IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 6, May 2025
Impact Factor: 7.67

Multivariate Engagement Analytics for Dropout Risk Prediction in Online Learning: A Novel Predictive Framework

Anant Manish Singh[1], Shifa Siraj Khan[2], Sanika Satish Lad[3], Sanika Rajan Shete[4], Disha Satyan Dahanukar[5], Darshit Sandeep Raut[6], Kaif Qureshi[7], Devesh Amlesh Rai[8]

Department of Computer Engineering[1,3,4,5,7,8]
Department of Information Technology[2]
Department of Electronics and Telecommunication Engineering[6]
Thakur College of Engineering and Technology (TCET), Mumbai, Maharashtra, India
anantsingh1302@gmail.com, shifakhan.work@gmail.com, ladsanika01@gmail.com
sanika.shetee@gmail.com, dishadahanukar@gmail.com, darshitraut@gmail.com
kaif0829@gmail.com, deveshrai162@gmail.com

Abstract: *Online learning platforms have experienced a surge in enrollment yet student dropout rates remain a persistent challenge. Existing predictive models often fall short in accurately identifying at-risk learners early enough for timely intervention. To address this, we propose a novel predictive framework that integrates temporal engagement patterns, behavioral indicators and academic performance data to detect potential dropouts in advance. Analyzing a dataset of 14,762 student records from three major online platforms, our model achieved a prediction accuracy of 87.3% significantly surpassing traditional methods. Notably, our approach uncovered previously underexplored engagement transition patterns that show strong associations with dropout likelihood. The proposed framework identified at-risk students up to 3.7 weeks earlier than conventional techniques. When applied in a real-world setting, targeted interventions guided by our model reduced dropout rates by 23.5% in the experimental group compared to the control group. This research offers a robust, interpretable solution that performs consistently across diverse course structures and student demographics, equipping educational institutions with actionable tools to improve student retention..*

Keywords: Online learning dropout prediction, multivariate engagement metrics, temporal learning patterns, educational data mining, early intervention strategies, machine learning, student retention, predictive analytics

DOI: 10.48175/568