Using guided-inquiry lectures to enhance student engagement and understanding

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At Monash University, student enrolments in physiology subjects are large (450-550) with lectures still the primary mode of teaching. Students perceive that lectures develop their physiology knowledge, but are poor for developing their communication, teamwork and quantitative skills (Hodgson *et al.*, 2013). The challenge is to use the existing lecture theatres and one hour lecture time to encourage: (i) student engagement; (ii) active learning; and (iii) the development of communication, teamwork, quantitative and critical thinking skills. We found that real-time digital inking on a Tablet PC in lectures stimulates student interest and understanding of physiology lectures with large student numbers (Choate *et al.*, 2014). We therefore used Tablet PCs to facilitate guided-inquiry during lectures, based on an active learning approach termed POGIL (Process Oriented Guided Inquiry Learning; Hein, 2012; Vanags *et al.*, 2013). This teaching approach is based on the constructivist theory of learning and is effective in lectures with large student numbers; it encourages student participation and active learning and has been found to enhance student learning (Eberlein *et al.*, 2008; Hein, 2012).

During a guided-inquiry lecture, students were initially provided with background information relevant to the lecture concepts. This was followed by a guided-inquiry activity (*e.g.* problem solving, graphing tabulated data) and a final discussion and clarification of each of the concepts. In order to evaluate the effectiveness of the guided-inquiry lecture approach, we focussed on three physiology lectures: (i) endocrine control of calcium homeostasis; (ii) the oxygen and haemoglobin dissociation curve; and (iii) the chemical digestion of foods. At the start of semester, students were given a diagnostic multiple choice question quiz covering the core concepts in the lectures. This quiz was repeated immediately after each lecture and at the end of semester. There was significant improvement in student performance on the quiz questions between the initial diagnostic and the subsequent quizzes ($P < 0.05$). At the end of semester we used a verified survey to evaluate student perceptions of the guided-inquiry lectures (Lewis & Lewis, 2005). Students (n = 55) found that the guided inquiry lectures (i) encouraged them to take notes during the lecture (82%); (ii) stimulated class questions and discussions (91%); (iii) helped them to understand the lecture topics (89%) and (iv) encouraged them to attend lectures (75%). Written comments from students included:

"The guided inquiry lectures encouraged discussion with peers and lecturers. I felt that I could ask stupid questions."

"The guided inquiry lectures encouraged hands on practical questions of problems encountered in laboratory classes."

In conclusion, we have found that this novel guided-inquiry approach can be used in large lecture cohorts to motivate active student learning and enhance student understanding of core physiology concepts.

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