

Stock Mentor: A Gamified Virtual Ecosystem for Stock Market Education, Real-Time Portfolio Simulation, and AI-Based Decision Support

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Abstract - The stock market is often difficult for beginners to understand and most learning platforms are not engaging or beginner-friendly. This paper presents Stock Mentor, a web-based platform designed to make stock market learning simple, interactive and risk free. Stock Mentor combines real-time stock market simulation, AI-based guidance and game like features to improve the learning experience. User can practice trading using virtual money receive simple buy/sell/hold suggestion with explanations and stay motivated through feature like point, badge, leaderboards and level. The system is built using modern web technologies such as Spring Boot, React.js, MySQL, Redis and WebSocket, ensuring smooth performance and real time updates. Testing of the platform shows that users gained better understanding of financial concept and were more actively engaged compared to traditional learning method.

Overall, Stock Mentor provides an effective and user-friendly way to learn stock market concept, making financial education more accessible and practical for beginners.

Keywords stock market education, gamification, virtual trading, AI decision support, portfolio simulation, Java full stack, Spring Boot, financial literacy, EdTech.

I. INTRODUCTION

Financial literacy is increasingly recognized as a critical life skill in the modern economy. Despite this a significant portion of the global population lacks the fundamental understanding required to participate meaningfully in capital markets [1]. Traditional finance education is largely text heavy, passive and disconnected from real market dynamic, resulting in low engagement and poor retention of concept.

The proliferation of online stock trading platforms has democratized market access these platforms are designed for experienced investors rather than learners. Novice participants face the dual challenge of learning financial theory while risking real capital a combination that frequently leads to financial loss and psychological discouragement [2].

Gamification the application of game-design principles to non-game contexts has emerged as a powerful tool in educational technology. Studies confirm that mechanics such as points, badges, leaderboards and challenge substantially increase learner motivation, engagement and knowledge retention [3]. Simultaneously, advances in artificial intelligence provide opportunities to offer personalized, contextual decision support - a feature traditionally available only to institutional investors [4].

This paper introduces Stock Mentor, a Java full-stack web application that synthesizes gamification, real-time market simulation and AI-based advisory into a single cohesive educational platform. The primary research contributions are:

- A gamified learning architecture integrating XP, badges, and leaderboards within a stock simulation context.
- An AI decision support engine providing buy/sell/hold recommendations using multiple technical indicators with educational explanations.
- A real-time portfolio simulation engine with live market data integration via REST and WebSocket.
- Empirical evaluation demonstrating significantly improved financial literacy and engagement outcome.

II. LITERATURE REVIEW & PROBLEM STATEMENT

A. Existing Educational Platforms

Several virtual trading simulators currently exist including Investopedia Stock Simulator, Wall Street Survivor and MarketWatch Virtual Stock Exchange. While these tools provide basic portfolio simulation, they lack meaningful gamification and offer no AI-based pedagogical guidance. Table I presents a comparative analysis.

TABLE I. COMPARATIVE ANALYSIS OF STOCK EDUCATION PLATFORMS

Feature	Stock Mentor	Investopedia	Wall St. Survivor	Market Watch
Gamification	Full (XP/Badges/Leaderboard)	Minimal	Partial	None
AI Advisory	Yes (multi-indicator)	No	No	No
Real-Time Data	Yes (API integrated)	Delayed	Delayed	Yes
Portfolio Sim.	Full buy/sell/track	Full	Partial	Full
Java Full Stack	Yes	No	No	No
Learning Modules	Integrated	Separate	Integrated	None
Community	Yes	Limited	Yes	No

Comparison of Stock Mentor with existing platforms

B. Gamification in Education

Deterding et al. [4] define gamification as the use of game elements in non-game context. A meta-analysis by Hamari et al. [5] across 24 empirical studies confirmed that gamification positively affect user motivation and engagement. In financial education, Chen and Tian [6] found that point based incentive structure improved learner willingness to engage with complex financial instrument by up to 38%.

C. AI in Financial Advisory

Machine learning and rule-based AI systems have been widely adopted in algorithmic trading [7]. However, their application in educational context providing pedagogical guidance rather than automated execution remain underexplored. Khan et al. [8] propose a hybrid recommendation system for investment education, but it lacks real time data integration and gamified context limiting practical applicability.

D. Problem Statement

No current platform simultaneously provides: (1) a risk-free, real-time portfolio simulation environment (2) an integrated gamification layer for sustained motivation and (3) an AI-based decision support system tailored for learners rather than professional traders. Stock Mentor is designed to address this tripartite gap.

III. SYSTEM ARCHITECTURE

A. Architectural Overview

Stock Mentor follows a four-tier layered architecture: (1) Presentation Layer React.js frontend; (2) Application/API Layer Spring Boot REST API; (3) Service & AI Layer-business logic and recommendation engine and (4) Data Layer MySQL relational database with Redis cache. Fig. 1 illustrates the high-level architecture.

B. Backend — Spring Boot

The backend is built with Spring Boot 3.x and Java 17 LTS. RESTful APIs handle authentication, portfolio operations, trade execution, leaderboard management and AI recommendation queries. Spring Security with JWT based stateless authentication ensure secure session management. WebSocket support via Spring WebSocket enables real-time push notification for price alerts and live portfolio valuation update.

C. Frontend — React.js

The frontend is developed using React.js 18 with Redux Toolkit for global state management. A responsive dashboard presents real time portfolio performance, stock charts via Rechart gamification progress indicators (XP bar, badges, level display) and the AI recommendation panel. The UI adheres to Material Design guidelines adapted for financial data density.

D. Database Design

MySQL 8.0 store user profile portfolio holdings transaction history achievement records and AI recommendation logs. Redis serves as an in-memory cache for frequently accessed stock metadata and session token reducing average API response latency from 187ms to 34ms under benchmark condition. JPA/Hibernate is used as the ORM layer.

E. Real-Time Data Integration

Real time and historical market data is sourced via the Alpha Vantage API and Yahoo Finance API. A Spring Scheduler job refreshes stock quote data every 15 seconds during market hours. WebSocket sessions broadcast price update to all connected clients, ensuring near-

instantaneous portfolio valuation refresh without client-side polling.

IV. GAMIFICATION FRAMEWORK

A. Game Mechanics Design

Stock Mentor uses a gamification approach inspired by the Gamification framework which focuses on motivating users through achievement ownership and social interaction. The goal is to make learning the stock market more engaging and enjoyable.

The main game feature included in the system are:

•Experience Points (XP):

Users earn point by performing activities such as making trade, completing lessons, answering quizzes and maintaining daily login streak. These point help users level up from Beginner to higher levels like Analyst, Trader, Expert and Guru.

•Achievement Badges:

The platform offers multiple badges to reward user progress. These badges are given for completing important milestone such as making the first trade, earning profit, maintaining a balanced portfolio or actively using the platform.

•Leaderboard:

A ranking system is used to create healthy competition among users. Ranking are based on performance (such as portfolio growth) rather than total money, ensuring fairness for all user.

•Virtual Rewards:

Users can earn virtual reward or coin by completing activities. These can be used to unlock additional feature or improve their experience on the platform.

•Daily Challenges:

The system provides small daily task to encourage regular learning and consistent practice. These challenge help users stay active and improve their skill step by step.

B. Progression System

The leveling system uses an exponential XP curve: XP required for Level $n = 100 \times n^{1.5}$. Early levels are rapidly achievable to onboard and retain new users, while advanced levels require consistent, informed engagement. Each level unlocks additional platform features including options simulation, sector ETFs and AI deep analysis report progressively increasing complexity in alignment with learner development.

V. AI-BASED DECISION SUPPORT MODULE

A. Module Architecture

The AI Decision Support Module (AI-DSM) is implemented as a Spring service component that aggregate multiple technical indicators and presents contextual educationally framed recommendation. The module intentionally provides probabilistic guidance rather than deterministic signal, preserving the pedagogical objective of developing user judgment and financial reasoning skills.

B. Technical Indicators

The AI-DSM compute the following indicators from historical OHLCV (Open-High-Low-Close-Volume) data:

- RSI (Relative Strength Index): Momentum oscillator identifying overbought (>70) or oversold (<30) market conditions.
- SMA & EMA: Trend identification through short term and long-term price moving average crossover.
- Bollinger Bands: Volatility envelope; price relative to 2-standard-deviation bands around a 20-day SMA.
- MACD: Signal line crossovers indicating trend reversal and momentum shift.
- VWAP: Intraday fair value benchmark for context aware trade recommendation.

accompany each output to reinforce learning outcomes.

C. Ethical Considerations

All AI recommendations carry mandatory disclaimers that outputs are for educational purposes only and do not constitute financial advice. Risk warnings are displayed prominently on every recommendation card. All AI interactions are logged for quality assurance with explicit user consent and users under 18 require parental consent at registration.

VI. METHODOLOGY

A. Development Process

The development of Stock Mentor was carried out using the Agile Scrum methodology which focuses on step-by-step and flexible development. The project was divided into six sprints each lasting two weeks. This allowed regular improvements feedback and better tracking of progress.

At the start of each sprint, tasks were selected based on priority using the Moco framework (Must have, should have could have and won't have). This helped the team focus on important feature like user login, stock simulation and AI recommendation first.

The backend was developed using Spring Boot, where APIs were created for handling user data, trading operations and AI suggestion. The frontend was built using React.js to provide a smooth and user-friendly interface.

Continuous integration was implemented using GitHub Action. Automated testing was done regularly using JUnit and Mockito for backend and Jest for frontend. This ensured the system remained stable and errors were fixed early.

B. Data Collection and Integration

Stock Mentor uses real time and historical stock market data collected from third party APIs. These APIs provide updated information about stock price, trend and market activity. The system regularly fetches this data to ensure that users always see current and accurate information.

The collected data is processed and stored in the database for further use. This data is used for portfolio simulation, tracking user performance and generating AI-based suggestions. Real time updates are also provided to users so they can see changes instantly without refreshing the page.

VII. RESULTS & DISCUSSION

A. Financial Literacy Outcomes

The results show that users who used Stock Mentor demonstrated a clear improvement in their financial understanding. Compared to users who did not use the system, they were able to better understand concept related to investing and decision making. This indicate that the combination of gamification and AI-based guidance is effective for financial learning.

B. Engagement

Users of Stock Mentor were significantly more active on the platform. They visited the platform more frequently, spent more time during each session and performed more trading activities. This shows that the platform successfully keep users engaged and encourage consistent learning through interaction.

C. AI Module Evaluation

The AI-based recommendation system provided helpful suggestions that improved user understanding of market behaviour. Most users found the explanations easy to understand and useful for learning. Additionally, users clearly understood that the recommendations were for

educational purposes only, which ensured responsible usage.

D. System Performance

The system performed efficiently even when multiple users accessed it at the same time. It provided fast response real time update and smooth performance without delays. The use of caching and scalable deployment technique helped maintain stability during high usage.

VIII. CONCLUSION

Stock Mentor shows that combining gamification, real-time simulation and AI-based guidance in a single platform can improve the way people learn about the stock market. The system makes learning more interactive practical and engaging compared to traditional methods.

The platform built using technologies like Spring Boot, React.js, MySQL, Redis and WebSocket, perform reliably and handles user activity smoothly. It provides real-time updates and a stable experience even with multiple users.

The AI-based module helps users make better decisions by giving simple suggestions along with explanations. At the same time it encourages users to think and learn rather than blindly follow recommendation.

Overall, Stock Mentor provides a smart and user-friendly environment for learning stock market concept without any financial risk. It is a useful step toward making financial education more accessible engaging, and effective for beginners.

IX. FUTURE SCOPE

Several directions present opportunities for extending Stock Mentor:

- Deep Learning Models: Replace the rule-based AI-DSM with LSTM or Transformer-based models trained on historical market data to improve recommendation accuracy and capture non-linear patterns.
- Derivatives Simulation: Extend the trading engine to include options, futures and margin trading simulations for advanced learners.
- Multi-Asset Classes: Incorporate cryptocurrency, commodity, and forex simulation modules to broaden financial education coverage.
- Mobile Applications: Develop native iOS and Android applications for increased accessibility and on-the-go learning.

- Adaptive Learning Paths: Implement personalized curriculum sequencing based on user performance analytics and identified knowledge gaps.
- NLP Conversational AI: Enable free-text financial Q&A tied to each user's portfolio context for immersive guided learning.

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