Addressing the complexity of online education: A learning analytics and big data perspective

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Learning is a complex phenomenon that includes cognitive, emotional, behavioral and social interactions with peers, teachers, and the environment at large. Learning also unfolds in time, progresses at different scales, and may regress or grow in surprising ways [1]. Whereas our knowledge of learning has been accumulating over the past decades, there is still much to decipher. A complex phenomenon requires a complexity-oriented approach that takes into account the multifaceted nature of learning as a process. Today, after the agonizing years of COVID-19, the world appreciates more than at any other time in history the worth of online learning and the need to tackle the emerging challenges thereof [2]–[4]. These emerging challenges and the possible opportunities for the future have been the hallmark of our 13th International Conference on e-Learning (eLearning-22), which was held on September 29-30, 2022, in Belgrade, Serbia. Several researchers have presented their ideas, solutions as well as their research contributions. The conference proceedings present a compilation of selected seven accepted papers at the conference out of 21 paper submissions received.

The main focus of the eLearning-2022 conference was on learning analytics and big data in education. Researchers from around the world presented their research, highlighting the importance of technological, pedagogical, and instructional design concepts involved in improving the educational system as a whole. Different perspectives from different institutions opened up a dialogue during the conference regarding technological and ethical aspects of using learning analytics and artificial intelligence in education, as well as diverse aspects of personal/student data usage in different research. The eLearning-2022 community acknowledged and raised awareness of different aspects that need to be worked on in the entire educational ecosystem.

The conference keynote was delivered by Professor Miguel Angel Conde from University of León and a valuable partner on Erasmus+ ILEDA project, who delivered the conference keynote on the topic "Going beyond the LMS logs: The complexity of analyzing learning evidences." His insightful talk shed light on the challenges and opportunities of leveraging learning analytics for evaluating teamwork competence. This research highlights how teamwork assessment was effectively carried out at the University of León over multiple academic years. The keynote paper is part of these proceedings and it brings up important issues that need to be taken into account when applying learning analytics.

Among the papers included in these proceedings is Dijana Oreški's paper titled "Using descriptive and predictive learning analytics to understand student behavior at LMS Moodle." This study employed descriptive and predictive learning analytics approaches in order to develop models that analyze student behavior and predict their success. The results revealed that a combination of unsupervised and supervised machine learning algorithms implemented on Learning Management System (LMS) data can provide useful models for explaining and predicting students' behavior on LMS.

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Another selected paper for this issue titled "Evaluation of STEAM Methodologies in Undergraduate Applied Mathematics Courses" was presented by Emilija Kisić. This paper presents part of the research and results developed within the Erasmus+ project FUTUREMATH, with the focus on development and the adoption of STEAM methodologies in undergraduate courses. The study presents designed and implemented methods in online and face-to-face teaching of complex mathematical topics with the evaluation of students' satisfaction with the developed approach and its impact on their understanding of complex mathematical topics.

Jovana Jović presented the paper titled "Prediction of student academic performance using machine learning algorithms," which focuses on using historical educational data collected from the Learning Management System (LMS) and Educational Management System (EMS) to develop a model for classifying student performance across different courses, showcasing the potential of predictive analytics in education. Paper presented results from training and evaluating a model on data from various courses and demonstrates the potential of different machine learning algorithms in student modeling.

Nemanja Zdravković presented the paper at the conference that is also part of this proceedings with title "A Lightweight Permissioned Distributed Ledger for Credentialing in Higher Education Institutions." This research explores the application of a permissioned blockchain solution for students' credentialing in higher education, and it presents a secure and transparent model utilizing the Hyperledger platform to provide authorized users with verifiable proof of student credentials.

Djordje Kadijevich's paper "Psychometric Properties of a 21st Century Digital Skills Scale," proposes a 7-item scale as an instrument to assess the promotion of 21st century digital skills. This research examines the quality of a digital skills scale used for assessing teachers' digital competencies. The study provides insights into the representativity, reliability, homogeneity, and validity of the proposed scale.

Lastly, Tijana Glušica presented "Learning Management Systems for Hybrid Teaching Models in Primary Schools in Serbia during the COVID-19 pandemic," included in these proceedings. This paper analyzes the quality of commonly used LMS platforms for implementing effective hybrid teaching models in primary schools with regard to educational policies. The research findings offer valuable insights on the level of fulfillment of the quality criteria, but it also highlights needed conditions for building a safe and stimulating hybrid constructivist teaching environment.

We extend our gratitude to all of the authors who contributed with their research for these proceedings. We would also like to thank all the participants, attendees, and volunteers who made eLearning-22 a successful and productive event. We hope that discussions, open dialogues, and identified issues and potential research topics will contribute to the advancement of the field of learning analytics, big data in education and to distance and online educational practices.

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