

AI IN PERSONALISED LEARNING

PROBLEM STATEMENT

Most digital learning platforms still rely on a “*one-size-fits-all*” model, which often fails to address the varied needs of learners. Advanced students can get bored, while struggling students may feel overwhelmed. This mismatch affects motivation and learning outcomes.

This project aims to address the problem by developing an **AI-powered adaptive learning system** that personalizes learning experiences. The system does not just deliver static content but uses machine learning to adapt in real time to a student’s performance, learning style, and engagement.

The importance of this work lies in making education more inclusive. By tailoring difficulty and feedback to individual learners, such a system could improve outcomes for both fast and slow learners. The main goal was to create a **working prototype** and evaluate its technical feasibility.

METHODOLOGY

Instead of relying on a single model, the system uses a **multi-model AI architecture** to capture different aspects of student behavior.

- **Learner Classification (Random Forest):** Identifies whether a student fits into broad categories like advanced or struggling, based on about 10 engineered features such as time taken, attempts, and accuracy.
- **Performance Prediction (Gradient Boosting):** Predicts the probability of success on upcoming questions, which helps in dynamically adjusting the difficulty.
- **Engagement Analysis (Random Forest):** Estimates whether the student is actively engaged. This model was trained on a balanced dataset to avoid unfair classification due to skewed data.

The **ASSISTments dataset** was used as the foundation. It contains real-world student interaction data, but it was quite messy, so preprocessing steps such as cleaning, handling missing values, and feature standardization were necessary.

The system was implemented in a **three-tier modular architecture**:

1. Student Interface (UI) – Built with Streamlit for quick prototyping.
2. AI Analysis Engine – Processes incoming student data.
3. Recommendation Engine – Suggests the next steps for the learner.

TOOLS & TECHNOLOGIES

- **Programming Language:** Python 3.8+
- **ML Libraries:** Scikit-learn (Random Forest, Gradient Boosting)
- **Data Processing:** Pandas, NumPy
- **UI Framework:** Streamlit (for interactive prototyping)
- **Dataset:** ASSISTments dataset

RESULTS & CONCLUSION

The models were evaluated on test data, and the results were promising:

Model	Accuracy	F1-Score (Macro)	ROC-AUC
Learner Classification	98.00%	0.9752	–
Performance Prediction	75.25%	0.7310	0.7912
Engagement Analysis	98.33%	0.9833	–

The entire pipeline runs in **under 100 ms**, which is fast enough for real-time learning applications.

However, there are some limitations:

- The dataset is restricted to one subject domain, which may limit generalizability.
- Students with unusual learning behaviors are sometimes misclassified.

- While Streamlit is suitable for demonstration, it is not optimized for production-scale deployment.

In conclusion, the project demonstrates that a **multi-model AI system can personalize learning in real time**. Despite limitations such as dataset bias and scalability issues, the prototype shows strong potential for enhancing digital education. Future improvements could include experimenting with deep learning models, integrating natural language feedback, or testing the system with real classroom users.

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