

Introducing inquiry-oriented learning at UNE to increase engagement of students with different interests and aspirations

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Approaches and Methods – adapting the fundamentals of cardiac conduction practical

Prior to the University of New England's involvement in the "Inquiry-oriented learning in science" project, the Toad heart and ECG practical in the PSIO210 Introductory Physiology I unit had comprised a classical formulaic practical where students followed a rigid set of instructions, obtained data and then interpreted their results. In 2012, the main curricular learning outcome was unchanged, which was to develop an understanding of the electrical activity of the heart and its control. The basic method to be used in the practical was also retained involving measuring the ECG and using a toad heart to measure force and rate of contraction under various conditions. The ECG and heart rate were measured using standard limb leads and the force of cardiac contraction via a hook attached from the single ventricle to a force transducer. Raw data was obtained and interpreted using the Powerlab and Chart software.

The major difference that was introduced this year was the aim to improve student engagement and interest in practicals by challenging them to think more deeply about the relevance of the practical to their chosen degree/career pathway and to try to increase the fun element in the practical. These goals had to be accomplished in a single practical. Therefore, to achieve our aims within the one 3-hour session, each activity was given a title and a small light-hearted but relevant blurb was added which gave an example of the relevance of each experiment. Examples included "the importance of environment", "balancing your minerals" and "becoming a cardiac surgeon". The first of these examined the effects of temperature (hot and cold Ringers solution) in relation to controlling the spread of cane toads in Australia; the second was placed in the context of diet, either human or livestock, and the last challenged the students to think of how different drugs could be used to change heart rate and force of contraction during an open heart operation. In addition to these preambles, a number of pre-measurement and post-measurement questions were added which required the students to attempt to think about and hypothesise as to what their results might be and then to comment upon what they found. The practical finished with a tutorial which continued the themes of providing context to

all students and reflection on the experiment outcomes but also included explanations and reinforcement of the learning objectives.

The new practical was evaluated in two ways. Human ethics approval was obtained from the University of New England to survey the students during the practical and to conduct a focus group after the practical was concluded. Although Associate Professor Roberts and Dr King were critically involved in designing the questions for the survey, both this and the focus group were conducted by people unconnected to the assessment of PSIO210. The survey contained 12 questions which students responded to using a 5-point likert scale ranging from strongly disagree to strongly agree and two additional questions where students could comment on the best aspects of the practical and make suggestions for its improvement. The questions covered topics such as the accompanying lectures; the practical instructions; the use of inquiry in the practical; timing; learning experience and whether the students had enjoyed the activity. The focus group was conducted and analysed by Associate Professor Kirkup who subsequently reported on his findings.

Data Analysis – Evidence of increased engagement

A total of 39 students filled in the surveys. Sixty-seven percent agreed that the practical had given them a chance to think for themselves, whilst 76% and 62% respectively agreed that the lectures had helped them understand the fundamentals of cardiac conduction and that the practical had connected well with the lecture material. The two other questions where more students agreed with the question compared to any other option were that the practical was interesting and a preference for more detailed instructions. There was only one question where students more strongly disagreed or disagreed compared to the neutral and more positive options, which concerned the amount of time devoted to completing the practical's activities. Students were neutral about whether this practical had increased their confidence for completing further practicals in their courses. Of the 29 students who gave an answer about the best aspects of the practical, 20 made specific reference to either the "hands on" nature of the practical or the ability to carry out a practical activity and see things for themselves. Constructive suggestions for improvement included a pre-practical tutorial; increased use of demonstrations and to consider splitting the practical over two sessions.

The clearest indication that we had achieved our objective of addressing the students' specific areas of interest was obtained from the report on the focus group involving 12 students. The participants included 8 BSc students (mainly majoring in animal science), 2 Bachelor of Pharmacy students, 1 Bachelor of Exercise and Sports Science and 1 Master of Agriculture student. With one exception all of the students had clear career aspirations including veterinary science, pharmacy, animal nutrition and research. These diverse and widespread career aspirations notwithstanding,

quoting from the executive summary compiled by Associate Professor Kirkup, “PSIO210 students on May 9, 2012 were clear – this practical did address their area of interest well. The key goal of the activity, as articulated by UNE academics was demonstrably achieved.” Students further stated that the practical was ‘very’ relevant to their career aspirations, course and general interest. This was attributed to a “deeper engagement and level of thinking”. In agreement with the survey results, students expressed enjoyment of the practical (variety, relevance, unique nature and working hands on) and went on to speak positively about “UNE science students are prided on their practical experience”.

There was also evidence from the focus group that this practical and, in particular, the concluding tutorial had increased their learning experience. Students suggested that the tutorial had helped reinforce the main principles and concepts and as evidence of increased reflection about their overall learning experience suggested that a similar tutorial be introduced into other practicals. Other evidence of improved engagement and higher order learning came from the support voiced about the value of inquiry learning and experimental design and to the correct placement of this within undergraduate and postgraduate studies. The advantage of the flexibility within the practical for meeting differences in student learning techniques was also apparent and appreciated from their reactions to expected/unexpected results. When the experiment gave the expected results the students learnt from the hands on experience, when the results were unexpected learning was achieved through the tutorial.

Discussions/reflections/conclusion

It was clear that the students had enjoyed this practical and had wanted it to be retained in the curriculum. Some modifications may however stimulate a higher level of achievement. This may involve reducing the practical content so that the greater amount of time available allows for deeper thinking and improving the practical manual to provide clearer instructions about each activity. The modified fundamentals of cardiac conduction practical was a first investigation into the potential introduction of inquiry based learning into science teaching at UNE. Our main finding was that this approach does enable us to increase engagement of all students regardless of their widely differing interests. This suggests that further work should be conducted scoping the feasibility of extending inquiry-oriented learning into other units that cater for divergent student interests. As a foundation in a second year introductory unit, it also provides a platform onto which further inquiry-oriented practicals could be scaffolded into the third year curriculum where students begin to design their own experiments to answer specific questions or tackle specific career related scenarios. In conclusion, the involvement of UNE in the inquiry-oriented learning project has been wholly beneficial from a perspective of student

engagement and as a driver towards modern, innovative and successful teaching practices.