

# Creating Relevance and Credibility: New Approaches for Bioscience Education in Pre-registration Nursing Curriculum

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## Abstract

In Australia, biomedical scientists typically service teach bioscience to pre-registration nursing students. It has been reported that nursing students consider these bioscience subjects to be difficult causing anxiety, which potentially leads to surface learning approaches. Traditional assessments in bioscience teaching, such as multiple choice questions, do not foster the development of critical thinking skills for integrating the bioscience to their nursing practice.

These difficulties led to a major revision of bioscience teaching within a nursing faculty at an Australian university. We developed a model for teaching bioscience with the purpose of restructuring the bioscience assessments to improve the connection between bioscience knowledge and clinical practice requirements, and to develop implement specific clinical sessions for biomedical lecturers to aid in their understanding of the relationship of bioscience to clinical practice. This was to ensure that bioscience teaching was aligned with the nursing faculty graduate attributes and registered nurses competencies for safe and competent practice.

This paper will describe the process undertaken by the bioscience teaching team to address these difficulties and the development of an integrated model of bioscience and clinical teaching. We will describe clinical sessions for the biomedical lecturers, the new assessments and their relationship to clinical practice, and how these relate to the new model.

## Introduction

The challenges faced by biomedical science university lecturers, providing service teaching for nursing faculties, have been well documented (Jordan *et al.*, 1999; Nicol, 2002). Nursing students often report that they find bioscience to be difficult and thus experience anxiety whilst engaged in these subjects (Clancy *et al.*, 2000; Friedel & Treagust, 2005; Jordan *et al.*, 1999; McVicar & Clancy, 2001). Nursing students also have trouble aligning bioscience knowledge and concepts with clinical nursing practice and this has been described as an underlying cause of the problems faced by educators (Davis, 2010). As such, providing service teaching within a specialised field such as nursing is difficult and further complicated by the fact that it needs to be delivered and integrated within the curriculum to provide relevance and conceptual understanding to clinical practice (Friedel & Treagust, 2005; Logan & Angel, 2011). Therefore, whilst much of the research focus has been about the effects and causes of this disconnect between bioscience and nursing, there is a distinct lack of literature outlining methods to alleviate the problem. This paper will provide a conceptually different approach to the teaching and assessment of bioscience in a nursing faculty and describe our preliminary findings about the new approach.

In the context of health professional education, nursing was the last health profession to move education into the university sector from an apprentice-style hospital-based education. Early bioscience education in the hospital-based training model was often delivered by medical doctors and this led to a biomedical teaching model which did not consider the holistic approach and psycho-social aspects of illness that underpins nursing practice (Davis, 2010). As such, nursing academics constructed university curriculum that emphasised the philosophical and behavioural aspects of health and nursing practice, and bioscience was service-taught, predominately by biomedical scientists from science faculties (Davis, 2010; McVicar *et al.*, 2010). This approach, however, created a situation where the bioscience theory became disconnected from clinical practice. Moreover, this approach has fundamental and conceptual differences from other health professional education. For instance, medical students are required to have a universal understanding of human biomedical science as this supports the work of medical doctors. As such, biomedical scientists can service teach their specialty content and medical students can be examined in a similar manner to science students. However, where this differs from nurse education is that the clinical teaching of biomedical science is reinforced significantly by practicing medical specialists whilst students are attending clinical placements. In contrast, registered nurses and nursing lecturers have less confidence in their bioscience knowledge (Friedel & Treagust, 2005), necessitating biomedical lecturers to provide a clinical context of the bioscience knowledge. Similarly, in allied health professional programs, only very specific bioscience is taught e.g. musculoskeletal anatomy to physiotherapists, which is highly relevant to their professional practice and is strongly integrated into the entire course. Therefore, nurse education provides unique challenges for biomedical scientists who provide bioscience teaching in the curriculum.

Service teaching of bioscience in nursing curriculum by biomedical scientists is also challenging because clinical nursing subjects are often not cohesively aligned with the bioscience subjects. Evidence from students, nursing lecturers, and registered nurses suggests that bioscience is not taught sufficiently in the clinical subjects, such that students are not able to synthesise the integral aspects of bioscience knowledge to patient experiences on clinical practice (Caon & Treagust, 1993; Craft *et al.*, 2012; Davies *et al.*, 2000; Friedel & Treagust, 2005). Conversely, it appears that the biomedical service lecturer frequently has little to no clinical experience. Thus bioscience material presented, although essential and relevant, may appear to have no connection to the professional degree, and especially the clinical aspect component, for which the student is studying. This approach to teaching bioscience relies heavily on the students being able to make the connections between the scientific content and clinical practice, which may also be limited. This lack of contextualisation can lead to poor integration, lack of interest and the loss of an opportunity to engage students. It has been suggested that team teaching using specialist bioscience and clinical instructors may decrease disconnection between bioscience and clinical practice (Larcombe & Dick, 2003). However, this approach would create numerous challenges. For example, this would necessitate that two educators are present and is directed towards practical laboratory-based classes which would substantially increase cost structures. Moreover, it only addresses who delivers the bioscience teaching and not the content. Therefore, a different approach was required. These challenges led us to develop a bioscience program that provides greater horizontal and vertical integration of bioscience in the nursing curriculum. In particular, we focussed on assessment construction, delivery modalities and improving the bioscience lecturers clinical practice acumen to facilitate greater clinical practice-bioscience synergies.

This paper will discuss the challenges of teaching bioscience in a nursing degree and the model that was developed to overcome these challenges and provide a strong integration between bioscience theory and clinical practice.

## Conceptual model

In developing the framework that would facilitate students making connections between bioscience and clinical practice, several factors needed to be considered. In addition to bioscience knowledge, university graduate attributes as well as the Australian Nursing and Midwifery National Accreditation Council (ANMAC) competency standards for the registered nurse and nursing education were included. Pre-registration nursing curricula in Australia are required to conform to the ANMAC standards for nursing education (Australian Nursing and Midwifery Accreditation Council, 2012). Nursing faculties are required to obtain accreditation, similar to other health professional education faculties, regularly (every 3-7 years). There is an emphasis in the accreditation process that the educational program will promote high standards of nursing education, such that students who complete a nursing program can become registered and provide patient care in a safe and competent manner. Within the developed framework, bioscience needs to be integrated and demonstrate how it serves the pre-registration requirements of student nurses. However, in practice this can be difficult, thus we decided to develop a conceptual model to underpin the bioscience delivery. It was, therefore, important to build a framework by which all students could engage in the material and have the opportunity to either learn or revise the essential science concepts required for the understanding of anatomy, physiology and pathophysiology.

The ANMAC competencies are organised into four primary domains, consisting of Professional Practice, Critical Thinking and Analysis, Provision and Coordination of Care, and Collaborative and Therapeutic Practice. The individual competencies are grouped under these domains and we chose the following for incorporation into the model:

- In the Domain of Professional Practice, we included competency 2, which states that the nurse “Practises within a professional and ethical framework (2.6).
- In the Domain of Critical Thinking and Analysis, two competencies were selected. Competency 3 “Practices within an evidence-based framework (3.2)” and competency 5 “Conducts a comprehensive and systemic nursing assessment (5.1).”

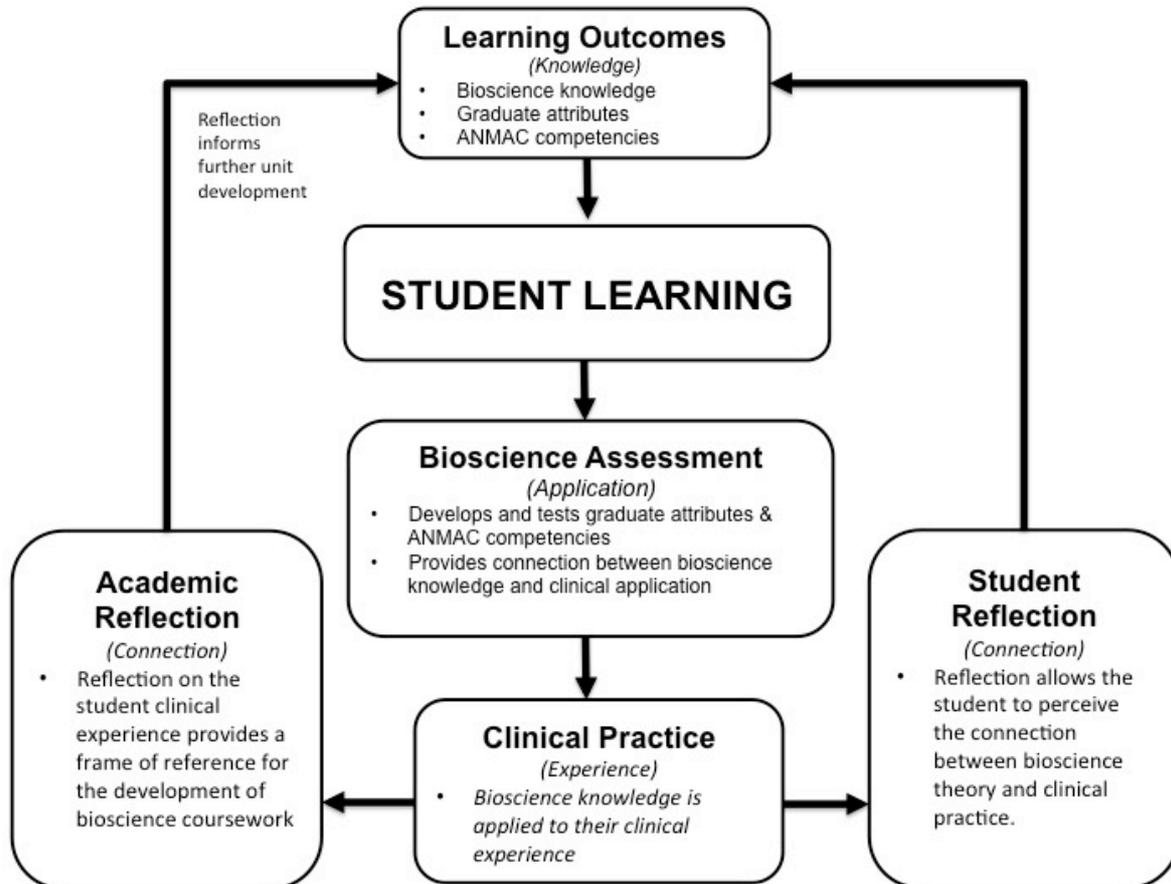
In addition to the ANMAC competencies, we included the nursing faculty graduate attributes, which we considered needed to be emphasised within the bioscience subjects and assist in the development of the subject. The following graduate attributes were chosen:

- Communication
- Information literacy
- Personal and intellectual autonomy.

These graduate attributes were selected for development in this subject, firstly because nurses need strong communication skills, both written and verbal. Good communication skills enable the nurse to communicate effectively with their patient, document information for their colleges and relay information to medical staff and the allied health team. Secondly, nurses need to have good information literacy skills to assist them in interpreting and making decisions based on the information with which they are presented. Thirdly, registered nurses need to have an ability to judge a situation and act expediently according to the information

with which they are presented. Thus, this subject was constructed to further increase personal and intellectual autonomy.

Our model included bioscience knowledge, clinical practice components, ANMAC competencies and the nursing faculty graduate attributes (Figure 1).



**Figure 1: Bioscience Integrated Model**

Figure 1 shows the framework that was developed to enable students to connect bioscience with clinical practice. The model was based on Kolb's theory of experiential learning. The learning outcomes (knowledge) were designed to not only incorporate bioscience knowledge but also the nursing faculty graduate attributes and ANMAC competencies. Learning was designed so that the clinical relevance of all bioscience theory taught was clearly stated. Student learning was then assessed using novel bioscience assessments that allowed students to contextualise bioscience knowledge within the clinical setting (application). During clinical practice (experience), students were able to draw connections between the bioscience theory and their practice and reflect on their own knowledge and learning (connection). The academics involved in teaching were also able to reflect on the clinical experiences encountered by students and provide a frame of reference for further development of the bioscience coursework.

## **Subject Development**

The new subject consisted of a blending of altered physiology and how this can develop into pathophysiological changes. Accordingly, this was the first pathophysiology subject that students received in this new program. In developing the bioscience material it was decided that an organ systems model approach would be utilised. Whilst this reflects a traditional biomedical approach, it was adopted as the anatomy and physiology textbooks that are relevant for this student population all use this approach. It was thought that a concepts-based approach to bioscience teaching would disenfranchise students who may not have a thorough knowledge of the organ systems and would struggle to align the material with the textbook content. Thus all lectures were delivered using this approach and tutorials were also based on a systems approach. However, the case studies and questions related to each organ system were modified so as to utilise a concepts-based approach, thus providing clinical context and connection. This was further reinforced using online learning modules. Each online module was designed around a clinical case study with students needing to explain the pathophysiology behind the clinical signs and symptoms being observed. By delivering the content in this way, students also had the opportunity to further develop the ANMAC competency “conducts a comprehensive and systemic nursing assessment.” Their critical thinking and intellectual autonomy were also further developed using this teaching methodology.

### **Clinical visits – providing context**

As one of the main objectives in designing the bioscience component of the nursing curricula was to create a clear connection between the bioscience taught and the clinical units, it was proposed that the biomedical scientists teaching the subject attend prescribed visits in the clinical settings where students participate in clinical practice. This clinical program for biomedical scientists provided contextual clinical references for the scientist developing the subjects, to have a clear understanding of the student nurses’ clinical experiences. Moreover, the scientist was provided with clinical references to facilitate clinical exemplars that were used to underpin the bioscience theory.

The clinical visits were arranged between a large metropolitan teaching hospital and the Nursing faculty. Briefly, the biomedical scientists were provided with clinical orientation to several acute care wards to gain insight into clinical practice requirements of student nurses. During each visit, a senior registered nurse, with biomedical qualifications, accompanied the scientists explaining why certain treatments were being performed and showing examples of clinical manifestations that would be observed in patients with high prevalence diseases. During this time the scientists had an opportunity to ask both the registered nurse and the patient questions.

These visits provided an excellent preparatory point for the development of teaching material and assessments. First-hand experience enabled the lecturers involved to create more clinically relevant case studies and assessments that were based on real patients. This first-hand experience also enabled the lecturer to speak with more authority as they had observed patients and nursing practice, which facilitated clinical context to the bioscience content, such as the patient’s clinical manifestations of signs and symptoms. Thus, a very strong connection between bioscience concepts and clinical practice was created. The clinical visits also provided grounding for what clinical context was lacking from bioscience concepts.

Therefore, these visits also enabled the lecturers to build further clinically relevant content for the learning modules around these incomplete bioscience concepts.

## **Assessments**

Traditionally, it could be argued that assessments such as multiple choice exams are chosen as they are easy to administer and grade when assessing large student cohorts (Mullen & Schultz, 2012). However, this form of assessment may encourage surface learning and may limit detailed critical reflection, limiting the extent of student learning (Paramenter, 2009; Struyven *et al.*, 2005). One aim in designing the formative assessments for the bioscience units was to enable the students to further connect their clinical practice with their bioscience knowledge. Thus a different assessment was utilised that was primarily formative in approach whilst retaining summative assessments at the end of the semester. This consisted of a written task, a case presentation and a formal examination, which we outline in detail below.

### **Patient information brochure and new graduate nurse letter**

This novel assessment was developed to incorporate several faculty graduate attributes as well as the ANMAC competencies 2.6 and 3.2. In terms of communication, this assessment enabled the student to develop both skills to communicate effectively with their patients and their peers. This required the student to be able to communicate using both scientific language and lay terminology.

Students were asked to design a patient information brochure for a common disease e.g. diabetes mellitus type 2. The brochure requirements consisted of a brief overview of the disease, an explanation of the pathophysiology, which risk factors were associated, the clinical manifestations that would be observed, a list of clinical investigations used for diagnosis and the relevant treatments or therapies. The student was told the brochure needed to be understood by a layperson, without medical knowledge. In addition, students were required to compile new graduate nurse letter, which provided greater detail regarding the information provided in the brochure. A new graduate nurse is a nurse who has just completed their degree and been registered to practice. Most new graduates rotate between several hospital placements to gain further experience. Students were required to include evidence-based research to support the letter and to use scientific language. To assist with uniformity, two templates were provided for the patient information brochure and new graduate nurse letter. Finally, a detailed marking rubric was provided to support the assessment. Before assessment submission, students completed a self-evaluation using the rubric.

### **Case study presentation**

This assessment piece was designed to enhance and support peer-to-peer learning and further extend oral and written communication skills thereby addressing the graduate attributes: communication; information literacy; and personal and intellectual autonomy. This assessment piece also developed further the competencies listed in the ANMAC Domain of Critical Thinking and Analysis by providing the student with the opportunity to practice within an evidenced-based framework and conduct a comprehensive and systemic nursing review. Briefly, groups of four students were required to present a case study and supporting written material for the class. Individual students were tasked with specific content related to

the case study in an attempt to mimic multidisciplinary health care teamwork. Students were graded both individually and on group work activity.

## **Subject evaluation**

Prior to introducing the new subject within the curriculum, we undertook a review of the bioscience subjects delivered in the previous nursing program. This consisted of a comprehensive analysis of subject content, delivery modes, assessments and learning objectives and outcomes, as well as lecturer and student feedback (both formal and informal) and an extensive literature review. For the purposes of this paper, herein we briefly present qualitative themes relating to student feedback reports. Then we present the pilot data evaluating the new subject and include a comparison of the subject evaluation scores before and after the introduction of the new subject.

When reviewing the free-text responses of student feedback from the previous years, prior to introduction of the new bioscience unit, there were many students commenting that they needed to have foundational bioscience knowledge to understand nursing practice. The following comments provide evidence of this theme:

*“This is a crucial subject to our nursing degree.”*

*“Strong bioscience is essential to nursing.”*

*“It is important that nurses know about the human body.”*

However, much of the negative commentary related to the lack of relevance to nursing generally, particularly with disconnection to clinical practice. Comments such as the following are typical of this theme:

*“I can see the relevance of certain parts, such as the functions of the body but I think this should be related to nursing.”*

*“Too much work, not enough application to nursing.”*

*“Huge volume of content, not well related to actual clinical nursing practice.”*

In addition, there appeared to be confusion about the scientific and nursing approaches and this particularly related to laboratory experiences:

*“The scientific report writing didn’t really relate to anything...”*

*“The relationship between the laboratory content and report writing were not relevant to nursing.”*

Therefore, overall the majority of themes were negative and student experiences of bioscience teaching were poor. These subjects were service-taught by biomedical lecturers and had many of the features that are evident in the literature such as student dissatisfaction, poor perceptions of bioscience and disconnection with nursing subjects and practice.

## Cohort

The Bachelor of Nursing (Advanced Studies) commenced in 2012 at a large metropolitan Australian university. The expectations for the degree are higher than other undergraduate nursing programs and entry is limited to secondary school students with a high university admission rating. Despite these circumstances, secondary school science is not a pre-requisite for entry to the program. This presents a challenge in the bioscience units where many of the students have either limited or no prior secondary school science with which to preface the level at which the bioscience is taught. Interestingly, prior research has demonstrated a strong linkage between secondary school science and subsequent university performance in bioscience subjects (Green *et al.*, 2009; Whyte *et al.*, 2011). Pre-requisite subjects for the degree do not include secondary school science and the lack of pre-requisite science in nursing programs has been explored previously and shown that students are often disadvantaged (Craft *et al.*, 2012; Gresty & Cotton, 2003; McKee, 2002). Nevertheless, to the best of our knowledge, pre-requisite secondary school science subjects are not universally mandated as entry requirements for Australian nursing programs.

## Pre-, post evaluation

All students enrolled in the subject were invited to participate in a research study evaluating bioscience teaching related to the subject. Ethics approval was granted by the Human Research Ethics Committee of the university and all participants provided written consent prior to the study. A total of 19 participants completed a pre-, and post-questionnaire related to their understanding of bioscience and the relationship to clinical practice and about their attitudes to bioscience study. Participant demographics are detailed in Table 1.

**Table 1: Participant demographics ( $n = 19$ )**

Variable	Percentage
Age in years: mean (SD and range)	20.6 (5.5, 17-41)
Female	94.7%
Secondary school science studied	68.4%
<i>Biology</i>	47.4%
<i>Biology with another science subject</i>	31.6%
<i>Any science subject other than biology</i>	21.1%
<i>No science</i>	31.6%

Participants were asked to rate their understanding of bioscience and the relationship to clinical practice on a ten-point scale, from poor (0) to excellent (10). There were significant increases in how participants rated bioscience knowledge, their understanding of clinical practice and importantly the relationship between bioscience knowledge and clinical practice ( $p < 0.05$ ; Table 2). These results suggest that the participants had meaningful improvements

in articulating bioscience to clinical practice, which was one of the primary motivators of this model implementation.

**Table 2: Self-ratings of bioscience–clinical practice linkage**

Item	Pre-survey mean (SD)	Post-survey mean (SD)	<i>p</i> value
Current physiology knowledge	5.2 (1.5)	6.6 (1.2)	<0.001
Understanding of relationship between altered physiology and clinical practice	5.5 (1.8)	6.9 (1.1)	<0.001
Current understanding of clinical practice	5.6 (1.8)	6.8 (0.9)	0.01
Confidence to explain biological basis of nursing decisions	5.0 (2.0)	6.4 (1.1)	0.005
Understanding of bioscience knowledge to make sense of what is wrong with patients	5.3 (2.0)	6.7 (1.2)	0.007

To ascertain how participants perceived how bioscience related to their learning and becoming a nurse, participants completed a further questionnaire with items using a five-point Likert scale, from strongly disagree (1), to strongly agree (5) (Craft *et al.*, 2012).

Generally, participants did not report increases in how they perceived assessments, or comparison of bioscience to nursing subjects ( $p>0.05$ ; Table 3). However, they reported that bioscience concepts are easier to visualise with a concomitant reduction in anxiety levels associated with bioscience teaching ( $p<0.05$ ).

**Table 3: Perceptions of bioscience learning to becoming a nurse**

Item	Pre-survey mean (SD)	Post-survey mean (SD)	<i>p</i> value
Assessments in bioscience are important to understanding of clinical practice	4.3 (0.6)	4.3 (0.6)	0.94
Importance of bioscience to form foundation of nursing practice	4.4 (0.6)	4.4 (0.7)	0.93
Bioscience subjects are harder than nursing practice subjects	3.5 (0.9)	3.2 (1.0)	0.22
Assist understanding if bioscience assessments related more to clinical practice	3.8 (0.7)	3.9 (0.7)	0.50
Bioscience concepts are easy to visualise	2.8 (0.8)	3.6 (0.8)	0.004
Anxiety related to bioscience teaching	3.2 (1.0)	2.6 (0.9)	0.015

Finally, we evaluated the formal university student feedback scores from the new subject to those prior (see table 4). There were increases in all domains and these results reflect students' positive experiences with the new model and demonstrate that the approach was important to increase the association of bioscience to clinical practice, which was a central tenet of the introduced model.

**Table 4: Overall student feedback scores related to subject evaluation**

Item	Pre-subject introduction	Post-subject introduction
Learn effectively	3.07 (1.14)	4.41 (0.56)
Assessment allowed me to demonstrate my learning	2.87 (1.23)	4.19 (0.68)
Feel more confident about understanding of nursing practice	3.14 (1.19)	4.21 (0.68)
Overall satisfaction	3.00 (1.21)	4.42 (0.62)

The overall subject feedback was positive. Typically, evaluations of hard subjects, such as bioscience, are often lower than clinical nursing subjects. Students reported high relevance to the degree similar to clinical subjects. This suggests strongly that the new bioscience model of increasing clinical relevancy was achieved and infers that a solid connection between bioscience knowledge and clinical practice was accomplished. Written feedback supports this supposition, was evidenced by the following:

*“I appreciated how what was taught directly correlated with the clear learning outcomes. No fuss. Loved this unit.”*

*“The assessment we did helped us develop valuable graduate attributes.”*

*“It is best to know these things, in order, to understand what’s going on in the patient. This will also allow me to provide better service to my patients.”*

### **Assessment items**

Generally, the standard of assessment items was of a high quality. It was interesting to note that students reported that the new graduate nurse letter was more difficult to complete than the patient information brochure. This is likely to relate to the different language style required, as many students felt intimidated by the scientific language. Furthermore, the student’s self-evaluation strongly correlated with final mark awarded. This was pleasing and aligns with the ability of health professionals to be able to self-critique work which has been shown to be valuable in health professional education (Saunders, 2012).

### **Discussion**

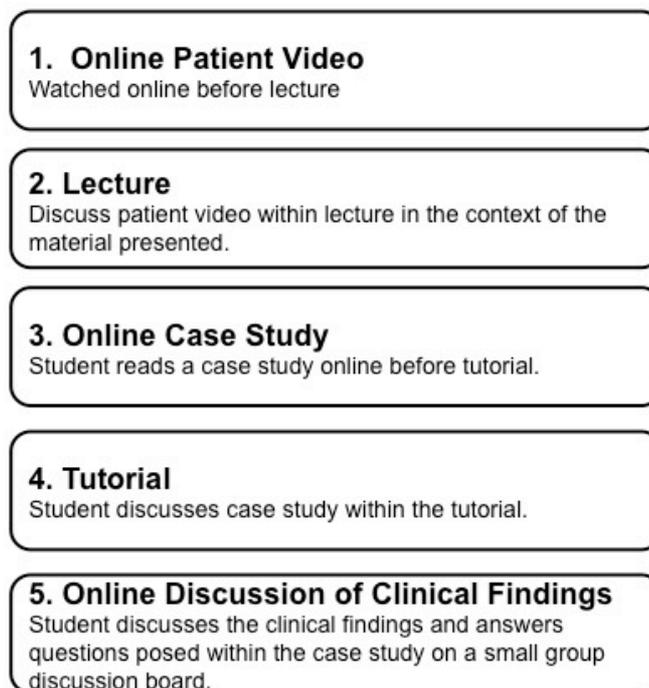
We have outlined a new novel bioscience-teaching model for pre-registration nursing students. This was developed with the aim of increasing the clinical relevance and facilitating both teaching delivery and assessments such that they augment bioscience-clinical practice synergy. To support this new model, we focussed on student learning, but also provided support for biomedical lecturers who were lacking clinical contexts and practice requirements relevant to student nurses. From the student feedback it appears clear that this subject enabled students with stronger connections between bioscience theory and clinical practice. The use of case studies, although not a new practice, were formulated from the biomedical lecturers’ clinical visits which allowed for a more nuanced discussion as the lecturer could contextualise the findings to what they had experienced. We believe that this provided an increase in student engagement and enhanced the learning experience. Lecturers reported

greater confidence in the case study delivery and more meaningful clinically related bioscience discussions.

The use of the patient information brochure and new graduate nurse letter was a novel assessment that greatly increased the development of key graduate attributes, engaged the students and contextualised the bioscience theory being taught. In addition to the development of written communication skills the student's also had the opportunity to further develop their IT skills, which has been shown to be beneficial in health professionals (Saranto & Leino-Kilpi, 1997). Overall feedback from the students regarding the assessment has been positive.

## Future Directions

We would like to further integrate the online component of the bioscience subjects with the face-to-face teaching. This can be achieved with the use of clinically relevant online material that supports both the bioscience knowledge content but the clinical implications related to the bioscience. This will permit students more time for reflection as well as strengthen the online material bioscience-clinical application. It is proposed that the following structure could be integrated with the existing model of bioscience education using a virtual learning space (Figure 2).



**Figure 2: Proposed refinements to the bioscience-teaching model.** The proposed model that has been developed to further enrich the online delivery of bioscience content taught in the nursing degree program.

Within this learning space, each organ body system will be divided into an online module. Students will view a video of a patient who displays pathophysiology related to the organ system being studied before attending the lecture. Within the lecture questions about the video will be incorporated to provide clinical context to the bioscience content of the lecture.

At the conclusion of the lecture, an online case study will be viewed in the students' own time and discussed in the subsequent tutorial. Following this, an online discussion board about the clinical findings will occur. It is anticipated that this approach will provide greater bioscience-clinical synergy.

## Conclusion

The disconnection reported between bioscience teaching and clinical practice in nursing education has been well documented. We have proposed a model that was implemented into a first year bioscience subject at a large Australian university. We found that the new model with the novel approaches to assessment and enhancing the clinical experience of biomedical lecturers improved the student experience and provided a greater context for student learning. Further research and evaluation is required to determine if the model is sustainable and consistently improves student's engagement in bioscience subject within the nursing curriculum.

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