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Research Paper

AI-GENERATED PERSONALIZED LEARNING PATH BUILDING

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Abstract

The AI-Generated Personalized Learning Path Building system is an intelligent educational platform designed to create customized learning paths according to the individual needs, knowledge level, interests, and learning goals of users. Traditional learning platforms generally provide the same course structure to all learners, even though students may have different backgrounds, abilities, and learning speeds. The proposed system uses Artificial Intelligence to overcome this limitation by generating a learning path specifically for each learner.

The system collects information such as the learner's current knowledge, preferred subject, learning objectives, available study time, and skill level. It analyzes this information using Artificial Intelligence and Natural Language Processing techniques to understand the learner's requirements. The system can also consider quiz results, completed courses, assessment scores, and learning progress to determine the learner's strengths and weaknesses.

Based on the collected information, the AI creates a structured sequence of topics, courses, lessons, practical exercises, quizzes, and learning resources. Basic concepts are recommended first when the learner has knowledge gaps, while advanced topics are suggested when the learner demonstrates sufficient understanding. The learning path can therefore change dynamically as the learner progresses.

The system continuously monitors learner performance and updates the recommended learning path. If a learner performs poorly in a particular topic, the system can recommend revision materials, simpler explanations, or additional practice. If the learner performs well, the system can suggest more advanced topics and challenges. This adaptive approach helps learners follow a more effective and personalized learning journey.

Overall, the proposed system aims to make education more personalized, flexible, adaptive, and learner-centered. It can be useful for students, professionals, online learning platforms, educational institutions, and corporate training programs. Future enhancements can include AI tutors, multilingual learning paths, skill-gap prediction, real-time recommendations, multimedia content generation, and integration with Learning Management Systems.

I. INTRODUCTION

Education is an important part of personal and professional development, but every learner has different abilities, interests, backgrounds, and learning requirements. Some learners may already understand basic concepts while others may require additional explanations and practice. Traditional educational systems generally follow a fixed curriculum, which may not effectively address these individual differences. Personalized learning provides an approach where educational content can be adjusted according to each learner.

The growth of Artificial Intelligence has created new opportunities for developing intelligent and adaptive educational systems. AI can analyze learner information, identify patterns in performance, recommend relevant resources, and predict areas where additional learning may be required. These capabilities allow educational platforms to move beyond fixed course structures and provide recommendations based on individual learner requirements.

The **AI-Generated Personalized Learning Path Building** system focuses on automatically creating a learning journey for each user. The learner provides information such as their target skill, current knowledge level, learning objectives, and preferred learning schedule. The system analyzes these inputs and identifies the topics that should be learned. It then arranges the topics in a logical order, starting from prerequisite concepts and progressing toward more advanced subjects.

An important feature of the proposed system is continuous adaptation. The learning path is not treated as a fixed sequence. As the learner completes lessons and assessments, the system evaluates performance and updates future recommendations. For example, a learner who has difficulty with a particular concept may receive additional learning resources and practice questions, while a learner who performs well may move directly to more advanced material.

II. LITERATURE SURVEY

Traditional educational platforms generally follow predefined curricula where all learners receive the same sequence of topics and learning materials. Learning Management Systems are useful for delivering courses, tracking completion, and conducting assessments, but their learning paths are often designed manually. Such fixed structures may not adequately address differences in learner knowledge, pace, interests, and learning objectives.

Research in **Personalized Learning Systems** has explored techniques for adapting educational content according to individual learner characteristics. These systems may use learner profiles, assessment results, previous activities, and preferences to recommend suitable resources. Personalized learning approaches have demonstrated the potential to improve learner engagement and provide more relevant educational experiences. However, many systems still depend on predefined rules and manually designed recommendations.

Adaptive learning systems extend personalization by continuously modifying content according to learner performance. These systems can identify knowledge gaps and recommend remedial content or more challenging material. Machine learning techniques can be used to analyze learner behavior and predict future learning

requirements. However, creating effective adaptive models requires sufficient learner data and carefully designed educational rules.

Recommendation systems have also been widely used in online education to suggest courses, videos, articles, and other learning resources. Collaborative filtering and content-based recommendation methods can identify resources that may be relevant to a learner. However, recommending individual resources is different from creating a complete learning path. A personalized learning path needs to consider prerequisites, topic dependencies, learning objectives, and the correct order of concepts.

Recent advances in **Generative AI and Large Language Models** have introduced new possibilities for creating personalized educational content. Generative AI can generate explanations, examples, quizzes, summaries, and learning activities according to learner requirements. It can also help organize topics into structured learning sequences. However, generated educational content requires validation to ensure accuracy, relevance, and appropriate difficulty.

Existing research indicates that combining learner analytics, recommendation systems, adaptive learning, and Generative AI can create more intelligent personalized education platforms. However, challenges remain in identifying accurate knowledge gaps, maintaining appropriate learning sequences, preventing irrelevant recommendations, and continuously adapting the learning path. The proposed **AI-Generated Personalized Learning Path Building** system addresses these challenges by integrating learner profiling, skill-gap analysis, AI recommendations, content generation, performance monitoring, and continuous path adaptation.

III. SYSTEM ANALYSIS

The **AI-Generated Personalized Learning Path Building** system is designed to create an individualized learning journey for each learner. The user first provides information such as their learning goal, current skill level, interests, and available study time. The system creates a learner profile based on the provided information and previous learning activities. An assessment module can evaluate the learner's existing knowledge and identify strengths and weaknesses. The AI analyzes the learner profile and compares it with the skills required to achieve the target goal. A skill-gap analysis module identifies missing concepts and prerequisite topics. The learning-path engine organizes these topics into a logical sequence. The recommendation module selects suitable courses, lessons, videos, articles, exercises, and assessments. The learner follows the generated path and completes learning activities. Performance data from quizzes and assessments is continuously analyzed by the system. Based on this information, the AI updates the learning path and provides new recommendations. The final system therefore creates a dynamic learning journey that changes according to the learner's progress and requirements.

Existing System

Existing online learning platforms generally provide predefined courses and fixed learning sequences for users. Learners are usually required to select a course and follow the modules in the order designed by the instructor. Some platforms provide course recommendations based on interests or previous activity, but these recommendations

may not represent a complete personalized learning path. Learners with different knowledge levels may receive the same lessons and assessments. Beginners may find advanced concepts difficult, while experienced learners may spend unnecessary time studying concepts they already understand. Traditional platforms may also have limited ability to identify individual knowledge gaps. Performance data is often used mainly for progress tracking rather than dynamically restructuring the learning journey. Recommendations may focus on individual courses or resources instead of prerequisite relationships between topics. Manual intervention may be required to create customized learning plans. The learning path may therefore remain unchanged even when learner performance changes. As a result, traditional systems provide limited adaptation and may not fully support individual learning requirements.

Disadvantages of Existing System

- Provides mostly fixed learning paths.
- Limited personalization for individual learners.
- Same course structure may be given to learners with different skill levels.
- Difficult to identify individual knowledge gaps.
- Limited adaptation based on assessment performance.
- Recommendations may not consider topic prerequisites.
- Learners may spend time studying already-known concepts.
- Beginners may struggle with advanced topics.
- Limited AI-based learning recommendations.
- Learning resources may not be organized into an optimal sequence.
- Manual effort may be required to create customized learning plans.
- Limited continuous adaptation to learner progress.

Proposed System

The proposed **AI-Generated Personalized Learning Path Building** system automatically creates a customized learning path according to each learner's requirements. The learner provides a target skill or subject along with their current knowledge level, interests, learning goals, and available study time. The system creates a learner profile using this information and previous learning activity. An assessment module evaluates the learner's existing knowledge and identifies important skill gaps. AI analyzes the target goal and determines the skills and prerequisite concepts required to achieve it. The learning-path engine organizes the required concepts into a logical sequence from basic to advanced levels. A recommendation engine selects appropriate learning resources, courses, exercises, projects, and assessments. Generative AI can create additional explanations, summaries, examples, and practice questions when required. The system continuously monitors learner performance and identifies areas that need improvement. The learning path is automatically updated when the learner's knowledge or performance changes. Advanced learners can receive challenging topics while learners with gaps can receive revision and remedial resources. This creates a flexible and continuously evolving learning journey for every user.

Advantages of Proposed System

- Creates personalized learning paths automatically.
- Adapts to the learner's knowledge and skill level.

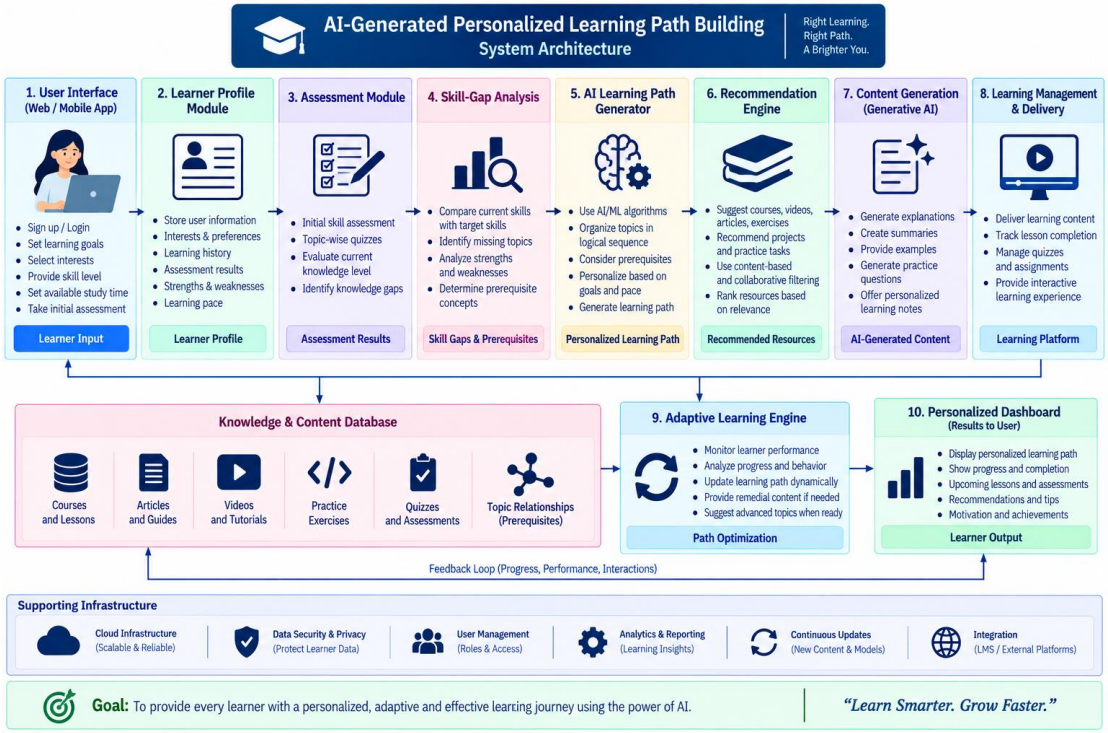
- Identifies individual knowledge and skill gaps.
- Considers learning goals and interests.
- Organizes topics according to prerequisites.
- Provides suitable learning resources and activities.
- Dynamically updates recommendations based on performance.
- Reduces unnecessary repetition of known concepts.
- Provides additional practice for difficult topics.
- Supports progression from beginner to advanced levels.
- Improves learner engagement and learning efficiency.
- Supports scalable personalization for many learners.

IV. METHODOLOGY

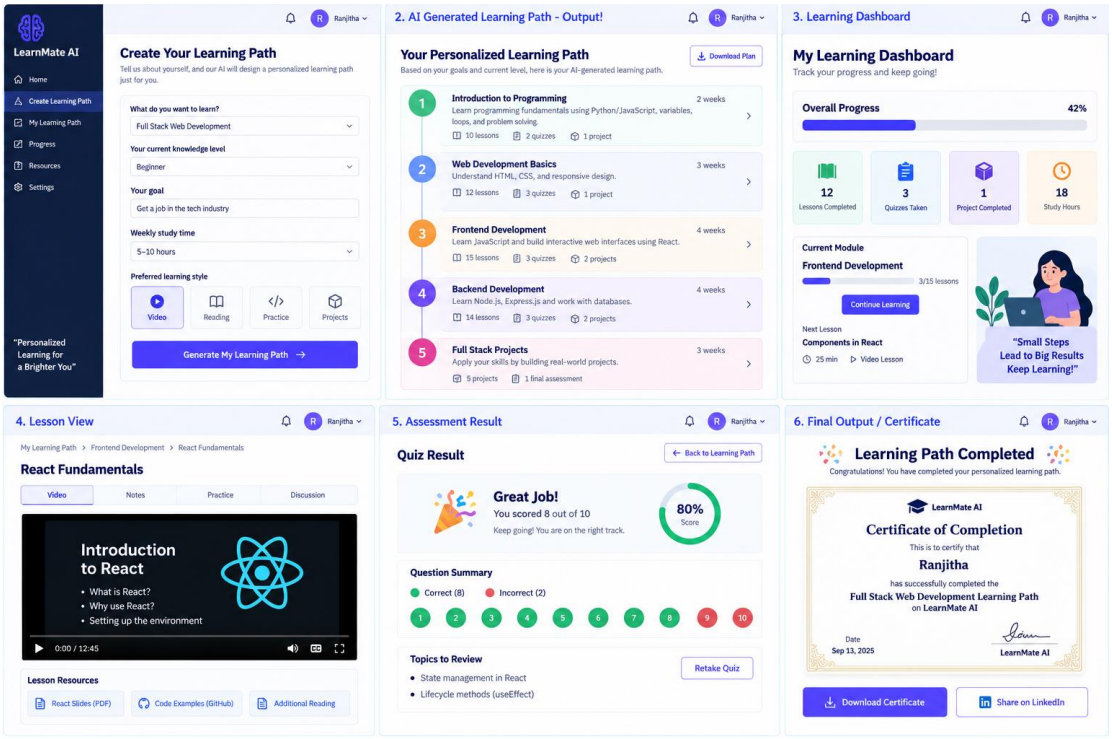
The methodology begins by collecting learner information such as target skills, current knowledge, interests, learning objectives, and preferred study time. The system creates a personalized learner profile from the collected information. An initial assessment is conducted to measure the learner's current understanding of important concepts. The AI analyzes the assessment results to identify strengths, weaknesses, and knowledge gaps. A skill mapping module compares the learner's current skills with the skills required to achieve the selected learning goal. The system identifies prerequisite concepts and determines the appropriate order of topics. An AI learning-path generator creates a sequence of courses, lessons, resources, exercises, and assessments. A recommendation engine selects suitable educational materials based on the learner profile. The learner then follows the generated path and completes lessons and assessments. The system continuously collects performance information such as scores, completion rates, and learning progress. An adaptive AI module analyzes this information and updates the learning path when necessary. Finally, the system provides an evolving personalized learning journey that continuously adjusts according to learner performance and goals.

SYSTEM ARCHITECTURE

The AI-Generated Personalized Learning Path Building architecture consists of several modules that work together to create and maintain a personalized learning journey. The User Interface allows learners to enter their goals, interests, skill level, and learning preferences. The Learner Profile Module stores relevant learning characteristics and previous progress. The Assessment Module evaluates the learner's current knowledge and performance. The Skill-Gap Analysis Module identifies missing skills and concepts required to achieve the learner's target. The AI Learning Path Generator organizes required topics and prerequisites into a logical sequence. The Recommendation Engine selects suitable courses, videos, articles, exercises, and projects. The Generative AI Module creates additional explanations, summaries, examples, and practice content when needed. The Learning Management Module tracks lesson completion, assessment results, and learner progress. The Adaptive Learning Engine continuously analyzes performance and modifies future recommendations. The Knowledge and Resource Database stores learning resources, topic relationships, and skill information. Finally, the Personalized Dashboard presents the recommended learning path, progress, upcoming activities, and updated recommendations to the learner.



V. RESULT AND OUTPUT



VI. CONCLUSION

The AI-Generated Personalized Learning Path Building system provides an intelligent solution for creating customized learning journeys based on the individual needs, skills,

interests, and goals of learners. Unlike traditional learning systems that provide fixed course structures, the proposed system dynamically creates learning paths according to each learner's current knowledge and requirements.

By combining Artificial Intelligence, Machine Learning, learner analytics, recommendation techniques, and Generative AI, the system can identify knowledge gaps and recommend suitable topics, courses, lessons, exercises, projects, and assessments. It organizes these resources in a logical sequence so that learners can progress from basic concepts to advanced skills effectively.

The adaptive learning component continuously monitors learner performance through assessments, completed lessons, and learning activities. Based on this information, the system can modify the learning path, provide additional practice for difficult topics, or recommend advanced content when the learner demonstrates sufficient understanding.

Overall, the proposed system makes learning more personalized, flexible, adaptive, and learner-centered. It can benefit students, professionals, educational institutions, online learning platforms, and corporate training programs. In the future, the system can be enhanced with AI tutors, multilingual learning paths, real-time skill-gap prediction, personalized multimedia content, advanced learner analytics, and integration with Learning Management Systems.

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