



AI-Supported Academic Performance Prediction Using Behavioral and Engagement Data

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BACKGROUND

In recent years, higher education institutions have increasingly adopted digital learning platforms, generating large volumes of student interaction data. Learning Management Systems (LMS), online assessments, and attendance tracking tools provide detailed insights into student behavior.

Despite this abundance of data, many institutions still rely on traditional evaluation methods, which often fail to identify at-risk students early. This gap highlights the need for intelligent systems that can analyze behavioral patterns and predict academic outcomes proactively.

Advances in artificial intelligence, particularly machine learning, have enabled the development of predictive models capable of identifying hidden patterns in educational data. These technologies offer the potential to enhance decision-making processes, improve student retention, and personalize learning experiences.

IDEA

This study proposes an AI-supported framework to predict student academic performance using behavioral and engagement data.

The core idea is to:

- Collect student interaction data (attendance, LMS usage, assignment submissions)
- Transform this data into meaningful features
- Apply machine learning algorithms to predict performance levels

The novelty of the approach lies in:

- Combining multiple behavioral indicators instead of relying solely on grades

- Using real-time or near real-time data for early prediction
- Enabling early intervention strategies for educators

The system aims not only to predict outcomes but also to provide actionable insights that instructors can use to support students more effectively.

IMPLEMENTATION

Data Collection

Data is gathered from:

- LMS activity logs (login frequency, time spent)
- Assignment submission records
- Attendance data
- Quiz and exam results

Data Preprocessing

- Missing data handling
- Normalization of numerical features
- Encoding categorical variables

Model Development

Several machine learning models are applied:

- Random Forest
- Support Vector Machine (SVM)
- Gradient Boosting (e.g., XGBoost)

Evaluation

Models are evaluated using:

- Accuracy
- Precision
- Recall
- F1-score

System Workflow

1. Input student behavioral data
2. Process and clean data
3. Apply trained model

4. Output predicted performance category (e.g., high, medium, low)

Expected Outcome

The system enables:

- Early identification of at-risk students
- Data-driven academic support strategies
- Improved overall student success rates

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