Student learning styles in anatomy and physiology: Meeting the needs of nursing
students

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Abstract

Anatomy and Physiology is a core subject in nursing programs, yet many students have difficulty successfully negotiating the large volume of content and the complex concepts in these biological sciences courses. Typically students perform poorly in these ‘foundational’ courses, despite numerous interventions to support student engagement. Investigation of the shortcomings in these courses, based on student feedback, indicated several key areas of difficulty, especially focused around a relative lack of hands-on ‘practical’ activities in laboratories and tutorials. To attempt to address this, academic and technical staff developed activities for students that promoted discussion and allowed students to interact easily and repetitively with difficult content. Interactive tables and posters that needed to be labelled or ‘filled-in’ using pre-prepared Velcro dots, as well as pre-prepared flash cards to promote group work, were used to enhance student experiences and promote hands-on learning. Over the academic year of 2013 these activities were introduced into the laboratory and tutorial classes for first year Bachelor of Nursing anatomy and physiology students. Staff and student participants positively rated the implementation of these new activities on surveys, as they facilitated exploration of some of the difficult aspects of anatomy and physiology, utilising various learning styles that may have been neglected in the past.

Keyword: Nursing, Learning Styles, Human Anatomy, Human Physiology, Biosciences.

Background/literature review

Anatomy and Physiology (A & P), provides a foundation for nursing care, and thus successful engagement with the basics of A & P is fundamental to the development of sound nursing skills and clinically-based critical thinking (Jordan & Reid 1997, McKee, 2002). It can be a very daunting, content-heavy subject during initial presentation in the first year of a nursing degree and is frequently one of the most conceptually challenging subjects that a nursing student will encounter throughout their degree (Craft et al., 2013). Many students struggle to grasp key concepts (Birks et al., 2013; Smales, 2010) and this results in lower passing rates and sometimes a reduction in content presentation such that programs barely meet industry-required knowledge levels (Davis, 2010). These phenomena have been widely reported internationally and are summarised well in a recent systematic review (McVicar et al., 2014).

Many factors have been cited as contributing to student difficulty with A & P subjects. Students who enter nursing programs who are often ‘non-traditional’ students who may initially struggle academically due to limited ‘social capital’ (Lizzio et al., 2002). They are frequently the first person in their family to attempt tertiary studies, come from a lower socio-economic backgrounds, work either part-time or full-time to support themselves resulting in less time to spend on campus and on studies, speak English as a second language, or have lower school entry scores than many other university student groups (Lizzio et al., 2002; Wilson, 2012). Moreover a significant portion of nursing students are classed as mature age students and are returning to study, changing career, or developing a career after having children, and therefore have been out of the education system for many years. Common themes amongst these students when asked about their perceptions of studying include that they are worried about failure, feel overwhelmed by study, feel the need to develop study skills to cope with university, and commonly feel isolated (Drury et al., 2008; McKee, 2002;

Ralph et al., 2013). Evidence however, suggests that once students enter university, it is time on task that is the primary determinate of success, rather than any other 'background' factors; relative lack of achievement of nursing students in challenging A & P subjects cannot simply be ascribed to the student population (Horstmanshof and Zimitat, 2007; Lizzio et al., 2002; Wilson, 2012).

Many other contributors to student difficulty with A & P subjects have been identified. These include factors such as negative previous student experience with biosciences in school and other tertiary preparatory institutes, causing students to become quite science-phobic and fearful of their ability to successfully engage with science subjects (Craft et al., 2013; McKee, 2002), the learning and teaching staff having greater or lesser backgrounds in the sciences and variable teaching skills (Clancy et al., 2000), and the time required to spend covering this material (Lizzio et al., 2002; McVicar et al., 2014). Other factors have been found to include teaching style and delivery technique (Good et al., 2013).

Increasingly, these foundational subjects are becoming primarily self-directed courses with few hands-on activities (Courtenay, 1991; Johnston, 2010; Meehan-Andrew, 2009). This is despite reports finding that densely web- or technology-supported course presentation does not necessarily suit all learning styles or accord with student expectations (Brown et al., 2008; Koch et al., 2010; Lujan and DiCarlo, 2006). Exploring methods for supporting student engagement with information content, as well as varying the methods of teaching such as using kinaesthetic activities to present the information, may assist in alleviating the trepidation associated with A & P (Brown et al., 2008) and improve student engagement with difficult content (Meehan-Andrews, 2009).

There are many models examining the ways students prefer to learn and the most effective ways students learn (McVicar et al., 2014), which include VARK (visual, aural, reading and kinaesthetic) and Kolb's learning styles inventory (Good et al., 2013; James et

al., 2011; Lujan and DiCarlo, 2006). They explore different aspects of a students' personality, social interaction, information processing and instructional preferences either as a whole or individually. Studies using the VARK model suggest that nursing students are more inclined to learn best kinaesthetically rather than through other methods (James, D'Amore, Thomas, 2011; Meehan-Andrew, 2009). Other studies have supported this, demonstrating that hands-on, practical laboratory exercises are very beneficial for first year nursing students (Johnston and McAllister, 2008). In the study conducted by Johnston & McAllister (2008) 85% of students indicated that they valued the hands-on experiences in laboratories, with the most valued activities including the real clinical tests students carried out.

Similar studies have shown that nursing students visiting cadaver laboratories find this hands-on experience very helpful, enabling them to physically interact and visualise various parts of the body, that seemed difficult at the time of learning but became clear when looking at the cadaver (Johnston, 2010). These sorts of investigations help academic staff to tailor their A & P subject presentation styles to best suit learning styles of students and thereby increase academic success. Clearly however, some kinds of hands-on activities including organ and cadaveric dissection/investigation have significant space and resource requirements. Dissections and other laboratory activities require experienced laboratory staff, ethical approval, appropriately rated laboratory areas and suitable safety clothing and equipment for participants (Johnston and McAllister, 2008). Cadaveric facilities are even more difficult and expensive to access and may have too great an affective component to suit all students (Johnston, 2010) suiting only a proportion of nursing students.

The student lifecycle project implemented at Griffith University in 2012 highlighted seven learning styles based on a number of learning style theories (Heffernan, 2012). The learning styles incorporated aspects of the VARK system and also included characteristics of the student's personality and social interactions to form the other three learning styles. The

seven styles include: auditory/aural, verbal/oral, visual, logical, kinaesthetic, social or in groups, and solitary (Heffernan, 2012). These styles were then compared to the content in various nursing subjects to see if the structure of the subjects accommodated for all the learning styles. From this data the project team set out to improve completion rate of the nursing students at Griffith University and to relate undergraduate student activity to activities required in and by the workforce (Heffernan, 2012). One of the major findings of this project was ‘a fear of the content in A & P’, a widely reported finding in studies of nursing students’ attitudes to the biosciences for decades (Clancy et al., 2000; Courtenay, 1991; Craft et al., 2013; McVicar et al., 2014).

To help alleviate apprehension associated with studying biological sciences in the first year of the undergraduate nursing degree, and to get students to engage more with anatomical and physiological content in a supported environment, a restructure of laboratory materials was proposed. Challenging aspects of anatomy and physiology needed to be presented in a different manner to help students overcome their anxiety and support both the rote learning and dense conceptual understanding required (Johnston, 2010). Due to the apparent lack of social and kinaesthetic learning activities in the subject, it was proposed that by introducing different ways to visualise and interact with the content, the needs of students could be better met. New learning activities were created to not only teach the content but also to make the content fun and engaging, thus providing the opportunity for students to interact with the content and with their fellow students, and to incorporate more styles of learning into the subject.

Method:

Initially, key areas for student support were identified from content analysis of the qualitative components of the teaching and subject evaluations for the A & P courses. Identified themes were discussed by academic staff and technical support staff within the

school of Nursing and Midwifery, who agreed that areas of content in the courses often lacked interactive support material. The challenging anatomical learning and physiological concepts that required greater support included: basic anatomical labelling and use of anatomical terms, electrolyte movement, action potential, the lymphatic system, homeostasis, and digestive enzymes.

In 2013, the students who enrolled in the first year undergraduate A & P courses participated in 3 hours of lectures and either a two-hour tutorial or a two-hour laboratory class each teaching week. In the laboratory sessions students were requested to participate in dissection activities, body chemistry experiments, and the new activities aiming to promote hands-on learning and group discussion. The activities were designed by academic and technical staff based on the subject content delivered in lectures and the prescribed subject text book. Students participated in the activities in both tutorials and laboratory sessions. Alongside the lectures, tutorials and laboratories, students also had access to an online resource, Mastering A&P, on which they could work during the laboratory session and/or at home in their own time.

Rote learning activities

The hands-on activities were divided into two areas, the first focused around rote learning activities. These activities required students to interact with repetitious tasks focused on anatomical areas in the form of: labelling posters of specific systems/organs, labelling each other, labelling a skeleton, or labelling an image of a full sized human body utilising Velcro dot tags (labels) that could be placed onto and off the activity. Images for the systems/organs were taken from the students' prescribed text book, as were the 'anatomical terminology' labels for the more advanced rote learning activities, such as labelling the full sized human or fellow student. The use of Velcro dot tags also allowed for easy correction, and the use of images from a source with which the students were familiar made (self)

checking the answers very simple for students and staff. Students were able to do the activities individually, in groups, or as a class, and because they were simple to use students could repeat the activity over and over until they felt confident with the anatomical locations. Tutors and laboratory staff were able to provide prompt feedback to students during the process because the activities were familiar, large and easy to read. These activities also allowed the tutor to carry out discussions with the class, and explore 'incorrect' or challenging responses in-depth with the use of a visual aid.

Conceptual understanding activities

The second type of hands-on learning activity took content with which students had already engaged in lectures and/or rote learning activities, and linked them to other content, supporting and enabling them to form connections within their knowledge base. This was undertaken by creating large interactive tables, flow charts, and flash cards based around topic areas. The tables and flow charts were taken from the prescribed text book and, once again, utilised Velcro dot tags. Students placed the Velcro-tagged labels onto tables and/or charts to complete the charts, promoting meaningful group work and discussion around which was the most appropriate label/process/stage. Students were required to put the pieces of the table or flow chart together by reading the labels or by physically moving tags to complete an image. Once again the Velcro tagged tables and flow charts allowed students to use trial and error processes and to repeat the activity until they felt they understood the concept/s illustrated. For ease of correction, each table or flow chart had a corresponding page number in the prescribed text for students to check or explore further. Tutors and laboratory staff were also able to lead small group discussions using the tables and flow charts with groups that were struggling while providing students with feedback during the process as the activities were large and easy to read.

Flash card activities took content with which the students had gained some familiarity and allowed them to test their knowledge, prompted by a word, picture, or description of the concept. These could be used as a rote learning activity, by giving students an anatomical name or term and asking them to identify it. They could also be used to promote conceptual understanding by providing students with an image or description and asking them to identify the subject of the card. Information on the flash cards was taken from sources with which the students were familiar and the answer was on the back of card so that students could check their partners'/groups' responses. Flash card activities were supplied to students in the laboratory and tutorial sessions as well as revision classes before the end of semester assessment.

Outcome Measures

Ethical approval was not required under the rules set out by the University Ethics committee, based on the National statement on Ethical conduct (NH&MRC, 2007 (updated March 2014)) as the data collected was part of a routine subject improvement survey and end of semester evaluations.

Evaluative data was collected in two forms: laboratory improvement surveys and subject evaluation. Laboratory improvement surveys were provided at the end of each laboratory and students were given the option to complete one. Students were told that the survey was a means for staff to gain an understanding of what the students did in the laboratory and how well they had learnt during each session. Questions on the survey included; What did you do in the laboratory today (followed by a list of activities in which the student could have participated)? What did you find useful? What wasn't useful? Were the hands on activities helpful? How do you think you learn best? Limited prompts were given to remind students that the surveys were available. Surveys were completely

anonymously and students could choose to answer all, some, or none of the questions. By answering the questions it was assumed consent was given. To avoid students being identified, students returned the completed surveys to a closed box at the end of each laboratory session. Surveys were collected every two weeks and data was entered by staff each fortnight.

At the end of each semester students were prompted to respond to online course evaluations. These evaluations are a part of a University-wide mandated evaluation process using a Blackboard interface. The evaluations were anonymous and students could choose to answer none, all or some of the questions. The evaluation examined the course as a whole, with the primary information relevant to this study captured in students' responses to the question: 'Was the teaching in the course effective to helping you learn'. Students were asked to use a 5-point Likert scale to respond to the question, with 'Strongly Agree' as the highest response and 'Strongly Disagree' as the lowest. Agree, neutral and disagree were the other responses students could choose from.

Upon completion of each semester, the exam results from the cohort that had used the new activities were compared to a cohort of similar size on a different campus who sat the same examination and had the same number contact hours, and course layout (lecture, tutorials and laboratory) but had not used these same resources. This comparison was to give some broad indication of the success of the project.

Results:

In semester one, 107 out of 231 students completed a lab-based subject evaluation. The results of the survey showed that in semester one the majority of students, 58.5%, said that they strongly agreed that the course met their learning needs, 34.9% said that they agreed that the course met their learning needs, 3.8% were neutral and 2.8% disagreed that the course

Discussion:

Students who participated in this study had clear concepts of how they best learned and, across the groups surveyed, learning styles differed widely. The largest group indicated that they learned best kinaesthetically. Hearing, speaking and listening also made up a large component of preferred learning techniques – suggesting that social learning, even hearing and seeing others ‘doing’ could support the majority of students. The findings of this study concur with others exploring learning styles for biosciences by nursing students (Good et al., 2013). A variety of learning exercises could potentially satisfy these learning style requirements, however the desire for hands-on activities is the area this study intervention most specifically targeted. This was informed by previous studies demonstrating very clearly that activities that encouraged peer discussion support learning and improved academic performance (Smith et al., 2009).

The hands-on activities developed around student feedback appear to incorporate elements students identify as of value for their learning, and were well evaluated by the majority of respondents. Of the students who chose to respond to the wider subject evaluation in both semesters the majority stated that they ‘Strongly agreed’ that the subject met their learning needs. This suggests that the combination of auditory, visual, and hands-on learning and teaching components on offer met the students’ desires and expectations and that there were sufficient hands-on activities to meet their learning needs. Again, this accords well with other studies describing effective teaching tools available for nursing students in the biosciences (James et al., 2011; Meehan-Andrews, 2009; Smales, 2010).

Use of these activities also appeared to support academic success in this group of students who achieved good course results; unlike many A & P courses, very few students failed to reach minimum standards (Courtenay, 1991; Friedel and Treagust, 2005).

Comparison of course grades between campuses demonstrated that the campus that was exposed to the new activities had a lower failure rate than the campus that didn't offer the activities. While it is clear that many factors can contribute to academic success in complex subjects, the other many similarities between these course offerings across campuses suggest that these additional activities may have constituted an important component of this success. As many of these clinical biosciences courses rely on a significant volume of rote learning (al-Modhefer and Roe, 2010; Good et al., 2013), and as many universities do not have the means or facilities to provide other hands-on activities such as dissection/laboratory experimentation to meet the learning needs of their students, simple activities from sources with which the students are familiar may provide an effective alternative resource that can assist subject convenors and tutors. Learning activities similar to the ones used in this study can be replicated in the tutorial time or lecture time as a way of incorporating various styles of learning into the classroom that are time efficient and simple to use (al-Modhefer and Roe, 2010), furthermore, students can also take the ideas home and replicate activities for their own study.

Increasingly, electronic resources are being developed and implemented to support student learning in the biosciences, as they are apparently cost- and time-effective for academic staff (Gresty and Cotton, 2003; Koch et al., 2010; Meehan-Andrews, 2009). Many technology-based learning tools however, have been shown to be relatively ineffective in this student population for many reasons which include relative computer-illiteracy and a lack of interest in engaging with on-line tools (Greene, 2006; Koch et al., 2010; Raynor and Iggulden, 2008; Wharrad et al., 2001) Moreover, some studies suggest that electronic resources are relatively ineffective for increasing content knowledge in clinical students (Kaveevivitchai et al., 2009) and that they can also constitute a significant cost for students

and/or tertiary institutions, both in terms of software purchase and hardware provision and maintenance (Childs et al., 2005).

Students have a diverse array of learning styles (Lujan and DiCarlo, 2006; Meehan-Andrews, 2009). Not all of these nursing students identify themselves as kinaesthetic learners and therefore other learning methods should not be discounted. Studies have shown that many students value the more hands on/active approach to learning (Johnston and McAllister, 2008; McVicar et al., 2010) but they also value attending lectures and tutorials as a means to better understanding (McVicar et al., 2014; Wharrad et al., 2005). The apparent success of interactive learning tools in assisting students with the large component of rote learning in A & P subjects (Johnston, 2010; Johnston and McAllister, 2008) suggests that the more hands-on activities to which students are exposed as a part of a variety of learning and teaching styles for A & P, the greater the probability of success in the course. Traditional methods have their part to play in education (McVicar et al., 2014), but they alone are not effective for many students (Efsthathiou and Bailey, 2012; Koch et al., 2010). Students valued having time with a tutor or staff member to help guide them through and develop an understanding of A&P, rather than rely on independent self-directed learning or on-line material (Kaveevivitchai et al., 2009; Wharrad et al., 2005).

Anatomy and physiology is often a daunting subject for students in their first year. It is often classed as a 'threshold' subject, opening (or barring) progress through nursing degrees. Many nursing students are non-traditional tertiary students who require effective support to engage with the academic content in such courses (Lizzio et al., 2002; Wilson, 2012). By introducing a range of activities and/or delivery methods that incorporate many learning styles, rather than just the traditional rote learning previously relied upon, a better learning environment can be developed for all students (Heffernan, 2012; McKee, 2002). Moreover, including a social factor in the course, such as group work or group based activities, may also

help breakdown the isolation barriers that many non-traditional students describe when they attend university (Drury et al., 2008). A more inclusive learning environment that meets the learning needs of more of its students may also help reduce the overwhelming fear of failure that many of these students report (Birks et al., 2013; Drury et al., 2008).

This study had a number of important limitations. The primary limitation was the lack of direct evidence of ‘value’ or outcome of the intervention. Future studies could consider directly linking access to activities and individual student outcomes. Additional limitations include a low level of response to the survey tools which may represent a biased/biasing sample population and limit development of a broad perspective of learning aids for nursing students in A & P courses. Greater participation in developing class activities that represent real student needs will support more effective engagement with those activities.

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Figure 1: Student response to anonymous evaluation statement, ‘The teaching of this course was effective in helping me learn.’ in semesters one and two. X-Axis shows Likert responses (1-5) and the y-axis shows the percentage of student responses.

Figure 2: Styles of learning students identified as their best way to learn. These seven styles of learning are based from the student lifecycle project carried out at Griffith University, Australia (Heffernan, 2012).

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Figure(s)

Figure 1: Student response to anonymous evaluation statement, ‘The teaching of this course was effective in helping me learn.’ in semesters one and two. X-Axis shows Likert responses (1-5) and the y-axis shows the percentage of student responses.

Figure 2: Styles of learning students identified as their best way to learn. These seven styles of learning are based from the student lifecycle project carried out at Griffith University, Australia (Heffernan, 2012).