Special Section on Data Capture and Analysis to Support Learning Engagement

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THE use of technology in education is an area that has undergone sustained rapid evolution over the last decade. Learning experiences are changing due to multiple factors, but technology mediation is related to substantial portions of that change. Together with this trend is the capacity to collect an ever-increasing variety of data points about how learners participate in an experience and up to what point engagement is achieved. From the initial data sources derived from learning management systems we are now seeing a much more diverse set of data sources such as biosignals, eye and gaze tracking, and so on.

The six contributions in this special section showcase studies that answer research questions related to the potential for this vast variety of data sources to be used to increase our understanding of how learning occurs, and the ways in which they can be used to increase the overall quality of the learning experience, as well as provide experiences that are engaging for learners.

José Ruipérez-Valiente, Matthew Gaydos, Louisa Rosenheck, Yoon Jeon Kim, and Eric Klopfer explore this variety of dimensions within the context of an inquiry-based massive multiplayer online game for the development of STEM and 21st century competencies in the K-12 space. Their study explores how to discover learner characteristics that correlate with engagement, how to understand the nuances of engagement in this context, and also the impact of the game's features on engagement.

The article presented by Ishari Amarasinghe, Davinia Hernández-Leo, Konstantinos Michos, and Milica Vujovic focuses on how to convey the complexity of interactions in a collaborative learning environment to the instructor through the use of a dashboard. Experiences that rely on technology to orchestrate collaboration usually require seamless integration between human and artificial cognition in a context incorporating complex orchestration measures. The article provides a solid connection between what the technology is capturing in these scenarios and what instructors need in order to make the knowledge actionable.

Ronald Antonio Pérez-Álvarez, Jorge Maldonado-Mahauad, Kshitij Sharma, Diego Sapunar-Opazo, and Mar Pérez-Sanagustín selected the area of self-regulation in the context of massive open online courses (MOOCs) to study how to use data to support student strategies for self-regulation based on their engagement. The study is centered around the use of data collected during notetaking and their connection with self-regulation and course engagement. These elements are especially important in the context of MOOCs, where the scale of student cohorts offers an opportunity to collect comprehensive datasets, but at the same time poses specific challenges to transform these data into knowledge.

The work of Zacharoula Papamitsiou, Ilias Pappas, Kshitij Sharma, and Michail Giannakos is concerned with how to combine data sources that are captured through clickstreams, eye tracking, electroencephalogram (EEG) and electrodermal activity sensors, and learner self-reports. The objective is to explore the relationship between these data points that underpin engagement and performance in an undergraduate course. The methodology employs a fuzzy-set qualitative comparative analysis and the findings advance the current knowledge about which combinations of data types provide a greater explanation of performance.

Vicente López Camacho, Elena de la Guía, Teresa Olivares, Julia Flores, and Luis Orozco-Barbosa exploit tracking and wearable technologies to increase user engagement in learning processes with the aid of multimodal learning analytics. Their study was carried out in a secondary school in a long-term participatory learning context. The analysis of the data has produced a set of rules that are intended to be interpreted by a nonexpert and that are aimed at helping the teacher observe, analyze, and make decisions with the purpose of fostering engagement.

The article written by María Jesús Rodríguez-Triana, Luis Prieto, Adrian Holzer, and Denis Gillet discusses how to promote effective use of social media in the classroom to raise engagement while avoiding disaffection. The results of their study, which involved anonymous social media, show that the mere introduction of social media in educational settings does not guarantee a positive impact on learning. In addition, they found that while simple measures of behavioral engagement are insufficient to predict academic performance, the use of relatively simple and unobtrusive indicators of both behavioral and emotional engagement and disaffection can improve the model. The authors' take-away message is that teachers need to design the learning tasks to align the social media use with the learning goals.

As the various contributions in this special section clearly show, the emerging landscape characterized by massive amounts of data being collected from multiple sources and their interdependence with numerous factors affecting learning experiences is a fertile ground for more in-depth studies. The findings and outcomes of these studies can have a profound impact on how learners engage and how to improve the quality of their experiences. We envision growth in this type of study

as education continues to expand into more flexible environments that cater to a larger audience and technology increases its presence to underpin this evolution.

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