Is H^+ the symbol for acid? Provision of learning support in foundation-level chemistry for Bachelor of Nursing students enrolled in bioscience subjects.

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Abstract

Despite the value given to the teaching of bioscience as a central component of undergraduate nursing education, it has been accepted that nursing students often find bioscience subjects some of the most difficult to both master and perform well in. This nuts and bolts paper explores a practical approach undertaken to give first year students, commencing their anatomy and physiology unit, the opportunity to self-assess their existing knowledge of chemistry. We then evaluated the outcomes of a providing a wiki of student-sourced web pages on chemistry that students could use to address any knowledge gaps or revise aspects of basic chemistry. We found that students were open to using online resources provided they saw the relevance, were aware of them and had time and access to tools. Additionally, results also indicated that encouragement from teaching staff may drive the usage of self-directed online resources.

Introduction

Bioscience is a term used to encompass: human anatomy and physiology, pathophysiology, clinical microbiology and pharmacology. As well as being considered a central component of undergraduate nursing education, bioscience is supported and highly valued by Bachelor of Nursing (BN) students as well as working nurses (Birks, Cant, Al-Motlaq, & Jones, 2011; Logan & Angel, 2011; McVicar, Clancy, & Mayes, 2010). Despite the value given to the teaching of bioscience, nursing students often find bioscience subjects some of the most difficult to both master and perform well in (Birks et al., 2011; Brown, Henry, Barbera, & Hyslop, 2012; El-Farargy, 2009; Johnstone, 2006; Logan & Angel, 2011; McVicar et al., 2010). There are likely to be many reasons for this (Brown et al., 2012). Biggs, drawing on the seminal work of Marton and Saljo, noted that "*meaning is not imposed or transmitted by instruction; but is created by the students*…{through} *their 'approaches to learning*'(Biggs, 1999; Marton & Saljo, 1976). Thus approaches to learning adopted by students would be central to students' mastery of, and performance in, bioscience. In applying this to teaching events, Biggs' 3P-model identifies both student-borne (e.g. prior knowledge, suitability to academic study and motivation) and teacher/institution contextual (e.g. teaching methods, teacher expertise, teaching spaces) "presage" factors. These factors interact at the process level to determine for any teaching event what approach to learning a particular student chooses (Biggs, 1999). With students commencing a university program, prior learning is likely to a key presage factor these students bring to any teaching and learning event. Bachelor of Nursing students is one of the cohorts that is typified as

having a broad range of prior learning of science ranging from none to recent high school graduates to mature-aged students who may have experienced a significant break in their secondary and tertiary studies, and/or where students experienced their learning of science in a different language to that of their current program (Jeffreys, 2007; Logan & Angel, 2011) (van Reyk, Ang unpublished results). Regardless of when and where this prior learning took place, it is also the case that the BN cohort is a group with a mixed experience of prior science learning including a substantial proportion of students who experienced significant difficulties (Andrew & Vialle, 1998; Potolsky, Cohen, & Saylor, 2003) (van Reyk, Ang unpublished results).

In the first year of a program, BN students usually study anatomy and physiology which relies, in part, upon foundation-level knowledge of chemistry. For example: chemical symbols, acids and bases, oxidation-reduction reactions, and structure and function of biologically significant organic molecules. Anatomy and physiology may be preceded by lectures and classes in basic chemistry either as a separate prerequisite, an optional bridging subject or the first component of an anatomy and physiology unit. Given, as previously stated, that a significant proportion of BN students encounter substantial difficulties with basic chemical concepts when these students commence their anatomy and physiology lectures: these same students are at a substantial disadvantage upon commencing their studies as they are faced with the double burden of mastering/re-mastering basic chemical and physical concepts as well learning tertiary-level anatomy and physiology.

Bioscience is a an ever burgeoning area embedded in BN programs which themselves must encompass an ever increasing body of knowledge if such programs are to meet the career demands of current registered nurses (Benner, Sutphen, Leonard, & Day, 2010; Brown et al., 2012). This creates constraints on the amount of time that can be allocated to foundation-level classes in areas such as chemistry. Also amongst BN cohorts there are students with a substantial mastery of chemistry (van Reyk, Ang unpublished results) for whom a substantial time allocation to foundational science could be counter-productive to their experience of learning bioscience. Thus alternatives strategies should be developed that target and then support those students who require extra learning support.

The aims of the project.

The aims of this project are to give first year students commencing their anatomy and physiology unit, the opportunity to self-assess their existing knowledge of chemistry, and then to provide them with resources that they can use to address any knowledge gaps or revise aspects of basic chemistry.

Project Tools

Chemistry Pre-test

The test comprised of eighteen multiple choice questions which covered a range of basic chemical concepts which were identified as being central to teaching anatomy and physiology. Specifically: (i) atomic and molecular structure; (ii) the chemical symbols for elements of significance to anatomy and physiology (e.g. Na, Ca, H); (iii) representing compounds and

molecules using chemical symbols (iv) ion nomenclature and representation of ions; (v) acids and bases and the pH scale; (vi) units of concentration.

Most of these topics have been previously assessed to be important chemical concepts by teachers of chemistry, nurse educators and graduate nurses (Brown et al., 2012).

The test was uploaded onto the Blackboard site for this subject as an online test. The availability of the test was posted as a Blackboard announcement and via class email. The test was optional and was available from a week before classes started and then throughout the semester. The number of attempts was unlimited. In this first iteration the feedback provided to students was limited to indicating whether an answer was correct or incorrect.

The Self Help Resources for Chemistry Wiki

Using the Campus Pack software built into Blackboard, a wiki was created comprising of web-based resources that included: text-based tutorials developed by lecturers and instructional videos from sources including the Khan Academy and YouTube. Rather than these being sourced by lecturers, these were selected by the lecturer from a pool of assignment submissions from students enrolled in the subject. That is an optional assignment was set where students were asked to identify a specific chemical concept they had difficulty with and then provide the URL and author details for a web-derived source they found useful. In addition to nominating the concept and providing the URL students had to provide a summary of the site which included a description of the content, how it was presented and its usefulness and/or limitations.

The resources were lodged in the wiki and sorted based on topic. A simple guide, comprising of a PowerPoint presentation of successive screenshots, was made available and provided a 'walk-through the wiki' for students.

Evaluations

Chemistry Pre-test

Out of a total class of 474 students enrolled in the subject, 83% of students attempted the diagnostic test at least once. A survey comprised of Likert scale and open-ended questions was conducted to evaluate the usage of the test. The key findings included that the majority (77%) of surveyed students either agreed or strongly agreed with the statement: *The Chemistry Diagnostic Test has given me an idea about how much background chemistry there is in anatomy and physiology*. Eighty-two percent either agreed or strongly agreed with the statement: *The Chemistry Diagnostic Test has given me feedback on how well I understand basic chemistry.*

A thematic analysis of the open-ended questions revealed that almost half (47%) opted to do the test because they wanted to test the extent of their own chemistry knowledge, mainly to check if their knowledge was adequate. Nine percent of students took the test to gauge the subject content requirements for chemistry. Notably 6% responded to the test either because they assumed that they were required to do the test or after the recommendations and suggestions of their laboratory demonstrators.

The Self Help Resources for Chemistry Wiki

A smaller proportion of students accessed the wiki (73%). A distinction needed to be made between accessing the wiki and using it considering that when surveyed only 28% of students chose "Yes" when asked "Have you used the online Self Help Resources for Chemistry Wiki?" Open-ended responses revealed that the majority (49%) of those who identified themselves as users were driven to do so to improve their knowledge and understanding of chemistry in general. Moreover, one in 10 specifically stated that the wiki was useful for revision and practice, whilst others (7%), in following-up on their results in the Online Diagnostic test, used the wiki to either to search for answers and solutions specifically to the online Chemistry tests and Chemistry problems, or because they had identified some difficulty understanding and applying Chemistry concepts. Five percent looked at the wiki out of curiosity - one quote that has left a substantial impression on the authors being "*Because I learned chemistry in chinese version* [sic] *& I want to know how chemistry is taught in English*". Also from the survey the majority of self-identified users (74%) either agreed or strongly agreed with the statement: *I found at least one resource in the Self Help Resources for Chemistry Wiki helpful with my studies of anatomy and physiology*. Sixty-six percent of the same group either agreed or strongly agreed with the statement: *I would recommend the Self Help Resources for Chemistry Wiki to other {subject name} students*.

From the findings, we can deduce that in one group, the wiki is used to build and improve one's knowledge (where students have not explicitly acknowledged facing difficulties with Chemistry), whilst in the latter group, the wiki is used explicitly to address Chemistry difficulties identified by students.

Amongst the respondents who did not use the wiki (and provided a reason for this) most simply chose not to use it without giving any reason. Despite the link for the wiki being directly the link students used to download lecture notes 18% of the students were unaware of the resource. A lack of time (10%) and difficulty using the wiki (7%) were also mentioned.

Implications

Our findings imply that students are open to using online resources provided they see the relevance, are aware and have time and access to the tools. Some of the drivers of usage of the diagnostic test we identified were in line with our aims namely as a self-assessment of the adequacy of current chemistry knowledge and as a gauge of the expectations and extent of chemistry knowledge required for anatomy and physiology. The value to student learning of such resources is supported by previous work from Sirhan and colleagues who found inclusion of a "pre-lecture" program of classes (of which the first component was a diagnostic test along the lines of what we have used) was linked to improvement in chemistry results for non-science major students (Sirhan, Gray, Johnstone, & Reid, 1999).

The findings also point to a critical role for lab demonstrators in helping students seek the help they need.

Given the difficulty some students had in either finding the wiki or using it we have identified additional ways that lab demonstrators can provide learning support.

Points of discussion for the session

- Can (or even should) we make the diagnostic test a teaching tool?
- Can a student-sourced wiki be considered a tool to develop critical thinking?
- Do self-study, and essentially extra-curricular, resources have the potential to impose an additional burden and source of stress/distress for students who are already struggling with the "on campus" teaching?
- Is the "elephant in the room" the on-going issue of how content heavy bioscience subjects remain?

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