

e-LION: Data integration semantic model to enhance predictive analytics in e-Learning

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Abstract. In the last years, Learning Management systems (LMSs) are acquiring great importance in online education, since they offer flexible integration platforms for organising a vast amount of learning resources, as well as for establishing effective communication channels between teachers and learners, at any direction. These online platforms are then attracting an increasing number of users that continuously access, download/upload resources and interact each other during their teaching/learning processes, which is even accelerating by the breakout of COVID-19. In this context, academic institutions are generating large volumes of learning-related data that can be analysed for supporting teachers in lesson, course or faculty degree planning, as well as administrations in university strategic level. However, managing such amount of data, usually coming from multiple heterogeneous sources and with attributes sometimes reflecting semantic inconsistencies, constitutes an emerging challenge, so they require common definition and integration schemes to easily fuse them, with the aim of efficiently feeding machine learning models. In this regard, semantic web technologies arise as a useful framework for the semantic integration of multi-source e-learning data, allowing the consolidation, linkage and advanced querying in a systematic way. With this motivation, the e-LION (e-Learning Integration ONtology) semantic model is proposed for the first time in this work to operate as data consolidation approach of different e-learning knowledgebases, hence leading to enrich on-top analysis. For demonstration purposes, the proposed ontological model is populated with real-world private and public data sources from different LMSs referring university courses of the Software Engineering degree of the University of Malaga (Spain) and the Open University Learning. In this regard, a set of four case studies are worked for validation, which comprise advance semantic



querying of data for feeding predictive modelling and time-series forecasting of students' interactions according to their final grades, as well as the generation of SWRL reasoning rules for student's behaviour classification. The results are promising and lead to the possible use of e-LION as ontological mediator scheme for the integration of new future semantic models in the domain of e-learning.