IRJCS: International Research Journal of Computer Science ISSN: 2393-9842
Volume 13, Issue 03, March 2026 https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.55

New Age Course Generation Transforming the Learning Experience

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Publication History
Manuscript Reference: IRJCS/RS/Vol.13/Issue03/CSMR26.MRCS10134
Research Article | Open Access | Double-Blind Peer Reviewed Article ID: IRJCS/RS/Vol.13/Issue03/CSMR26.MRCS10134
Received: 30, January 2026, Revised: 13, February 2026, Accepted: 28 February 2026 Published Online: 25 March 2026
https://www.irjcs.com/volumes/Vol13/iss-03/55.CSMR26.MRCS10134.pdf
Article Citation:Deepak,DilipKumarAshutosh,Dr.Sujatha(2026),New Age Course Generation Transforming the Learning Experience,IRJCS: International Research Journal of Computer Science, Volume 13,Issue 03 of 2026 pages 414-420 **Doi:>** https://doi.org/10.26562/irjcs.2026.v1303.55
BibTeX Key Deepak@2026New Orcid: https://orcid.org/0009-0004-9398-7488
IRJCS papers should be cited as IRJCS (International Research Journal of Computer Science, AM Publications, India 2026, ISSN 2393-9842, https://doi.org/10.26562/ijrcs.2025.v1303.55 The journal's official abbreviation is IRJCS.

Abstract: In the rapidly evolving digital era, education is undergoing a significant transformation through the integration of technology and innovative learning methods. The project "New Age Course Generation: Transforming the Learning Experience" aims to design and develop an advanced online learning platform that personalizes education for learners of all backgrounds. This system leverages modern technologies such as Artificial Intelligence (AI) and data analytics to automatically generate, organize, and deliver interactive courses based on learners' interests, skills, and learning pace. The platform focuses on creating a flexible, engaging, and adaptive learning environment where users can access customized study materials, multimedia lessons, and real-time assessments anytime and anywhere. By combining intelligent course recommendation systems with user-centric design, this project seeks to bridge the gap between traditional learning and modern digital education. Ultimately, "New Age Course Generation" envisions transforming the learning experience into a more dynamic, efficient, and inclusive process that empowers lifelong learning in the digital age.
Keywords: Course Generation, Artificial Intelligence, Data analytics, Adaptive learning environment, Course recommendation systems.

I. INTRODUCTION

In an era where time is precious and learning needs are diverse, students and professionals struggle to find study materials that match their specific requirements and time constraints. Traditional e-learning platforms offer rigid, one-size-fits-all courses that often don't align with individual learning goals or last-minute preparation needs. This project introduces an innovative AI-powered platform that revolutionizes personalized learning by allowing users to generate custom courses on-demand. By simply specifying their topic of interest, desired content length, and structural preferences, users can instantly create tailored study materials powered by advanced AI and curated multimedia resources. Beyond individual use, the platform cultivates a vibrant learning community where users share, explore, and rate courses, transforming education into a collaborative and accessible experience for everyone. This project introduces the concept of "New Age Course Generation," a transformative system poised to redefine the learning experience. At its core, this initiative is about harnessing the immense power of artificial intelligence (AI), machine learning (ML), and data-driven insights to transcend the limitations of traditional education. Imagine a learning environment where every course, every module, and every interaction is dynamically tailored to the individual student their prior knowledge, preferred learning modalities (visual, auditory, kinesthetic, reading/writing), cognitive pace, and even their career objectives. This system aims to create personalized learning pathways that are not only adaptive and responsive but also deeply engaging and intrinsically motivating. By moving beyond static content delivery to embrace intelligent, adaptive course generation, this project envisions a future where education is not just about imparting knowledge, but about cultivating a lifelong love for learning, fostering critical thinking, and equipping individuals with the precise skills and understanding required to thrive in an ever-changing global society. This system represents a pivotal step towards a truly personalized, equitable, and effective educational future. The current educational model often leads to significant challenges: high dropout rates in online courses due to lack of personalization, students feeling either overwhelmed or under- challenged, and educators spending an inordinate amount of time on content creation rather than focused student interaction. We are moving beyond "one-size-fits-all" education. This project introduces a transformative AI platform that empowers users to become architects of their own learning journey.

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Whether you need a 10-minute crash course or a deep-dive module, our system generates bespoke educational content instantly. By combining cutting-edge AI with a vibrant, community-driven market place for knowledge sharing, we are making personalized, collaborative learning accessible to everyone, everywhere.

LITERATURE REVIEW

Traditional e-learning platforms like Course raa ndUdemy have redefined global education through structured content, yet research highlights significant drawbacks in their one-size-fits-all approach. Centralized models often fail to meet individual needs, causing disengagement and in efficiency. Conversely, personalized learning significantly improves student outcomes but faces scalability hurdles. This tension creates a demand for adaptive systems that tailor content difficulty and learning paths. Artificial Intelligence serves as a transformative solution, with Large Language Models and Natural Language Processing capable of synthesizing high- quality, contextually relevant educational modules within seconds. Students often find AI-generated materials as clear as human-made versions, while Intelligent Tutoring Systems provide targeted feedback that boosts academic performance by focusing on specific knowledge gaps and individual learning styles.

Beyond automated generation, the evolution of modern educational platforms relies heavily on collaborative ecosystems and social learning. Community-driven models, supported by transparent peer-rating systems, enhance retention by offering diverse perspectives and quality assurance. These systems thrive on network effects, where shared knowledge becomes a collective asset for all participants. Technically, this is supported by API- driven architectures and the MERN stack, which offer the flexibility needed to handle dynamic content and rapid scaling. Integrating multimedia, particularly video resources from repositories like YouTube, further improves comprehension and retention. NoSQL databases like MongoDB are ideal for these evolving schemas, while React.js ensures highly maintainable user interfaces. Security remains paramount in this digital landscape, utilizing JSON Web Tokens for stateless authentication and adhering to strict data privacy standards to protect sensitive learner information. Such security measures ensure that the platform remains a trustworthy environment for users to explore and share content without compromising their digital safety. Furthermore, the use of Express.js and Node.js allows for efficient asynchronous operations, which is critical when handling real-time AI requests and heavy video traffic simultaneously. Despite these advancements, critical research gaps remain in the current academic land scape. Existing literature lacks focus on real- time, on-demand course generation and the comprehensive integration of AI with community features. Most systems are designed for long-term study, neglecting time-constrained learners who require rapid skill acquisition or last-minute preparation scenarios. This project directly addresses these deficiencies by developing a holistic platform that merges AI-powered synthesis, curated multimedia, and community collaboration. By leveraging the MERN stack. Everyone. This approach not only solves the limitations of current e-learning models but also establishes a new framework for immediate, high-quality learning tailored to the specific constraints of the modern user. It justifies the need for a shift toward more agile, intelligent, and socially integrated educational tools that can keep pace with the increasing demands of today's knowledge- driven society and professional environment. Ultimately, it seeks to revolutionize the standard pedagogies through technical innovation and architectural design

PROPOSED METHODOLOGY ARCHITECTURE

The proposed architecture represents a significant shift from traditional, rigid educational models toward a fluid, user-driven intelligence framework. Simple automation by embedding a social layer that allows individuals to publish their personalized creations, explores the work of others, and engage in a transparent rating system.

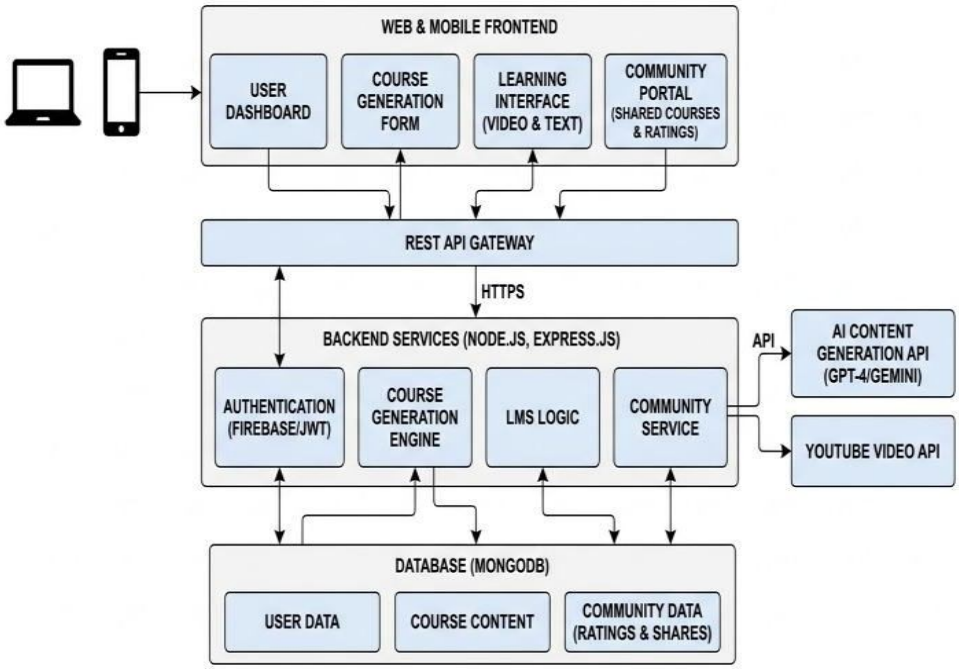

Fig.1. Architecture Diagram

ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.55

This transforms a solitary academic exercise into a vibrant, collaborative learning ecosystem where knowledge is constantly refreshed and peer-reviewed. This AI-Powered Course Generation Platform functions as a sophisticated engine designed to dismantle the limitations of standardized learning by placing total control in the hands of the student. By prioritizing a user-centric philosophy, the system allows for the immediate creation of bespoke educational pathways. When a learner interacts with the interface, they are not merely searching for pre-existing material but are actually commissioning a unique course by defining specific parameters such as the subject matter, the intended duration of study, and the depth of the curriculum through chapter and module count. Behind the scenes, the platform orchestrates a complex symphony of technologies, utilizing the advanced Gemini API to synthesize structured textual content while simultaneously crawling the YouTube API to curate high-quality multimedia assets that complement the written modules. his dual-stream approach ensures that the resulting course is both academically rigorous and visually engaging. Furthermore, platform transcends.

A. Conceptual Framework and AI-Driven Content Synthesis

The proposed system represents a paradigm shift in digital education by moving away from static, pre-recorded content and toward a dynamic, user-centric generation engine. At its core, the platform functions as an intelligent intermediary between vast knowledge bases and the specific, immediate needs of the learner. By integrating the Gemini API, the system can interpret complex user prompts regarding a specific topic and immediately synthesize a structured curriculum consisting of multiple chapters and modules. This is not merely a text generation tool; it is a holistic content curator that simultaneously interfaces with the YouTube API to identify and embed relevant multimedia resources that align with the generated text. This dual-layered approach ensures that the learner receives a multifaceted educational experience that combines the depth of written theory with the engagement of visual demonstrations. Furthermore, the system includes a social layer that allows these custom-built courses to be published to a public repository.

B. Strategic Objectives for Functional and Technical Excellence

The roadmap for this platform is anchored by a set of primary and secondary objectives designed to ensure both immediate utility and long-term architectural stability. The primary mission is to automate the pedagogical process, allowing for the creation of personalized courses based on highly specific user-defined parameters such as content length and structural depth. Beyond content generation, the project focuses on building a secure and intuitive environment. This includes implementing robust authentication protocols to protect user data and developing a responsive user interface that provides a consistent experience across mobile and desktop devices. Secondary objectives look toward the efficiency of the backend, with a specific performance target of generating full courses in under sixty seconds. The architecture is purposefully designed to be horizontally scalable, meaning it can handle an increasing volume of users and content without a dip in performance. Additionally.

C. Pedagogical Advantages and Radical Personalization

One of the most significant advantages of this intelligent system is the elimination of "content bloat" through radical personalization. In traditional e-learning, students are often forced to sit through hours of irrelevant introductory material to reach the specific information they need. This platform solves that problem by allowing users to generate courses that match their current knowledge level and specific requirements, thereby maximizing study efficiency and cognitive focus. This efficiency is a game-changer for time-constrained learners, particularly students engaged in last-minute exam preparation who need to master a specific skill or topic in a fraction of the time it would take to manually research the material. By automating the research.

D. Economic Democratization and Social Learning Dynamics

Beyond its technical merits, the platform serves as a powerful tool for the democratization of high-quality education. By offering AI-powered course generation and access to community-shared content free of charge, it effectively removes the financial barriers that often prevent talented individuals from accessing premium educational resources. This economic accessibility is paired with a vibrant social learning ecosystem. The platform encourages users to contribute their personalized courses to a collective knowledge base, where they can be explored and rated by others. This community-driven approach creates a self-sustaining cycle of quality assurance; the rating system helps users identify the most effective courses while providing creators with the feedback necessary to improve their materials. This collaborative model ensures that the platform's library remains diverse, up-to-date, and reflective of a wide variety of perspectives and teaching styles.

E. Architectural Flexibility and Modern Development Standards

Finally, the project serves as a showcase for modern full-stack development best practices and the power of technological integration. Unlike legacy systems with rigid structures, the content generated by this platform is inherently flexible. Users retain the ability to edit, restructure, and customize their courses even after they have been generated, providing a level of pedagogical agency that is rare in digital learning. From a development standpoint, the seamless integration of generative AI, third-party APIs (like Gemini and YouTube), and cloud-based database services demonstrates a sophisticated use of the MERN stack. This modular approach not only solves existing gaps in the e-learning market such as the lack of on demand content and the difficulty of multimedia curation but also establishes a robust foundation for future innovations.

TECHNOLOGIES USED

A. MongoDB: No SQL Database Management

The foundational layer of the data architecture is MongoDB, a document-oriented NoSQL database chosen for its flexibility and horizontal scalability.

ISSN: 2393-9842
https://www.irjcs.com/archives
https://doi.org/10.26562/irjcs.2025.v1303.55

Unlike traditional relational databases, MongoDB's schema-less nature allows it to handle varied content structures, which is essential for storing diverse course formats and evolving user-generated data without rigid constraints. It excels in rapid prototyping, enabling the platform to store complex nested objects such as chapters, modules, and multimedia links in a single document for efficient retrieval.

B. Express.js:Backend Framework and Routing

Express.js serves as the minimalist web application framework for the Node.js environment, facilitating the creation of a robust backend. It manages the server-side logic, routing, and middleware required to handle incoming HTTP requests from the frontend. By providing a streamlined approach to building web services, Express ensures that the application can efficiently process complex workflows, such as triggering AI content generation or managing user sessions, with minimal overhead and high performance.

C. React.js: Interactive Frontend Interface

The user interface is built using React.js, a powerful JavaScript library designed for creating component-based, interactive UIs. React's virtual DOM implementation ensures superior performance by updating only the necessary parts of the page, which is critical for a platform where content is dynamically generated and displayed in real-time. Its extensive ecosystem of libraries allows for a highly maintainable and reusable codebase, enabling the development of a responsive dashboard that functions seamlessly across all user devices.

D. Node.js:ScalableJavaScriptRuntime

As the core execution environment, Node.js allows the entire stack to be unified under a single language: JavaScript. Its event- driven, non-blocking I/O model is particularly suited for data- intensive real-time applications, such as the on-demand generation of course materials. Node.js enables the backend to handle multiple concurrent connections efficiently, ensuring that the target of generating a complete, multimedia-rich course in under sixty seconds remains technically feasible even as the user base expands.

E. GeminiAPI: Generative AI Core Engine

The intelligence of the platform is powered by the Gemini API, which utilizes Large Language Models (LLMs) to synthesize educational content. When a user specifies a topic, this API processes the requirement to generate coherent, contextually relevant, and structured learning modules. This technology transforms raw data into a logical pedagogical flow, providing clear and organized study materials that students often rate as comparable or superior to traditionally authored textbooks in terms of clarity and organization.

F. YouTube API: Multimedia Content Integration

To supplement the AI-generated text, the platform integrates the YouTube API for automated video curation. This allows the system to programmatically search for and embed high-quality educational videos that correspond to the specific chapters generated by the Gemini engine. By combining textual theory with relevant video resources, the platform adheres to multimedia learning theories that show significant improvements in learner comprehension and information retention compared to text-only environments.

G. JSONWeb Tokens(JWT):Secure Authentication

Security is managed through JSON Web Tokens (JWT), which provide a stateless and secure method for user authentication. This technology allows the server to verify user identity without the need for server-side session storage, which improves the scalability of the application. JWT ensures that user data, personalized course libraries, and social interactions remain protected through secure token generation and appropriate expiration mechanisms, upholding modern data privacy standards and best practices.

H. RESTful API Architecture: Modular Connectivity

The platform follows a RESTful architectural style, utilizing standardized HTTP methods to facilitate communication between the frontend, backend, and external service providers. This resource-based design promotes statelessness and a uniform interface, making the system modular and easy to maintain. By leveraging REST principles, the application can seamlessly integrate with various specialized APIs for content, analytics, and multimedia, ensuring a feature-rich experience that remains more scalable than traditional monolithic systems.

I. DevOps and Development Tools

The development lifecycle is supported by GitHub for version control and DevOps principles for deployment and continuous integration. These tools allow for collaborative development, enabling the team to manage code changes, track issues, and deploy updates efficiently. By using industrial-level tools like GitHub, the project ensures code integrity and facilitates a streamlined path from local development to a live, scalable cloud environment, ensuring long-term viability and performance stability for the global user base.

A. System Implementation and Architecture

The "New Age Course Generation" project is designed to transform traditional e-learning by providing an AI-powered platform for personalized study materials. To achieve this, the developers implemented a robust and scalable architecture built on the MERN stack.

B. Frontend and Backend Technologies The platform's user

Interface is developed using React.js and Next.js, ensuring intuitive navigation, responsive design across various devices, and a seamless experience for course creation and exploration. For the backend infrastructure, the system utilizes Node.js and Express.js to create a RESTful API architecture. This backend structure houses the business logic, API endpoints, and middleware necessary for routing and handling operations securely.

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Data storage, indexing, and retrieval are managed by MongoDB, a NoSQL database that maintains distinct collections for user profiles, course content, metadata, ratings, and session activity. Additionally, the system implements robust JWT-based authentication to manage secure user logins, password management, and data privacy.

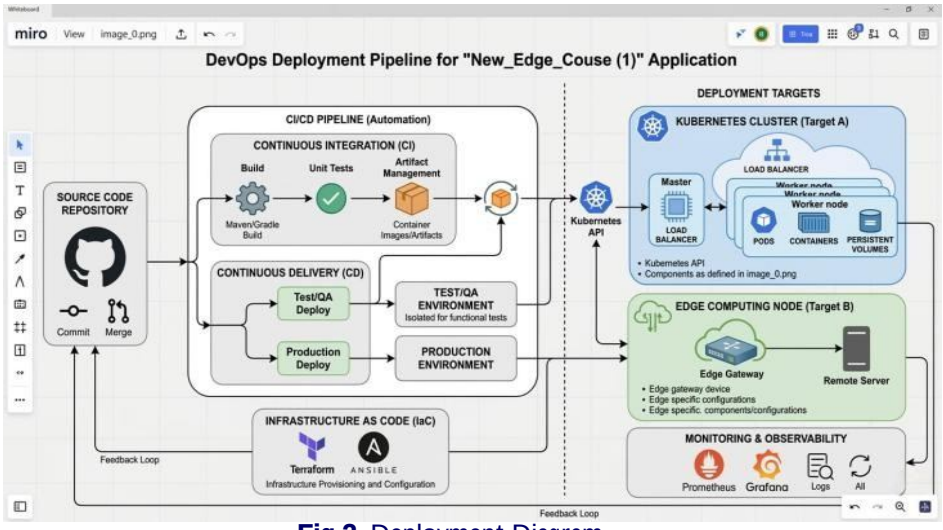

Fig.2. Deployment Diagram

IMPLEMENTATIONS AND RESULTS

C. AI and External API Integration

The core functionality of customized course creation relies heavily on the integration of external APIs. The platform uses the Gemini API as its primary engine for intelligent AI content generation, dynamically building course content, chapter structures, and modules based on the user's specific inputs regarding topic and duration. To supplement this text-based generation, the system integrates the YouTube API to search, fetch metadata, and embed highly relevant educational video resources directly into the course modules.

D. Data Processing and Feature Extraction

Before delivering content to the user, the platform employs a sophisticated Preprocessing System. This system validates and sanitizes user inputs to prevent security vulnerabilities like SQL injection or XSS attacks. It also formats API requests, filters out irrelevant or duplicate content returned by the APIs, and normalizes the data for consistent database storage. Furthermore, a Feature Extraction module analyzes the generated content to identify keywords, difficulty levels, and key concepts, while also extracting YouTube video metadata (such as view counts and channel credibility) to ensure only high-quality resources are selected.

E. Results and Platform Advantages

The implementation of this architecture yields significant results that directly address the pain points of modern learners, such as rigid course structures and inefficient resource discovery.

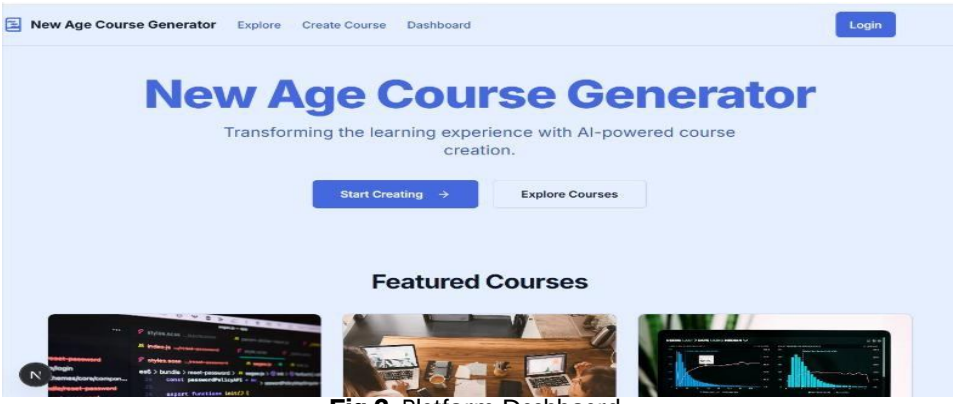

Fig.3. Platform Dashboard

F. Personalized and Efficient Learning

The most immediate result of the platform is the delivery of a highly personalized learning experience. Users can easily and instantly generate courses with flexible durations and flexible numbers of chapters tailored precisely to their knowledge gaps. By automating the generation of both text and video resources into a single unified interface, the platform eliminates the need for manual searching across multiple websites, making it highly time and cost-efficient—especially for learners needing last-minute exam preparation.

G. A Collaborative Ecosystem

Beyond individualized course generation, the implementation successfully establishes a community-driven learning ecosystem. The platform allows users to save, modify, and publicly publish the courses they have generated. Coupled with an automated classification system that categorizes courses by subject and difficulty, the platform features an "Explore" module where learners can search for trending or peer-created content.

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The inclusion of a user rating and review system ensures that high- quality courses are easily discoverable, continually enhancing the overall standard of learning materials through peer validation. Ultimately, the platform successfully democratizes education by offering flexible alternatives to traditional e-learning, with an architecture designed to support future enhancements like real- time multi-user collaboration and premium monetization models.

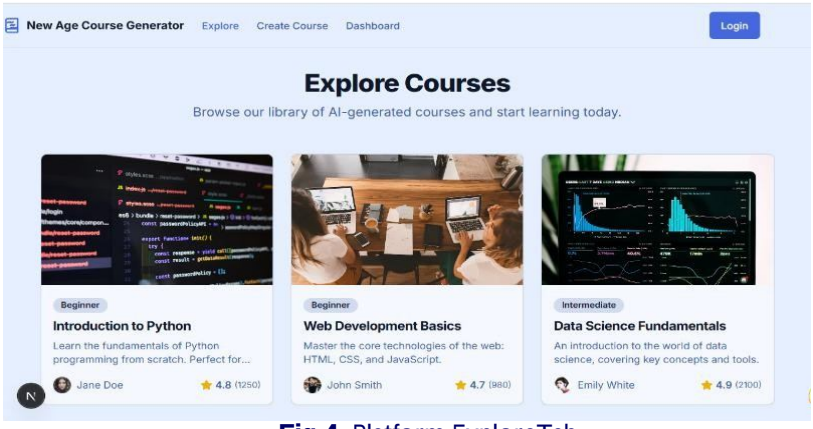

Fig.4. Platform ExploreTab

FUTURE ENHANCEMENTS

A. Advanced Collaboration and Personalization

Real-Time Multi-User Collaboration: A major planned upgrade is the implementation of collaborative features that will allow multiple users to seamlessly co-create and edit course materials simultaneously. By incorporating real-time synchronization, comprehensive version control, and dedicated collaborative editing tools, the platform will empower teams, educators, and study groups to build comprehensive courses together. Machine Learning Integration**:** To further tailor the learning journey, the system will integrate advanced machine learning algorithms. This enhancement aims to move beyond basic user inputs to provide highly intelligent, automated course recommendations by actively analyzing a user's learning history, specific preferences, and overall performance metrics.

B. Sustainability and Community Incentives

Premium Subscription Model: Ensuring the long-term sustainability of the platform is a priority, which will be addressed through a planned monetization model. This premium tier will offer subscribers exclusive quality-of-life features such as unlimited course storage, an ad-free browsing experience, access to highly-rated premium courses, and advanced analytics regarding their learning progress. Creator Revenue Sharing: To foster a vibrant ecosystem, a revenue-sharing model will be introduced for successful course creators. By compensating creators financially for popular and highly-rated courses, the platform directly incentivizes the community to consistently produce and maintain high-quality educational content.

C. Enhanced Engagement and Accessibility

Interactive Learning & Gamification: To boost user retention and ensure knowledge comprehension, the platform will shift from passive reading to active learning by introducing interactive features. These include integrated quizzes, formal assessments, detailed progress tracking, and the ability to earn certifications upon successful course completion. Additionally, gamification elements such as achievement badges, competitive leader boards, and comprehensive achievement systems—will be integrated to significantly enhance user motivation. Native Mobile Applications: Finally, the project plans to expand its global reach through dedicated mobile application development. By building native applications specifically optimized for iOS and Android platforms, the system will provide users with seamless, on-the-go access to their educational materials. Crucially, these mobile apps will feature offline download capabilities and push notifications for course updates, ensuring learning can happen anywhere, regardless of internet connectivity.

CONCLUSION

The AI powered Course Generation Platform represents a profound advancement in educational technology by bridging the gap between generic platforms and learner needs. By integrating Gemini API for intelligent content and YouTube API for multimedia, this MERN application revolutionizes how study materials are generated. Its community driven ecosystem empowers users to publish, explore, and rate courses, fostering sustainable knowledge sharing. Furthermore, the robust architecture provides a solid foundation for ambitious future enhancements. Planned integrations, including real time multiple user collaboration and machine learning recommendations, will elevate overall user engagement. Ultimately, this scalable solution democratizes access to personalized education while establishing a forward-looking framework poised to evolve into a comprehensive marketplace for all global learners around the world.

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