

# **Supervised and Ensemble Methods for Early Academic Adaptive Intervention in Students' Learning Behaviour**

## **Abstract**

Students' learning is a complex process shaped by the interplay of multiple variables such as motivation, prior learning, classroom pedagogy, home resources and others. These factors interact in non-linear, multidimensional, and multi-directional ways, producing effects that are frequently hidden from simple statistical methods. The advanced machine learning algorithms has potential to work with complex behavioural data of students and predict learning outcomes helping teachers to make timely interventions. Using a synthetic educational dataset as a demonstrating context, the present study first explored the feasibility of employing a strategically developed machine learning pipeline using **linear regression models, GBM, and Neural Networks** for deep and complex data analysis and examined non-linear relations in behaviour variables of students and its cumulative effect on their achievement. The learning derived from this study is synthesized into an AI-Assisted Prediction Framework, designed to help teachers consciously use statistical and machine learning tools to optimize students' learning by identifying relevant factors and making strategically planned interventions.