

Educational Data Mining: A Foundational Overview

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Educational data mining (EDM) is a novel scientific area that focuses on developing and applying methods to analyze datasets generated within educational settings. This paper outlines the evolution, significance, and applications of EDM. With the increasing popularity of e-learning in web-based educational systems, EDM has expanded to include a variety of analytical methods and data sources. Some key methodologies addressed include classification, regression analysis, clustering techniques, association rule mining, and Natural Language Processing, among others. Additionally, this paper looks at how EDM can facilitate data-driven decision-making among other areas such as curriculum development and customization of learners' experiences. It also touches on issues related to the challenges of the scientific field. Finally, some projections about EDM's future trends are made, especially concerning its integration into AI technologies and development trends like augmented reality or virtual reality, which imply greater possibilities for changes than any other series witnessed before within this sphere.

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Educational data mining is a fairly new discipline that aims to develop new techniques for examining datasets obtained from the educational environment and applying these techniques in order to shed new light on students and educational settings. Over the past decades, EDM has expanded significantly, reflecting its increasing significance in the field of education. Initially, it involved the use of data mining techniques on educational data to answer some important questions ^[1]. However, with e-learning growth along with web-based education systems emergence, EDM's scope has expanded and now covers a wide range of data sources as well as methods ^[2]. Consequently, it has given rise to more advanced models and approaches for analyzing student behavior and learning outcomes ^[3].

The development of EDM is characterized by an interdisciplinary approach. It integrates machine learning techniques, didactics, and cognitive psychology, among others; thus, it facilitates a more holistic understanding ^[4]. This interdisciplinary nature has allowed EDM to address complex challenges, such as personalized learning and the predictive modeling of student performance. A key milestone in the development of EDM was the organization of the first educational data mining conference in 2008, which provided a platform for researchers to share information and developments in the field ^[5]. Since then, the number of conferences, publications, and related research has grown exponentially, highlighting the growing academic and practitioner interest in EDM.

New terms and subfields have emerged alongside EDM, such as learning analytics (LA), academic analytics, and big data in education, reflecting the increasing focus and application of data analytics in educational contexts ^[6].

While EDM is mainly concerned with technological challenges, LA focuses on data-driven decision-making from what is being taught and integrates social and pedagogical dimensions [7]. Academic Analytics (AcAn), on the other hand, focuses on the use of broader data with the aim of using it mainly for administrative and decision-making purposes. Finally, the use of big data, which is now available, allows for the integration of large amounts of data from gamification and virtual reality tools [8].

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