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Editorial: Analytics and Mathematics in Adaptive and Smart Learning

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Editorial on the Research Topic

Analytics and Mathematics in Adaptive and Smart Learning

We have reached an era where finally online learning has become the norm and reality due to unexpected risk factors, and in this case, it was due to the COVID-19 pandemic. Educational institutions have for a long time resisted major changes to teaching and learning but were quick to adapt to this new reality. Online learning transformed the "chalk and talk" teaching and learning process that has been the norm for decades. The historical development of online learning and availability of synchronous technologies enabled most classrooms to continue to operate without walls and structured learning spaces. However, a good online teaching ecosystem goes beyond just replicating the chalk and talk methodology. Educators need training and tools to ensure that the interaction that happens in a regular classroom can be simulated in different ways when conducted online. The training is also needed to address educators' fear of technology and suspicion of the effectiveness of online learning.

Smart and adaptive learning has the potential to provide some agile solutions to enhance and expedite the adoption of online learning. It has the ability to use analytics to make the teaching and learning process leaner centric, collaborative, and personalized. In an online learning environment, access to the Internet becomes an important criterion for successful learning to happen, as it is now the interface to allow a better cognitive, social, and teaching presence. With a high network of intellectuality happening in the virtual space, here is now a need for mathematics and analytics to be in the forefront of skills that are needed to conduct further analysis for more informed decisions to improve the performance of platforms and guarantee optimal student achievement.

Thus, the data from the digital interactions replaces the traditional teacher observation in a physical platform where with the assistance of the analytics, educators can assist students at risk or under pressure. The nature of modern and sophisticated analytics is that educators can get automated early warnings and hence provide timely, motivational, and personalized interventions. In this manner, all students, inclusive of the highly motivated ones can be nurtured to achieve greater heights.

This special issue has come at a crucial period where we could juxtapose analytics and mathematics with online learning. There are two streams of thought in this special issue: 1. How can smart learning help in teaching mathematics? and 2. How can mathematics and analytics help in smart learning?

The nature of Mathematics teaching involves an understanding of the fundamental principles, application of these principles to get the solutions and then test the understanding of the method by varying use cases. Smart learning can address the 3 aspects by pinpointing to the Mathematics teachers where the students fail. Whether it is the understanding phase of application phase or the use cases phase.

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The role of mathematics and analytics in smart learning is an interesting challenge. Kohen and Orenstein [1] have explained the process of how real world problems can be modeled mathematically.

Another interesting use of Mathematical modeling in learning is the application of linear regression model in the evaluation of teacher's information ability [2]. The study with data collected over 5 first level indicators, 20 s level indicators and 60 third level indicators.

Another definitive work on this domain is by Tezer [3] where STEM integration on mathematical modeling has been done in terms of the basic elements (knowledge, process, skills), social elements (students, teachers, and media) and teaching elements (teaching process, teaching skill, teaching approach, and teaching strategies).

This special issue is a step in this direction with the publications reflecting the diversity of the work in the domain.

The use of a knowledge based smart trainer (KBST) in enhancing the performance of long jump in students was explored in Kamnardsiri et al.. The paper is significant in that it shows the ways by which analytics-based learning can help in sports and thus open up a prism of learning for the future. The study demonstrated how learning systems can codify the knowledge from the experts, find patterns, transfer knowledge and insights to the subjects of the study and also provide highly useful data to experts. This transfer of actionable knowledge is an interesting paradigm relevant for future.

YouTube videos are a popular form of reference for all learning. The analytics data from the videos was used to find out interesting insights into the preference of viewers in Rahman et al.. The process of acquiring insights is an important application in line with the theme of this special issue.

In keeping with the learning trend, a prediction model for students' learning was developed by Raza et al.. This model considers interaction logs and past achievement scores. While use of past achievement scores is not new, the addition of interaction logs in the course is. The work is an example where teachers can identify students at risk in real time in a virtual environment. This will allow for timely interventions and targeted responses from teachers.

Assistive technologies are more synonymous with the technology aspects like mobile learning, tablet-based learning, and online intelligent systems. Reddy et al. showcased the effectiveness of assistive technologies which are student centric like lecture capturing, asynchronous videos and gamification. An interesting result is that students preferred to go through recorded lecture videos more than online videos in the domain. This result is however specific to mathematics domain.

The effort by Chand et al. focused on the use of data surveys to understand the factors in learning Mathematics. Based on the data, recommendations to improve the teaching ecosystem were given. This work has a broad appeal and the conclusions apply to every Mathematics teaching environment.

The work by Raza and Reddy investigated the pedagogical methods to teach Mathematics. Evidence was presented on how engaging instructional activities can enhance the learning of Mathematics. The instructional activities included the following: online labs, weekly assessments, weekly forum activities, quizzes, and active resources. The overriding theme is that even self-contained courses need to have engaging activities to challenge the students and keep them in touch with learning.

Our work in resilience (Raghunathan et al.) investigates the views of the teachers and the trait of resilience. Resilience is an important trait in Adaptive and smart learning and has immense potential for future exploration. Our study emphasized the need for Educational systems to focus on three facets–internal, interpersonal and external aspects of teachers and strengthen factors such as support for teachers, strong academic leadership, trust of teachers, increase self-motivation, enhance communication with stakeholders and emphasize systems that enhance student-teacher communication.

Overall, the special issue has thrown up several interesting research areas in smart learning. The use of analytics in modeling, mining insights and then transferring them back to the teacher, use of interaction data to predict students state in the course and thus identifying students at risk, the role of assistive teaching and the efficiency of engaging innovative pedagogical activities. Though further detailed research is needed this special issue with different case studies is a step in the right direction.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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