American Journal of Distance Education, , .

Interpretable Early-Warning Models for Student Support in Online Distance Education

J. Cifuentes Quintero; F.A. Olarte; L.K. Herrera Quintero

Abstract-

In online distance education, early disengagement can be difficult to detect because tutors and instructors have limited direct visibility of students’ learning behavior. This study examines whether weekly participation and assignment-submission records can support the early prediction of final academic status in online post-secondary technical training and transition-to-higher-education courses. It also evaluates the use of NN2Poly to provide an interpretable representation of neural network predictions for academic monitoring. The analysis used administrative and academic process data from 4,069 students enrolled in online short-cycle technical training courses. A neural network model classified students into passing, failing, and abandonment using cumulative temporal windows that progressively incorporated the information available at different stages of the course. The resulting decision functions were approximated with NN2Poly through symbolic polynomial expressions, and approximation quality was evaluated using classification fidelity and normalized logit-level RMSE. The largest improvement in predictive performance occurred after incorporating participation records from the first four weeks and assignment-submission records from the first three deliverables, identifying this period as a relevant window for early academic intervention. The neural network achieved competitive performance relative to traditional classifiers, while the NN2Poly approximation showed that assignment-submission variables increased the passing logit and reduced the failing and abandonment logits. As engagement data accumulated, the model shifted from a combination of contextual and academic-process signals towards a stronger reliance on assignment-submission indicators. These findings suggest that interpretable early-warning models can support tutor-led monitoring in online courses when predictions are used to inform rather than determine academic support decisions. By combining temporal early-warning modelling with symbolic interpretability, the study identifies when digital engagement traces become informative for intervention and provides an interpretable representation of their changing role in the neural network decision function.

Index Terms-

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Citation:
Cifuentes, J.; Olarte, F.A.; Herrera, L.K. "Interpretable Early-Warning Models for Student Support in Online Distance Education", American Journal of Distance Education, , .