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Science in Nursing or nursing science? A preliminary report.

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Abstract

Introductory level sciences occupy approximately a quarter to a third of undergraduate nursing programmes. It has long been held that the science subjects in undergraduate nursing programmes cause students, on average, the most anxiety. Science lecturers have expressed concern over an apparent need to reduce content in order that students cope. The professional literature indicates the existence of a science–nursing tension, however, there is little to clarify what it is about the sciences that nurses wish to reject and there is expressed a binary polarity from ‘science is extremely important to nursing’ to ‘science should be removed from nursing curricula’. There have been calls to ‘re-envision’ science curricula for nursing. This has resulted in programmes being redesigned such that the science content is fully integrated rather than discrete. The few evaluations performed on such programmes have not demonstrated a lessening of student anxiety or indicated evolving changes to the science–nursing tension. The aim of this project is to clarify the level of science that nursing professionals feel is actually required for undergraduate programmes. The method has been designed as a modified Delphi approach using focus groups, surveys and document analysis.

Introduction

The culture of nursing as it has developed as a profession has sought autonomy, rejecting the role of ‘handmaiden’ to the medical profession. The philosophy of human science as an aspect of nursing practice, whether the philosophy is recognised or not, has, at times, resulted in a rejection of the medical ‘scientific’ model of care. Human science philosophy concerns itself with ‘lived experience’ and respecting or allowing persons, in the case of nursing - ‘patients’, the opportunity to act within their own experiences in relation to health and quality of life. Human science rejects the biomedical model upon the grounds that scientific norms (knowledge) are a tool of power with significant opportunity to create limited boundaries, supplanting ‘care’ with ‘control’. Several nursing theories are based in the human science paradigm: Parse’s *Theory of Human Becoming*, Watson’s *Theory of Human Caring* and Newman’s *Theory of Health as Expanding Consciousness* (Cody & Mitchell, 2002). This viewpoint sets objective data in opposition to subjective life experience, yet nursing practice involves

understanding of both, particularly from the nursing viewpoint of ‘knowledge broker’ where the nurse brings together scientific and technical knowledge with patient care knowledge. The National Review of Nursing (Heath, 2002a, p.14) states “... nurses must demonstrate a high level of skills including humanistic and technological elements incorporating the knowledge and understanding underpinning the skill”. The dichotomy formed between ‘care’ and ‘science and technology’ underpins the basis of the ‘science-nursing tension’ and its interplay can be seen in the International Council of Nurses definition of nursing:

Nursing encompasses autonomous and collaborative care of individuals of all ages, families, groups and communities, sick or well and in all settings. Nursing includes the promotion of the health, prevention of illness, and the care of the ill, disabled and dying people. Advocacy, promotion of safe environments, research, participation in shaping health policy and in patients and health systems management, and education are key nursing roles (ANF, 2005).

The Macquarie Dictionary defines science as:

The systematic study of man and his environment based on the deductions and inferences which can be made, and the general laws which can be formulated, from reproducible observations and measurements of events and parameters within the universe.

Something is scientific when it:

Pertains to science or the sciences; occupied or concerned with science; regulated by or conforming to scientific principles of exact science: *a scientific method*; systematic or accurate.

This definition of science forms the basis of many science and health science disciplines, the word ‘science’ being incorporated into the names of many degree programmes, including those for nursing. It is the basis of standards for Evidence Based Practice (EBP) which are included as a requirement in the competency documents for nursing professionals. Cody and Mitchell (2002) note the decline in journal submissions that fit within the human science framework and the increase in those associated with EBP since the early 1990s. Heath (2002b, p.61) indicates that “nursing has also become far more scientifically based, with technological innovations leading to a blurring of diagnostic testing and clinical monitoring”. With the recent introduction of the Nurse Practitioner, nurses gain a wider referral role and a more significant role in medical diagnostic assessment and prescribing rights, which are distinct from a nursing diagnosis role, within their chosen specialist arena.

The science-nursing tension is at its most evident when attempting to teach science content to nursing students. Undergraduate nursing students are stressed by the breadth and depth of content to the extent that some science educators feel the need to reduce content in programmes. Some of this anxiety may be attributed to the various entry modes to programmes based on recognized prior learning (RPL). Such RPL is often limited to a requirement that a student can demonstrate their ability to study and no pre-requisite subjects are included that might alleviate the need to quickly ‘catch-up’ on

background that a high school leaver might be expected to know. This has been a source of research worldwide for a number of science educators. Friedal and Tregust (2005) convened focus groups of students and nurse educators to ascertain their viewpoints regarding bioscience content in nursing programmes. They found that students' viewpoints were actually more positive than those of the nurse educators and that the educators had less self-efficacy regarding bioscience than the students they taught. It was thought that preceptors and nurse educators may themselves have insufficient background to help the students apply science principles to their practice. Such circumstances undermine the importance of bioscience to practice and clinical reasoning by disassociating theory from practice.

Colleagues at the Dubbo Campus of Charles Sturt University surveyed past and then present students to ascertain characteristics surrounding their period of enrollment. Of the cohort 21% had left school at 15 years of age. Only 11% of students were under the age of 20 years indicating that few Year 12 school leavers were choosing Dubbo Campus for their nursing programme. Those older than 35 years formed 26% of the cohort and almost half of those returning the survey had children living with them (Maginnis, Croxon, 2004). These figures contrast with national estimates that indicate 37% of those enrolling in nursing pre-registration programmes had completed school and only 9% were mature age entries (Heath, 2002b). It is recognized that previous experience of the biological sciences impacts upon success in nursing studies (Wharrad, Allcock & Chapple, 1994, Peat, Franklin, Devlin, Charles, 2005). Collis and Biggs (1991) indicate that students who have missed the final years of schooling, Years 11 and 12, are disadvantaged at university level studies as they miss the developmental stages of multi-structural levels of functioning encouraged by basic school sciences. These formal stages include theoretical models, language forms of symbolic notation and understanding relationships between variables. Studies of student's approach to learning have identified that females are more likely to adopt deep learning approaches compared to males and that mature age students are also more likely to use such strategies as they are more determined to learn the reasoning aspects rather than memorise facts (Regan, Regan, 1995, Ofori, 2000). However, this is in contrast to Regan and Regan's results that examined styles across first year discipline cohorts. Their findings identified that the nursing students were the most likely to adopt surface strategies despite the student body being female dominated. Heath (2002b) notes that nursing remains a female dominated discipline with 88% of enrolments being women.

Deficiencies in knowledge for nursing practice have been identified by King (2004) and Manias and Bullock (2002) regarding pharmacology understanding and by Wilkes and Batts (1998) regarding chemical and physical sciences. King found that in the United Kingdom nurse respondents felt insecure as they felt either not enough time had been spent on pharmacology or it had been integrated into other topics downplaying the need for a continuous pharmacology theory and undermining its importance. Manias and Bullock's Australian study determined that there were no specific guidelines on levels to be taught for efficacy in practice and consequently programme content was variable. Clancy and colleagues (2000) have identified that 98% of students wish to have the opportunity for more human biological science study within their programmes to prepare them for practice and this would certainly impact on not only undergraduate anxiety but the postgraduate insecurity identified by King. Jordan (1994) suggested that by reversing the 'theory then practice' model by introducing bioscience as a means of

reflection on practice might reduce student anxiety and would impact on recognized levels of relevance by students. It might also impact on recognized levels of relevance for those practicing clinicians that do not have the background to assist their students in bioscience application to practice.

It is recognised that a greater potential for understanding and efficacy in nursing practice is achieved when scientific knowledge is incorporated into nursing care (Wynne, Brand, Smith, 1997) and that research identifying the bioscience knowledge needed for safe nursing practice is needed. Jordan, Davies and Green (1999) suggest a qualitative method would be the most appropriate to achieve clarity. Wilkes has attempted this for the chemistry and physical sciences in her PhD thesis (Wilkes, 1992). However, appropriate levels for undergraduate anatomy, physiology, pathophysiology, nutrition and pharmacology have yet to be identified.

The Carrick Institute Review of Nursing cite areas considered lacking in pre-registration programme curriculum. These included indigenous health issues, cultural safety, rural and remote health issues, IT & technology, changing nature of hospitalisation, occupational health and safety, preparation for mental health, and aged care (Van Loon, Clare, Brown, 2005). The National Review of Nursing found that the role of 'knowledge broker' required "... high levels of communication skills, broad scientific knowledge, understanding and trust. In addition, the broker needs to be able to search, and retrieve information and then assess and critique that information (Heath, 2002b, p.160)."

Method

This report concerns document content analysis and focus groups narratives. The documents to be studied include the competency statements for registered nurses and the individual state guidelines for pre-registration programmes provided by the respective nurses and midwives registration board. University course outlines, when available, were accessed via each university's web site and examined for an indication of science subject content. The focus group was convened following the days agenda of the May 2006 National Nurse's Organisation meeting. Members were invited to join the focus group to participate in a discussion regarding science in nursing. This first focus group meeting forms the initial data for a modified Delphi project that is being conducted as part of a PhD project by the first author. Ethics approval has been granted by Charles Sturt University.

NMB Accreditation programme guidelines

Each state has its own registration board that governs nursing. The boards also have the role of determining whether institutions are appropriate providers of nursing education and the determination of whether their pre-registration programmes meet requirements to enable a graduating nurse to gain registration. All Australian programmes are judged by the board residing within the institution's home state, and the programmes are monitored regularly by that board. Guidelines for institutions preparing programmes are available on each board's web site. These were downloaded and the contents searched for mention or directions for science subjects including the appropriate level to be taught. The guidelines also provide directions for determining appropriate teachers of the content to be taught.

The Australian Nurses Council Incorporated provided the ANCI National Competency Standards for the Registered Nurse 3rd Edition, May 2000. These were updated in December in 2005 and released in January 2006 by the Australian Nurses Federation (ANF) under whose auspices the review project was conducted by the University of South Australia. The competencies were searched for mention of specific science based behaviours.

Pre-registration Undergraduate Nursing Programmes - Course outline analysis

The contents were searched for obvious science subjects determined either because taught by science faculty or the subject's title and an estimate was calculated for the percentage of the total programme for those subjects.

Focus group held at the Australian Nurses Federation, National Nursing Organisations meeting, May 5th, 2006, Sydney.

An invitation to participate in the focus group was sent via email to those attending the meeting by the ANF with the meeting agenda. The number of groups represented by membership of the NNO is 53. The May meeting expected 36 attendees, of whom nine self-selected to participate. The meeting was held for an hour and was recorded to provide a transcript. An independent scribe took notes during the meeting to supplement the tape. The following questions were posed for discussion:

What are your feelings regarding the science content within undergraduate programmes?

Would you consider nursing an applied science? If so, then is not the nurse the expert of the science to be taught within an undergraduate programme?

Do you feel that it should be a nurse who teaches science subjects?

How would you envision science might be integrated into practical subjects?

What do you feel are the science basics that must be included?

Using the textbook vignettes provided, could you indicate the level you feel most appropriate for undergraduate science classes?

Would you see the pathophysiology fitting more with the nursing subjects rather than the science subjects?

The transcript was analysed for eventuating themes.

Results and Discussion

Pre-registration Programme Accreditation guidelines.

Guidelines in each of the pre-registration programmes range in detail from four pages of information to sixty. The guidelines provide imprecise statements regarding science when it is itemised. Of the seven state guidelines science is mentioned in only two specifically which use the term health science as distinct from nursing science. Health science is mentioned only once in each of these two guidelines and then included with law and ethics and social science. It is stated that these topics should be taught in order to 'adequately support' nursing subjects. One other refers to EBP and technology, but

not to health science. All guidelines give considerably more direction for clinical subjects and placements.

Provision is made within the guidelines for who should be teaching undergraduate nurses. The guidelines are unanimous in that the Head of a Nursing School must be a registered nurse or midwife within the teaching institution's home state. Teachers of nursing subjects must be suitably qualified in their field of expertise as recognised by that state's board and with a minimum of two years practice experience. Preference should be given to those with postgraduate level qualifications. Teachers of allied subjects, when included, should be experts in their field and suitably qualified as required by the professional body governing that discipline (ACTNMB, 2005, NMBNT, 2005, NBSA, 2005, NBT, 1999, NBV, 2005, NBWA, 2004, QNC, 2005).

ANCI 2000 and ANMC 2005 National Competency Standards for the Registered Nurse. Both sets of competencies include many science based behaviours if it is assumed that clinical reasoning is essentially a process that involves hypothesis testing. The more recent ANMC Competency Standards specifically include:

- knowledge of and critical analysis of empirical research data;
- knowledge of and critical assessment of empirical physiological data;
- use of a range of data gathering techniques;
- accurate interpretation of data; accurate use of health care technologies;
- identification of deviation from normal;
- the ability to evaluate effectiveness of health care plan and adjust it accordingly for better health outcomes.

Subject Outline analysis

The university web sites were searched in April 2006. At this time, in Australia, 31 universities were offering pre-registration nursing programmes. Four universities did not have course outlines available on the web. Course outlines were available on web sites as public documents for 26 universities. These revealed that on average the science subjects comprised approximately 17% of the course outline. The minimum was 9%, the maximum was 37%. All except three programmes required three years full-time study. Two programmes were seven semesters with one that was eight semesters in duration. One course was an accelerated two year programme. One six semester course contained a 50% clinical programme. Only one programme was delivered entirely by distance education involving periodic intensive on-campus residential schools.

Three universities had integrated physical and biological science into nursing subjects making separation for a percentage calculation not obvious, although other subjects were clearly delineated as science curricula. Consequently, the estimated value for science content is likely to be below the real value, thus causing the average percentage to be an underestimate. One of these universities did however describe the available programme as having been designed into two distinct strands: a health science strand and a nursing strand. Obvious science components, such as anatomy and physiology, were clearly designated in the health science strand, although this strand also contained subjects that were clearly nursing subjects. This highlights the cross-over.

Focus group transcript analysis.

Four main themes surfaced from the focus group transcript. These are titled 'content', 'levels', 'inter-relatedness' and 'concepts of science'. As these formed the basis of the intention for the focus group discussion this is not surprising however, the focal points that were generated under these themes were not entirely expected. Excerpts or comments from the focus group transcript are included in italics in the following discussion.

Concerning the 'content' theme areas of particular mention included chemistry, pharmacology, nutrition, physiology and pathophysiology. Chemistry was referred to by group participants for understanding of pathology reports and renal disease in particular. Programmes personally experienced either by attendance or by pre-ceptorship or mentoring of students as undergraduates or postgraduates were criticised for their lack of pharmacology preparation or their lack of specific material regarding background to specialities, in particular, the lack of preparation regarding reproductive biology, health and sexuality. The general consensus regarding undergraduate programme content was expressed as: *There can never be enough!*

It was also evident that those who had initially trained in the hospital based system felt they had missed out becoming aware of essential theory for application within clinical reasoning skills. One participant expressed this in the following statement: *If only I'd known!* Other participants confirmed this either verbally or by nodding vigorously.

The other aspect concerning 'content' referred to the context within which it was taught. There was consensus by the group that science content had be taught in an applied context so that the undergraduate student recognised the relevance of the material to their future nursing practice. Regarding the student's understanding:

It is essential that they understand the biology and the physiology of everything that has happened to Mrs. Smith so that she can actually survive.

The 'levels' theme relates to the level of detail/precision that it was felt undergraduate nurses required in their studies. It was clearly indicated that medical physiology and precise anatomy texts, it was felt, belonged to post-graduate levels of study. However, this clarity lost decisiveness when attempting to determine between essentials of anatomy and physiology texts and similar texts intended for tertiary level study. Some of this indecisiveness might be due to this particular group personally relating to those who entered university via alternate entry pathways rather than university entry exams. The focus group were for the most part initially hospital trained nurses who then upgraded their qualifications to degree, then progressing to post graduate study where medical physiology texts were incorporated in their learning. Each participant agreed that science material underpinned nursing practice particularly with regards to EBP and clinical decision making but opinions varied when attempting to determine the appropriate level to be taught despite recognition that the level was important. What was agreed upon was that students needed to be able to: *recognise that something isn't right* so that they would then *take it up a step*.

The theme 'Inter-relatedness' captures those ideas regarding who and how science content should be taught to undergraduate nurses. The 'content' theme captured the necessity of an applied context and in this way the 'inter-relatedness' theme could well sit within the 'content' theme however, this would separate the 'who should teach science' discussion which captured aspects of 'inter-relatedness' that did not fit within a 'content' theme.

The role of a nurse as 'knowledge broker' is intimately connected to the 'inter-relatedness' theme. The nurse acts as 'interpreter' between all health related fields and the patient's level of understanding. In their 'care' role they 'broker' the scientific and technological information for the patient. This requires a basic understanding by the nurse of all the discipline languages being used in medical and allied health as indicated by the participant who noted:

Nurses need a certain level of knowledge to discuss with other health professionals.

It is often the nurse who acts as a central point of translation for all of the questions a patient wants to ask after having time to assimilate the information that relates to their health status. This aspect of nursing practice, it was indicated by the focus group, was supported by exposure to other health disciplines and consequently by exposure to teachers of other health disciplines. For example, one participant stated referring to teaching muscle cell physiology: *I think the appropriate person would be a physiotherapist.*

The discussion of who are the appropriate teachers of science content clearly indicated that it was felt the nurse did not have the expertise to deliver such content but that the applied scientist, such as the physiotherapist, would be more appropriately qualified to do so. The group unanimously agreed that the 'pure' scientist was an inappropriate person to teach undergraduate nurses as they were unlikely to be able to apply their knowledge to nursing practice. In this context, the group viewed the 'pure' scientists as being the chemists or physicists, although they did not discount the idea that these specialists would be appropriate provided they were willing to take the time to learn the relationships required by nurses in their practice. One participant highlighted this aspect by recounting her experience of a veterinarian teaching kidney function:

... when the vet gave a lecture on something to do with the kidney and all we were thinking of was 'is he thinking a horse or a human?' ... because he actually didn't tell us at the beginning, ... he didn't tell us how it related to nursing but he did tell us he was a vet ...

'Inter-relatedness' also emphasised by one participant by the following response:

... that nurse who's teaching the clinical skills in the lab also needs to be talking ... to the applied science person and saying 'Can you give me a brush -up, just for a moment here again, ... because I want them to relate it back to their physiology as well.'

The other aspect of ‘inter-relatedness’ was apparent in a discussion of timing or sequencing science content with nursing content. For the most part during the focus group discussion the nursing content referred to clinical skills content. The discussion centred on the need to deliver material *just in time* in order to make

those relationships really apparent to them ... that all those components that they may have had actually get captured ...

and that

constant linkage every step of the way ... reminding and revisiting ...clear clinical relationships.

The last theme concerns the groups ‘concept of science’ within nursing practice. Most Nursing degrees have titles such as Bachelor of Health Science (Nursing), Bachelor of Science (Nursing) or Bachelor of Nursing and are usually, but not exclusively, delivered by discipline schools that reside within Faculties of Health Science. The group was asked if they regarded nursing as an applied science and the response was an overwhelming ‘yes’. They backed up their response with the title of their degrees. This prompted the facilitator to ask if they regarded themselves as ‘scientists’ and this prompted a delay in spoken contributions while participants considered the notion. It was apparent by the body language and facial expressions that they had not considered this as a title for a nurse. One even went so far as to state that, when referring to science content: ... *couldn’t teach those things.*

It was apparent that the group felt that science literacy was important for nurses to be able to educate individuals and communities and to explain science ‘facts’ as reported by the media. Although the necessity to be able critique such science reports was not discussed directly, indirect reference was made by one participant when she used the word ‘credibility’:

It’s really important to be able to give those scientific facts ... to have them at your fingertips and be able to give them in a succinct manner ...with credibility.

The facilitator was, however, reminded by the focus group that nurses *have a foot in each camp.*

The focus group touched upon areas of the science-nursing tension when they discussed the difficulty of learning science. It was highlighted that during undergraduate study the emphasis on practice and practical skills caused the student to concentrate on mastery of tasks rather than the theory – practice relationship. Clinical placements required and examined skill mastery based upon the achievement of competency. Those who trained in the hospital based system found that they gathered added depth to their practice during their degree studies and that theory coming after the learning of nursing skills created an ‘ah ha’ experience that emphasised the need to know more. This supports the

conclusions reached by Jordan (1994) who suggested that a reversal of the theory then practice model might reconnect science to practice.

Comments made by the focus group may give some indication to results found by Regan and Regan (1995) regarding nursing students being the most likely to adopt surface learning strategies. Participants noted that those *who may not be the brightest students* but were thought of as having a *caring nature* were often encouraged by careers advisors to seek entry to nursing. Thus, these students may begin their university studies without necessarily having studied subjects that would help them in their tertiary science subjects, increasing their anxiety and resulting in the adoption of surface learning techniques as they attempt to catch-up. This would add a component to the disproportionate levels of stress suffered by nursing students in science classrooms (Jordan, Davies, Greene, 1999) along with school completion at 15 years of age and mature age entry.

Conclusion

Documentary guidelines for science content in undergraduate nursing is far from precise despite competency documents including several science discipline behaviours. The focus group elicited ideas concerning the importance of science content within undergraduate programmes but the level of the content to be taught remains unclear. It was, however, very clear that such content needs to be taught in a way that directly relates to nursing practice. This project will continue by developing a survey, based upon the data presented in this report, to be delivered to a broad range of nurses currently working nationally to obtain a clearer understanding of these issues.

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