improvement in managing quiz content and refining the overall design and layout. However, the positive ratings across most categories suggest that the system effectively supports teachers in their educational tasks as shown in figure 31.

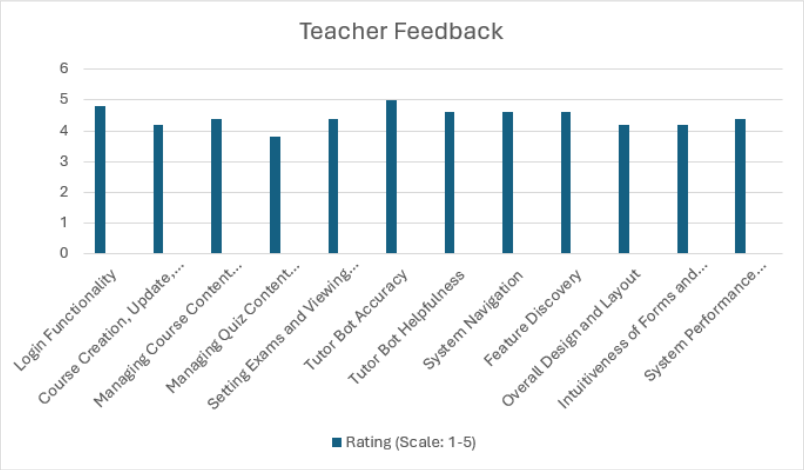

Fig 31 *Teacher Feedback*

The LearnLink system is highly satisfactory for students, especially in key areas such as login functionality, attending quizzes, and tutor bot interactions. There are opportunities for slight improvement in answering quiz questions to enhance efficiency. However, the positive ratings across all categories suggest that the system effectively supports students in their educational tasks as shown in figure 32.

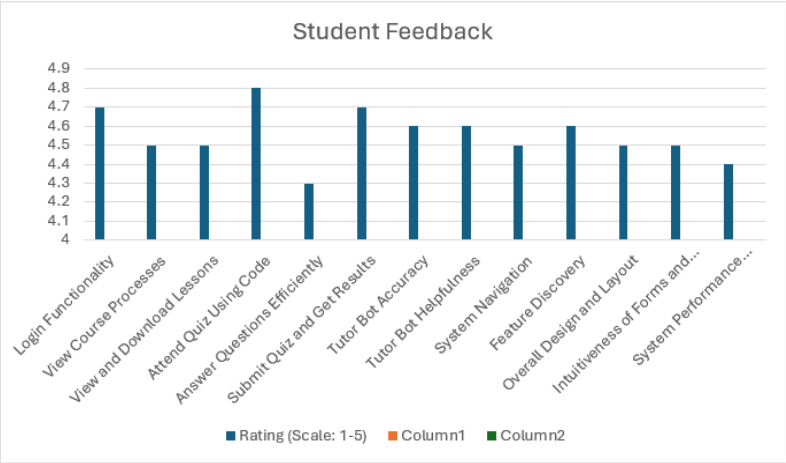

Fig 32 *Student Feedback*

5. Conclusion

Conclusion reviews the achievements and future work for the Course Management System (CMS) with AI at SMK Puchong Batu 14, exploring key aspects and recommendations for enhancement. The CMS with an integrated AI web application successfully enhances course management for the ICT Club. Educators can publish, update, and modify lessons, which students can access anytime, promoting self-paced learning. A notable feature is the AI Tutor bot, offering real-time assistance, explanations, and resources, thereby improving the learning experience and aiding students outside class hours. Interactive quizzes with immediate feedback support self-assessment and motivate students. The system's continuous availability ensures flexible learning, accommodating students' varied schedules.

The web application has limitations affecting user experience. Online courses lack the dynamic interaction of face-to-face settings, potentially reducing student engagement and communication richness. Storage and bandwidth limits restrict content hosting, posing financial burdens and performance issues, especially during peak usage. The AI Tutor bot, while beneficial, has limited contextual understanding and lacks emotional intelligence, affecting its ability to provide nuanced support.

To enhance the CMS, improve the AI Tutor bot's contextual understanding and regularly update its training data and knowledge base. Collect and analyze user feedback for targeted improvements. Invest in scalable cloud storage solutions and optimize bandwidth usage with techniques like file compression and content delivery networks. Develop advanced quizzing features and encourage the use of interactive multimedia content. Provide educators with training and resources for creating engaging content.

The CMS and AI application meet the project objectives and user requirements, despite some limitations. Proposed enhancements aim to improve performance and usefulness for users.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: study conception and design: Dharvina A/P Raja Kumar, Puan Hanayanti Binti Hafit data collection Dharvina A/P Raja Kumar; analysis and interpretation of results: Dharvina A/P Raja Kumar; draft manuscript preparation: Dharvina A/P Raja Kumar, Puan Hanayanti Binti Hafit All authors reviewed the results and approved the final version of the manuscript.

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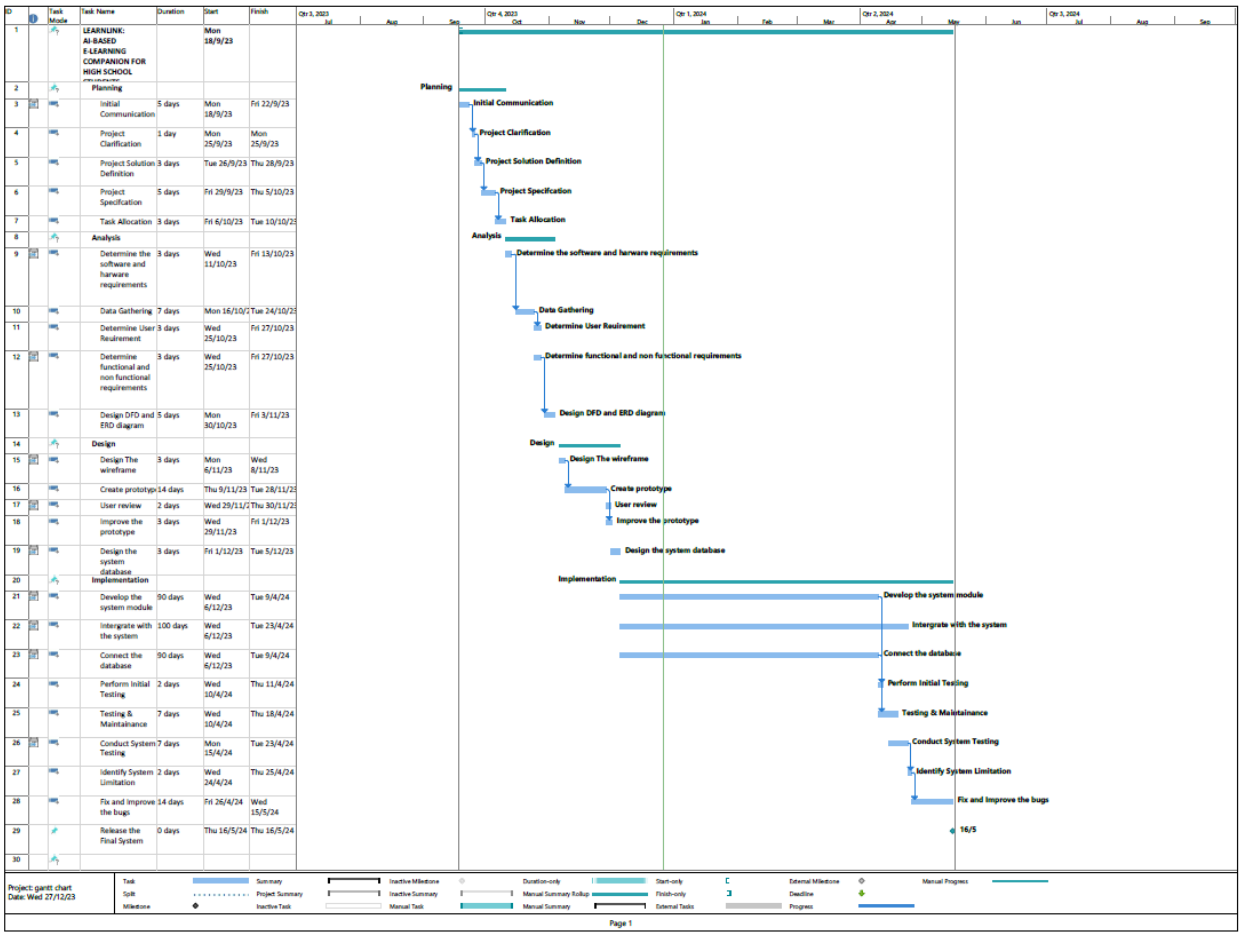
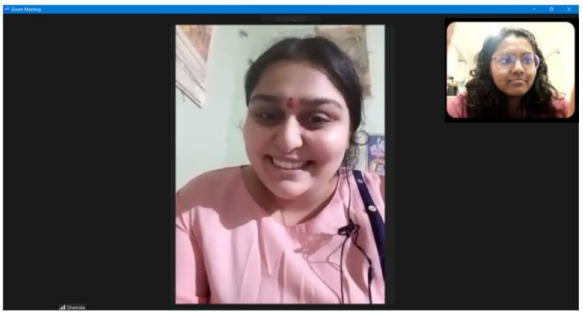
Appendix A



Gantt Chart Overview

Appendix B

Time & date: 27/11/2023 10:15pm-10:45pm
Platform used: Whatsapp Call
Interviewee name: Puan Shamala A/P Marriapan
Work experience: 12 years
Specialization: Information and Technology



Interviewer: Thank you for joining us today. We're excited to discuss the upcoming project. To start, could you please introduce yourself and provide some background on your role in the context of this project?
Interviewee: Hi I am Shamala teacher in charge of the ICT Club in SMK Batu 14.I graduated from UPSI, Perak in 2011. I have been teaching for about 12 years. I worked in SMK Puchong Utama 1 for 5 years and transferred to SMK Puchong Batu 14 in 2016. I've been appointed as the teacher in charge for the ICT Club since 2018. Before the pandemic the syllabus for the computer club curriculum was face to face and the syllabus felt outdated. However, during the pandemic we truly felt the impact of traditional learning. So, I've decided to upgrade the curriculum to online so students can have a dynamic learning experience while catching up to the latest trends in modern coding.
Interviewer: Great! Let's begin by talking about the overall vision for this project. What are the primary goals you hope to achieve with this new system?
Interviewee: The primary goals for this project are to enhance various aspects of our educational platform. We aim to improve course management by implementing efficient tools and features for teachers. Streamlining teacher tasks is a specific objective, ensuring that educators can easily manage and customize course content. Additionally, we want to enhance user engagement by creating a seamless learning experience for our users. This involves implementing interactive features, such as quizzes and a Tutor Bot, to make the learning process more engaging and effective. Ultimately, the goal is to create a user-friendly platform that fosters a positive and productive learning environment.
Interviewer: Excellent. Moving on to user access, we've identified the need for Teacher Login, User Sign Up, and User Login forms. Can you provide more details on any specific requirements or preferences you have for these authentication features?

Interviewee: For teacher login, it's crucial to ensure secure authentication mechanisms, prioritizing the protection of sensitive information. Additionally, implementing role-based access control is essential, allowing teachers to access specific functionalities based on their roles and responsibilities within the platform. Regarding user sign-up, we should include fields for essential information such as full name, email address, and a secure password. Depending on our needs, we may consider gathering additional information, such as the educational institution they are associated with. As for user login, incorporating social media integration can enhance the user experience. Allowing users to log in using their existing social media credentials simplifies the process and encourages seamless engagement with the platform. This can contribute to a more user-friendly and accessible login experience.
Interviewer: Understood. Now, let's delve into features for teachers. The Teacher Dashboard is crucial. What functionalities or information would you like to see included in the Teacher Dashboard?
Interviewee: The Teacher Dashboard should encompass a range of functionalities and provide comprehensive information to facilitate efficient course management and student engagement. A snapshot of all active courses with key details such as course names, enrollment status, and upcoming milestones. Individual student progress indicators, including completion status, grades, and participation metrics. A section for important announcements, upcoming events, and notifications to keep teachers informed and engaged. Analytical tools displaying overall course performance metrics, student engagement trends, and assessment results. Integration with an event calendar displaying key dates, deadlines, and scheduled activities related to courses. Tools for providing feedback on student assignments and assessments, as well as mechanisms for students to provide

feedback. Visual representations of course and student performance through charts, graphs, and data summaries.

Interviewer: Moving to course management, we've outlined CRUD operations on Course and Course Playlist pages. What specific details or functionalities are crucial for effective course management?

Interviewee: When it comes to course management and the outlined CRUD operations on the Course and Course Playlist pages, several crucial details and functionalities come to mind. The ability to create new courses with ease, including providing essential details such as course title, description, and relevant metadata. Flexibility in updating existing courses, allowing for modifications to course content, descriptions, and associated materials. While less frequent, the option to remove outdated or irrelevant courses is to maintain a clean and organized course list. The capability to create, modify, and delete playlists within courses, offering a structured way to organize and present course materials. By incorporating these functionalities into the CRUD operations for Course and Course Playlist pages, we can create a robust course management system that empowers educators to organize content effectively, adapt to evolving needs, and deliver a seamless learning experience for students in the ICT Club.

Interviewer: Continuing with content, what are the key functionalities or requirements for Video Content, Event Calendar, Quiz Categories, and Quiz Pages?

Interviewee: Here are the key functionalities and requirements I envision for Video Content, Event Calendar, Quiz Categories, and Quiz Pages. Teachers should have a straightforward process for uploading video content, with options to manage and organize videos within courses. Incorporating features like comments, discussions, or annotations to encourage student interaction and engagement with video content. Ensuring that videos are accessible to all students, with options for captions, transcripts, and compatibility with assistive technologies. A user-friendly interface for creating events on the calendar, allowing teachers to set details like date, time, location, and event type. Enabling teachers to easily create and manage quiz categories, grouping quizzes based on topics, difficulty levels, or other relevant criteria. Providing customization features for quiz categories, including the ability to add descriptions, images, or specific instructions. Tools to sort and filter quizzes within categories, enhancing organization and accessibility for both teachers and students.

Interviewer: We've included a Quiz Bot in the project. Could you provide more insight into how you envision this Quiz Bot functioning and any specific capabilities it should have?

Interviewee: The Quiz Bot holds significant potential to enhance the interactive learning experience within the platform. Here's how I envision its functioning and specific capabilities. The Quiz Bot should have the capability to automatically generate quizzes based on predefined criteria such as topic, difficulty level, or learning objectives. This would save time for teachers and ensure a diverse set of quizzes. The Quiz Bot should provide instant feedback to students after completing a quiz, highlighting correct answers, explaining incorrect choices, and offering suggestions for improvement. This immediate feedback promotes a more interactive learning process. Implementing NLP capabilities allows the Quiz Bot to understand and process natural language queries or responses from students. This fosters a more conversational and user-friendly interaction.

Interviewer: Shifting to Assessment and Results, what specific functionalities or data points are crucial for tracking and evaluating user performance?

Interviewee: The platform should support a variety of assessment types, including quizzes, exams, assignments, and project submissions. This diversity ensures a holistic evaluation of different skills and knowledge areas. A robust feedback mechanism is crucial for student growth. The platform should enable teachers to provide detailed feedback on assessments, highlighting strengths and suggesting areas for improvement. The ability to perform comparative analysis, comparing a student's performance against the class average or predefined benchmarks, provides valuable context for assessment results. Generating comprehensive progress reports helps students and teachers track performance over time. These reports can include cumulative scores, trends, and areas that may require additional focus.

Interviewer: Finally, for general pages like Home, About, and potentially others, what content or functionalities would you like to see to ensure an informative and appealing user experience?

Interviewee: Certainly. For the Home and About pages, it's crucial to create a compelling and informative user experience. Here are the specific content and functionalities I believe are important. The Home page should provide a concise yet engaging introduction to the platform, outlining its purpose, mission, and the value it brings to users. Ensure that the Home page offers intuitive navigation, guiding users to essential sections such as courses, quizzes, and resources. A well-organized layout enhances the overall user experience. The About page should delve deeper into the platform's background, mission, and the team behind it. Introduce key stakeholders, their expertise, and the shared vision for the platform's role in education. Ensure that both the Home and About pages are optimized for various devices, providing a seamless experience whether users access the platform from a desktop, tablet, or smartphone. By focusing on these content and functionality considerations, the Home and About pages can effectively serve their dual purpose of introducing the platform and encouraging users to explore further, ultimately contributing to a positive and appealing user experience.

Interviewer: Thats all from me, thank you for joining us.