



## Review

## Biosciences within the pre-registration (pre-requisite) curriculum: An integrative literature review of curriculum interventions 1990–2012



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## SUMMARY

**Background:** The learning of biosciences is well-documented to be problematic as students find the subjects amongst the most difficult and anxiety-provoking of their pre-registration programme. Studies suggest that learning consequently is not at the level anticipated by the profession. Curriculum innovations might improve the situation but the effectiveness of applied interventions has not been evaluated.

**Objective:** To undertake an integrative review and narrative synthesis of curriculum interventions and evaluate their effect on the learning of biosciences by pre-registration student nurses.

**Review methods:** A systematic search of electronic databases CINAHL, Medline, British Nursing Index and Google Scholar for empirical research studies was designed to evaluate the introduction of a curriculum intervention related to the biosciences, published in 1990–2012. Studies were evaluated for design, receptivity of the intervention and impact on bioscience learning.

**Results:** The search generated fourteen papers that met inclusion criteria. Seven studies introduced on-line learning packages, five an active learning format into classroom teaching or practical sessions, and two applied Audience Response Technology as an exercise in self-testing and reflection. Almost all studies reported a high level of student satisfaction, though in some there were access/utilization issues for students using on-line learning. Self-reporting suggested positive experiences, but objective evaluation suggests that impacts on learning were variable and unconvincing even where an effect on course progress was identified. Adjunct on-line programmes also show promise for supporting basic science or language acquisition.

**Conclusions:** Published studies of curriculum interventions, including on-line support, have focused too heavily on the perceived benefit to students rather than objective measures of impact on actual learning. Future studies should include rigorous assessment evaluations within their design if interventions are to be adopted to reduce the 'bioscience problem'.

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## Introduction

Pre-registration student nurses appreciate the importance of learning biosciences but studies over the last 20–30 years have identified that it presents a major difficulty for many. A lot of studies have originated in the United Kingdom (UK; Akinsanya, 1987; Race and Holloway, 1992; Chapple et al., 1993; Nicoll and Butler, 1996; Jordan et al., 1999; Clancy et al., 2000) but reports from Ireland (McKee, 2002) and New Zealand (Friedel and Treagust, 2005) suggest a much wider problem. In the USA the understanding of science by pre-registration (pre-requisite) students has long been acknowledged as a critical predictor of a successful course outcome (e.g. Wong and Wong, 1999; Wolowitz and Kelley, 2010).

In the UK, the *Fitness for Practice* directive (United Kingdom Central Council for Nursing, Midwifery and Health Visiting (UKCC), 1999) clearly anticipates nurses at registration having met competencies that include application of a sound understanding of biosciences, that is, anatomy,

physiology, immunology, and biochemistry. Studies suggest that nurses qualify with an understanding that on average equates to a UK-standard of around General Certificate of Secondary Education to Advanced Level (Campbell and Leathard, 2000; McVicar et al., 2010) which arguably fails to meet statutory expectations (McVicar and Clancy, 2001; Davis, 2010). Similar concern has been expressed in New Zealand (Friedel and Treagust, 2005).

Despite concerns there has been little suggestion that the level of bioscience understanding has posed an actual risk to patient safety. In this respect, a recent UK study by McVicar et al. (2010) presented post-operative clinical scenarios to surgical care nurses and found that they generally were aware of the significance of key observations but were less able to explain physiological changes that could have potential meaning for patient welfare. While accurate observations are essential to patient assessment simply maintaining the status quo is not conducive to further practice development. Clinical decision-making requires a level of expertise in problem-solving which for bioscience entails awareness of how complex anatomical and physiological systems interact in pathological processes to produce symptoms of disorder, of how

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medication and care has an impact, and of the potential outcomes for the patient. These aspects are implicit in *Fitness for Practice* (UKCC, 1999) which paved the way in the UK for the recent introduction/expansion of graduate nursing intended to facilitate the development of such skills. However, it cannot be assumed that the associated higher entry qualification requirements will resolve the 'bioscience problem' in pre-registration education. Reports suggest that nursing students still have difficulties with bioscience subjects in Australia and New Zealand where graduate nursing is well-established (e.g. Friedel and Treagust, 2005; Whyte et al., 2011).

Possible factors that may contribute to student difficulties with learning bioscience include admission criteria, teaching strategy, lecturer ability, and curriculum time (see McVicar and Clancy, 2001; Davis, 2010). Historically it has been suggested that the position of biosciences within pre-registration curricula does not reflect the level of importance attributed to them since they are usually taught outside the holistic approaches to individualised care (Wynne et al., 1997). This curriculum shift has been claimed to devalue biological sciences in favour of behavioural science (Trnobranski, 1993; Torrance and Jordan, 1995). Though students themselves would like more curriculum time spent on bioscience (Friedel and Treagust, 2005; Davis, 2010) it seems likely that this issue would have been resolved during the last 20 years had re-apportionment been feasible. The biosciences comprise just one component of the pre-registration nursing curriculum and any re-apportionment would be at the expense of other topic areas.

Requirements of pre-registration curricula in the UK since 2000 include greater and earlier exposure of students to clinical placements (Nursing and Midwifery Council (NMC), 2010). Working with experienced practitioners could help to reinforce learning, bridge the theory-practice gap, and improve skills but this necessitates clinical staff themselves being confident of their understanding of biosciences, an area which seems lacking however (Prowse and Heath, 2005; McVicar et al., 2010; Davis, 2010). Better strategies for improved bioscience learning therefore should be developed alongside these wider curriculum developments possibly involving teaching that focuses more directly on student need by accommodating a range of learning styles and/or the application of more 'active' learning activities (Torrance and Jordan, 1995; Michael, 2006; Meehan-Andrews, 2009). However, an evaluation of strategies that have been tried has not been conducted. The current study therefore presents a review of innovative teaching strategies introduced specifically to support learning and teaching of bioscience within the pre-registration nursing curriculum in order to evaluate their outcomes.

## The Review

### Aim

The aim of this integrative review was to evaluate the impact of curriculum interventions on bioscience learning in pre-registration nurse education programmes.

### Method

A systematic review was not possible because precise inclusion criteria (see Shuldham et al., 2008) could not be applied to the selected literature due to a lack of homogeneity of study designs in terms of the study objectives, sample size, type of intervention, duration of the intervention, and type of data. Accordingly, the review was broadened as an integrative review to provide a synthesis of the characteristics of curriculum interventions, of their receptivity by students, and of the evaluation strategies used to evaluate impact.

An integrative review supports the selection of evidence from studies that have applied different methods and included a range of variables in the process (Whittemore and Knaf, 2005) but it does not provide the specificity of evaluation ordinarily anticipated with

systematic reviews. In this study, interventions were collated under two categories: (1) classroom-based or (2) on-line interventions. Key variables related to the accessibility and/or acceptability of the intervention and to the strategy applied to evaluate the impact. Comparative components such as control groups in most instances were lacking (see 'Quality Assurance'). However, the utilization of a range of data types provides strength to data interpretation, and for this study the means to determine gaps in research evidence for the value of curriculum interventions to support bioscience learning (Whittemore and Knaf, 2005).

A search of the research literature related to the learning and teaching of biosciences in pre-registration nursing curricula published between January 1990 and June 2012 was conducted of the databases EBSCO (which includes PubMed and CINAHL), and British Nursing Index. The earliest date marked the entry of pre-registration nursing education into the Higher Education sector in the UK, which was the focus of this review. The selected databases are the most prominent for sources in this field but relevant papers potentially might have appeared in journals other than those in these databases. The search was therefore repeated using Google Scholar, and also supported by a manual search of citations in selected papers. Accordingly we are confident that the review is based on a comprehensive literature search. Key words used to search in the Title and Abstract fields are given in Fig. 1. Inclusion criteria were: studies published in peer-reviewed journals in the selected timeframe, English language, pre-registration nursing students as participants, provision of a description of a curriculum intervention specifically to support bioscience learning, and an evaluative strategy with outcome data. Excluded studies were those involving post-registration courses or registered nurses, descriptive, discussion and editorial papers, and dissertations.

The decision to include or exclude studies was made through inter-rater agreement (see 'Quality Appraisal' below) and in most instances there was little or no debate since the intention to involve only interventional studies readily narrowed the field (see Fig. 2). In the early phase of the search, however, there was discussion about the inclusion of those related to learning and teaching of pharmacology or genetics. These topics raised specific issues beyond the learning of basic bioscience (anatomy, physiology, biochemistry; immunology) in particular nurse prescribing or medication errors and gene technologies, respectively. A joint decision therefore was taken to exclude them.

## Results

### Data Abstraction

Abstracts were scrutinized by SA and AM to provide an agreed initial database. All discussion or opinion papers were discarded. In the relatively few instances where an abstract was not available but the title looked relevant then the paper was automatically included in the next phase. The papers were then sought either from electronic sources or via the British Library and read in full by both SA and AM for independent selection and subsequent discussion with reference to the inclusion and exclusion criteria. The literature flow-through is illustrated in Fig. 2.

Data abstraction was conducted by two experienced researchers, normally jointly but when not then any decisions ultimately were agreed following further discussion. Such instances were uncommon as the strict inclusion criteria and the systematic recording of data (see Table 1) provided clear guidance as to what was required. When discussions arose it was normally because of lack of clarity in the papers, for example as to year of course. The final database comprised fourteen studies specifically related to the introduction of innovative teaching and learning strategies for biosciences in the pre-registration nursing curriculum (see Table 1). Eight studies were located in the UK (7 England, 1 N Ireland), 3 in Australia, and 1 each in Brazil, Italy and the USA. The

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