

# Delta AI: Tailored Learning, Empowered by Adaptation

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**Abstract.** This paper presents Delta AI, a data-driven, adaptive learning platform designed to personalize educational experiences using artificial intelligence. The system integrates machine learning algorithms with web-based technologies to assess individual learning patterns and deliver customized academic content. Delta AI leverages Firebase for secure authentication and Supabase for scalable data storage, enabling real-time performance tracking and personalized content recommendations. The platform also addresses key ethical considerations such as bias, transparency, and data privacy. By bridging the gap between traditional instruction and personalized digital learning, Delta AI contributes to the evolution of educational technology and learner engagement strategies.

**Keywords:** Artificial Intelligence, Adaptive Learning, Educational Technology, Firebase, Machine Learning, Personalized Education, Supabase, Student Analytics, Web Application Development.

## 1 Introduction

The transformation of traditional education through artificial intelligence (AI) has unlocked new pathways for customized, student-centric learning. With increasing demand for interactive, flexible, and personalized education, AI-driven solutions are gaining traction among students and institutions alike. Delta AI, a fully adaptive and intelligent web-based platform, aims to bridge the gap between standardized instruction and personalized needs by utilizing machine learning models to offer tailored learning experiences. The platform focuses on improving student engagement, learning efficiency, and academic outcomes.

Originally designed as a mobile app, Delta AI is currently undergoing a transition to a web application to ensure broader accessibility, scalability, and integration with learning management systems (LMS). This paper presents a comprehensive study on the theoretical design of Delta AI, supported by literature, system modelling, and user-centered survey data.

## **2 Related Work**

### **2.1 Li et al. (2024) – Generative AI for Customized Learning Paths**

Li and colleagues [1] focus on using generative AI to tailor learning paths that adapt dynamically to student progress. Their approach reflects the importance of flexibility in modern education. Similar to their model, Delta AI adapts learning content in real time, ensuring each learner progresses at a comfortable pace.

### **2.2 Bangkit et al. (2023) – Learning Style Classification with SVM**

This study [2] applies SVM to classify learners based on the Felder-Silverman learning style model. The results support the idea that understanding a student's style helps tailor content more effectively. Delta AI uses this concept at its core, automatically adjusting delivery format and difficulty level depending on the user profile.

### **2.3 El-Sabagh (2021) – Learning Styles and Student Engagement in Adaptive e-Learning**

El Sabagh research (2021) [3] showcased their test regarding “the effect of adaptive e-learning on student interaction”, their finding showcased that utilizing adaptive e-learning resulted in more excitement, motivation, engagement, and improved understanding about the course than the students in a normal e-learning environment.

### **2.4 Gligorea et al. (2023) – AI-Driven Adaptive Learning: A Systematic Literature Review**

An article (Gligorea et al., 2023) [4] stated that the way to measure e-learning efficiency is through the extent of which the students are able to pick up the knowledge online. This solidifies the must to have an adaptable platform for education to build a variety of activities with different learning strategies to enable students to receive personalized content that increases their engagement and retainment of the knowledge.

### **2.5 Misra et al. (2023) – AI Trends in Education**

Misra et al. [5] provide a big-picture view of where AI in education is heading. Their mapping identifies behaviour tracking, real-time adaptation, and NLP as key areas of growth. These insights echo Delta AI's own design, especially in how it uses Hugging Face NLP to generate assessments tailored to the learner's current needs.

## **3 System Concept and Design**

Delta AI's system design revolves around modularity, scalability, and responsiveness. It integrates various open-source technologies and frameworks to support real-time adaptation to individual learner needs. The architecture connects user interactions, machine learning models, and database systems into a seamless feedback loop. The following sections explain the architecture, data flow, and AI model workflow that together enable Delta AI to deliver a fully personalized experience.

### 3.1 Architecture Overview

The system is designed using a scalable tech stack:

- Frontend: Next.js for optimized loading and seamless UI.
- Backend: FastAPI for efficient request handling.
- Database: Supabase (PostgreSQL) for structured, scalable storage.
- Authentication: Firebase Authentication for user roles and security.
- AI Layer: TensorFlow, PyTorch, and Hugging Face for machine learning models.

Hosting is split between Vercel (frontend) and Render (backend) to leverage zero-cost, high-performance deployment models.

The overall architectural interaction between components is visualized in Figure 1, depicting how the user communicates with the system layers—frontend, backend, and AI services. This modular structure enables real-time personalization based on learner behaviour and supports scalable deployment.

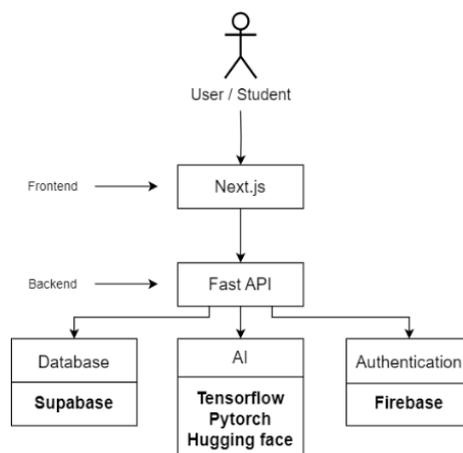
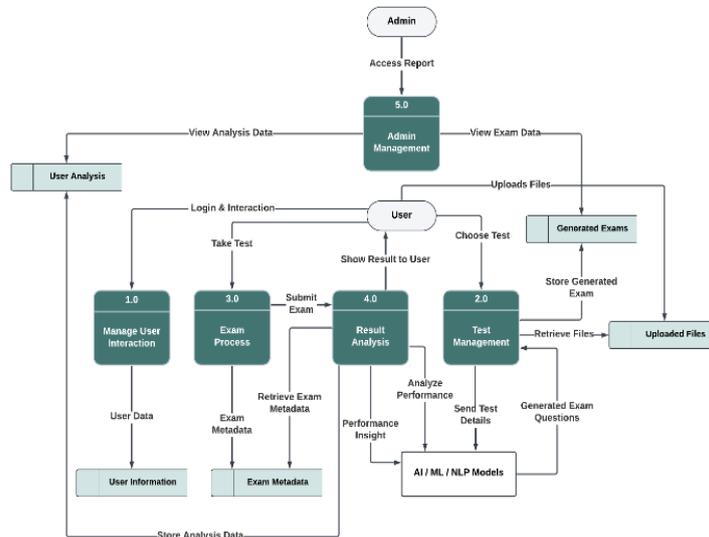


Fig. 1. Delta AI – Adaptive Web Application Architecture Overview.

### 3.2 Data Flow and UX Logic

The effectiveness of an adaptive learning system depends on how well it can process and respond to real-time user data. In Delta AI, data flow is designed to be minimal yet highly responsive, allowing the system to collect learner inputs, analyse them, and generate meaningful feedback instantly. This section outlines the step-by-step process that governs how data moves through the system, from the moment a student logs in to the point they receive personalized content.



**Fig. 2.** Delta AI – Data Flow and UX Logic Diagram.

1. User signs in via Firebase Authentication.
2. Learning preferences and quiz responses are submitted to the backend.
3. FastAPI routes data to ML modules.
4. Supabase stores learner profile, performance, and style classification.
5. Personalized content and progress feedback is delivered back through the frontend.

### 3.3 ML Model Workflow

Delta AI’s intelligence layer is powered by machine learning models that classify learners and adapt the content accordingly. These models are built to interpret behavioural and quiz response data, identify learning styles, and fine-tune the learning environment to match user needs. This section outlines the internal logic that drives these ML features, with a focus on classification and dynamic content generation.

- SVM model classifies users into learning styles (Visual, Auditory, Reading/Writing, Kinesthetic).
- Recommendation engine personalizes study material.
- TensorFlow evaluates real-time engagement and generates adaptive quiz content.

## 4 Research Methodology

### 4.1 Survey Design

A structured survey was developed targeting students aged 18 to 35. Questions were designed to assess preferences for AI learning features, adaptability, and system usability.

### 4.2 Analysis Tools

Survey responses were collected via Google Forms and visualized using Microsoft Power BI. Mean rating scores for AI features were calculated per age group.

## 5 Results and Analysis

The following section presents findings from the user-centered survey and feature analysis conducted as part of the Delta AI study. The goal was to evaluate which AI-powered features users find most useful, understand the dominant learning styles among participants, and gauge interest in the adoption of Delta AI as a learning tool. The three visuals below correspond to this evaluation, offering a clear summary of the data collected.

### 5.1 Participant Demographics

**Table 1.** Participant Demographics.

Category	Option	Count	Percentage
Age Group	18 - 22	11	57.9%
	23 - 27	7	36.8%
	28 - 35	1	5.3%
Field of Study	Arts / Humanities	3	15.8%
	Business / Management	4	21.1%
	Computer Science / IT	10	52.6%
	Engineering	2	10.5%

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## 5.2 Feature Preferences by Age Group (Matrix Visualization)

Feature	18 - 22	23 - 27	28 - 35	Total
Visual explanations, videos, or interactive elements	4.55	4.57	5.00	4.58
Personalized study plans based on my learning style	4.09	4.43	4.00	4.21
Gamified learning experience (badges, rewards, levels)	4.55	4.00	5.00	4.37
Content recommendations based on my past performance	4.18	4.00	3.00	4.05
AI-based chatbot for learning support or clarification	4.18	4.14	2.00	4.05
Ability to switch between visual, verbal, or hands-on formats	4.45	4.43	4.00	4.42
Real-time progress tracking and insights	3.91	4.14	4.00	4.00
AI-generated quizzes that adapt to my weak areas	4.18	4.43	3.00	4.21
<b>Total</b>	<b>4.26</b>	<b>4.27</b>	<b>3.75</b>	<b>4.24</b>

**Fig. 3.** Average rating of Delta AI features across different age groups.

Most favoured features:

- Visual explanations and interactive elements (4.58 average)
- Gamified experience (4.37)
- Adaptive format switching (4.42).

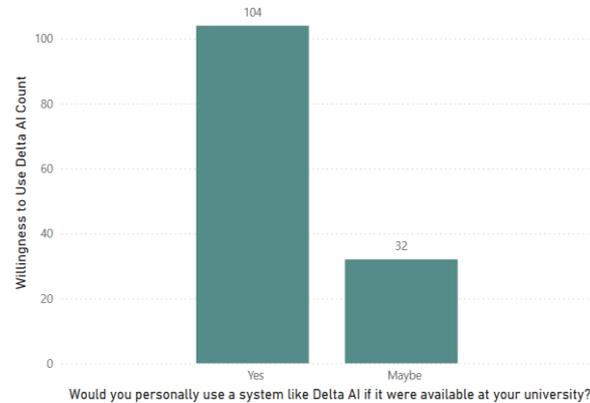
## 5.3 Learning Style Breakdown



**Fig. 4.** Distribution of preferred learning styles (Visual vs Verbal) among participants.

As showcased in the pie chart, 89.47% of students understand concepts better via visual methods.

## 5.4 Adoption Intent



**Fig. 5.** Student willingness to use Delta AI if available in their institution.

- 104 respondents would personally use Delta AI if offered.
- Strong user interest suggests feasibility and market demand.

## 6 Discussion

The data confirms a high demand for personalized, visual-first learning tools. Delta AI's architecture meets this need by combining SVM-based profiling with real-time adaptation. Students across age groups found features like AI-generated quizzes and visual modules highly useful. The system also prioritizes cost-effectiveness using open-source and freemium services. Its modular design supports future upgrades like peer-to-peer learning or instructor analytics.

## 7 Conclusion and Future Work

Delta AI positions itself as a revolutionary AI-powered education platform that prioritizes personalization, scalability, and accessibility. The system's theoretical model, backed by relevant literature and survey insights, outlines a practical roadmap for development. Future work includes prototyping and integration of additional ML features such as automatic content summarization, collaborative learning tools, and teacher dashboards.

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