Dynamic Content Planner: An Ai-Powered Approach to Personalized Learning

Arpit Kumar Rai; Manav Tomar
Shakil Ur Rehman; Anubhav Awasthi
Computer Science and Engineering Noida Institute of Engineering and Technology Greater Noida, India

Abstract— In today's fast-evolving digital landscape, the demand for personalized and structured learning paths is increasing. Traditional course planning methods often lack adaptability and require extensive manual effort, making it challenging for learners to create efficient study plans that align with their goals and timelines. The AI Course Builder tackles this problem by using Generative AI to generate personalized learning paths automatically.

This platform enables users to input their desired subjects and timelines, after which AI generates a tailored course plan, integrating curated resources such as YouTube tutorials and supplemental materials. The system enhances learning efficiency through personalized recommendations, helping learners stay on track while adapting to their progress. Additionally, AI-driven course generation can assist educators by identifying learning gaps and optimizing content delivery.

Keywords— Generative AI, personalized learning, course generation, educational technology, AI-driven study plans.

I. INTRODUCTION

In today's fast-paced world, ongoing learning and skill development are essential for both personal and professional growth. Although online platforms such as Udemy, Coursera, and Khan Academy provide extensive educational content, many learners face challenges in designing personalized, structured study plans that cater to their specific goals and schedules. Traditional course design requires significant human effort, making it difficult to tailor learning paths effectively for individuals.

To address this gap, we introduce AI Course Builder, an intelligent web application that automates personalized course creation based on user preferences. Leveraging Generative AI, the platform enables users to select subjects, define learning timelines, and generate structured study plans dynamically. By integrating APIs like YouTube (for curated video content) and adaptive learning techniques such as quizzes tailored to user progress, AI Course Builder enhances engagement and knowledge retention.

The increasing role of AI in education is evident, with a growing number of students and educators turning to Generative AI for academic assistance. While concerns about academic integrity persist, AI-driven course creation presents a revolutionary opportunity to enhance self-directed learning, making high-quality, customized education accessible to all.

The primary objectives of the AI Course Builder are:

- Automating course creation through AI algorithms.
- Curating relevant content via API integrations (e.g., YouTube, online resources).
- Designing an intuitive user interface to ensure smooth user interaction.

DOI: https://doi.org/10.5281/zenodo.15567710

Built with Next.js, Clerk for authentication, Drizzle ORM for database management, and Gemini API for AI-driven course recommendations, AI Course Builder offers a scalable and efficient approach to personalized learning. By transforming the way learners access, structure, and engage with educational content, the platform ensures a smarter, more adaptable learning experience, empowering users to achieve their educational goals effectively.

II. Review of Previous Works

The educational technology (EdTech) sector has seen significant advancements in recent years, reshaping teaching and learning approaches. This review examines two crucial areas driving this transformation: Trends and Advancements in Educational Technology, and the Integration of AI in Educational Platforms. By analyzing these factors, we aim to offer insights into the current landscape of EdTech and its potential influence on the future of education.

A. Trends and Advancements in Educational Technology

Recent innovations in EdTech have significantly influenced instructional methods, enhancing engagement and accessibility. Some key trends include:

1) Artificial Intelligence in Education

The integration of AI into educational platforms has revolutionized teaching and learning. AI-driven tools like chatbots, virtual tutors, and personalized learning systems are revolutionizing both content delivery by educators and student engagement with learning materials. AI enables automated assessments, real-time feedback, and adaptive learning experiences, customizing education to meet each learner's unique needs [1].

2) Automated Course Generation

AI-driven platforms utilize machine learning algorithms, natural language processing (NLP), and automation to create personalized learning experiences. Platforms like Create-My-Course, introduced by Wijerathne et al., use AI to automate various course-related processes, including:

-Video segmentation and transcription
- Lecture note generation

Similarly, AI-powered platforms like Coursebox and Courseau showcase AI's role in course automation, demonstrating the potential for personalized and adaptive learning experiences.

3) Immersive Technologies (VR & AR)

Immersive technologies such as Virtual Reality (VR) and Augmented Reality (AR) have brought significant changes to the field of education [2]. By offering interactive and highly engaging experiences, these tools enable students to grasp concepts more effectively through hands-on and immersive learning environments. By blending the digital and physical worlds, VR and AR create dynamic learning environments that enhance understanding and retention of complex topics.

These technologies allow students to:

- Explore complex concepts through 3D models
- Engage with interactive simulations

While AR enhances classroom experiences by providing 3D visualizations, VR enables students to explore entire virtual environments.

4) Gamification in Education

Saleem, Noori, and Ozdamli [3] highlight in their literature review that gamification can serve as an effective tool for acquiring knowledge and enhancing critical capabilities such as decision-making, cooperation, and communication. Gamification has become a powerful strategy to boost student engagement and motivation. By integrating game-like features such as points, badges, and leaderboards, learning platforms foster greater participation while enhancing decision-making, collaboration, and communication skills.

DOI: https://doi.org/10.5281/zenodo.15567710

As EdTech continues to evolve, embracing AI, immersive technologies, and gamification presents new opportunities for personalized and engaging learning experiences. However, challenges such as accessibility, implementation costs, and ethical considerations must be addressed to ensure inclusive and effective learning environments.

A.Integrationof AI In Educational Platforms

The integration of AI in educational platforms has unlocked transformative opportunities, particularly in course creation, personalized learning, and adaptive assessments.

1) Ai-Driven Course Personalization

AI enables platforms to generate personalized course outlines and study plans based on learners' preferences, prior knowledge, and goals. Wijerathne et al. [4] introduced "Create-My-Course," an automated platform tailored for self- paced programs in asynchronous e-learning.

AI enables platforms to generate personalized course outlines and study plans based on learners' preferences, pace, knowledge in-depth, timeline, and goals.

2) Curated Video Tutorials

Video-based learning is an essential component of modern education, enhancing comprehension through visual aids. While Coursebox [5] and Courseau [6] automate course creation, they lack integrated video tutorials. Our AI Course Builder fills this gap by blending with YouTube API to formulate high-quality video tutorials, ensuring learners receive structured and engaging content.

3) Adaptive Quizzes and Real-Time Feedback

AI-powered platforms offer adaptive quizzes that modify their difficulty according to the user's performance, ensuring a personalized learning journey. Real-time feedback helps learners identify their strengths and areas for improvement,promotingongoingdevelopment.

By integrating AI-powered personalization, adaptive assessments, and video tutorials, our AI Course Generator enhances learning experiences, making education more engaging, flexible, and efficient.

III. Problem Statement

Despite the availability of numerous online learning platforms, learners struggle to create personalized and structured study plans that align with their specific goals and timelines. Traditional course creation methods require significant manual effort, making it difficult to dynamically tailor educational content for individual learners.

Existing platforms lack an automated approach to course customization, forcing users to manually sift through vast resources to build a coherent learning path. This often results in inefficiencies, disengagement, and suboptimal knowledge retention. Moreover, educators and content creators face challenges in scaling personalized course content, as traditional methods are time-consuming and do not leverage AI-driven automation.

To address this gap, this research focuses on developing AI Course Builder, a web-based platform that utilizes Generative AI, machine learning, and API integrations to generate structured study plans dynamically. The platform aims to:

- Automate course generation based on user preferences, such as subjects and learning duration.
- Curate relevant educational content from platforms like YouTube.

This study investigates the impact of AI-driven course generation on learning efficiency, engagement, and content accessibility, providing a scalable solution for personalized education.

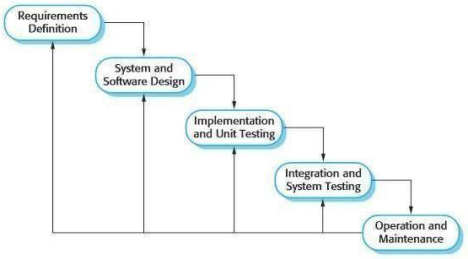
IV. Proposed Methodology

A. Iterative-Waterfall Approach

We have deliberately chosen the iterative waterfall model, which blends the structured nature of the traditional

DOI: https://doi.org/10.5281/zenodo.15567710

Waterfall approach [7] with the adaptability of iterative cycles. Also referred to as the mini-waterfall model, it overcomes the drawbacks of the conventional Waterfall method by integrating feedback loops and continuous refinements throughout the development process. . As shown in Figure 1,



this methodology maintains an organized sequence of phases while allowing for adaptability and efficiency improvements.

Fig. 1 Iterative-Waterfall Model

The following sections will elaborate on each stage of our iterative waterfall technique as it applies to our project, detailing the specific tasks, approaches, and results within each phase.

B. Requirements Analysis

To gather user requirements for the AI Course Generator platform, we have studied various case studies.

Based on these insights, the essential features identified for development were:

1. Personalized study plans
2. Automated course generation
3. Adaptive quizzes
4. Visually appealing interfaces
5. Access to supplemental materials

Additionally, to enhance functionality, we identified key API integrations, the Gemini Model for content development, and YouTube for instructional content. These technological advancements, combined with user expectations, provide a clear roadmap for developing a user- centric learning platform.

C. System Design

The system design phase focuses on outlining the architecture, database design, and technological components required for implementing the platform.

1) System Architecture

- Frontend: Utilized Next.js for client-side rendering, TailwindCSS for responsive styling, and Shadcn UI for efficient component management.
- Backend: Drizzle for a cloud-hosted SQL database, Clerk for user authentication.

-Deployment: Hosted on Vercel, with version control on GitHub. The GPT API server is deployed on a dedicated Linux server, with continuous monitoring and updates.

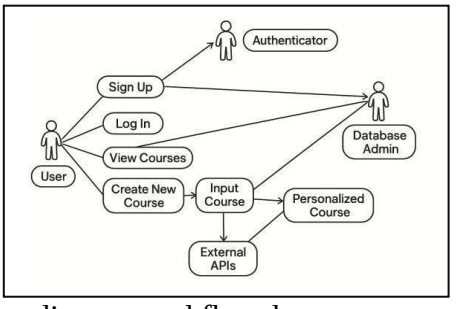
2) **Component Details**

-SignUp&Login:Secured witNextAuth.

- Dashboard/Library:Displayscurated courses and recommendations.
- Create Course Page: Users select topics, and AI generates personalized study plans.
- Course Page: Displays structured modules and lessons.
- Lesson Page: Includes video lessons, summaries, and adaptive quizzes.

3) **Data Flow & Integration**

- The platform follows a structured sequence: user registration, topic selection, AI-generated courses, content retrieval via APIs, course display, and interactive learning through quizzes.
- Figures 2 and 3 illustrate the system's



use case diagram and flowchart.

DOI: https://doi.org/10.5281/zenodo.15567710

Fig. 2 Use Case Diagram

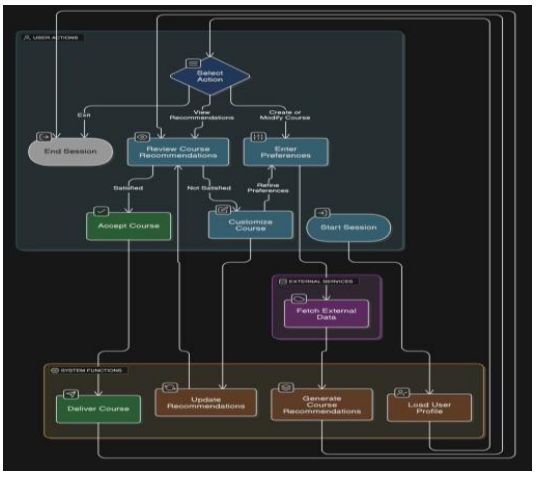
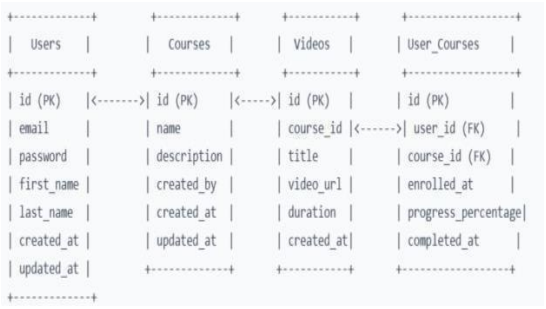
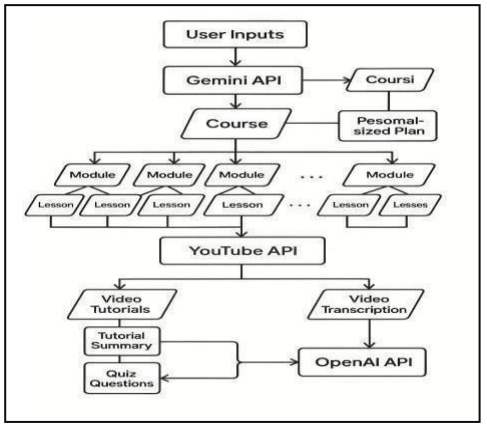


Fig. 2 Use Case Diagram

Fig. 3 System Design Flowchart





4) High-Fidelity Prototype

- A coded prototype using Next.js, TailwindCSS, and Shadcn was developed to visualize the user interface before full-scale implementation.

D. Implementation

1) Backend Development

- Database Management: Designed using PostgreSQL, the schema includes interconnected model tables such as Account, User, User-Created Course, Course, Module, Unit, and Question, ensuring efficient handling of user data, course content, and subscriptions.

Fig. 4 Database Schema

- User Authentication & Access Control : Implemented using Clerk , providing secure and seamless authentication. The current setup supports up to 100 users, ensuring controlled access while maintaining system performance. Future scalability options can be explored to accommodate a growing user base.

-Course Generation: Utilized Gemini API and OpenAI API to generate study plans and quizzes based on user inputs.

- YouTube API: Retrieves relevant instructional videos.
- OpenAI API: Generates summaries and quiz questions from video transcriptions.

Fig. 5 APIs Integration

2) Frontend Development

- Built using Next.js and TailwindCSS, incorporating UI improvements based on the high-fidelity prototype.
- Designed for optimal usability, aesthetics, and user engagement.
- Figure 6 depicts the entities involved in the frontend

3) Frontend Development

- Built using Next.js and TailwindCSS, incorporating UI improvements based on the high-fidelity prototype.

DOI: https://doi.org/10.5281/zenodo.15567710

- Designed for optimal usability, aesthetics, and user engagement.
- Figure 6 depicts the entities involved in the frontend

Fig. 6 ER Diagram

By leveraging these methodologies and technologies, the AI Course Generator platform is structured to deliver a seamless, intelligent, and user-centric learning experience.

V. Result

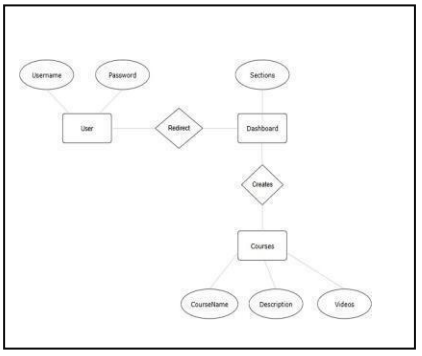
The development of the AI Course Builder represents a major step forward in personalized and self-directed learning. This platform effectively addresses the challenge of creating customized study plans by leveraging Generative AI and machine learning to generate structured course paths based on user-defined subjects and timelines.

The architecture ensures scalability and efficient performance, while the iterative waterfall methodology enables continuous refinement throughout development. A thorough requirements analysis, informed by user surveys, guided the design and implementation, resulting in a feature- rich and user-centric platform.

However, current testing has been limited to a small group of three participants from the Department of Computer Science. While their feedback has been insightful, future improvements should involve a broader and more diverse group of users to evaluate usability and effectiveness comprehensively. Expanding testing would provide deeper insights and help identify areas for further optimization.

Future enhancements could include integrating additional APIs, incorporating interactive elements such as live tutorials and discussion forums, and further refining AI-driven course adaptation for a more personalized learning experience.

In conclusion, the AI Course Builder is an innovative educational solution. The platform's successful development and deployment mark a significant milestone,



paving the way for continued advancements and greater impact in the field of educational technology.

VI. Acknowledgment

We would like to express our heartfelt thanks to Mr. Sanjay Nayak, our mentor, for his constant guidance, encouragement, and thoughtful insights throughout the development of our research on the AI Course Builder. His support played a vital role in steering the project in the right direction. We are also grateful to our team members for their commitment, teamwork, and consistent efforts, which significantly contributed to the success of this project. The combined efforts of our four-member group enabled us to develop an innovative solution for personalized learning.

Additionally, we are grateful to all the participants who provided feedback during the testing phase, helping us refine the platform for a better user experience.

This research is a testament to the power of teamwork and mentorship in advancing AI-driven educational technology.

DOI: https://doi.org/10.5281/zenodo.15567710

encouragement, and thoughtful insights throughout the development of our research on the AI Course Builder. His support played a vital role in steering the project in the right direction. We are also grateful to our team members for their commitment, teamwork, and consistent efforts, which significantly contributed to the success of this project. The combined efforts of our four-member group enabled us to develop an innovative solution for personalized learning.

Additionally, we are grateful to all the participants who provided feedback during the testing phase, helping us refine the platform for a better user experience.

This research is a testament to the power of teamwork and mentorship in advancing AI-driven educational technology.

VII. References

[1] V.J. Owan, K.B. Abang, D.M. Idika, E.O. Etta, and B.A. Bassey, "Exploring the potential of artificial intelligence tools in educational measurement and assessment," EURASIA Journal of Mathematics.

[2] P. Kuna, A. Hašková, and Ľ. Borza, "Creation of Virtual Reality for Education Purposes," Sustainability, vol. 15, no. 9, p. 7153, Jan. 2023, doi: https://doi.org/10.3390/su15097153.

[3] A. N. Saleem, N. M. Noori, and F. Ozdamli, "Gamification Applications in E-learning: A Literature Review," Technology, Knowledge and Learning, vol. 27, no. 1, pp. 139–159, Jan. 2021, doi: https://doi.org/10.1007/s10758-020-09487-x.

[4] A. Wijerathne, B. Sandaruwan, and D. Oddugama, "Create-My- Course: An Automated Course Generator for Self-Paced Programs," International Journal of Innovative Science and Research Technology, vol. 7, no. 11, 2022, Accessed: May 19, 2024.

[5] "AI Course Creator," www.coursebox.ai. https://www.coursebox.ai/ (accessed May 16, 2024).

[6] "Develop engaging courses with the help of AI," courseau.co. https://courseau.co/ (accessed May 16, 2024).

[7] C. Kaur and V. Kumar, "Comparative Analysis of Iterative Waterfall Model and Scrum," International Journal of Computer Science Research (IJCSR), vol. 3, no. 1, pp. 11–14, Mar. 2015

[8] Science and Technology Education, vol. 19, no. 8, pp. em2307 em2307, Aug. 2023, doi: https://doi.org/10.29333/ejmste/13428.

[9] "AI Course Creator," Coursebox AI, Available: https://www.coursebox.ai/, accessed May 16, 2024.

[10] "Develop engaging courses with the help of AI," Courseau, Available: https://courseau.co/, accessed May 16, 2024.

[11] M. Jiang, "The Impact and Potential of Educational Technology: A Comprehensive Review," RAE, vol. 2, no. 7, pp. 32–49, Jul. 2023.

[12] V. J. Owan, K. B. Abang, D. M. Idika, E. O. Etta, and B. A. Bassey, "Exploring the potential of artificial intelligence tools in educational measurement and assessment," EURASIA Journal of Mathematics, Science and Technology Education, vol. 19, no. 8, pp. em2307-em2307, Aug. 2023.

[13] A. Wijerathne, B. Sandaruwan, and D. Oddugama, "Create-My- Course: An Automated Course Generator for Self-Paced Programs," International Journal of Innovative Science and Research Technology, vol. 7, no. 11, 2022.

DOI: https://doi.org/10.5281/zenodo.15567710