Back to the future with Hands-on Science: Perceptions of Nursing students learning Anatomy and Physiology
This paper examines student perceptions of learning in relation to anatomy and physiology in a Bachelor of Nursing program. One strategy in teaching the sciences is through simulated learning. Simulated learning technology offers exciting potential to teach nursing science. Virtual environments for laboratory learning may offer numerous benefits: teachers can convey information to a larger group of students, reducing the need for small laboratory classes; less equipment is required, thus containing ongoing costs; and students can learn in their own time and place. However, simulated learning may also diminish access to: the personal teacher-student relationship; opportunity for guided practice and guided linking of theory with practise. Without this hands-on experience, there is a risk that students will not engage as effectively, and thus conceptual learning and the development of critical thinking skills are diminished. Yet, student perceptions of these learning experiences are largely unknown. Thus, this study examined students’ perceptions of laboratory experiences in anatomy and physiology and the importance they placed on real ‘hands-on’ experience in laboratory settings.
**Background**

Understanding of science and scientific problem-solving skills are pivotally important for preparing students of nursing for competent clinical practice, especially with the explosion of knowledge in the biological sciences leading to many more surgical and medical procedures and treatments (Carvalho, 2003; Courtenay, 1992; Nyatanga, 2003; note: by science we refer to anatomy, physiology and ultimately pathophysiology and pharmacology). Yet there are some commentators who argue that science pedagogy within health education programs has not kept pace with advances in teaching the art of clinical practice (Bynum, 1993; Weatherall, 2006; Wynne, Brand & Smith, 1997). Indeed, in the 1980s and 1990s there was ambivalence, or perhaps even reluctance to emphasise scientific knowledge because it was felt to compete with the need to emphasise humane, compassionate care (Bevis & Watson, 1989). Now that a balanced view is restored, wherein both the art and science of nursing is appreciated (Pesut & Herman 1999), it is important to continue the conversation about what effective teaching and learning in the sciences might mean in a variety of contexts.

Tanner (2003) argues convincingly that simply focusing science courses on technical procedures and processes does not best serve the needs of nursing students primarily because students are best served in the short-and longer-term by developing their own critical thinking skills, their own drive to explore and inquire. In order to engage students and deepen understanding, activities are required that stimulate inquiry and critical thinking. Moreover, we need to document the effectiveness of such processes to further our own understanding of what a good teacher of nurses and nursing does and how they do it.
In the 1990’s in Australia, following trends set in McMaster University in Canada, nursing education in many universities adopted the concept of integrated learning, where students were encouraged to engage in discovery learning and teach themselves with the support of facilitators, using a problem-based approach (Alavi & Cattoni, 1995). Students were given case studies, taught a systematic approach for analysis, and encouraged to self-identify issues for further inquiry. Science was integrated into this holistic, discovery-based approach, along with humanities, psychosocial and technical skills. This educational practice, while clearly valuable, found students lacking in some fundamental building blocks required for good clinical practice, such as anatomy and physiology (Williams, 1999). Current emphasis in most Australian universities is now placed on the direct importance of an understanding of discrete units of study including anatomy and physiology as they relate to nursing; anatomy and physiology within a clinical context. This applied approach does not replace the humanistic or skills-based courses, but rather complements them, supporting clinical practice techniques with a sound basis in biological science.

Recently, computer assisted technology has been used in the teaching of science as an alternative to the traditional laboratory learning experience (Jeffries, 2005a, 2005b; Medley & Horne, 2005). Simulations in education are designed to mimic real-life situations, giving students opportunity to reason through a clinical problem or exercise and make decisions without the potential of harming actual patients or other animals (Bond & Spillane, 2002). Simulations also provide the opportunity for repeated practice in a skill, where students can learn and make mistakes in a safe and controlled environment (Wilson, Shepherd, Kelly & Pitzner, 2005). When time is of
the essence, and opportunities to experience and practice a range of nursing skills are constrained, simulated learning offers exciting potential to maintain rigour and quality in clinical learning. There may also be economic benefits in being able to use simulated environments rather than have to establish and maintain expensive laboratory equipment and personnel. Simulated technologies can add novelty and variety to conventional teaching and they offer the potential for greater student access because eventually students may be able to access this technology in their own homes and at their own times (Jang, Hwang, Park, Kim, & Kim, 2005). Thus, there are increasing calls for simulations to be used not just in the acquisition of clinical skills but also in the more fundamental learning experiences of Anatomy and Physiology (Jeffries, 2005a). Computer or model simulation systems facilitate safe and reliable practice of simple clinical skills (Medley & Horne, 2005) yet there is still very little demonstrated evidence or clear understanding of the educational usefulness of simulations in nursing (Jeffries, 2005c).

One significant challenge to the extensive use of teaching simulations is that they tend to lack the emotive and psychological impact of real-life clinical situations and interventions. Researchers had previously described the value of problem-based learning in the application of clinical knowledge, particularly recognising the increased retention of knowledge precisely because it is a teaching method which is said to engage students and to require applied knowledge as compared to rote learning information (Beers & Bowden, 2005), creating active rather than passive learners. We suspected that laboratory exercises might have some of the same kind of affective as well as applied relevance and thus inspire students to understand, rather than just ‘learn’ anatomical and physiological information.
Traditional laboratory learning continues to offer numerous benefits to the teaching and learning of science, enhancing scientific knowledge but also aesthetic and ethical ways of knowing. For example, use of dissection material in a laboratory situation is an opportunity to emphasise both rationalist and humanist ways of knowing. It is possible for the instructor to convey knowledge about the relevant organ system whilst also facilitating learners’ personal feelings about mortality, humanity, objectification and understanding how to be a dispassionate yet respectful clinician. Garrison (2003) has written elegantly and persuasively about the importance of student exposure to real organs, real tissues and real bodies. Hands on experience of dissection can also be used to enhance students’ ability to apply anatomical information to the clinical context and thus broaden students’ appreciation of the relevance of scientific knowledge to nursing practice (Fredricks & Wegner, 2003). While there is research-based recognition that anatomists like to teach using cadaver material or at least animal-based dissection material, as previously stated the use of computer-based anatomical teaching is increasing (Berube, Murray & Schultze, 1999) and there is very little understanding of the impact of this educational change on students’ abilities, particularly their ability to engage with and develop from such educational experiences. Moreover, there is very little understanding of the impact of such change on nursing students’ perceptions of Anatomy and Physiology courses.

Whilst most educators recognize the need for nurses to understand science concepts, especially concepts associated with anatomy and physiology (Wilkes, Cooper, Lewin, & Batts, 1999) rarely do studies actually seek student input into student-directed learning, despite industry-based urgings to look at factors that influence students’
understanding of the sciences (Wilkes & Batts, 1998). Moreover, rarely have the impacts of these on nursing students’ recall, understanding and engagement with the material been examined.

It is within this context that the current evaluation took place. It was designed to examine the student perceptions of learning in relation to anatomy and physiology in a major Australian University.

Students complete two Anatomy and Physiology courses and two other science courses within a three year program that comprises 23 courses. These anatomy and physiology courses are taught conventionally – that is using a combination of 3 weekly lectures (of 1 hour) and a 3 hour practical classes fortnightly. The practical classes consisted of a series of practical laboratory-based dissections, clinical tests (such as blood-grouping and blood smears) and model reconstructions.

THE RESEARCH

Method

Formal ethical clearance was not required under the rules set by the National and University Ethics committee, since data collected was part of the routine course evaluation undertaken in a usual semester. Even so, students are required to understand course evaluation data requests and completion is understood to be consent. All students had the opportunity to anonymously avoid participation in the study. The study used a simple 20 statement questionnaire, written by the course convenor and course tutor, to evaluate the importance of the ‘hands-on’ laboratory sessions in the student’s understanding of the concepts and details of the anatomical
and physiological knowledge presented in their lecture series. Students were asked to
nominate whether they agreed or disagreed with statements outlined on a 5 point scale
(1 = strongly agree, 2 = agree, c = no opinion, d = disagree, e = strongly disagree).
The questions, presented below, covered the material presented in the laboratories, the
importance of that material in their overall conceptual understanding of anatomical
and physiological material and the input of those experiences in their understanding of
anatomical and physiological concepts presented in lectures. Questions were
designed to cover a range of course areas including course information, understanding
and perceived value, while not overtaxing student time. The survey included positive
and negative statements about laboratory classes in order to provide some measure of
internal validation and control. It is important to note that, while laboratory sessions
were not compulsory, attendance averaged 96% over the course of the semester.

Students were asked to note their responses, anonymously, on computer-mark sheets
which were collected up by student nominees into envelopes, and returned to support
staff. There was no compulsion on students to participate in the survey, the lecturer
left the room while the survey was being completed and collected.

Results
Of a total student enrolment of 125, 104 students completed the evaluation. Results
of the survey are presented in Table 2.

Discussion
The overwhelming result was one of positive import of laboratory sessions in the
teaching of Anatomy and Physiology. The majority of students felt that laboratory
sessions enabled them to gain information (97%), added to information presented in the traditional lecture sessions (94%) and, perhaps most importantly, helped them to understand material presented in lectures (97%). Thus, unlike some other studies examining the use of simulation or web-based teaching and learning (see for example (Gee, Peterson, Martin & Reeve, 1998; Jang, Hwang, Park, Kim, & Kim, 2005), this study did not examine one or the other – but rather the importance of integration of the two in student’s perception of their learning experience.

While a significant part of the laboratory sessions included small group time in which students were invited to ask questions that they could not or would not ask in lectures and to interact with a variety of academics and thus seek multiple explanations and perspectives, this did not explain all of the satisfaction achieved in laboratory classes. Eighty five percent of students indicated that they genuinely valued the ‘hands-on time’ they spent in the laboratories. This reflects the findings of other studies which have addressed similar issues. Mitchell, McCrorie & Sedgwick (2004) found that students universally valued time spent in a dissecting room in order to learn anatomy and that many students wanted more ‘hands-on’ time to gain knowledge of anatomical structures.

The most significantly valued element identified in the practical sessions was the ability to undertake and complete ‘real’ clinical tests such as blood grouping and blood smears. These sorts of exercises are gradually moving out of nursing and even conventional science laboratory programs, primarily because of the increased safety requirements associated with the use of human tissue, especially human body fluids (even the students’ own fluids). While use of a physical containment level 2 (safety
rating of procedures) laboratory facility and carefully supervised techniques does not preclude these as teaching elements, costs and limited access to appropriate facilities does precludes these tests in many nursing programs. It is significant then, that of all the practical’ exercises these nursing students undertook, they most valued the opportunity to examine and undertake these, more organizationally challenging, assays. While studies examining the effectiveness of web-based teaching of clinical skills, such as ECG, indicate high levels of student motivation and satisfaction (Jang, Hwang, Park, Kim, & Kim, 2005), these studies often point to a need to enhance “motivation for more active learning” (p. 38). Results from this study suggest that one of the best motivators may well be interaction with real material in a hands-on way, which enables students to engage with, understand and then apply knowledge acquired in alternative contexts.

While time spent with models and posters was clearly valued by the students (32% strongly agreed that access to these teaching tools was important), this did not compare to the 53% who felt strongly agreed that specimen dissections was a valuable part of their laboratory time (cf. 66% clinical tests). Unsolicited comments on the surveys included several quite negative comments about the use of videos/DVDs in various laboratory exercises. This study echoed findings of some other studies (Buckley, 2003; Rouse, 2000), simulations, models and posters do not replace use of real (animal) tissue or actual physiological tests in terms of the students’ positive perceptions of their learning experience.

The importance of contextualization of Anatomy and Physiology knowledge for student engagement and satisfaction emerged in several areas of the survey. The
value placed on clinical tests, together with the very positive response to time spent discussing normal anatomy and physiology with a practising clinician (91% agreed or strongly agreed that this was a valuable part of their A & P laboratories) reinforces the notion that the relevance of knowledge is paramount in student’s perception of its importance.

**Limitations**

These data are relatively limited in scope and certainly do not encompass the myriad of possible laboratory teaching aids able to be utilized in Anatomy and Physiology. They do not specifically address the concerns of students who for various reasons may not wish to participate in, or even observe dissection of animal material, or their own biological samples (eg. blood). They do, however, indicate the importance and significance of the laboratory experience to the majority of nursing students undertaking Anatomy and Physiology courses – and the more relevant and hands-on the better. Of the students surveyed, 57% felt that the laboratory classes should be a compulsory element of Anatomy and Physiology and only 10% felt that their time would be better spent in private study (a portion of this group also felt that their time in laboratories was wasted time).

While the development of the science courses in the Bachelor of Nursing Program continues, this data strongly argues for the continued inclusion of laboratory classes in the courses, supporting and augmenting more traditional lecture formats. As educators it is difficult not to support the inclusion of valuable and illuminating hands-on experience in an educational process; this study demonstrates that the majority of this population of students also support this educational framework.
Science elements in nursing degrees have often been viewed with some level of apprehension by students, with reasonable cause. Unpublished data from within the university reveals that failure rates in initial nursing science-based courses can be upwards of 30%, outstripping many other first year nursing courses. This is reflected in the students’ perception of a requirement for laboratory sessions in Anatomy and Physiology. More than 80% of students surveyed felt they would struggle to learn their Anatomy and Physiology without the educational support of laboratory sessions, while 63% felt that they would fail these courses without the laboratory classes. As the surveys were completed anonymously it is not possible to match perception of possible failure with actual academic results however, given the failure rate with laboratory sessions and the perceived importance of laboratory sessions in gaining and understanding information content it seems self evident that laboratory sessions are an essential part of the learning and understanding experience of these first year nursing students.

**Conclusion**

This study found that students perceive hands-on laboratory sessions as important in their learning. While these kinds of laboratory exercises are demanding on staff in terms of hours of contact, students clearly appreciate and value these efforts. In contrast, preparation of simulation material can be expensive in the first instance, but it may then become resource-efficient and economical. Nonetheless, effective use of existing, well-researched, conventional techniques remains a valuable method of contributing to the educational preparation of students for contemporary nursing.
References


Bond, W., & Spillane, L. (2002). The use of simulation for emergency medicine resident assessment. *Academic Emergency Medicine, 9*(100), 1295-1299.


Table 1: Survey instrument used.

1. The laboratory sessions are fun
2. I feel I gain information from laboratory sessions
3. The laboratory sessions add to lecture content
4. Laboratory sessions help me understand lecture material
5. I feel laboratory sessions are an essential part of my AMP learning
6. I would struggle to learn AMP if I did not have the laboratory sessions
7. I would reconsider enrolling in AMP if it had no laboratory sessions
8. I think I would fail AMP without the laboratory sessions
9. I value the ‘small group time’ I get in my laboratory sessions
10. I think laboratory sessions are a waste of time
11. I can ask questions in laboratory classes I cannot ask in lectures
12. I can ask questions in laboratory classes I would not ask in lectures
13. I appreciate the hands-on time provided to me in laboratory classes
14. I find time to explore the human anatomy posters and models an important part of my laboratory time
15. I find the specimen dissections an important part of my laboratory time
16. I value the time to do real clinical tests like blood grouping and blood smears
17. I would rather laboratory sessions were compulsory
18. I value the time to discuss normal anatomy and physiology with another member of staff (other than my lecturer)
19. I value the time to discuss normal anatomy and physiology with a practising clinician
20. I would rather use laboratory session time to complete my private study
Table 2: Survey results.

<table>
<thead>
<tr>
<th>response</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>no response</th>
</tr>
</thead>
<tbody>
<tr>
<td>question#</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>51</td>
<td>46</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>74</td>
<td>26</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>69</td>
<td>28</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
<td>27</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>72</td>
<td>25</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>53</td>
<td>30</td>
<td>18</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>29</td>
<td>24</td>
<td>32</td>
<td>10</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>36</td>
<td>30</td>
<td>20</td>
<td>16</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>58</td>
<td>31</td>
<td>9</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>19</td>
<td>69</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>66</td>
<td>31</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>64</td>
<td>29</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>68</td>
<td>19</td>
<td>14</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>33</td>
<td>44</td>
<td>18</td>
<td>6</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>55</td>
<td>29</td>
<td>17</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>68</td>
<td>24</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>33</td>
<td>26</td>
<td>26</td>
<td>15</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>59</td>
<td>29</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>65</td>
<td>29</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>29</td>
<td>39</td>
<td>1</td>
</tr>
</tbody>
</table>