Can active learning principles be applied to the bioscience assessments of nursing students? A review of the literature

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SUMMARY

Objectives: To explore if active learning principles be applied to nursing bioscience assessments and will this influence student perception of confidence in applying theory to practice?

Design and Data Sources: A review of the literature utilising searches of various databases including CINAHL, PUBMED, Google Scholar and Mosby’s Journal Index.

Methods: The literature search identified research from twenty-six original articles, two electronic books, one published book and one conference proceedings paper.

Results: Bioscience has been identified as an area that nurses struggle to learn in tertiary institutions and then apply to clinical practice. A number of problems have been identified and explored that may contribute to this poor understanding and retention. University academics need to be knowledgeable of innovative teaching and assessing modalities that focus on enhancing student learning and address the integration issues associated with the theory practice gap. Increased bioscience education is associated with improved patient outcomes therefore by addressing this “bioscience problem” and improving the integration of bioscience in clinical practice there will subsequently be an improvement in health care outcomes.

Conclusion: From the literature several themes were identified. First there are many problems with teaching nursing students bioscience education. These include class sizes, motivation, concentration, delivery mode, lecturer perspectives, student’s previous knowledge, anxiety, and a lack of confidence. Among these influences the type of assessment employed by the educator has not been explored or identified as a contributor to student learning specifically in nursing bioscience instruction. Second that educating could be achieved more effectively if active learning principles were applied and the needs and expectations of the student were met. Lastly, assessment influences student retention and the student experience and as such assessment should be congruent with the subject content, align with the learning objectives and be used as a stimulus tool for learning.

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Introduction

Nursing is becoming more self-governing and as such the ability to apply theoretical bioscience concepts to clinical practice is essential (Efstathiou and Bailey, 2012; Taylor et al., 2015). The complexity of the health care sector is often characterised by a dynamic and evolving mass of information and research (Mate, 2013). Consequently employers expect nursing graduates and students to have not only a mass of information and research (Mate, 2013). Consequently employers expect nursing graduates and students to have not only a...
appropriately applying concepts to patient conditions (Wissen and McBride-Henry, 2010; Birks et al., 2011). Students detail that the lack of applied learning in the bioscience curriculum has led to difficulties in their role as a registered nurse (Davis, 2010; Logan and Angel, 2011; Taylor et al., 2015). Therefore academics are challenged to incorporate active teaching and learning strategies that reflect the diversity in student demographics and ensure that they produce safe competent practitioners (Meehan-Andrews, 2009; McVicar et al., 2014).

Problems

Teaching bioscience presents a multifactorial problem, and can be challenging due to, students differing academic entry levels, large class sizes, length of classes, allocated time motivation, and, concentration (Efstathiou and Bailey, 2012; McVicar et al., 2015; Taylor et al., 2015). Due to the current Australian government marketing initiatives and widening participation agendas, universities have increased access to the Bachelor of Nursing degree (Koch et al., 2010; Taylor et al., 2015). Subsequently there has been an increase in the educational diversity of students enrolling in the course, with some of these students having no science or nursing background (Koch et al., 2010; Efstathiou and Bailey, 2012). Bioscience is reported to be an intense subject with a heavy study load that is conceptually challenging (Davies et al., 2000; McVicar, 2009; Johnston et al., 2015). Students have found that many of the concepts are not familiar and the binomial nomenclature is difficult to grasp (McVicar, 2009; Logan and Angel, 2011). Mature aged students may have not entered a learning environment for a substantial amount of time, and younger students find that the mode of content delivery is substantially different from secondary school (McVicar et al., 2010; Efstathiou and Bailey, 2012; Johnston et al., 2015).

The large class sizes for lectures, particularly in first year where most bioscience units are taught pose a problem as complex systems need to be explored and the students may lack confidence in the learning process (McVicar et al., 2010; Efstathiou and Bailey, 2012). Content delivery modalities have been criticised as not appropriate or favourable in regard to student learning approaches (Davis, 2010; McVicar et al., 2015). Students have conveyed that there is insufficient time allocated for the large amount of content they are required to learn (Davies et al., 2000; Meehan-Andrews, 2009; Taylor et al., 2015). There has been discussion that more curriculum time and teaching content in smaller groups may be more beneficial (McVicar, 2009; McVicar et al., 2015; Taylor et al., 2015). The delivery of bioscience content through a lecture series is favoured by students and universities as this didactic approach is often viewed as efficient and economical (Meehan-Andrews, 2009; Efstathiou and Bailey, 2012). It is viewed as a method to present concepts to a large group of students and stimulate topic interest (Meehan-Andrews, 2009) though it is heavily criticised as outdated, and ineffective to learning as the students remain passive and can experience stress from the surplus of information (Meehan-Andrews, 2009; Efstathiou and Bailey, 2012). It has further been demonstrated that students can only concentrate for 20–30 min at a time and as such there is a limited amount of actual information exchange occurring (Davies et al., 2000; Efstathiou and Bailey, 2012). Therefore due to their time length lectures are criticised as being a poor mode of content delivery that may compromise student learning (Meehan-Andrews, 2009; Efstathiou and Bailey, 2012). Lectures utilised should incorporate a combination of visual, aural, kinaesthetic and reading processes with question time encouraged to facilitate active learning ideals and maintain student participation and concentration (Meehan-Andrews, 2009).

An ensuing problem associated with the teaching of bioscience includes that there is no congruency in the level and depth of teaching between units and institutions (Efstathiou and Bailey, 2012; Taylor et al., 2015). This may be because bioscience educators may be ill equipped and unprepared to teach the complex subject matter (Efstathiou and Bailey, 2012; McVicar et al., 2015; Taylor et al., 2015). Additionally there is a trend in Australian universities for scientists to teach the nursing bioscience curriculum (Craft et al., 2013; McVicar et al., 2015). This has promoted surface or rote learning of bioscience content due to the high volume of concepts (Logan and Angel, 2011; Craft et al., 2013). These factors may have led to decreased comprehension levels of the intrinsic relationship between bioscience and the clinical interventions utilised in nursing practice (Logan and Angel, 2011; Christopher et al., 2013; Craft et al., 2013). Scientists may never have been exposed to the clinical environment and this lack of context can lead to the student’s poor integration of bioscience theory into the clinical setting (Logan and Angel, 2011, 2014; Craft et al., 2013; Christopher et al., 2013). Research details a theory–practice gap where the theory that should guide nursing practice is unable to be understood to be applied (Wissen and McBride-Henry, 2010; Logan and Angel, 2011).

Methods

Aim

Therefore taking into consideration the problems detailed above this literature review will explore if active learning principles be applied to nursing bioscience assessments and will this influence student perception of confidence in applying theory to practice?

Search Strategy

• The search process utilised four databases, namely CINAHL, PUBMED, Google Scholar and Mosby’s Journal Index. The citations of the identified papers were also manually reviewed to identify studies that could be of relevance to our literature search.
• The keywords utilised included bioscience, assessment, assignment, student, nursing, and teaching. These keywords identified from the research theme were integrated with Boolean operators “and” and “or” to create appropriate search phrases.
• Eligibility criteria were applied to further narrow down the selection of studies and suitable papers were identified by removing duplicates and reviewing the title and abstract. Inclusion parameters were applied further to narrow the list to documents published in the last fifteen years (2000–2015), with the full text available, from peer reviewed publications in English. This prevented any translational problems and preserved the authenticity of the papers.
• From the literature 26 journal articles of various methodology including qualitative discursive and review articles were found to meet the inclusion criteria. A critical analysis of the methodology of the remaining papers established validity with various congruent themes identified utilising an inductive strategy detailed in the results.

Results

From the literature several themes with additional concerns were identified. Firstly there are many problems with teaching nursing students bioscience education (Taylor et al., 2015). These include: student academic entry level, motivation, concentration, length and size of class, a lack of congruency in teaching depth between institutions, insufficient time allocated for classes, a lack of confidence in the learning process, ineffective teaching modalities and the types of assessment utilised by educators (Efstathiou and Bailey, 2012; McVicar et al., 2015; Taylor et al., 2015). Secondly that educating could be achieved more effectively if active learning principles were applied and the needs and expectations of student were met (Al-Modhefer and Roe, 2009; Koch et al., 2010). These needs and expectations include: utilising tutorials, practical and lab based learning, providing feedback, innovative teaching and assessment strategies, anonymity in the marking process and a learning focus (McVicar et al., 2015). Assessment that employs active learning is congruent with the subject content and aligns with the learning
objectives can be used not only for assessment purposes but also as a stimulus tool for additional learning (Boud and Falchikov, 2007).

**Teaching Principles and Assessment Strategies**

Learning is achieved more effectively if the approach through which a concept is taught embodies active learning principles such as reflection, interaction, and engagement (Al-Modhefer and Roe, 2009; Koch et al., 2010). Learning involves the internalisation of new data into an existing mental schematic; creating new pathways that permit the retention of this new information (Al-Modhefer and Roe, 2009). This networking occurs more proficiently if the methods utilised involve the active participation of the student (Al-Modhefer and Roe, 2009; McVicar et al., 2015). Fundamental aspects of active teaching and learning need to be applied to nursing bioscience education to encourage students to become engaged, maintain enthusiasm, and encourage participation (Efstatthiou and Bailey, 2012). Studies demonstrate that students that are actively involved in their learning are associated with advancement in educational achievement (Efstatthiou and Bailey, 2012).

As new modalities of teaching are explored and implemented there is a necessity to examine and reconceptualise the current methods for assessing and testing students (Boud and Falchikov, 2007; Logan and Angel, 2014). Generally there is a divide in how assessment can focus on and be used as a tool for learning that will assist students to apply the theory in practice (Boud and Falchikov, 2007; McVicar et al., 2015). It can be argued that when there is alignment between new effective learning modalities, and methods utilised for assessment an improved learning environment may be experienced (Boud and Falchikov, 2007). There is continued support for assessments that incorporate active learning process and academic merit for the representation of assessment as a learning tool; this encourages the student to become an active participant in their study (Boud and Falchikov, 2007; Logan and Angel, 2011). Learning is recognised as an active process and the views of students are increasingly being considered in the formation of unit assessments (Clouder, 2012). Students have found bioscience learning more understandable when active learning principles were applied and the learning was related to their practice either through simulation or placement (Fell & James, 2010). This paper highlights that theoretical bioscience concepts must be related to practice and reinforced through clinical examples and experiences that incorporate self-evaluation, reflection and collaboration (Fell and James, 2012; Boud and Falchikov, 2007).

The type of assessment provided to students can also assist to facilitate and encourage learning (Meehan-Andrews, 2009; Taylor et al., 2015). There are many different types of assessments incorporated in the tertiary curriculum (Smales, 2010; Taylor et al., 2015). These include both formative and summative assessments (Falchikov, 2005). Several methods are available that can be utilised to assess student learning in biosciences (Smales, 2010; Taylor et al., 2015).

Multiple choice questions (MCQs) are a popular choice for use in exams (Smales, 2010; Taylor et al., 2015). These are convenient because they are able to be taken online, but there is debate over whether MCQs promote a deep understanding of the topic or if they can assess high cognitive functioning such as application, synthesis of knowledge and interpretation (Smales, 2010; Taylor et al., 2015). The use of clinical simulations has also become a popular assessment tool in nursing education. These assessments allow the student to actively respond to physiological changes in the patient’s condition (Smales, 2010). This practice based learning (PBL) has been debated as a possible method of employing active learning in assessment (McVicar, 2009; Logan and Angel, 2014). While PBL should not completely diminish university based styles of educating it may assist by providing nursing students with experiences of applied learning (McVicar, 2009).

Students reported a view of exams as harder than other forms of assessment pieces (Craft et al., 2013). Therefore utilising written assessment pieces such as case studies has been identified as a valuable tool for increasing the learning of nursing students (Lavelle et al., 2013). Nursing students can develop increased insight into their own strengths and weaknesses by engaging in academic writing which will consequently assist in developing their problem solving skills (Lavelle et al., 2013). Literature has detailed that writing is linked to the reflective process, increases critical thinking, and both personal and professional development (Lavelle et al., 2013). Critical thinking is an integral concept in nursing literature and writing assignments allows the student to correlate content with increased development in their cognitive abilities (Lavelle et al., 2013). PBL with an embedded bioscience focus such as case studies is gaining support as a method to encourage applied learning and address the theory-practice gap (Logan and Angel, 2011, 2014). PBL requires self-motivated, and self-directed students as the content builds on their previous experiences to provide clear relevance of bioscience content to clinical scenarios (Logan and Angel, 2011, 2014). This can remove the feeling of being overwhelmed by bioscience content, and provide a context for information transference thus addressing the theory practice gap (Logan and Angel, 2011, 2014). Practice in applying bioscience content can provide an opportunity for a nexus between bioscience units and practical clinical experience (Logan and Angel, 2014). Academic writing can present a challenge for students with English as a second language (ESL), though it is also heralded as a method to assist in comprehension, language development and academic success (Salmonson et al., 2010). It may be prudent to ensure student access to further academic writing support mechanisms (Salmonson et al., 2010).

Reflective writing can also be used as a method which assists to foster analytic thinking (Lavelle et al., 2013). This is a method through which the student can engage in self-appraisal and critique their personal responses to assessment tasks (Lavelle et al., 2013). It is a process through which students can assimilate theoretical content and reflect upon their application of content with practice (Lavelle et al., 2013). This can also be used as a method to enhance continuous dialogue and interaction between the educator and student (Lavelle et al., 2013).

**Student Expectations**

Research has identified several key features that students expect in their assessment items (Clouder, 2012). These include feedback, innovation, anonymity, a learning focus, and ease of submission (Clouder, 2012). In regard to feedback students request comments that are provided with clear time frames, access to face to face feedback if required, and constructively written comments on their exam pieces (Clouder, 2012). Students further report the usefulness of exam feedback in the form of prep sessions with information regarding where students struggled in the past, key learning points and exam techniques (Clouder, 2012). Written feedback on assessment items is most useful to students when it is individualised, understandable, timely, focused on both strengths and weaknesses, constructive and expressed positively (Iqbal et al., 2014). Feedback should be consistent with graded marks and stimulate student thought processes (Iqbal et al., 2014). Despite how invaluable students find feedback as a learning tool and stimulus it is not uniform among teachers even within the same disciplines (Iqbal et al., 2014).

Innovation in the design of assessment items and in teaching strategy includes involving the students in the process of assessment development (Clouder, 2012). Research details that in this process the assessment that the students had designed was more complex than the previous form utilised (Clouder, 2012). Students reported feelings of engagement and ownership and felt as if they were an active participant in their learning and course (Clouder, 2012). There are several ways that students can become involved in the assessment process. These include through peer assessment, self-assessment, feedback provision, self or peer testing, and collaborating with assessors on particular aspects of the project (Falchikov, 2005).
An innovative strategy that has been demonstrated to assist student learning is the use of a web interface (Koch et al., 2010; Clouder, 2012). Web-based learning activities and materials have the ability to provide further educational support to the increasing number of students with external commitments and the large portion of diverse ESL students (Koch et al., 2010). This will enable students to study at home and at their own pace thus assisting the student to achieve a balance between work, study, and life (Koch et al., 2010). Students reported this extra resource as helpful in assisting them to comprehend content and meet learning objectives (Koch et al., 2010). Researchers have found that students responded favourably to the use of technology with the main noted limitation identified as a lack of internet access at home (Koch et al., 2010).

Anonymity in the marking process was detailed as an important method to remove any perceptions of bias and to provide reassurance to the students (Clouder, 2012). Anonymous marking is not encouraged to accuse academics of discrimination but is advocated as a method to alleviate student’s perceptions of bias (Clouder, 2012). This process is recommended for all forms of summative assessment items (Clouder, 2012).

Learning focussed refers to assessment that is part of the learning process, including the use of formative assessment pieces (Clouder, 2012). Formative assessment allows the student to reflect on their own learning process and level of comprehension and can allow the student to identify the standards required by the marker (Clouder, 2012). Formative assessment should be integrated in the curriculum in a strategic way that facilitates the educational growth and development of the student (Clouder, 2012). This can occur through various methods such as tutorials of laboratory based learning. Tutorials can be described as learning sessions in smaller groups that provide the student with the opportunity to engage with and learn content in more detail (Meehan-Andrews, 2009; Davies et al., 2000). Tutorials promote an increased comprehension of course concepts, and permit the student to learn actively by engaging with the tutor and their peers (Meehan-Andrews, 2009; Davies et al., 2000). The success of tutorials is dependent on the size of the class, as larger class sizes diminish the required interaction necessary to facilitate an interactive and engaged learning environment (Meehan-Andrews, 2009). The dynamic of the tutorial group is important and student led tutorials can foster greater participation, improve tutorial atmosphere, and increase student leadership (Meehan-Andrews, 2009).

Practicals or laboratory based learning incorporates the themes presented in lectures and tutorials and allows the student to learn kinaesthetically (Meehan-Andrews, 2009). The students can develop confidence and practical skill, exploring the concepts that were presented in theory (Meehan-Andrews, 2009). Literature discusses the success of practicals in reiterating and emphasising bioscience concepts and encouraging interest (Meehan-Andrews, 2009). Practicals encourage active learning and critical thinking with the smaller class sizes advocated (Meehan-Andrews, 2009). It is important for academics and educators to provide multiple types of learning, assessing modalities to cater to the various types of learners in their student cohort that employ the attributes of active learning (Meehan-Andrews, 2009). This approach of teaching in multiple modalities further provides the student with several opportunities to form connections and comprehend content material (Meehan-Andrews, 2009).

Submission of assessments should be through a mode that has an ease of accessibility and flexibility (Clouder, 2012). Electronic submission has been advocated though there are practical limitations such as ensuring materials have been received (Clouder, 2012). In regard to submission a reliable integrated electronic method of submitting work, then receiving results and feedback should be implemented where possible (Clouder, 2012).

Discussion

There are multiple problems associated with teaching and assessing bioscience. These include problems with academic level, large class sizes, length of classes, allocated time, motivation, concentration, understanding terminology, content delivery methods, lack of academic skills, congruency in level and depth of teaching and lecturer perspectives and background (Efstathiou and Bailey, 2012; McVicar et al., 2015; Taylor et al., 2015). The type of assessment utilised can directly influence student academic achievement and attrition. As students are consumers in regard to their education an inclusive approach to incorporating their views, expectations, and participation in assessment development should be encouraged (Efstathiou and Bailey, 2012). Assessment should be viewed as a tool to increase and facilitate learning (McVicar et al., 2015). Therefore it should incorporate active learning principles and development should be an iterative process constantly evolving to remain innovative and applicable (Clouder, 2012). Students have discussed a range of aspects that they feel are needed in assessments (Clouder, 2012). These include feedback, innovation, anonymity in marking, and a learning focus. There are various methods that can be utilised to incorporate these methods including PBL such as simulations, case studies, written assessments, and formative assessments in tutorials, labs, and reflective essays (McVicar, 2009; Meehan-Andrews, 2009; Logan and Angel, 2011, 2014; Lavelle et al., 2013). Clearly further research is needed on the relationship between type of assessment utilised and their efficacy in encouraging learning that facilitates the integration of bioscience knowledge into the clinical setting.

Implications for Further Research

Despite evidence regarding the best principles to apply to teaching assessment there remains the question of what type of assessment in the field of nursing bioscience education is the most appropriate to utilise to encourage student learning and address the theory practice gap. Therefore the implications for further research should include studies that focus on:

- Understanding better the needs of nursing students in regard to integrating bioscience theory to practice.
- What type of assessment can assist in facilitating bioscience integration?
- How can nursing bioscience units incorporate active learning principles into their curriculum and assessment items as they relate to clinical nursing practice?

Conclusion

As nursing becomes more autonomous the need to produce nursing practitioners that are safe, competent, and able to appropriately apply bioscience concepts to practice is paramount. The ability to integrate bioscience theory to practice correlates with improved patient outcomes and as such it is vital to ensure and facilitate this integration in nursing education. This is a major problem as students and established registered nurses report difficulties in learning and applying bioscience content. There are numerous reported difficulties in the teaching and assessment modalities utilised which indicates the need for innovative active teaching and learning strategies to be researched and applied to the bioscience curriculum to foster an encouraging student driven learning environment. Active learning and teaching methods include involving students in assessment design and development. Furthermore noting what students expect from assessments such as feedback, innovation, anonymity, and a learning focus will allow educators to form assessments that align with student needs and assist in addressing the theory practice gap by ensuring students can apply the theory to clinical situations.

References


