

AI-Powered Tutoring System for Automatic Notes Summarization and Quiz Generation

Irfan Syafie Nor Afian¹, Lizawati Salahuddin^{2*}, Ariff Idris³, Fiza Abdul Rahim⁴

^{1,2,3}Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka (UTeM),
Melaka, Malaysia

⁴Faculty of Artificial Intelligence, Universiti Teknologi Malaysia (UTM), Kuala Lumpur, Malaysia

DOI: <https://dx.doi.org/10.47772/IJRISS.2025.910000097>

Received: 02 October 2025; Accepted: 10 October 2025; Published: 05 November 2025

ABSTRACT

The AI-Powered Tutoring System is developed to address the persistent challenges of limited personalized learning support and cognitive overload that students experience when managing and revising extensive academic materials. Despite the growing use of digital learning tools, few systems effectively integrate automated summarization and quiz generation to promote active, self-directed learning. This study bridges the gap by designing an intelligent tutoring platform that enhances comprehension and engagement through AI-driven automation. The system allows students to upload academic materials such as PDFs, text files, and PowerPoint presentations, which are then processed using DeepSeek's natural language processing API to generate concise summaries and structured quizzes. The system was developed using a full-stack web architecture comprising React.js for the frontend, Node.js and Express for the backend, and PostgreSQL as the database. Guided by the Agile methodology, the development process was structured into iterative sprints encompassing key phases such as planning, design, development, and testing. The system integrates the DeepSeek API for natural language processing, enabling the platform to provide summarized lecture notes and structured quizzes tailored to each uploaded document. It also includes user authentication, file handling, progress tracking, and a personalized library, allowing users to manage their learning resources effectively. A user acceptance test (UAT) with 31 undergraduate students was conducted using a five-point Likert scale questionnaire. The UAT results show that perceived usefulness, perceived ease of use, capability, trustworthiness, attitude toward the system, and behavioral intention to use had a high acceptance rate. Theoretically, this work contributes to the advancement of AI-driven educational technology by integrating principles from self-directed learning and technology acceptance models. Pedagogically, it offers an innovative approach to improving accessibility, comprehension, and learner autonomy through adaptive AI tools for content summarization and assessment.

Keywords: Artificial intelligence, educational technology, DeepSeek, automated notes summarization, quiz generation

INTRODUCTION

Many students today face strong pressure to succeed in exams, especially when they need to study a large amount of theory from different subjects. Traditional study methods often demand significant time and effort, especially when students struggle to understand complex topics or memorize essential information. Common methods like memorization and relying on disorganized digital files often lead to low retention and poor understanding. Students frequently struggle to organize their notes effectively, identify key points within lengthy documents, and assess their knowledge in a clear and structured way. One major problem is the limited time available for revision, especially during final exam periods. As a result, students frequently resort to less effective methods such as rote memorization or relying on online materials that are not aligned with their specific course content. This can hinder deep learning and long-term retention.

A recent study highlighted various factors influencing students' learning performance and emotional well-being

in higher education, including stress, motivation, and mindfulness, but provides limited insights into how technology can actively mitigate such stressors through adaptive learning tools [1]. Similarly, [2] discussed the limitations of traditional summative assessments and the need for more engaging evaluation methods, yet practical AI-based solutions to support such approaches remain underexplored. Additionally, [3] identified both opportunities and challenges in adopting AI in education, calling for research to investigate how learning objects are to be used in personalized and adaptive learning.

In response to these challenges, this study aims to design, develop, and evaluate an AI-Powered Tutoring System that automatically summarizes academic materials and generates quizzes to support students' self-directed learning. This web-based application is designed to assist students in their independent learning by providing smart tools for organizing, analyzing, and processing study materials. Users can upload academic resources such as PDFs or text files, which are processed by the system's artificial intelligence engine to generate concise summaries and create personalized quiz questions tailored to the content. The system is built using modern web technologies, including React for the user interface, Node.js for backend functionality, and PostgreSQL for data management. The platform includes performance tracking features that allow students to monitor their progress across various topics and subjects.

This project contributes to the field of educational technology by integrating AI into content management and formative assessment tools. It provides a practical solution for students who want to improve their understanding while reducing the time spent on traditional study routines. By converting raw academic content into organized summaries and interactive quizzes, the AI-Powered Tutoring System encourages effective study habits and enhances overall learning outcomes.

Related Work

Recent studies highlight the growing role of artificial intelligence in education, particularly in intelligent tutoring systems, automated notes summarization, and quiz generation. Studies from [3], [4] report that AI-driven platforms can improve learning outcomes by enhancing engagement, providing adaptive feedback, and simplifying access to key concepts. These findings reflect the growing demand for educational technologies that accommodate diverse learning styles and help students manage large volumes of academic content efficiently. Moreover, [5] explores AI-based approaches for students to learn Python through quizzes and discussions. The findings indicate that generative AI serves as an effective resource for educational advancement, as it can lower learning anxiety and increase interest in learning.

Table I shows the comparison between existing systems and the proposed AI-Powered Tutoring System. Socratic by Lumination AI [6] uses AI to explain homework questions, but does not support uploading full lecture notes or creating structured quizzes, thereby limiting its pedagogical depth and learner engagement. Khanmigo by Khan Academy [7] offers personalized guidance during lessons, yet is limited to Khan Academy's internal content and cannot process user-supplied materials. Likewise, Quizlet AI Tools [8] emphasize flashcard-based repetition, but provide limited opportunities for higher-order thinking or contextual understanding. Thinkific AI Quiz Generator [9] helps educators transform instructional content into quizzes, but it is primarily designed for course creators and lacks automated summarization or learner-centered adaptation. Overall, most existing systems do not holistically support constructivism and self-regulated learning principles. Constructivist theory emphasizes the active role of learners in constructing meaning [10], while self-regulated learning highlights the importance of autonomy, goal-setting, and reflection [11].

Compared to these platforms, the proposed AI-Powered Tutoring System uniquely combines automated summarization and quiz generation with user-uploaded academic materials (PDF, TXT, PPT). By integrating the DeepSeek API for natural language processing and a full-stack web architecture (React, Node.js, Express, PostgreSQL), the system allows students to generate structured summaries and quizzes from their own notes while tracking performance over time. This high level of personalization and content control addresses gaps in current solutions and supports more effective, self-directed learning.

Table1 Comparison Between Existing And Florahub

Feature	Socratic	Khanmigo	Quizlet	Thinkific Quiz Generator	Proposed AI-Powered Tutoring System
Target Audience	Students seeking help with Specific questions	Learners using the Khan Academy platform	Students preparing for exams with flashcards	Course creators and instructors	Students preparing for exams using personal academic content
Content Source	Scanned questions or typed input	Khan Academy Course materials	User-created flashcards or textbook extracts	Educator-provided course content	User-uploaded academic notes (PDF, TXT, PPT)
Main Functionality	AI-powered explanations and answers	Personalized tutoring via chat	Flashcard and test creation using AI	Auto-generated quizzes from lesson materials	AI-generated summaries and quizzes from user notes
Level of Personalization	Low (general responses)	High (interactive but limited to fixed content)	Medium (based on flashcards)	Low (non-student focused)	High (based on the user's own content and learning progress)
Performance Tracking	Not available	Limited to learning sessions	Limited to quiz attempts	Not designed for tracking	Tracks quiz results and show performance over time
Technology Stack	Mobile app with an AI backend	Web-based chat system with LLM integration	Web/app platform with AI Content generators	Web application with AI modules	Full-stack web app
User Control Over Content	Low (no note upload feature)	Low (restricted to pre-set materials)	Medium (allows flashcard input)	Low (for instructors only)	High (users upload, organize, and use their own academic content)

METHODOLOGY

The project adopts an Agile methodology with the Scrum framework. As highlighted by [12] Agile methodology supports iterative development, continuous feedback, and adaptability, which are the key features that are essential for the successful development of complex systems such as AI-powered tutoring platforms. The workflow is explained in the following subsections.

Planning

Key features such as user authentication, note uploading, AI summarization, quiz generation, and performance tracking were outlined. A feasibility analysis was carried out to evaluate the available resources and tools, leading to the selection of the DeepSeek API for AI-related tasks and a full-stack development framework comprising React, Node.js, Express, and PostgreSQL. This phase also included breaking down the project into manageable tasks that could be implemented over several Agile sprints.

System Design

Once planning was complete, the system architecture and user interface were designed. Fig. 1 illustrates the system architecture, highlighting the interaction between the frontend, backend, database, and external AI processing layer. The system is designed based on client-server architecture, which delineates responsibilities between two main components: the client and the server. This architectural model ensures modularity, simplifies maintenance, and supports future scalability. It also enables secure and efficient interaction between system components during data processing and retrieval.

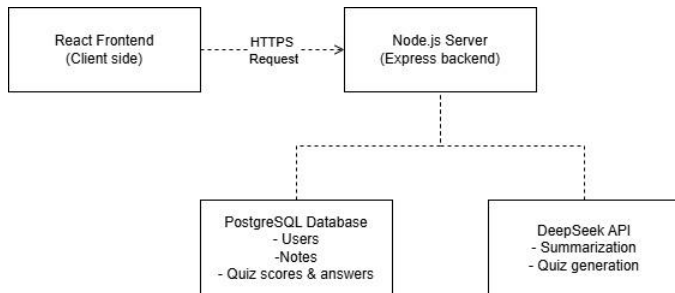


Fig. 1 System Architecture

UI wireframes were created to visualize the layout of major components, including the dashboard, upload section, summary viewer, and quiz page. During this stage, the backend was also designed, encompassing the design of the database schema and the design of key components such as file upload, generated summaries, and quiz management. API endpoints were outlined to ensure smooth interaction between the frontend, backend, and AI services. The design stage ensured that every module was logically structured and ready for incremental development.

Fig. 2(a) displays the upload notes interface. User needs to press the “Choose file” button to upload a file from their devices. The system then generates a summary of the notes and displays it on the summary preview page as illustrated in Fig. 2(b). The left panel displays the original uploaded content, while the right panel presents the generated summary content. Additionally, “Save” and “Copy” buttons are provided, which allow users to save the summary in their personal database or copy the summarized text for external use.

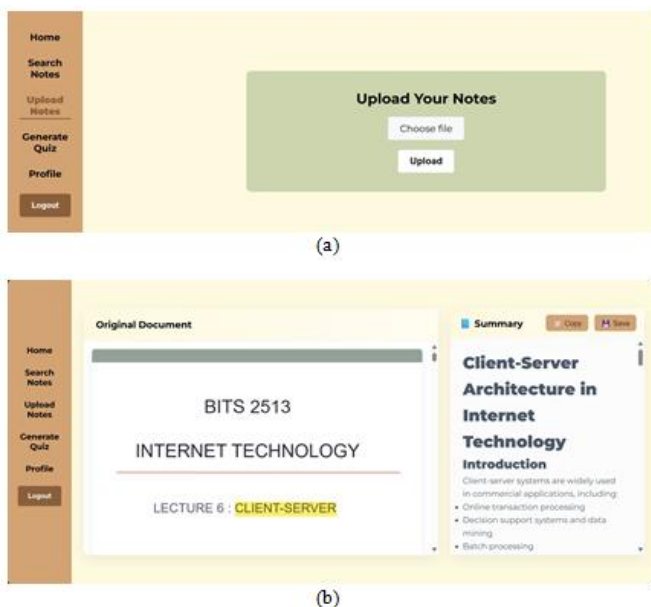


Fig. 2 (a) Upload Notes, (b) Summary Preview

Fig. 3(a) displays the interface for quiz generation. The users begin by selecting a note from which to generate quiz questions. Next, the users specify the desired quiz difficulty level and the number of questions to be

generated (Fig. 3 (b)). Finally, Fig. 3(c) illustrates the resulting quiz questions automatically generated by the system.

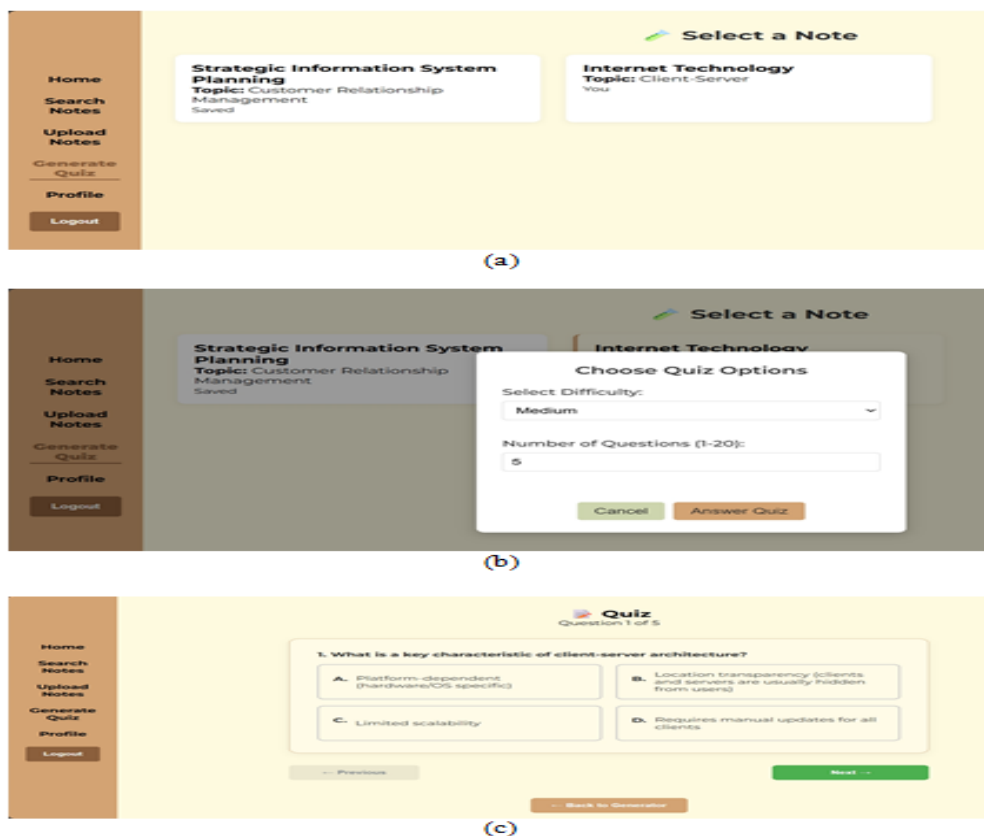


Fig. 3 (a) Generate Quiz, (b) Select Quiz Difficulty, (c) Quiz question

Development

The system was developed following the structure established during the planning and design phases. Frontend development was implemented using React, focusing on creating a responsive layout, smooth navigation, and a user-friendly interface. The backend was developed using Node.js and Express, responsible for managing user sessions, processing uploaded files, and facilitating communication with external APIs. Data storage and management were managed by PostgreSQL database, including user profiles, uploaded content, and quiz results. AI integration was achieved through the DeepSeek API, enabling both summarization and automatic quiz question generation. Each module was coded, tested, and refined during development to ensure stability before moving to the next feature.

Evaluation

Testing was conducted throughout the development to verify the accuracy and reliability of system functions. Black box testing was applied to both frontend and backend components. AI-generated summaries and quizzes were reviewed for relevance and clarity. Performance tracking features were also tested to evaluate system responsiveness and processing efficiency. This continuous testing helped reduce errors and enhance the user experience. Finally, a user acceptance test (UAT) was conducted to ensure that the system not only functions correctly but also meet the educational needs of its target audience. The testing process was divided into two main phases:

1. Developer-led functional and performance testing: Conducted by the developer to validate technical correctness.
2. End-user acceptance testing: Conducted by participants to assess usability and learning value.

The UAT was conducted with 31 undergraduate students from a public university in Malaysia. A purposive sampling technique was employed in selecting participants who had prior experience using digital learning platforms. Each participant was provided access to the live production environment of the AI-Powered Tutoring System. Their feedback was collected through a structured Google Form questionnaire consisting of 23 items, as presented in Table II. A 5-point Likert scale questionnaire items were adapted from [13], [14]. The questionnaire items were divided into six constructs named perceived ease of use, usefulness, capability, trustworthiness, attitude toward the system, and intention to use. Participants were asked to use the proposed system for five to ten minutes before they answered the questionnaire. All procedures adhere to ethical research standards.

Table2 Uat Questionnaire Items

Constructs	Questionnaire Items
Perceived Ease of Use	EU1: The AI-Powered Tutoring System is flexible to interact with.
	EU2: I find it easy to get the AI-Powered Tutoring System to do what I want.
	EU3: It is easy to become skilled at using the AI-Powered Tutoring System.
	EU4: I find the AI-Powered Tutoring System easy to use.
	EU5: Interaction with the AI-Powered Tutoring System is clear and understandable.
Perceived Usefulness	PU1: Using the system helps me understand my academic notes more efficiently.
	PU2: I find the AI-Powered Tutoring System useful in supporting my studies.
	PU3: Using the system enhances my effectiveness in preparing for exams.
	PU4: The system makes it easier to generate practice quizzes.
	PU5: The system helps summarize complex content more clearly.
Capability	CP1: The system provides clear instructions for uploading and summarizing notes.
	CP2: Quizzes can be easily generated and attempted within the system.
	CP3: The capabilities of the system meet my learning and revision needs.
Trustworthiness	TW1: I trust the system with the information on my profile.
	TW2: The system provides security for my quiz data and uploaded notes.
	TW3: The system safeguards my profile information.
	TW4: I feel safe using the AI-Powered Tutoring System.
Attitude Toward the System	ATT1: I like using the AI-Powered Tutoring System.
	ATT2: It is enjoyable for me to use the system.
	ATT3: I am willing to continue learning how to use the system.
Intention to Use	IU1: I intend to use the system for note summarization and quiz practice.
	IU2: I intend to use the system to revise academic topics more effectively.

IU3: I will continue to use the system in the future for academic purposes.

RESULT

Black box testing was conducted to verify that all core features operate as intended. A total of 14 test cases were executed across key modules, including user authentication, file upload, AI summarization, quiz generation, performance tracking, and note saving. The results show 14 test cases passed successfully, confirming that the system functions correctly under normal and edge-case conditions. The backend responded within acceptable timeframes, AI outputs were coherent and relevant, and error handling was appropriate. These results demonstrate that the system meets its functional requirements.

Performance test reveals that all the performance test cases passed successfully. The API response time for quiz generation was measured using the Time to First Byte (TTFB) in the browser's Network tab, confirming that the backend processes requests efficiently. The 18-page PDF was processed within the acceptable timeframe, demonstrating reliable performance under typical academic workloads.

The UAT was conducted with a targeted cohort of 31 undergraduate and diploma-level students, representing the primary user base of the AI-Powered Tutoring System. Demographic analysis of the respondents reveals a highly focused sample aligned with the system's intended audience: students actively engaged in academic revision. All participants fall within the age range of 20 to 23 years, with the majority (18 out of 31, or 58.1%) being 23 years old. The remaining participants consist of nine aged 22, three aged 20, and one aged 21, reflecting a typical university-aged population. In terms of academic level, 26 participants were pursuing a bachelor's degree, while 5 were enrolled in a diploma program. This balanced representation ensures that feedback was gathered from both degree-seeking and diploma learners, validating the system's usability across different stages of higher education without external outliers.

Table III presents a descriptive analysis of the constructs obtained from the UAT. All mean values were above 4.5, which falls within the "Agree" range on the Likert scale. The highest mean is for intention to use (4.82), indicating a strong willingness among users to continue using the system. The lowest, though still very high, is trustworthiness (4.69), suggesting users are confident in the system's security. The low standard deviations indicate consistent agreement across items within each construct, reflecting stable and reliable user perceptions. These findings confirm that the AI-Powered Tutoring System is well-received and meets user expectations in terms of usability, usefulness, and overall satisfaction.

Table III Descriptive Analysis Of The Uat Constructs

Construct	Mean ± Standard Deviation
Perceived Ease of Use (EU)	4.75 ± 0.051
Perceived Usefulness (PU)	4.77 ± 0.032
Capability (CP)	4.80 ± 0.051
Trustworthiness (TW)	4.69 ± 0.071
Attitude Toward the System (ATT)	4.75 ± 0.051
Intention to Use (IU)	4.82 ± 0.017

The findings demonstrate that the proposed AI-powered system can enhance student engagement, autonomy, and self-directed learning by providing personalized summaries and quizzes. For practical application, educators and instructional designers can integrate such systems into blended and online learning environments to reduce students' cognitive load and improve exam preparedness. Moreover, institutions can leverage this technology to support formative assessment strategies aligned with constructivist and self-regulated learning principles.

Limitation And Future Works

While the system performed efficiently, the system also has a few limitations for improvement in future work. First, it currently supports only PDF, PPTX, and TXT files, which may exclude users with other formats, such as DOCX. Support for additional file formats, such as DOCX and scanned PDFs, should be added. Second, the system does not include OCR (Optical Character Recognition), hence scanned PDFs cannot be processed. By integrating OCR technology like Tesseract.js or Google's Vision API, the system could extract text from image-based documents, expanding its usability for students who use scanned notes or scanned images. Third, the mobile responsiveness is functional but not fully optimized for smaller screens, which could affect usability on smartphones. A dedicated mobile layout or even a Progressive Web App (PWA) version could allow students to use the system on smartphones more comfortably, especially during quick revision sessions. Lastly, the system relies on internet connectivity and the availability of the DeepSeek API, meaning it cannot operate offline. Implementing offline functionality using service workers and local storage could allow users to access previously generated summaries and quizzes without internet access. Future versions could also include learning analytics such as performance trends over time, topic-wise progress, and weak area recommendations to provide deeper insights into user learning patterns. These enhancements would make the system more versatile, accessible, and effective for a wider range of users.

CONCLUSION

This study set out the design, develop, and evaluate an AI-Powered Tutoring System that automates the summarization of academic notes and the generation of quizzes to enhance students' self-directed learning. Grounded in constructivist and self-regulated learning principles, the system encourages students to actively construct knowledge, monitor their progress, and engage in autonomous learning. The system provides meaningful benefits to students by offering an intelligent, user-friendly platform for academic revision. Besides, this system helps students improve their study habits through automated note summarization and quiz generation, making it easier for them to understand and retain important information. By reducing the time spent on manual revision, the system supports more effective learning during exam preparation. All core features, such as user authentication, file upload, AI summarization, quiz generation, and performance tracking, are fully operational and validated through rigorous testing. The high user satisfaction score of 4.76 confirms that the system is well-received and meets real student needs. By focusing on personal learning needs and integrating AI into everyday study routines, the system serves as a practical solution for modern learners seeking efficiency, clarity, and better results in their academic journey.

ACKNOWLEDGEMENT

The authors would like to express gratitude to Fakulti Teknologi Maklumat dan Komunikasi (FTMK), Universiti Teknikal Malaysia Melaka (UTeM), for their invaluable support and resources provided throughout this research.

REFERENCES

1. S. Zhang, S. Rehman, Y. Zhao, E. Rehman, and B. Yaqoob, "Exploring the interplay of academic stress, motivation, emotional intelligence, and mindfulness in higher education: a longitudinal cross-lagged panel model approach," *BMC Psychol.*, vol. 12, no. 1, 2024, doi: 10.1186/s40359-024-02284-6.
2. R. Lee and S. Thompson, "Exam Anxiety: A Review including Assessment Alternatives to Summative Exams," *J. Bus. Educ. Scholarsh. Teach.*, vol. 18, no. 1, pp. 21–28, 2024.
3. T. K. F. Chiu, Q. Xia, X. Zhou, C. S. Chai, and M. Cheng, "Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education," *Comput. Educ. Artif. Intell.*, vol. 4, no. September 2022, p. 100118, 2023, doi: 10.1016/j.caeai.2022.100118.
4. F. Kamalov, D. S. Calonge, and I. Gurrib, "New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution," *Sustainability*, vol. 15, no. 12451, pp. 1–27, 2023.
5. C.-K. Chang and L.-C.-T. Chien, "Enhancing Academic Performance with Generative AI-Based Quiz Platform," in *2024 IEEE International Conference on Advanced Learning Technologies (ICALT)*, 2024, pp. 193–195, doi: 10.1109/ICALT61570.2024.00062.

6. Lumination AI., “Socratic Owl: Question Answer [Mobile app],” Google Play. <https://play.google.com/store/apps/details?id=com.luminationai.homeworkhelper&hl=en> (accessed Oct. 05, 2025).
7. Khan Academy, “Khanmigo [Computer software].” <https://www.khanmigo.ai/> (accessed Oct. 05, 2025).
8. Quizlet, “Quizlet AI [Computer software].” <https://quizlet.com/> (accessed Oct. 05, 2025).
9. Thinkific Labs Inc., “Thinkific AI quiz generator [Computer software].” <https://www.thinkific.com/> (accessed Oct. 05, 2025).
10. Bada and S. Olusegun, “Constructivism Learning Theory: A Paradigm for Teaching and Learning,” *J. Res. Method Educ.*, vol. 5, no. 6, pp. 2320–7388, 2015, doi: 10.9790/7388-05616670.
11. B. J. Zimmerman and D. H. Schunk, “Self-regulated learning and performance: An introduction and an overview,” *Handb. self-regulation Learn. Perform.*, pp. 15–26, 2011.
12. S. P. Rath, N. K. Jain, G. Tomer, and A. K. Singh, “A systematic literature review of agile software development projects,” *Inf. Softw. Technol.*, vol. 182, p. 107727, 2025, doi: <https://doi.org/10.1016/j.infsof.2025.107727>.
13. F.-C. Tung, S.-C. Chang, and C.-M. Chou, “An extension of trust and TAM model with IDT in the adoption of the electronic logistics information system in HIS in the medical industry,” *Int. J. Med. Inform.*, vol. 77, no. 5, pp. 324–335, 2008, doi: <https://doi.org/10.1016/j.ijmedinf.2007.06.006>.
14. M. H. Tseng and H. C. Wu, “A cloud medication safety support system using QR code and Web services for elderly outpatients,” *Technol. Heal. Care*, vol. 22, no. 1, pp. 99–113, 2014, doi: 10.3233/THC-140778.