

AI-Powered Agentic Learning and Workforce Relevance Platform Prototype

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Abstract—The proposed system presents an AI-powered adaptive learning platform developed to provide personalized and career-oriented learning support for users. The platform analyzes user skills, educational background, and career goals to identify missing competencies and learning requirements. Based on the analysis, the system generates customized learning pathways and recommends suitable courses, certifications, and technical resources. An adaptive learning agent continuously monitors user progress and suggests the next appropriate skill to maintain continuous learning and improve engagement. The platform combines recommendation techniques, skill gap analysis, and progress tracking to support structured and efficient learning experiences. The developed framework helps users avoid unnecessary learning content while improving workforce readiness and technical skill development. Experimental results show that the system provides effective personalized guidance and serves as a reliable solution for intelligent learning and career growth.

Index Terms—Adaptive Learning, Personalized Education, Skill Gap Analysis, Recommendation System, Workforce Relevance, Career Development, Intelligent Learning

I. INTRODUCTION

Many learners face difficulties in identifying the exact skills required for their desired career roles due to the absence of proper learning guidance and workforce-oriented educational support. Digital technologies and artificial intelligence have significantly changed the skills required in modern industries. Organizations today expect individuals to possess practical and industry-oriented knowledge in areas such as artificial intelligence, data science, cloud computing, and

software development. Existing online learning platforms mainly provide generalized educational resources without considering user interests, current skill levels, or career objectives. This often results in unstructured learning experiences, reduced learning efficiency, and confusion regarding career preparation [1]. Artificial intelligence and adaptive educational technologies have created new opportunities for developing personalized learning systems that provide customized recommendations and intelligent learning guidance according to user requirements. Modern recommendation systems and adaptive learning platforms are increasingly being integrated into educational environments to improve learning experiences and user engagement. These systems analyze learner behavior, educational background, and learning progress to generate personalized suggestions and structured learning pathways. Recommendation mechanisms supported by artificial intelligence help users identify relevant courses, certifications, and technical resources according to their career objectives. Such technologies improve personalized education by reducing unnecessary learning content and supporting efficient skill development [2]. The integration of adaptive learning, recommendation systems, and skill gap analysis helps improve personalized learning experiences and workforce readiness. The platform is capable of identifying missing competencies and generating structured learning pathways according to user skills and career objectives. Adaptive learning guidance continuously tracks user progress and recommends the next suitable skill to maintain learning continuity and improve engagement. The recommendation system also provides relevant courses, certifications, and technical resources based

on identified skill gaps and workforce requirements. Experimental observations indicate that the proposed framework improves learning efficiency and supports effective career-oriented skill development [3]. The proposed framework is designed to support multiple users with different educational backgrounds, technical skills, and career objectives through a scalable and adaptive architecture. The system continuously analyzes user profiles, learning progress, and workforce requirements to generate personalized recommendations and structured learning pathways for each individual user. Adaptive learning mechanisms allow the platform to dynamically update suggestions according to completed skills and changing career goals. The modular API-based architecture and database-driven design also improve system scalability and enable efficient management of large amounts of user data and learning activities [4]. To provide personalized and workforce-oriented learning support, it is essential to analyze user skills, career objectives, and industry-required competencies accurately. Different users possess varying educational backgrounds, technical knowledge, and learning requirements that must be considered while generating recommendations. The proposed system identifies missing competencies through skill gap analysis and generates structured learning pathways according to user career goals. Through adaptive recommendation mechanisms and continuous progress tracking, the platform provides more effective learning guidance and supports efficient skill development. These capabilities help users improve workforce readiness and achieve better career-oriented learning outcomes [5].

Along with personalized learning guidance, the integration of recommendation systems further improves the effectiveness of workforce-oriented educational platforms. The proposed system generates customized recommendations based on user skills, learning progress, and career objectives. These recommendations may include suitable courses, certifications, technical resources, and skill development pathways required for specific industry roles. The platform not only functions as a recommendation system but also acts as an adaptive learning support framework that continuously guides users throughout the learning process. The ability to provide structured and personalized educational

guidance helps users improve learning efficiency and supports better career preparation.

The development of intelligent educational platforms also highlights the importance of integrating artificial intelligence, adaptive learning technologies, recommendation systems, and workforce analytics into a unified framework. Large-scale user data and learning activities can be efficiently processed and analyzed using modern computational technologies, enabling the creation of scalable and personalized educational solutions. In addition, the combination of recommendation mechanisms with adaptive learning guidance improves the capability of the system to generate structured learning pathways and workforce-oriented support for users. Such integration of technologies demonstrates the potential of intelligent learning systems to address challenges related to personalized education and career development.

Although several intelligent educational platforms have been developed, there are still many challenges in providing effective personalized and workforce-oriented learning support. Issues such as variation in user learning behavior, changing industry requirements, and the need for accurate recommendation mechanisms continue to affect system performance and learning efficiency. In addition, adaptive learning systems must remain transparent and reliable to improve user trust and educational effectiveness. To address these challenges, continuous improvements are required to make recommendation models more scalable, adaptive, and efficient. These systems also require regular evaluation and validation to ensure their reliability and usefulness in real-world educational and career development environments.

Overall, the integration of adaptive learning technologies, recommendation systems, and skill gap analysis provides an effective approach for improving personalized and workforce-oriented education. The proposed platform has the potential to enhance learning efficiency by generating structured learning pathways and identifying industry-relevant competencies according to user career objectives. Continuous progress tracking and adaptive recommendation mechanisms help users improve technical skills and maintain effective learning progression. As research in intelligent educational

systems continues to advance, more scalable and efficient learning platforms can be developed to further improve career guidance, workforce readiness, and personalized learning experiences.

II. LITERATURE SURVEY

With the increasing use of artificial intelligence and adaptive educational technologies, the field of personalized learning and workforce-oriented education has undergone significant improvements. The concept of integrating recommendation systems, adaptive learning models, and skill gap analysis to provide structured and personalized learning support is becoming increasingly common in modern educational platforms. These technologies help overcome the limitations of traditional learning systems by enabling personalized guidance, continuous progress tracking, and career-oriented recommendation generation. The integration of recommendation engines, intelligent learning agents, and workforce analytics has further expanded the scope of adaptive educational systems, making learning more efficient and accessible. In addition, explainable and user-friendly artificial intelligence techniques have improved transparency and trust in intelligent educational platforms. Consequently, recent research mainly focuses on improving recommendation accuracy, adaptive guidance, workforce relevance, and personalized learning experiences in intelligent educational systems. Several studies have focused on adaptive learning systems, recommendation technologies, and workforce-oriented educational platforms using different artificial intelligence techniques and methodologies. Research on workforce analysis highlights the importance of identifying skill gaps and improving career-oriented learning support through intelligent educational systems [6]. Studies on adaptive educational technologies emphasize the need for personalized and user-friendly learning platforms that improve engagement and learning efficiency [7]. The development of recommendation systems has also increased the use of intelligent algorithms for generating customized learning suggestions and structured educational pathways [8]. In addition, adaptive learning frameworks and intelligent tutoring systems have demonstrated promising results in providing continuous guidance and personalized educational support for learners [9]. Moreover, modern

educational platforms that integrate recommendation engines, intelligent agents, and skill analysis mechanisms are increasingly being used to improve workforce readiness and career development opportunities [10].

Besides recommendation-based and adaptive educational approaches, intelligent learning platforms supported by artificial intelligence have also shown significant improvements in personalized education and workforce-oriented learning. Advanced recommendation architectures that combine skill analysis and adaptive learning techniques have improved the accuracy of personalized learning pathway generation and educational guidance [11]. Machine learning-based recommendation systems are increasingly being used to analyze learner behavior, educational interests, and career objectives for generating customized learning suggestions [12]. Adaptive educational frameworks supported by intelligent algorithms have also helped improve continuous learning progression and user engagement across digital learning platforms [13]. In addition, hybrid recommendation models enable the integration of user skills, learning history, and workforce requirements to generate effective career-oriented educational support [14]. Research on user behavior analysis and personalized recommendation systems further highlights the importance of contextual and learner-centered approaches in intelligent educational environments [15].

Recent studies are also focused on improving computational techniques and integrating adaptive recommendation mechanisms to enhance personalized learning and workforce-oriented educational systems. Intelligent recommendation models and adaptive learning frameworks have been used to improve educational guidance by analyzing user skills, learning behavior, and career objectives [16]. Machine learning-based educational systems have enabled the development of personalized recommendation services and structured learning support for learners across different technical domains [17]. The analysis of learner behavior and workforce requirements has also improved through hybrid recommendation architectures and adaptive learning models designed to generate customized educational pathways [18]. Moreover, real-time progress tracking systems supported by intelligent recommendation techniques have enabled

continuous learning evaluation and adaptive educational guidance with improved transparency and efficiency [19].

Lastly, recent research in intelligent educational systems emphasizes the importance of personalization, transparency, and user-centered learning support in workforce-oriented platforms. Multimodal recommendation techniques and adaptive learning models are increasingly being integrated to improve the accuracy and effectiveness of personalized educational guidance [20]. Explainable artificial intelligence methods have also contributed to improving user trust and understanding in recommendation-based educational systems, especially in career-oriented learning applications. In addition, there is a growing focus on advanced artificial intelligence models and intelligent educational assistants capable of providing adaptive guidance and continuous learning support, although challenges related to privacy, recommendation accuracy, and scalability still remain. Overall, recent developments indicate a clear shift toward intelligent, adaptive, and user-friendly educational platforms that combine personalized learning with workforce relevance and modern computational technologies.

III. METHODOLOGY

The proposed methodology provides a structured approach for developing a personalized and workforce-oriented adaptive learning platform. The system combines user profile analysis, skill gap identification, recommendation generation, adaptive learning guidance, and progress tracking within a single framework to improve learning efficiency and career preparation. The process begins with collecting user information and continues through stages such as skill analysis, personalized learning path generation, recommendation processing, adaptive guidance, and performance monitoring. Each stage is designed to understand user learning requirements and match them with industry expectations while providing personalized educational support. The methodology focuses not only on generating accurate recommendations but also on supporting continuous learning progression through adaptive guidance. The final stage includes progress tracking and intelligent recommendations that improve the practical usefulness of the platform by helping users develop relevant skills and achieve workforce-oriented learning outcomes as shown in Figure 1.

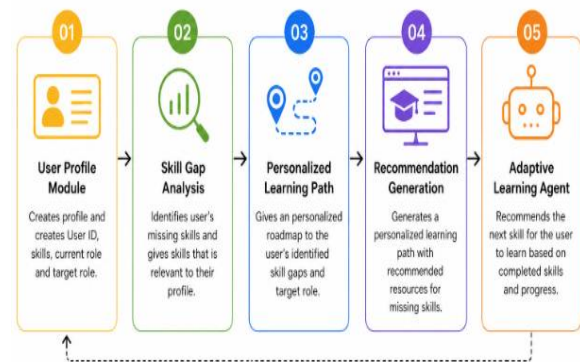


Fig. 1: System Architecture

A. User Profile Module

The initial stage of the proposed system involves collecting user information through an interactive platform interface. The system gathers important details such as educational background, existing technical skills, career interests, current role, and target job role from the user. Since users may have different learning requirements and career objectives, accurate data collection is essential for generating personalized learning support. The collected information is organized and stored securely in the database for further analysis and recommendation generation. User profiles are then processed to identify individual learning preferences and workforce-related requirements. This stage helps the system understand user competencies and provides the foundation for adaptive learning guidance and skill gap analysis. By maintaining structured user data, the platform ensures effective personalization and supports efficient career-oriented learning recommendations.

B. Skill Gap Analysis

After collecting user information, the system performs skill gap analysis to identify the difference between the user's existing skills and the competencies required for the selected career role. The collected profile data is compared with predefined industry-relevant skill requirements stored in the system database. This analysis helps identify missing technical skills, learning areas, and competencies that require improvement for achieving workforce readiness. The system organizes the identified skill gaps into a structured format to support effective recommendation generation and personalized learning guidance. Priority is given to the most relevant and industry-oriented skills to improve learning efficiency and career preparation. This process helps users clearly understand the areas that require additional learning and supports the generation of personalized educational pathways for career-oriented development.

C. Personalized Learning Path Generation

During this stage, the system generates personalized learning pathways based on the identified skill gaps and user career objectives. The platform focuses on creating structured and career-oriented learning roadmaps that guide users from foundational concepts to advanced technical skills. Learning recommendations are organized according to user competency levels, industry requirements, and target job roles. The generated learning paths help users focus on relevant educational content while avoiding unnecessary learning materials. This stage is important in improving learning efficiency because it provides a clear and systematic approach for skill development and career preparation. The personalized roadmap also helps users track their progress effectively and supports continuous learning through structured educational guidance.

D. Recommendation Generation

The recommendation generation stage is responsible for providing personalized learning suggestions according to the identified skill gaps and user career objectives. The system analyzes user profiles, existing competencies, learning interests, and target job roles to recommend suitable courses, certifications, projects, and technical learning resources. Recommendation mechanisms are used to match user requirements with industry-relevant educational content and structured learning pathways. The generated recommendations help users focus on the most important skills required for workforce readiness and career development. This stage improves learning efficiency by reducing irrelevant educational content and providing targeted learning support. The recommendation module also supports continuous learning progression by dynamically updating suggestions based on completed skills and user performance.

F. Adaptive Learning Agent

The adaptive learning agent is integrated into the system to provide continuous and personalized learning guidance for users throughout the educational process. The system continuously monitors user progress, completed skills, learning activities, and recommendation history to determine the next suitable skill for development. Based on user performance and career objectives, the adaptive agent dynamically updates learning recommendations and adjusts personalized learning pathways accordingly. The system is capable of identifying changes in learning progression and providing adaptive guidance that

supports continuous skill improvement and workforce readiness. This stage improves user engagement and learning continuity by ensuring that users receive relevant educational support at every stage of their learning journey. The adaptive learning agent also helps maintain structured learning progression and enhances the overall effectiveness of the personalized learning platform.

IV. RESULT AND DISCUSSION

The proposed AI-powered agentic learning and workforce relevance platform was evaluated using multiple user profiles collected from users with different educational backgrounds, technical skills, current roles, and career objectives to ensure diversity in learning requirements and workforce expectations. The collected records included information related to user competencies, target job roles, learning interests, completed skills, and progress tracking, which enabled complete evaluation of the adaptive learning framework. A structured evaluation approach was followed to analyze the performance of the User Profile Module, Skill Gap Analysis, Personalized Learning Path, Recommendation Generation, and Adaptive Learning Agent. System performance was evaluated using metrics such as recommendation relevance, adaptive guidance efficiency, learning path consistency, and user progress tracking accuracy, which provided a detailed analysis of the effectiveness of the platform. The proposed system demonstrated efficient personalization capability and reliable adaptive learning support across different user profiles and workforce-oriented learning scenarios.

The evaluation results show that the proposed platform was able to generate accurate and personalized learning recommendations with high effectiveness across different user profiles and career objectives. The system successfully identified missing competencies and generated structured learning pathways according to workforce requirements and user learning needs. This improved performance can be attributed to the integration of skill gap analysis, adaptive learning guidance, recommendation generation, and personalized educational support within a unified framework. The recommendation process maintained high relevance while reducing unnecessary learning content, and the adaptive learning agent consistently

provided suitable next-skill suggestions based on completed learning activities and user progress. These observations confirm that the proposed framework can serve as a reliable and efficient solution for personalized learning, workforce readiness, and career-oriented skill development.

In Table 1, the performance evaluation of the proposed system modules under different personalized learning and workforce-oriented educational scenarios. According to the obtained results, the framework achieved consistently high performance across all modules, indicating effective adaptive learning support and recommendation generation. The Skill Gap Analysis and Adaptive Learning Agent modules achieved comparatively higher performance because of their ability to accurately identify missing competencies and continuously recommend suitable learning objectives according to user progress. The User Profile Module showed slightly lower performance compared to the other modules due to variations in user-provided information and learning preferences, which is common in real-world educational environments. Nevertheless, the overall system performance remained highly satisfactory, demonstrating the effectiveness of the proposed framework in providing personalized learning guidance and workforce-oriented educational support.

Table 1: Comparison of Existing Learning Platforms and Systems

System	Personalization	Skill Gap Analysis	Progress Tracking
Coursera / edX	Partial	No	Basic
LinkedIn Learning	Moderate	Limited	Moderate
Traditional LMS	None	No	Basic
Proposed Platform	High	Yes (Full)	Comprehensive

Table 2: Skill Gap Analysis Results

User Role	Existing Skills	Missing Skills	Recommended Skill Area
Student	Basic Programming	Python, SQL	Programming Fundamentals
Data Analyst Aspirant	Excel, Statistics	Power BI, Machine Learning	Data Analytics
Web Developer Aspirant	HTML, CSS	JavaScript, React	Full Stack Development
AI Engineer Aspirant	Python Basics	Deep Learning, NLP	Artificial Intelligence

Figure 2 illustrates the improvement in personalized learning progression and recommendation efficiency achieved by the proposed adaptive learning platform during system evaluation. The graph shows a gradual increase in recommendation relevance and learning performance as the system continuously analyzes user progress, completed skills, and workforce-oriented learning requirements. The adaptive learning mechanism dynamically updates educational suggestions according to user competency levels and career objectives, which helps maintain consistent learning progression throughout the educational process. The close relationship between learning progression and recommendation accuracy indicates that the system effectively supports personalized learning and workforce-oriented skill development across different user profiles.



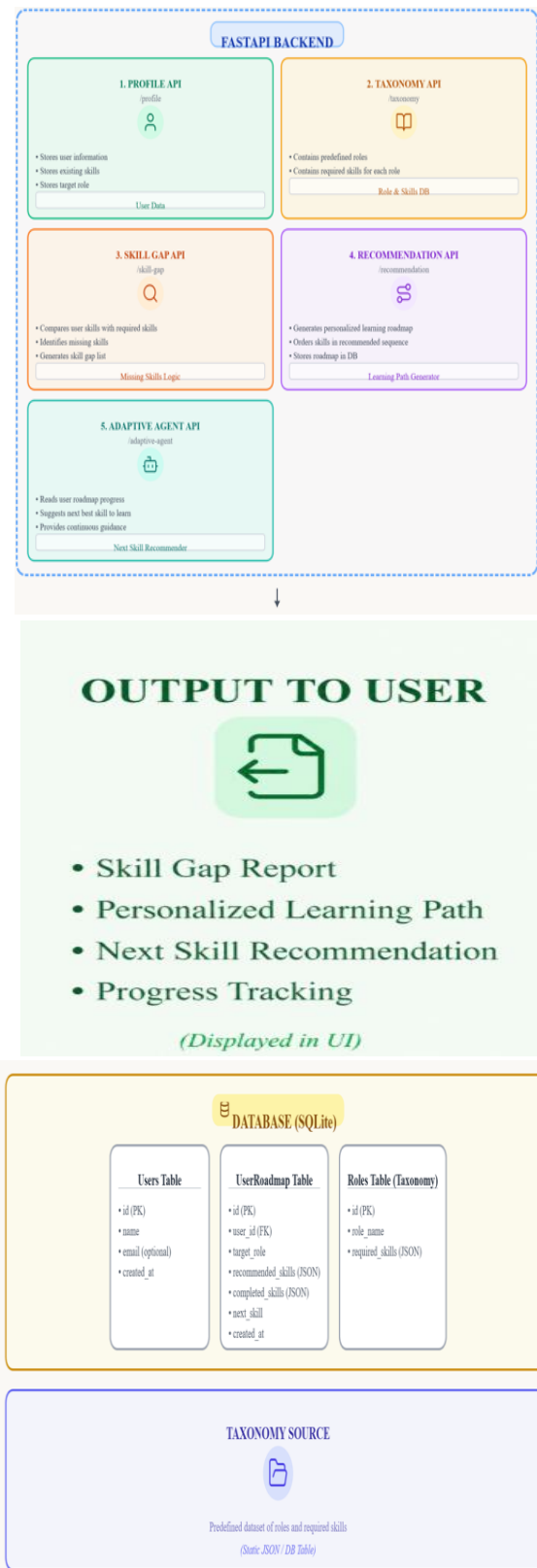


Figure 3 illustrates the overall architecture of the proposed AI-powered adaptive learning and workforce

relevance platform. The system begins with the User Interface module, where users enter their existing skills, select their target role, view identified skill gaps, access personalized learning pathways, and receive next-skill recommendations. This interface acts as the interaction layer between the user and the adaptive learning platform, enabling smooth communication and personalized educational support.

The core processing of the framework is handled through the FastAPI backend, which contains multiple interconnected APIs responsible for different platform functionalities.

The Profile API stores user information, existing skills, and target roles for further analysis. The Taxonomy API maintains predefined career roles and required industry-related skills stored within the database. The Skill Gap API compares user competencies with required workforce skills and identifies missing competencies that require improvement. The Recommendation API generates personalized learning pathways and organizes recommended educational resources according to user career objectives. The Adaptive Agent API continuously monitors user learning progress and recommends the next suitable skill based on completed learning activities and competency progression.

the database architecture used in the proposed framework. The database consists of multiple tables for storing user information, generated learning roadmaps, recommended skills, completed learning activities, and predefined workforce-related roles. The Users Table stores user identification details and profile information, while the User Roadmap Table maintains personalized learning recommendations, completed skills, and next-skill suggestions. The Roles Table stores predefined career roles and required competencies used for skill gap analysis and recommendation generation. The taxonomy source acts as the predefined dataset containing workforce-related skills and career role mappings used throughout the recommendation process. The output generated by the proposed adaptive learning platform. After processing user information and skill analysis, the system generates detailed outputs including skill gap reports, personalized learning pathways, next-skill recommendations, and progress tracking information. These outputs help users clearly understand their current competency levels, identify missing skills, and follow structured learning guidance according to

workforce requirements and career objectives. The generated recommendations continuously update according to user progress and completed learning activities, thereby improving personalized learning experiences and career-oriented educational support. The proposed framework introduces an effective approach for providing personalized and workforce-oriented learning guidance through the integration of adaptive learning technologies, recommendation systems, and skill gap analysis. The system combines user profile analysis, learning pathway generation, recommendation processing, adaptive guidance, and progress tracking within a unified architecture capable of supporting structured and career-focused learning experiences. The developed framework improves learning efficiency by reducing unnecessary educational content and continuously guiding users according to workforce requirements and completed skills. The adaptive learning mechanism and recommendation generation process enhance user engagement and support efficient career-oriented skill development. The proposed platform demonstrates significant potential for real-world educational and workforce-oriented applications, particularly in personalized learning environments and career preparation systems. Future improvements may include integration of advanced artificial intelligence models, real-time workforce analytics, intelligent chatbot support, and explainable recommendation systems for improving recommendation accuracy and adaptive learning performance. Additional enhancements such as scalable cloud deployment, real-time progress monitoring, and support for broader educational domains can further improve the effectiveness and usability of the proposed adaptive learning framework in modern intelligent educational systems.

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