SkillMorph: An AI-Powered Personalized Learning Roadmap Generation Platform

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Abstract - Artificial Intelligence has been rapidly being integrated into various fields and domains over the last few years and the educational domain is no different. The traditional learning methods fail to take into account the learners' capabilities and time they can invest in learning. The aim of SkillMorph is to integrate Artificial Intelligence into the learning process and enhance the skill development in learners. The study suggests that Artificial Intelligence can bridge the gap that the absence of a dedicated mentor leaves in an online learning environment. Existing applications are either Massive Open Online Courses or Static Roadmaps. Initial evaluations display that SkillMorph can generate learning paths tailored to individual skill levels, time constraints, and learning preferences.

Key Words: AI integrated learning, education technology, learning pathways, online learning

1.INTRODUCTION

Today, the education and technological development sector faces big hurdles, with technology evolving at a rapid pace. Acquiring skills continuously to remain competitive in the workforce has become necessary for individuals. Traditional models provide fixed curriculum and uniform pacing, so as to accommodate all types of students. This fails to take into account the learning speed and goals of individual students. A look at historical data shows that learners' performance increased in 59 percent of studies, and engagement increased in 36 percent with adaptive and personalized learning [1].

The need for personalized learning is felt as learners are required to learn continuously increasing amounts of skills with finite time [2]. As Artificial Intelligence and large language models are integrated in more and more fields, it is not a surprise that it has started being used in the field of education too [3]. AI can not only make the learning process adaptive but also dynamic and hence help in the process of personalized learning.

Creating truly personalized learning experiences at a scale in a traditional model remains challenging due to; assessment complexity, resource curation, path adaptation and scalability limitations. SkillMorph is designed to address these problems by leveraging Google's Gemini large language model to automate skill assessment, path generation with curated resources and tracking learner's progress.

The rest of the paper is organized as follows: The Literature Review section explores existing work and research in personalized learning and highlighting gaps addressed by this research. The Methodology section the technology stack used, database implementation, evaluation and path generation algorithms. The Results and Discussion section details the qualitative result and compares the project with products already existing in the market, followed by an analysis of their key implications. And lastly, the Conclusion section discusses limitations and future scope of the project.

2. LITERATURE REVIEW

This section analyzes the related works in the field of personalized education and AI-driven education.

A. Adaptive Learning Platforms

Research on adaptive learning platforms has been done extensively over the past two decades. Systems like ALEKS (Assessment and Learning in Knowledge Spaces) use the concept of knowledge space to model a learner's understanding. Other platforms such as Khan Academy use data driven approaches to recommend content. Most of these platforms, however, focus on content delivery adaptation rather than generating a comprehensive pathway.

B. Application of AI in Education Technology

AI is used in the field of education for purposes other than learning too. It can be used for grading essays and generating questions for assessments [4][5]. Use of Natural Language Processing makes these processes easier. Models like GPT-4, Claude and Gemini can not only summarize educational concepts but also generate questions and evaluate open ended responses. Machine Learning techniques like clustering and filtering are used for course recommendation systems. These recommendation systems, however, require large amounts of historical data and struggle with cold start problems

C. Static Roadmaps

Platforms like roadmap.sh provide pre-defined learning paths for various skills but lack personalization for learners. Some recent works also explore using LLMs for curriculum design, but few systems integrate assessment, generation, and progress tracking in a unified platform.

D. Dynamic Assessment Models

Opposite of the traditional static models, in which a test or evaluation only tests the knowledge or level of a learner at that moment, Dynamic Assessment Models change the evaluation based on a learners' answer and capabilities. For example, if the learner gives a correct answer, the model asks a harder question and if the learner gives a wrong answer, the next question is easier. A paper published in 2025 claimed that dynamic assessments and personalized learning improved performance in learners by 25%, in comparison the traditional methods improved performance by 14% [6]. However, this was only an experimental study and focused more on assessment rather than personalized path generation.

SkillMorph addresses these gaps by providing personalized roadmap generation with continuous progress tracking and initial assessment

3. METHODOLOGY

This section includes the technology stack used, database implementation, evaluation and path generation algorithms.

A. Overview

SkillMorph uses a multi-layered architecture, separating tasks into presentation, application and data layers. Figure 1 illustrates the architecture.
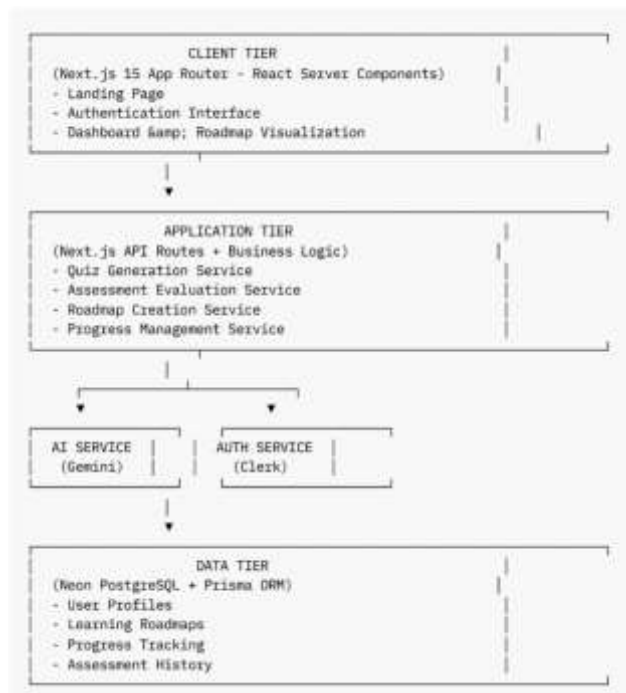

Fig -1: Architecture of SkillMorph

B. Technology Stack

The Frontend framework used is Next.js with App Router [7]. It enables server-side rendering, automatic code splitting, and optimized performance. Google Gemini API is leveraged for Quiz generation for initial skill assessment and roadmap creation [8]. Clerk is used for authentication as it provides social logins and session management [9]. For database

services Neon PostgreSQL and for styling Tailwind CSS is used [10][11].

C. Database Schema

Skill Morph uses a relational database schema with four primary entities, illustrated in Figure 2.
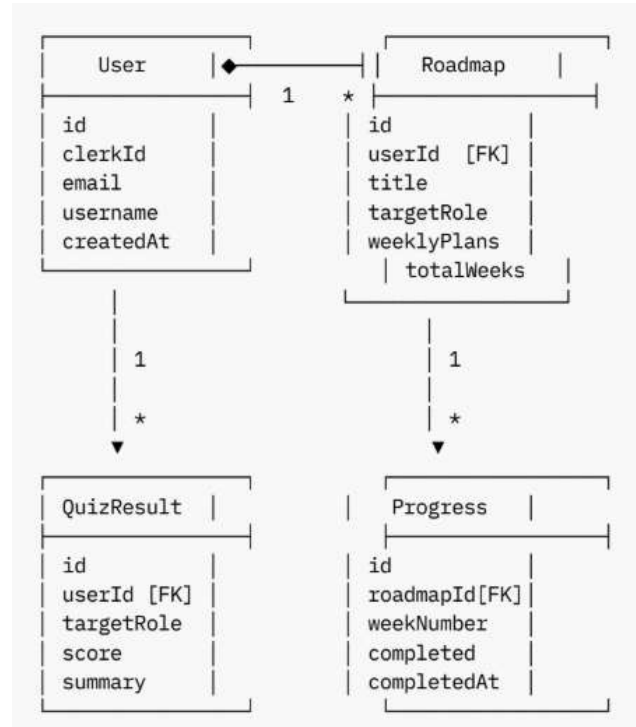

Fig -2: Schema of SkillMorph database

D. Skill Assessment

To assess a learner's skill, a three-step process is used.
1. Quiz Generation
2. Evaluating the learner's answers
3. Skill Gap Evaluation

E. Roadmap Generation Algorithm

The algorithm used for roadmap generation is;

Fig -3: Algorithm used in SkillMorph

4. RESULTS AND DISCUSSION

We conducted an evaluation with 15 participants of varying skill levels (beginner, intermediate and advanced) targeting various roles and skills. The qualitative results showed high user satisfaction and roadmaps being highly relevant on average.

A. Comparisons with existing products

Feature	SkillMorph	Khan Academy	Coursera	roadmap.sh
Personalized Assessment	✓	✗	Partial	✗
Custom Roadmap	✓	✗	✗	✗
Progress Tracking	✓	✓	✓	✗
Resource Curation	✓	✓	✓	✓
Time Adaptation	✓	✗	✗	✗
Style Preference	✓	✗	✗	✗

Fig -4: Comparison of existing products

B. Technical Performance

- Average quiz generation time: 3.2 seconds
- Average roadmap generation time: 8.7 seconds

C. Implications

The implications of SkillMorph are;

- Reduced barrier to personalized learning for those who don't have a personal mentor or instructor.
- Professionals can continuously upskill throughout their careers AI curation reduces time spent searching for appropriate learning materials

5. CONCLUSION AND FUTURE SCOPE

A. Limitations

- Multiple-choice quizzes provide limited insight into practical skills. Future versions can include coding challenges.
- AI-curated resources may include outdated materials. User feedback mechanism can improve accuracy.
- Self-reported learning preferences may not reflect optimal approaches. Adaptive systems that adjust based on engagement data will improve outcomes.
- Currently English-only, for accessibility, multi-lingual support can be added.

B. Future Scope

- Dynamic roadmap adjustment based on progress.
- Incorporate coding challenges, peer evaluations, forums and study groups
- Native iOS and Android apps for offline access layers.

This paper presented SkillMorph, an AI-powered platform for generating personalized learning roadmaps. By combining automated skill assessment, intelligent path generation, and progress tracking, it addresses key limitations of traditional educational models. SkillMorph's modular architecture and open design enables future enhancements and research directions.

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