Editorial – Volume 21, Numbers 2 & 3

What is the point of studying science if you are not going to be a scientist? This question is often raised by allied health students, for whom biomedical science subjects are usually a compulsory component of their degree. In many ways, teaching biomedical science into allied heath courses (e.g. nursing, paramedics, physiotherapy, nutrition, pharmacy, etc.) can be challenging. The content of subjects is often prescribed by professional bodies. The academic, social, and economic backgrounds of students can vary greatly, and student engagement and desire to develop a deep understanding of concepts can be low. However, there are also a number of opportunities (e.g. the development of innovative teaching practices that engage and inspire the next generation of health-care professionals). It was with these challenges in mind that the *International Journal of Innovation in Science and Mathematics Education* and members of the *Collaborative Universities Biomedical Educators Network (CUBEnet) Allied Health Working Group* called for contributions to a special issue devoted to the *Teaching Biomedical Science to Allied Health Students*. The focus of this issue was to be on the challenges associated with teaching biomedical science to allied health students, how educators are addressing these challenges, and how they are seizing the opportunities to engage students and improve outcomes. When the dust had settled, we had received submissions from educators/researchers across five Australian universities, with three of these universities having a regional/remote focus. It is these articles that we have the great pleasure to present to you in this issue.

This special issue has been the work of the Allied Health Working Group of CUBEnet, a network of educators, administrators and support staff that aims to develop and promote biomedical science education in Australia. The Allied Health Working Group consists of academics whose teaching focus is to students of the allied health professions. Teaching biomedical science to allied health students includes some challenges that could be considered unique (or at least having greater impact) when compared with teaching students enrolled in 'pure' science degrees. Students in allied health programmes have clear graduate destinations for their studies, and biomedical science is often perceived as ancillary to their final destination. Frequently, these students expect course content be *immediately* relevant to their intended vocation and taught at a level commensurate with their needs. When the relevance is not immediately apparent, students can approach to the material with range of negative emotions from anxiety to hostility. As trained scientists, biomedical science teachers are valued for our expert knowledge, but many of us have little or limited experience of the clinical practice our graduates are moving towards. As a result, a tension can develop between student expectations of what they need to study and the teachers expectations of what students' needs to learn.

Many of the articles in this special issue relate to teaching bioscience to nursing students. This is unsurprising considering that the largest individual cohort of allied health students are Bachelor of Nursing students. However, this issue also contains contributions that allow for an expansion of the discussion to include other health science disciplines (physiotherapy, exercise physiology, dentistry/oral health, paramedicine, just to name a few). Articles within this special edition add to the literature in that they describe subject designs addressing teaching and learning in large cohorts (200 to 500 students), multi-campus teaching, and the influence of technology as an emerging tool to promote learning. What is striking about these articles is the constancy of the issues associated with teaching biomedical science in allied health (student science anxiety, failure rates, attrition and satisfaction), as well as the diversity of solutions that are being implemented. The articles presented address these issues

from an Australian perspective and showcase the creativity that educators in Australia are deploying to address the ongoing challenges of teaching biomedical science. However, we believe the research presented deals with universal themes, and as such, will be of interest to the wider academic community.

Three major themes emerge from the articles included in this issue: (1) The impact of science education in high school has on success and self-efficacy in studying bioscience; (2) subject redesign to accommodate the diversity of students studying bioscience and promote active learning environments relevant to allied health student expectations; and (3) the use of technology and feedback as teaching and learning tools.

1) At least three articles (Ang & van Reyk, Logan, Cox & Neielsen, Crane and Cox) address the question of the impact prior science education on student performance or attitudes towards biomedical science. These papers tell a story that Chemistry *should* be a prerequisite for physiology, and that those students who lack an understanding of chemistry struggle with physiology. A take home message from these papers is that that the quickest solution to the "biomedical science problem" would be to provide the appropriate foundation to learning bioscience, i.e. chemistry. Pragmatically, this will not happen since (A) many allied health courses will not make chemistry a prerequisite for entry; (B) courses are already crammed with content and disciplines will not sacrifice time for "general science" subjects; and (C) students demand that their education be relevant to their discipline and have difficulty relating foundation concepts to their vocational intentions. Crane and Cox make the observation that science-anxiety can lead to low student efficacy for biomedical science, lower student engagement, and possibly, a negative attitude towards the subject.

2) Articles by Rathner, Hughes & Schuijers; Gordon & Hughes; Weerakkody; and Logan, Dunphy, McClean & Ireland have focused on subject redesign. Rathner et al., Gordon & Hughes, and Logan et al. describe subject redesigns that attempt to address the "biomedical science problem" for nursing students. Rathner et al. describe a subject redesign that balances Inquiry (Active) Learning, individual learning accountability, stake holder demands and institutional priorities as guiding principles. Gordon & Hughes address stake holder demands by introducing and emphasising clinical relevance of biomedical science, addressing the "disconnect" between science content and clinic practice. This work aligns well with the article by Weerakkody that describes the incorporation of clinical relevance into subject redesign for dentistry students, as well as addressing institutional priorities. An important driver for work of Gordon & Hughes and Weerakkody appears to be the recognition that students are less interested in the content of the subject for knowledge sake, and want biomedical science subjects more directly focused on their vocational destinations. The article by Logan et al. discusses how reflective-practice has driven the redesign process of a suite of biomedical science subjects taught across multiple campuses into different allied health courses. The redesign described aimed to align the learning objectives and assessment tasks with Bloom's taxonomy as a mechanism for focusing the student learning and teaching efforts.

3) Finally, two articles address the development and use resources and feedback in biomedical science teaching (Page & Earl; Munns; and Kay Colthorpe, Shaohong Liang & Kirsten Zimbardi). Page & Earl have used online videos in place of Lab classes to allow them to focus on the intended learning outcomes of understanding the importance of proper food handling procedures to reduce the transmission of pathogens. Video presentation removes the anxiety of correctly following protocols and achieving the correct result, and

focuses students' attention on the interpretation of reliable data. Munns presents interesting analysis of the students' use and attitudes towards podcasts of biomedical science podcasts. Interestingly, while podcasts were liked (and used) by students, their use did not appear to have any impact on students' final grades. A result that highlights the need to balance the cost/benefit relationship associated with resource development. Finally, Colthorpe et al. investigated the most effective forms of feedback on academic writing tasks. While good feedback is critical to learning, it is time consuming to produce, and the results of Colthorpe et al. provide interesting insights into the type of feedback most likely to be taken on board by students.

The editorial team would like to thank all the authors and invited reviewers that have contributed to this special issue. It has been a pleasure bringing this research together and we hope readers find the articles as interesting and informative as we have.

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