Research Statement

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Background

My educational research is rooted in the use of technology to elucidate or augment teaching and learning. The use of Artificial Intelligence (AI) in Education is especially promising as it has the potential to address problems in education and to innovate current teaching and learning practices. With this as the central theme of my research, my research can broadly be categorized into AI for affective learning, AI for collaborative learning and Generative AI for personalized learning.

Research Areas

AI for Affective Learning

Students experience a wide repertoire of emotions or affect in academic settings and both positive emotions e.g. hope, pride and relief and negative emotions such as anxiety and boredom are prevalent in learning. The positive emotions e.g. enjoyment of learning affect achievement positively by strengthening motivation and enhancing flexible learning whereas the negative emotions e.g. anxiety erodes motivation and draws attention away from the task, resulting in shallow learning. Affect thus influences student's learning achievement. In my research into affective learning, AI techniques are used to infer the affective states of students. For example, in one of my conference publication, I extracted the facial and head pose features from recorded face videos of students and passed them into a custom designed Graph Attention Network to infer the affective states of students. The results demonstrated the feasibility of detecting academic emotions by proposing a graph based deep learning model that modelled both the spatial and temporal dimensions of facial landmarks.

AI for Collaborative Learning

Collaborative learning, an educational approach which involves learners working together in small teams towards a common goal, is posited to lead to enhanced learning outcomes as compared to didactic instruction. In contrast to didactic instruction where learners receive knowledge passively from the teacher, collaborative learning is an active learning approach where learners participate actively with each other and co-construct their knowledge in the process. A part of my research is on analysis and visualization of educational activity logs captured by educational technology tools e.g. input devices such as digital whiteboards to uncover collaborative behaviours of students. The proliferation of educational digital tools in teaching and learning has made it easier to capture and store students' interactions and actions performed within the tool itself. The analysis of these logs, in turn, allows

educators to uncover the process of collaborative work and problem-solving behaviours of students, offering an alternative lens into assessment and evaluation of students' collaborative work. A key finding from my work is the possibility of applying AI techniques to uncover collaborative states of students from the digital whiteboard activity traces.

Generative AI for personalized learning

Within the area of generative AI for personalized learning, I have recently embarked on the use of Large Language Model (LLM) in uncovering programming misconceptions of students. Novice programmers and students often exhibit misconceptions which inhibit their ability to learn and make progress. Understanding the misconceptions of students is thus pertinent for informing instructors of the challenges faced by their students in learning computer programming. With knowledge of the common misconceptions or errors made by their students, instructors can then enact appropriate effective instructional strategies to resolve these misconceptions. This however entails investment of significant effort and time from the instructor in manually going through all the students' code submissions. The advent of ChatGPT has seen its use in many application areas including education. ChatGPT has been shown to be capable of understanding and analysing programming codes and this motivates my study to investigate into the use of LLMs e.g. ChatGPT to automatically collate programming errors of students from their code submissions and to summarize these errors into common misconceptions of students. The findings from this research would aid in the automatic collation of students' errors

from the large collection of code submissions for instructors to have an accurate picture of their students' misconceptions.

Selected Publications and Outputs

- Designing an overseas experiential course in data science, IEEE International Conference on Teaching, Assessment and Learning for Engineering, 2023

- Investigating collaborative problem-solving temporal dynamics using interactions within a digital whiteboard, International Conference on Computer Supported Education (CSEDU), 2023

- Unveiling the process of collaborative learning through the use of digital whiteboard historical action logs, International Conference on Computers in Education (ICCE), 2022

- Deep Learning-based text recognition of agricultural regulatory document, International Conference on Computational Collective Intelligence (ICCCI), 2022

- Fine-grained detection of academic emotions with spatial temporal graph attention networks using facial landmarks, International Conference on Computer Supported Education (CSEDU), 2022

- An architectural design and evaluation of an affective tutoring system for novice programmers, International Journal of Educational Technology in Higher Education, 2018