International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 13 Issue: 11 | Nov 2026 www.irjet.net p-ISSN: 2395-0072

AI-BASED ADAPTIVE FINANCIAL LEARNING SYSTEM

[1]Mrs Vinutha K P, [2]Rachana P Gumgol, [3]Rakshitha K N, [4]Sujay Kumar Sindhe B R, [5]Pramod K S

[1]Assistant Professor, CSE Dept. Bapuji Institute of Engineering and Technology, Davangere, Karnataka, India
[2345] UG Student, Department of Computer Science and Engineering, Bapuji Institute of Engineering and Technology, Davangere, Karnataka, India

---

Abstract - *Financial literacy is important for making informed financial decisions, yet many students struggle to understand financial concepts and investment options. This paper presents FinLearn AI, an AI-based adaptive financial learning system that combines concept learning with practical simulations across four domains: Investment, Post Office Savings Schemes, Stocks and Bank Fixed Deposits. The system uses Google Gemini API for AI-generated lessons and quizzes, keyword-based Retrieval-Augmented Generation (RAG) for relevant information retrieval, and rule-based adaptation to adjust learning difficulty based on quiz performance. It also incorporates financial data sources such as AMFI NAV and Twelve Data. Developed using React, FastAPI, Python and SQLite, the system aims to make financial education interactive, accessible and practical.*

Key Words: Financial literacy, adaptive learning, Gemini API, retrieval-augmented generation, personalized learning, quiz generation.

1. INTRODUCTION

Financial literacy plays an important role in helping individuals make informed decisions about saving, investing and managing money. However, many students and beginners lack practical knowledge of financial products such as mutual funds, stocks, Post Office savings schemes and Bank Fixed Deposits. Traditional learning methods often provide theoretical information without personalized guidance or practical experience.

To overcome these challenges, FinLearn AI – An AI-Based Adaptive Financial Learning System is developed to provide interactive financial education through AI-generated concept learning and practical simulations. The system covers four financial domains: Investment, Post Office Savings Schemes, Stocks and Bank Fixed Deposits. It uses Google Gemini for lesson and quiz generation, keyword-based RAG for information retrieval, and a rule-based adaptive mechanism to adjust learning difficulty based on user performance.

The platform also provides financial simulations to help users understand investment growth, interest calculations, maturity values and stock market profit or loss. By combining theoretical knowledge with practical learning, FinLearn AI aims to improve financial awareness and make financial education more accessible and engaging.

1.1 Motivation

The motivation behind developing FinLearn AI comes from the lack of practical financial knowledge among students and beginners. Many people are aware of saving and investing but find it difficult to understand financial products, interest calculations, market changes and investment risks. Existing learning resources often focus on theoretical explanations and may not provide personalized learning or hands-on experience.

This project aims to make financial education easier to understand by combining AI-based concept learning with practical simulations. It allows users to explore different financial domains, test their knowledge through quizzes and understand financial calculations using real-world examples. The main motivation is to help beginners develop financial awareness and make better-informed financial decisions through an interactive learning environment.

2. PROBLEM STATEMENT AND OBJECTIVES

Traditional financial education provides generalized information without considering individual learning needs. Users often find financial concepts difficult to understand and apply in real-life situations. There is a lack of personalized learning paths based on users' interests and financial goals. Existing platforms provide limited interactive and visual learning experiences. Users also lack continuous guidance based on their learning progress and performance. Therefore, there is a need for an AI-based personalized financial learning system that makes financial education simple, interactive, and adaptive.

- To design a personalized financial learning platform based on users' financial profiles, goals, interests, and risk preferences.
- To develop an adaptive learning system that analyzes users' progress and performance to provide personalized learning recommendations and AI-based financial assistance.
- To implement interactive financial visualizations, comparisons, and simulations to improve users' understanding of financial concepts and practical financial decision-making.

3. RELATED WORK AND RESEARCH GAP

Several researchers have explored artificial intelligence and adaptive learning to improve the educational experience. Kabudi et al. [1] reviewed AI-enabled adaptive learning systems and discussed how artificial intelligence can support personalized learning based on students' needs and performance.

Wang et al. [2] studied learner models in adaptive e-learning systems and highlighted the importance of understanding students' knowledge levels to provide suitable learning experiences.

Li et al. [3] examined the use of Retrieval-Augmented Generation (RAG) in educational applications. Their study explained how retrieving relevant information before generating responses can support more reliable AI-based learning.

Chamberland et al. [4] investigated the relationship between financial literacy and performance in a financial simulation game, showing the importance of practical activities in financial education.

3.1 Research Gap

Existing research explores adaptive learning, AI-generated educational content and financial simulations as separate approaches. However, there is scope to combine these approaches into a single financial learning platform.

FinLearn AI addresses this need by integrating AI-generated lessons, quiz-based performance evaluation and adaptive difficulty adjustment with practical simulations across four financial domains: Investment, Post Office Savings Schemes, Stocks and Bank Fixed Deposits. This approach connects theoretical financial knowledge with practical financial calculations in one learning environment.

4. SCOPE AND METHOD

FinLearn AI focuses on improving financial knowledge through AI-based learning and practical simulations. The system covers four major financial domains: Investment, Post Office Savings Schemes, Stocks and Bank Fixed Deposits. Users can explore financial concepts, receive AI-generated explanations, attempt quizzes and improve their understanding through performance-based difficulty adjustment.

The platform also provides simulations to estimate investment growth, savings-scheme maturity, stock profit or loss and Fixed Deposit returns. It uses financial data sources such as AMFI NAV and Twelve Data, along with official government and bank information sources. The system is intended for students, beginners and individuals who want to improve their financial awareness without making actual financial investments.

4.1 DEVELOPMENT PROCEDURES

- Requirement Analysis: Identify user needs and select four financial domains: Investment, Post Office Savings Schemes, Stocks and Bank Fixed Deposits.
- Frontend Development: Develop the user interface using React.js, Vite and JavaScript for interactive learning and simulations.
- Backend Development: Use Python and FastAPI to manage application logic, user requests, calculations and API communication.
- AI Integration: Integrate Google Gemini API (Gemini 2.5 Flash) for generating financial lessons and multiple-choice questions.
- Knowledge Retrieval and Adaptive Learning: Implement keyword-based RAG to retrieve relevant financial information and a rule-based mechanism to adjust learning difficulty based on quiz scores.
- Financial Simulation Development: Develop four simulation modules to estimate investment growth, Post Office scheme maturity, stock profit or loss and Fixed Deposit returns.
- Database and API Integration: Use SQLite and SQLAlchemy for data management, along with AMFI NAV, Twelve Data and official financial information sources.
- Testing and Validation: Test the learning modules, AI-generated content, quiz evaluation, financial calculations and external data connections to improve system reliability.

5. PROPOSED SYSTEM AND FUNCTIONAL MODULES

FinLearn AI separates user interaction from backend processing. The learner chooses a domain and topic; the backend retrieves context, selects a difficulty instruction, requests structured content from Gemini, and returns the result for display. The four domains provide different introductory concepts while sharing the same generation and adaptation workflow.

5.1 Adaptive Learning

The learner model may include selected topics, self-reported familiarity, completed lessons, quiz scores by topic, number of attempts, and requests for further explanation. A new learner has little history, so the system can begin with an introductory pathway based on selected interests and refine it as evidence accumulates. Recommendations should remain explainable and under user control.

A rule-based engine can apply prerequisite and score rules. For example, an incomplete prerequisite leads to the

prerequisite lesson; a low topic score leads to a simpler explanation and practice quiz; and a satisfactory result with completed prerequisites may lead to the next topic. A possible prototype policy is below 40% for reinforcement, 40–69% for additional practice, and 70% or above for considering progression. These thresholds are illustrative, not validated educational cut-offs, and should be calibrated through evaluation.

The recommendation process can be represented as a repeatable decision cycle: collect the learner's current topic and result, check prerequisite completion, apply the configured rule, select an eligible activity, and record the recommendation event. Recording the rule outcome makes the process easier to debug and audit. If a recommendation is unsuitable, the learner should be able to choose another topic, and the system can use that choice as an additional preference signal. The initial engine does not require a large historical dataset, unlike many data-driven personalization methods.

5.2 AI lesson and quiz generation

The backend constructs a prompt containing the selected domain, topic, retrieved passages, and target difficulty. Gemini is requested to return structured JSON for a lesson and a five-question quiz. The expected quiz structure includes answer options and the correct answer for each question. JSON formatting improves consistency for parsing but does not itself guarantee factual correctness; returned fields and answer structure should be validated before display.

5.3 Financial Learning Modules

Product information should show its source and last-updated date. Historical returns do not guarantee future performance; displayed values in screenshots establish the intended interface, not the accuracy of live data. Goal projections and asset-allocation suggestions must disclose assumptions and be labelled as scenarios rather than personalized financial advice.

Module	Visible functions and learning purpose
Mutual funds	Fund category, fund house, NAV, historical returns, CAGR, AUM, expense ratio, minimum SIP, details/charts, and paper-invest actions; supports learning about costs, performance periods, and risk.
Stocks	Company, symbol, sector, displayed price, daily movement, 52-week range, sorting/filtering, and simulated purchase; supports reading market quotations.
Post Office schemes	PPF, SSY, and SCSS details, rates, payout/compounding, tax labels, eligibility, and search/filter controls; highlights scheme-specific rules.
Bank FDs	Deposit amount, tenure, assumed rate, compounding, interest, maturity value, and inflation-aware interpretation; teaches compound interest and liquidity.
Goal planner / compare	Goal target and horizon, monthly contribution, feasibility/shortfall, allocation scenarios, and comparison of risk, liquidity, tax, and guarantees.
Virtual portfolio	5,00,000 starting virtual cash, holdings, invested capital, available cash, and simulated profit/loss; supports practice without real transactions.

6. SYSTEM ARCHITECTURE AND WORKFLOW

FinLearn AI follows a four-tier web application architecture consisting of the User Interface Layer, Backend API Layer, Application Logic Layer and Data Layer. The architecture connects the frontend, backend, AI services, database and external financial data sources to provide an integrated financial learning experience.

The User Interface Layer is developed using React.js, Vite and JavaScript. It allows users to access the dashboard, financial learning modules, quizzes, goal-planning features and virtual portfolio activities. The Backend API Layer, developed using Python and FastAPI, manages user requests, API communication, learning progress and financial operations through REST APIs.The Application Logic Layer handles the main processing activities of the system. It uses Google Gemini API for generating financial lessons and quizzes, keyword-based Retrieval-Augmented Generation (RAG) for retrieving relevant financial information, and a rule-based adaptive mechanism to adjust learning difficulty according to quiz performance. It also performs financial calculations and supports practical simulations across four domains: Investment, Post Office Savings Schemes, Stocks and Bank Fixed Deposits.

The Data Layer uses SQLite for storing application information, with SQLAlchemy ORM supporting database operations. External financial sources such as AMFI NAV, Twelve Data and official government and bank sources provide relevant financial information, depending on their integration availability.

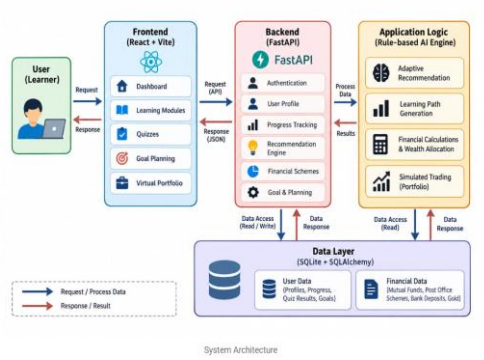

Fig: Archetecture Diagram

6.1 USER WORKFLOW

The proposed system follows a modular approach that combines AI-based concept learning with financial simulations.

1) User Input: Users select a financial domain, topic and preferred difficulty level.
2) Information Retrieval: A keyword-based retrieval technique identifies relevant passages from the local financial knowledge collection.
3) AI Content Generation: Google Gemini API is used to generate financial explanations and multiple-choice questions based on the retrieved information.
4) Performance Evaluation: The system evaluates quiz answers and calculates the user's score.
5) Adaptive Learning: A rule-based mechanism adjusts the difficulty level according to quiz performance.
6) Financial Simulation: Users enter financial values to estimate investment growth, savings maturity, stock profit or loss and FD returns.
7) Data Integration: Financial information is obtained from sources such as AMFI NAV, Twelve Data and official government and banking sources, depending on integration availability.
8) Result Display: The system displays learning content, quiz results and estimated financial outcomes through an interactive interface.

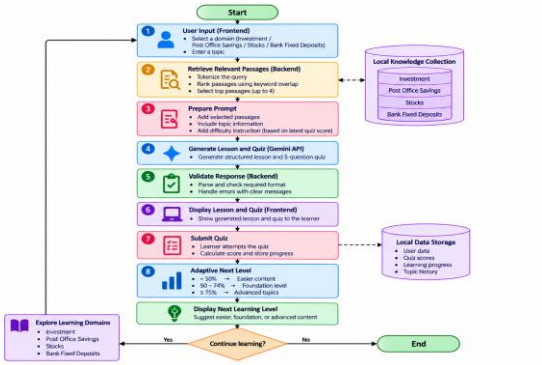

Fig : Workflow

7. TOOLS AND TECHNOLOGIES

- Frontend: React.js, Vite and JavaScript are used to develop the user interface and provide interactive learning and simulation features.
- Backend: Python and FastAPI are used to handle application logic, user requests and REST API communication.
- Backend Server: Uvicorn is used to run the FastAPI application.
- Database: SQLite is used for storing application data, while SQLAlchemy ORM manages database operations.
- Generative AI: Google Gemini API with Gemini 2.5 Flash is used for generating financial explanations and quiz questions.
- AI Architecture: Retrieval-Augmented Generation (RAG) provides relevant retrieved information as context for AI-generated responses.
- Adaptive Learning: A rule-based algorithm adjusts the learning difficulty according to quiz performance.
- Mutual Fund Data: AMFI NAV data is used to retrieve mutual fund Net Asset Value information.
- Stock Market Data: Twelve Data API is explored for retrieving stock market quotes.

8. PROPOSED EVALUATION

The proposed evaluation of FinLearn AI focuses on checking the accuracy, usability and effectiveness of the system. The concept learning module will be evaluated based on the relevance of AI-generated lessons, quiz accuracy and the system's ability to adjust learning difficulty according to the user's quiz performance. The four financial simulation modules Investment, Post Office Savings Schemes, Stocks and Bank Fixed Deposits will be tested by comparing their calculated results with standard financial formulas and expected values. The system will also be assessed for response time, ease of use and correctness of displayed information. User feedback can further help identify areas for improvement and measure whether the platform makes financial concepts easier to understand.

Available score	Difficulty	Purpose
No prior score	Beginner	Introduce basic concepts
Below 50%	Easier beginner	Simplify and reinforce
50% to below 75%	Foundation	Practice and consolidate
75% or above	Advanced	Introduce deeper topics

9. CONCLUSION AND FUTURE WORK

FinLearn AI provides an interactive approach to financial education by combining AI-based concept learning with practical financial simulations across four domains: Investment, Post Office Savings Schemes, Stocks and Bank Fixed Deposits. By using the Google Gemini API, keyword-based information retrieval and rule-based adaptive learning, the system helps users understand financial concepts through lessons, quizzes and performance-based difficulty adjustment. The simulation modules provide practical experience with financial calculations and help beginners gain a better understanding of different financial products. In the future, the system can be enhanced by introducing advanced machine learning techniques for personalized learning, integrating more reliable real-time financial data sources and adding topics such as insurance, taxation, loans and retirement planning. Multilingual support, advanced portfolio analysis, risk assessment and detailed progress reports can also be included. These improvements can make FinLearn AI more comprehensive, accessible and effective in improving financial literacy.

REFERENCES

1] T. Kabudi, I. Pappas, and D. H. Olsen, "AI-enabled adaptive learning systems: A systematic mapping of the literature," Computers and Education: Artificial Intelligence, vol. 2, 2021.

[2] X. Wang, Y. Maeda, and H. H. Chang, "Development and techniques in learner model in adaptive e-learning system: A systematic review," Computers & Education, 2024. DOI: 10.1016/j.compedu.2024.105184.

[3] Z. Li, Z. Wang, W. Wang, K. Hung, H. Xie, and F. L. Wang, "Retrieval-augmented generation for educational application: A systematic survey," Computers and Education: Artificial Intelligence, vol. 8, 2025. DOI: 10.1016/j.caeai.2025.100417.

[4] C. Chamberland, D. de Hemptinne, and S. Tremblay, "The relationship between financial literacy, self-efficacy, and performance in a financial simulation game," Acta Psychologica, vol. 266, 2026. DOI: 10.1016/j.actpsy.2026.106906.