Use of machine learning-enabled scenario-based teaching in Haematology and Biomedical Science, as a replacement and supplement to traditional tools and in-person teaching during COVID-19.

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One of the biggest challenges during the COVID-19 pandemic has been maintaining student engagement and providing the best learning experience with limited face-to-face (FTF) contact, and social distancing requirements. Whilst multiple tools are available to provide some interactivity in online learning, such as quiz software and virtual labs, there are limited opportunities for continuous learning, or decision-making, such as interpretation of case studies or scenarios.

Alongside traditional forms of teaching such as lectures (albeit online), we utilised a machine learning-enabled scenario-based tool (Resimion) with BSc (Hons) Biomedical Science students (150 second- and 52 third-year), to replace unavailable activities which would normally have been laboratory-based or FTF tutorials. With this tool, students are provided with the opportunity to understand the impact of decisions they make, based on text and other media. Decision-making can be tracked, and continuous engagement monitored, as well as formative and summative feedback provided.

Our data shows considerably increased student engagement when using tools such as Resimion. Third year haematology students were provided with an optional post-lecture Resimion case study and an alternative online quiz, with uptake of these by the cohort 75% and 12% respectively.

In 53% of cases, students took a given scenario more than once, obtaining a better outcome in 76% of additional attempts. Further, using peer reminders, where students are reminded to attempt the scenario and the percentage of their cohort who have already engaged is indicated, engagement increased by 14%.

Whist student engagement remains a primary goal of institutions, an important secondary goal is that this occurs at the optimal time (OT) of day and day of the week to maximise outcomes. Using Re-enforcement Learning (a machine learning discipline), Resimion uses Markov Decision Processes to determine OT to remind students to engage, based on i) individual historic OT, ii) OT providing the best scenario results, and iii) cohort OT. On average, it took 3 scenarios to determine the best OT, achieving a 9% increase in our students selecting the optimal scenario path.

A considerable issue highlighted in the past year has been digital poverty, and lack of inclusivity and access for some students to resources. We did not experience this issue in this study, due to access via a standard web browser or through the app on any mobile device. Additionally, accessibility can limit engagement, which would have affected 1.2% of scenarios run within our cohort without the inbuilt accessibility features.

Student feedback using this approach was very positive, with requests to increase use within teaching. Competitive, real-time scenarios in live online tutorials were particularly popular, enabling a cohort feel and peer-learning in sessions where students tend to otherwise feel very isolated.

Scenario-based learning is an effective tool to complement/replace existing teaching methods, particularly laboratory practicals and clinical case studies, where learners undertake logical decision making. Detailed feedback is provided to the learner, and also the lecturer, enabling modification of current and future sessions. Based on a wealth of literature confirming retention of 90% of active learning, versus 10% of passive learning, scenario-based teaching is a valuable addition to our toolbox of methods for haematology and biomedicine.