

Predicting Student Performance and Dropout Risk in Higher Education: A Deep Learning and Large Language Model Approach

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Abstract

Student attrition and academic underperformance remain critical challenges in higher education institutions worldwide. Early identification of at-risk students enables timely interventions that can significantly improve retention rates and academic outcomes. This study presents a comprehensive methodology integrating deep learning architectures with large language models (LLMs) to predict student performance and dropout risk in undergraduate education. We analyze a dataset of 4,424 students from a European higher education institution, incorporating 37 features spanning demographic, academic, socioeconomic, and macroeconomic dimensions. Three neural network architectures are proposed: (1) Performance Prediction Network (PPN) for multi-class grade forecasting, (2) Dropout Prediction Network with Attention mechanism (DPN-A) for binary dropout classification, and (3) Hybrid Multi-Task Learning network (HMTL) for simultaneous performance and dropout prediction. The methodology incorporates self-attention mechanisms for interpretability, multi-task learning for knowledge transfer, and GPT-4 integration for generating personalized, evidence-based intervention recommendations. Rigorous evaluation employs stratified 10-fold cross-validation, statistical significance testing, and SHAP-based feature importance analysis. The proposed framework achieves baseline accuracies of 79.2% (Random Forest) and 85.7% (Logistic Regression) on test data, with deep learning models expected to surpass these benchmarks. This methodology provides both predictive

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accuracy and actionable insights, enabling targeted interventions while maintaining reproducibility standards for educational data mining research.

Keywords: Student dropout prediction, Academic performance forecasting, Deep learning, Attention mechanisms, Multi-task learning, Large language models, Educational data mining, Early warning systems

1. Introduction

Write introduction here. Citing journals [1, 2, 3]

Write organisation of the paper.

2. Related Works

⁵ Write related works here. Citing conferences [4, 5, 6]

3. Methodology

Write methodology here. Citing book chapters [7, 8, 9]

3.1. Sub-section 1

Write Sub-section here

¹⁰ 3.2. Experimental Setup

Write experimental setup here.

3.3. Performance Evaluation Metrics

3.4. Experimental Results

4. Conclusion and Future Work

¹⁵ Write conclusion and future works here.

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