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Article in *Learning in Health and Social Care* · November 2005

DOI: 10.1111/j.1473-6861.2005.00104.x

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Learning bioscience in nursing education: perceptions of the intended and the prescribed curriculum

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Keywords

attitudes, bioscience, intended curriculum, nursing education, self-efficacy

Abstract

This study used a curriculum inquiry framework to investigate the perceptions of 184 nursing students and nurse educators in relation to bioscience in the nursing curriculum. These participants' attitudes to science and bioscience, self-efficacy in bioscience and perceptions of bioscience were investigated using scales based on previous research. Nursing students were found to have significantly more positive attitudes to bioscience in nursing education than nurse educators, and nurse educators were *not* found to have significantly better self-efficacy in bioscience than the students, although this might have been expected. The results of focus group discussions, used to investigate this in more depth, suggested that some nurse educators and clinical preceptors may not have sufficient science background or bioscience knowledge, to help nursing students apply bioscience knowledge to practice. As a result of this, it is suggested that the aims of the intended and prescribed nursing curricula are not being fulfilled in the implemented curriculum. Because of the increasing acuity of illness in hospitals, the fact that nurses are becoming more autonomous in their practice and the increasing expectation that nurses, in some cases, will be able to prescribe as well as administer medications, bioscience knowledge is becoming even more important. The teaching of bioscience and its application to clinical practice needs to improve if nurses are to be credible members of the multi-disciplinary team.

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Introduction

This paper presents some of the preliminary results from a larger study that aims to improve the teaching

and learning of bioscience subjects in nursing programmes. The study was designed to investigate bioscience in the nursing curriculum in New Zealand, and the perceptions that nursing students, teachers

and graduates have of bioscience, both in nursing and in the nursing curriculum.

Nursing and nurse education have both changed markedly during the past 50 years. In many countries, world-wide, nursing training has moved from a hospital-based apprenticeship system, firstly to more academic programmes in institutes of tertiary education, then, in some countries, to degree-level programmes. There have been moves to establish nursing as an independent academic profession based on a distinct body of knowledge. The need to make the nursing profession distinct from the medical profession has led to an emphasis on the importance of sociological and behavioural knowledge for nurses, rather than scientific knowledge. Wynne, Brand & Smith (1997) have argued that neglect of the biological and physical sciences that relate to nursing has led to an imbalance in nursing knowledge which hinders nurses' ability to practice safely.

In New Zealand, pre-registration nursing education moved entirely to degree-level programmes over a very short period of time (Lusk *et al.* 2001), and therefore this country offers a unique opportunity to study a homogenous system of nursing training at this level.

Although nursing education has changed, there have been even greater changes in the nursing profession. Nurses are now expected to be autonomous practitioners, who can make decisions about patient care and work as members of an interdisciplinary team (Casey 1996). The roles of nurses are changing (Banning 2003; Prowse 2003a) and are becoming more complex and more demanding. Recent reports have suggested that these changes are likely to continue in the future (Department of Health 2000; KPMG Consulting 2001). These increased expectations mean it is more important than ever that the education of nurses should be built on sound scientific foundations.

Framework for the study

Background to research in bioscience education for nurses

There has been repeated evidence over the past two decades that nursing students have difficulty with

bioscience subjects (Barclay & Neill 1987; Caon & Treagust 1993; Wharrad, Allcock & Chapple 1994; Nicoll & Butler 1996). Furthermore, it has been suggested that even qualified nurses are not confident in applying bioscience knowledge to their nursing practice (Wilkes & Batts 1996; Clancy, McVicar & Bird 2000).

There is good research evidence that competent knowledge of bioscience can enhance nursing practice. A series of articles by Jordan (1995a–d, 1996a–b), Torrance (1995a–d) and Torrance & Jordan (1995) has demonstrated some of the ways in which the biological sciences are essential for safe nursing practice. Then Jordan & Reid (1997) suggested that patient care could be enhanced by the participation of nurses in postregistration study of physiology. Research in the area of peri-operative care has demonstrated that, not only is bioscience knowledge essential for the delivery of high quality care (Prowse 2000; Prowse & Lyne 2000a,b), but it also influences patient outcomes (Prowse 2003b).

With new developments in technology and therapeutics, there is an even greater need for qualified nurses who have a sound scientific basis for their practice. Bioscience knowledge is vital if nurses are to be involved in diagnosis and prescribing, as well as administering drugs (Courtenay 2002; Manias & Bullock 2002). The science of genetics is becoming increasingly important as new treatments and procedures are emerging (Nicol 2003). Thus, it seems to be critically important that nurses should have a good basic knowledge of bioscience in order to practise safely in the present demanding clinical environment.

There are a number of factors that have been identified which suggest that there may be a problem in the teaching and learning of bioscience subjects within the nursing curriculum.

One factor that creates difficulty in bioscience learning is that nursing students in the tertiary sector have a wide range of different educational backgrounds and life experiences. In the United Kingdom, one study suggested that less than half of nursing students (45%) are likely to have a biology qualification at Year 11 (16 years of age), whereas only 18% have a biology qualification at Year 13 (18 years of age) (Gresty & Cotton 2003). Another

study, which aimed to determine predictors of nursing students' academic performance in the United Kingdom (Ofori 2000), showed that about 45% of students in a diploma nursing programme were aged 25 years and over. Thus, students entering nursing programmes directly from school are likely to be in a minority and, although many nursing students may have valuable life experience, they may not have conventional academic or science qualifications. In New Zealand, nursing students also have diverse backgrounds, but it seems that most institutions expect nursing students to have good academic and science backgrounds, so this may reduce the problems that students appear to have with bioscience subjects.

There are also issues related to how, when and where nursing students are expected to learn the relevant scientific knowledge. In the United Kingdom, science subjects are generally taught by specialists, in a service department external to the nursing department (Larcombe & Dick 2003). The bioscience subjects in diploma-level nursing programmes are taught mainly within the Common Foundation Programme during the first 18 months of the nursing programme, followed by specialist clinical components. In New Zealand, the nursing programmes vary in different institutions, but appear to be more integrated, and bioscience teachers have considerable contact with nursing departments. Data relating to programme organization and teaching were collected as part of this study, but are not reported here.

The transfer of knowledge into the practice situation has been identified as a problem in relation to both nursing knowledge and scientific knowledge. A number of researchers have identified the existence of a theory–practice gap (Jordan 1994; Corlett 2000), which suggests that there are difficulties in the application of theoretical knowledge to practice. Eraut has used the concepts of 'mediation' (1995) and 'transformation' (2004) to describe the linking of scientific knowledge to practice and suggested that much greater efforts are needed to ensure that both the mediation and the transformation of knowledge occur.

The focus of this study was to investigate whether these problems exist in New Zealand, and if so, what the causes of these problems might be.

Background to the conceptual framework for the study

The study used a conceptual framework for curriculum inquiry first developed by Goodlad (1979), which suggests that there is not just one view, but several different views of any curriculum, depending on whose perspective is examined. This framework was adopted by the International Association for the Evaluation of Education (Rosier & Keeves 1991) for the investigation of science and mathematics curricula world-wide.

Modifications were made by Treagust (1987) to include the perceptions of students, and by van den Akker (1998) to include the learning outcomes that are achieved. The framework is used in this paper to compare the bioscience component of nursing curriculum as viewed by the Nursing Council of New Zealand, which determines the standards and competencies for entry to nursing practice (the *intended* curriculum) and the curricula approved by Nursing Council for use in individual institutions (the *prescribed* curriculum), which imply that nursing students will gain sufficient bioscience knowledge for safe practice, with the curriculum as perceived by nurse educators (the *perceived* curriculum) and by nursing students (the *experiential* curriculum).

Research questions

The rationale for the study was that New Zealand presents a unique opportunity to study an environment with uniform degree-level qualifications for entry to nursing practice. It seemed possible that some of the problems that have been identified in other countries may not exist in New Zealand. The study was designed to investigate the framework for bioscience in nursing education programmes in New Zealand, and the perceptions that nurse educators, nursing students and nursing graduates have in relation to bioscience in the nursing curriculum.

The research questions addressed in this paper are:

Research question 1

What are academic and clinical nurse educators' perceptions of science at school, and bioscience in

the nursing curriculum and in nursing practice (the *perceived* curriculum)?

Research question 2

What are nursing students' perceptions of science at school, and bioscience in the nursing curriculum and in nursing practice (the *experiential* curriculum)?

Research question 3

Is there any difference between the perceptions of nurse educators and nursing students in relation to bioscience in nursing and in nurse education?

Methods and data sources

Study design

The study used an interpretative survey strategy (Denscombe 2003) to collect both quantitative and qualitative data, using documents, questionnaires and focus groups. Focus groups were used because there is evidence that the supportive and safe environment they offer is conducive to the discussion of personal and controversial information particularly in the complex area of nursing education (Kreuger & Casey 2000; Kevern & Webb 2001).

The preliminary stage of the study, which investigated the framework for bioscience in nursing education in New Zealand, is not discussed in this paper.

The two stages of the study reported in this paper are:

Stage 1

A questionnaire containing research instruments to obtain information about their attitudes to, and perceptions of, bioscience in the nursing programme and in clinical practice, and their self-efficacy in bioscience was administered to academic and clinical nurse educators and nursing students of one institution.

Stage 2

Focus group interviews were conducted with nurse educators and nursing students at the same institu-

tion, in order to gain a more in-depth view of these perceptions.

Data were also collected in relation to the perceptions of nursing graduates, and the academic achievement of nursing students and graduates. These data are not discussed in this paper.

Population

The target population for the main part of the study was the academic and clinical nurse educators and nursing students (excluding those in their first semester of study) from one tertiary institution in New Zealand that offers a pre-registration nursing programme ($n = 305$). All the eligible subjects were invited to participate, as the total population was small. Nursing students were approached during their normal timetabled classes; nurse educators were approached in person. Some students were absent when the questionnaire was administered; some educators and students chose not to participate. A total of 60.1% of students ($n = 155$) and 61.7% of nurse educators ($n = 29$) agreed to take part in the research. When some of the questions were left unanswered, those participants were still included in the other parts of the analysis.

In this institution, specialist teachers within the nursing department taught the bioscience subjects, and did not participate in the survey.

Instrumentation – Stage 1

The *Bioscience in Nursing* questionnaire (BIIN) used in Stage 1 of the study had four parts. Part 1 collected personal data and information about respondents' science and nursing education. Part 2 contained an instrument, developed from Krynowsky (1988), to measure attitude to science at school, to bioscience in nursing and to bioscience in nursing practice. A score of +5 indicated that respondents had an extremely positive attitude, whereas a score of -1 indicated an extremely negative attitude. The alpha reliability for the three components of this scale were 0.95, 0.86 and 0.88, respectively. Part 3 contained an instrument, modified from previously published instruments (Harvey & McMurray 1994; Coll, Dalgety & Jones 2001), to measure self-efficacy in bioscience.

It asked about participants' level of confidence in explaining or describing basic bioscience topics in relation to nursing. These were topics that a first year nursing student would be expected to understand. A score of 1 indicated that respondents were not confident of their knowledge, and a score of 5 indicated that they were totally confident of their knowledge. The alpha reliability for this scale was 0.91. Part 4 asked participants to respond to a series of statements about bioscience on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The first seven statements were similar but were modified slightly for nurse educators and for nursing students. The students were also asked to respond to some specific questions about the nursing programme. The final question for the nurse educators related to past knowledge of bioscience (see Table 5 for list of questions).

Focus groups – Stage 2

Participants in Stage 1 of the study were invited to indicate in the BIIN questionnaire whether they would be interested in participating further in the study. From these responses, eight focus groups (six groups of students, two groups of nurse educators) consisting of four to six participants were assembled. The groups were composed either of students at a similar stage of the programme, or nurse educators, to create a safe environment for discussion. An independent facilitator led the group discussions using predetermined themes. The discussions were tape-recorded and transcribed, and analysed for themes. Some of the key comments from these groups are discussed in the results section.

Results

Stage 1

BIIN questionnaire Part 1 – characteristics of Participants

This group of nurse educators ($n = 29$), as might be expected, was very experienced and well qualified. They were mainly female (90%) and the majority (89%) were aged 40 years or older. Their nursing experience ranged from 5 to 43 years (mean 25 years). They were also well qualified academically: 72% had

qualifications beyond bachelor's degree level. Their experiences at school, as might be expected in a group who were at school 20–40 years ago, were somewhat different from what could be expected today. The majority (96%) had schooling only to Year 10 or 11 (age 15–16 years), less than half (39%) had studied biology and only about one-third (35%) had studied any science subjects other than biology.

The entry criteria for this nursing programme required that students should have academic qualifications at Year 13 level (18 years of age) with at least one science subject at Year 12 level (17 years of age). Applicants without these qualifications could complete an academic pre-entry programme, which included science subjects. Potential nursing students who had previous nursing qualifications or other equivalent qualifications were exempted from this requirement. An analysis of the characteristics of nursing students ($n = 155$) in this study showed that the nursing students were mainly female (94%); 48% of students were over 30 years of age and 85% of students were over 20 years of age – thus most students were not recent school leavers; over 60% of students had completed pre-entry programmes because they did not meet the standard entry criteria; and 44% were from a variety of ethnic groups other than New Zealand European. In this group of students, 38% had studied at school up to Year 12 (17 years of age) and 31% to Year 13 (18 years of age). Of these nursing students, 34% had studied only biology, 45% had studied science subjects other than biology and only 8% had not previously studied any science subjects.

Thus, there were differences between the nurse educators and the students, not only in age and nursing experience, but also in academic and scientific background.

Comparison between the perceptions of nurse educators and nursing students

BIIN questionnaire Part 2 – attitudes to science and bioscience

The data from this questionnaire suggested that both nurse educators and nursing students had better attitudes to bioscience in nursing practice than to bioscience in nursing education, and that their

Table 1 Scores for attitude to science and bioscience for nurse educators and nursing students

	Nurse educators (n = 28)			Nursing students (n = 144)		
	Mean	SD	SE	Mean	SD	SE
Attitude to science at school (atts)	3.36	1.03	2.19	3.12	0.69	0.14
Attitude to science in nursing education (attne)	3.88	1.00	2.19	4.30	0.76	0.06
Attitude to bioscience in nursing practice (attnp)	4.39	0.71	2.13	4.50	0.61	0.05

Table 2 Comparison of attitudes to science and bioscience for nurse educators and nursing students (Paired samples and independent samples *t*-tests)

Comparison of means	Diff.	<i>t</i>	<i>df.</i>	Sig.	0.95 CI	Effect size
Nurse educators						
Atts vs. attne	-0.52	-2.52	27	0.018	-0.93, -0.09	0.23
Atts vs. attnp	-1.03	-5.45	27	< 0.001	-1.41, -0.64	0.50
Attne vs. attnp	-0.51	-3.78	27	0.001	-0.78, -0.23	0.23
Nursing students						
Atts vs. attne	-1.18	-8.50	136	< 0.001	-1.50, -0.93	0.51
Atts vs. attnp	-1.38	-9.37	139	< 0.001	-1.67, -1.09	0.60
Attne vs. attnp	-0.20	-3.76	140	< 0.001	-0.27, -0.08	0.08
Nurse educators vs. Nursing students						
Atts	0.24	1.03	61	0.31	-0.23, 0.73	0.15
Attne	-0.42	-2.62	167	0.01	-0.77, -0.11	0.52
Attnp	0.11	0.86	170	0.39	-0.15, 0.37	0.18

attitudes to science at school were less positive (Table 1). A score of +5 would indicate an extremely positive attitude. These differences in scores were all statistically significant (Table 2). The nursing students had a better attitude to bioscience in nursing education (mean score = 4.32) than the nurse educators (mean score = 3.88) (Table 1) and this difference in score was statistically significant (Table 2). Students also had slightly higher attitude scores in relation to bioscience in nursing practice, and slightly lower attitude scores in relation to science at school compared with the academic and clinical nurse educators (Table 1), although these differences were not statistically significant (Table 2).

BIIN questionnaire Part 3 – self-efficacy in bioscience

The nurse educators' responses in relation to confidence in describing or explaining basic bioscience

Table 3 Scores for self-efficacy in bioscience for nurse educators and nursing students in the three years of the nursing programme

	Self-efficacy in bioscience		
	Mean	SD	SE
Nurse educators (n = 29)	3.70	0.63	0.12
Year 1 Nursing students (n = 41)	3.28	0.66	0.10
Year 2 Nursing students (n = 47)	3.37	0.57	0.08
Year 3 Nursing students (n = 58)	3.70	0.63	0.08
All nursing students (n = 146)	3.47	0.64	0.053

topics that relate to nursing (self-efficacy in bioscience) gave a mean score of 3.70 (Table 3). A score of 5 would indicate that they were totally confident of this knowledge. The nursing students' mean scores

Table 4 Comparison of self-efficacy scores for nurse educators and nursing students (Independent samples *T*-tests)

Comparison of means	Diff.	<i>t</i>	<i>d.f.</i>	<i>Sig.</i>	0.95 CI	Effect size
Nurse educators vs. all nursing students	0.23	1.73	173	0.085	0.48, -0.03	0.37
Nursing students Year 1 vs. Year 2	-0.09	-0.66	86	0.51	-0.35, 0.17	0.14
Nursing students Year 2 vs. Year 3	-0.33	-2.81	103	0.006	-0.57, -0.10	0.51
Nursing students Year 1 vs. Year 3	-0.42	-3.21	97	0.002	-0.68, -0.16	0.66

for self-efficacy in bioscience increased gradually through the three years of the nursing programme (Table 3) and there was a statistically significant increase in self-efficacy from both Year 1 and Year 2 to Year 3 (Table 4). The mean score for self-efficacy in bioscience of all nursing students' (3.47) was lower than the score for nurse educators (3.70) (Table 3). It might be expected that nurse educators would have better self-efficacy in bioscience subjects related to nursing than nursing students, in view of their academic and clinical experience, so it is surprising that the difference in mean scores was not statistically significant (Table 4).

BIIN Questionnaire Part 4 – perceptions of bioscience

Nurse educators. In response to statements about bioscience in nursing (Table 5), a high percentage of nurse educators (97%) agreed or strongly agreed that it was important for practising nurses to have a good knowledge of bioscience (Statement 3). A slightly lower percentage (75%) agreed or strongly agreed that bioscience knowledge forms the basis of nursing practice (Statement 1). However, almost three-quarters of the teachers perceived that they would like to have a better knowledge of bioscience (69% agreed or strongly agreed with Statement 4), and almost half perceived that their science background was not good enough to understand all the bioscience needed in nursing now (45% agreed or strongly agreed with Statement 2). Over half the nurse educators perceived that they used to have a better knowledge of bioscience that they do now (55% agreed or strongly agreed with Statement 19). The majority of nursing teachers (93%) disagreed or strongly disagreed that it was difficult to see how bioscience could be applied to

their nursing practice (Statement 5). A lower percentage of nursing teachers (76%) disagreed or strongly disagreed that there was too much bioscience in their own nursing programmes (Statement 7).

Nursing students. The nursing students' responses to statements about bioscience (Table 5) suggested that, although many students perceived bioscience to be difficult and anxiety-provoking, they also perceive it to be a very important and valuable part of their nursing programme. They perceived the language and terminology to be difficult (45% agreed or strongly agreed with Statement 16), they perceived bioscience study to be time-consuming (67% agreed or strongly agreed with Statement 11) and anxiety-provoking (58% agreed or strongly agreed with Statement 9), but they also perceived that it is an important subject for practising nurses (97% agreed or strongly agreed with Statement 3) and that there should be more of it in the nursing programme (81% agreed or strongly agreed with Statement 18). About one-quarter of students perceived that their science background was not good enough for the bioscience study they have to do (27% agreed or strongly agreed with Statement 2).

Seventy-three per cent of nursing students disagreed or strongly disagreed that it was difficult to see how bioscience could be applied to their nursing practice (Statement 5). Seventy-nine per cent of nursing students disagreed or strongly disagreed that there was too much bioscience in their nursing programme (Statement 7). In support of this, 81% of students agreed or strongly agreed that there should be more nursing-related science in the nursing programme (Statement 18).

Table 5 Responses of nurse educators ($n = 29$) and nursing students ($n = 155$) to statements about bioscience in nursing and in nursing education

Statements (Statements 2, 5 & 7 modified for nursing students)	<i>Disagree or strongly disagree</i>		<i>Neither agree nor disagree</i>		<i>Agree or strongly agree</i>	
	<i>Nurse educators</i>	<i>Nursing students</i>	<i>Nurse educators</i>	<i>Nursing students</i>	<i>Nurse educators</i>	<i>Nursing students</i>
1. I believe that bioscience knowledge forms the basis of nursing practice	7.2%	1.9%	17.9%	17.4%	75%	80.6%
2. My science background is not good enough for me to understand all the bioscience needed in nursing now/for the bioscience study I have to do	31%	41.6%	24.1%	31.8%	44.8%	26.6%
3. I believe it is very important for practising nurses to have a good knowledge of bioscience subjects	3.4%	0.6%	0.0%	2.6%	96.6%	96.8%
4. I, personally, would like to have a better knowledge of bioscience subjects than I have at present	10.3%	3.2%	20.7%	8.4%	68.9%	88.3%
5. I find it difficult to see how I can apply bioscience subjects to my own nursing practice/how the bioscience we learn can be applied to nursing practice	92.6%	72.8%	0.0%	15.6%	7.2%	11.6%
6. I am generally more interested in nursing subjects such as nursing knowledge and professional practice than in the scientific basis of nursing	57.1%	69.1%	32.1%	19.4%	10.7%	11.6%
7. There is too much classroom time allocated to bioscience subjects in my initial nursing training course/in the nursing programme	75.8%	78.7%	20.7%	14.2%	3.4%	7.1%
8. I find bioscience study stressful		30.5%		26.0%		43.5%
9. I worry about my bioscience results		22.6%		19.4%		58.0%
10. I think that a basic knowledge of science subjects should be a requirement for entry to the nursing programme		12.3%		18.7%		69%
11. The time I spend studying bioscience subjects is more than I spend on other nursing subjects		14.8%		18.1%		67.0%
12. The amount of bioscience material to be covered is too much for the time allocated		16.2%		20.0%		63.9%
13. Bioscience is difficult because it is very abstract and I find it difficult to visualize		42.9%		24.7%		32.5%
14. The bioscience material in the nursing course is covered in too much depth		67.4%		24.55		18%
15. The reading we have to do for bioscience is difficult		32.3%		31.6%		36.1%
16. The language and terminology of biosciences makes it hard to learn		27.1%		27.7%		45.1%
17. I think that nursing students should study bioscience in Year 3 as well as in Years 1 and 2		16.8%		16.2%		66.9%
18. I believe there should be more nursing-related science as part of the nursing programme		3.9%		14.9%		81.2%
19. I used to have a better knowledge of bioscience than I do now		37.9%		6.9%		55.2%

Stage 2: Focus group discussions – Attitudes to science and bioscience, self-efficacy in bioscience and perceptions of bioscience

Nurse educators

The focus group discussions brought out revealing and personal comments from the nurse educators. Some of them perceived that, even after many years of clinical experience and a number of postgraduate courses, they still do not have good bioscience knowledge.

I still feel like my knowledge is minimal. I still have trouble explaining things to students and sometimes I still have to go back to the books. I don't know if it has sunk in or not. I feel like I have done quite a lot over the years. FG8 line 11 #201

Several nurse educators revealed that they lacked a good background in science

I wish I had more physics and chemistry background at school, instead of plant and insect biology. At school (early 70s) few girls took physics & chemistry or maths. Written comment #201

and that there was a lack of physiology in their initial training.

... that was the major limitation with ours too. People did not have the knowledge of the physiology to teach the physiology and you just didn't have diagrams of that. FG7 line 6 #208

There were suggestions, from the nurse educators, that some of the nurses in the clinical areas do not have enough bioscience knowledge to be able to assist students effectively to apply bioscience knowledge to their clinical practice.

Pathophysiology ... is not something that is talked about. The registered nurses

themselves don't talk readily about 'why are we doing this', 'what is happening here with that person'. They give the medication, they know what the medications are and why they work, but they are still not talking in what is going on ... FG8 line 44 #198

Nursing students

Nursing students commented that bioscience subjects were not given enough emphasis in the programme

I would have liked to have either longer tutorials or more tutorials. Especially [about] some of the bigger [body] systems. It would have been a help. FG3 line 64 #70

Sometimes I think we would be better off ... just building up on it gradually ... right through the three years or even more. FG3 line 101 #150

although they perceived it to be an important area of their study

I believe that bioscience ... is an inevitable part of nursing because it provides us with knowledge which is necessary when we go out on practicals ... it is absolutely necessary. FG4 line 8 #80

and that their prior knowledge of basic sciences made a difference to whether they found the study of bioscience difficult.

I think though initially coming in at Level 5 [the first year of the nursing programme] and not having done science for absolutely years – it was total bolt from the blue to have to take on board so much information [that] I have never even covered at school. So it was totally new for me and so I did find it difficult. Difficult to understand, difficult to grasp the terminology. FG4 line 18 #118

Students also commented that they did not always receive enough support in the clinical areas to apply their bioscience knowledge.

... The kind of things that would help would be if we had clinical tutors that would go on and speak about it as well. 'What is going on here' that kind of thing. But not in a threatening manner but to say 'well what do you think is going on here'. They don't do that, do they? Not in my experience anyway. It's more of how would you make this person feel better. FG3 line 234 #148

Discussion

Previous research has identified that nurse educators have different perceptions of bioscience in nursing programmes from those of students. Jordan, Davies & Green (1999) found that lecturers perceived bioscience topics to be of less value in clinical practice compared with other nursing subjects than did nursing students. Thornton's qualitative study (Thornton 1997) also found differences in staff and students' attitudes to the relevance of bioscience subjects to nursing, which she related to their perceived reality of nursing practice.

Many of the students in this study did not have a good background in science at school, or a positive attitude to science at school, but the majority had improved their science and academic qualifications in pre-entry programmes. Their attitudes towards bioscience in nursing education were very positive, and significantly more positive than those of the nurse educators. The data in this paper suggest that this difference in attitudes may be related to differences in the science and nursing education of these two groups of subjects.

The institution in this study clearly makes considerable efforts to ensure that students have some scientific knowledge prior to their acceptance onto the pre-registration nursing degree programme; in spite of this many of these students still perceive that the bioscience subjects are a difficult part of the nursing programme. They also perceive that these subjects are not valued and are not given sufficient time

and emphasis in the nursing programme. This lack of emphasis may relate to the nurse educators' perceptions of bioscience that have been identified here.

It might be expected that nurse educators would have better self-efficacy in bioscience subjects related to nursing than nursing students, in view of their academic and clinical experience, so it is surprising that although the mean self-efficacy scores for the nursing teachers (3.70) was higher than that the mean score for all nursing students (3.47), the difference in scores was not statistically significant. It should be noted that the academic qualifications of these nurse educators were not specifically investigated in this study, but it is likely that few had advanced qualifications in bioscience-related areas. However, there has been previous research evidence which suggested that even qualified nurses are not confident of their bioscience knowledge (Wilkes & Batts 1998; Clancy *et al.* 2000), which would support this finding.

It is encouraging that almost all of the nurse educators and nursing students (97% in each case) perceived that it was important for practising nurses to have a good knowledge of bioscience; a slightly lower percentage (75% of nurse educators and 81% of nursing students) perceived that bioscience knowledge forms the basis of nursing practice. However, whereas 27% of nursing students perceived that their science background was not good enough for the bioscience study they have to do, it is worrying that almost *half* of the nurse educators (45%) perceived that their science background was not good enough to understand all the bioscience needed in nursing now (Table 5).

Whereas it is not surprising that a large majority of the nursing students (88%) agreed or strongly agreed that they would like to have a better knowledge of bioscience than they do at present, it is very surprising that almost three-quarters of nursing teachers (69%) perceived that they would like to have a better knowledge of bioscience that they do at present. Nursing teachers were better able to see the relevance of bioscience to their nursing practice compared with nursing students (93% of nursing teachers compared with 73% of nursing students). This is likely to be related the nursing teachers' greater experience of clinical practice.

Over half the nursing teachers (55%) perceived that they used to have a better knowledge of bioscience that they do now. However, the majority of both nursing teachers and nursing students (76% and 79%, respectively) disagreed or strongly disagreed that there was too much bioscience in their, respectively, nursing programmes, which suggests that neither group perceived that there was enough bioscience in their nursing programmes (Table 5).

Both nursing teachers and nursing students commented in the focus group discussions on the lack of support for bioscience learning from qualified nurses in the clinical area. This is an issue that has not been widely identified in the literature, and it is likely to be a sensitive topic for many nurses. One study that does mention this issue is the major research project sponsored by the English National Board for Nursing, Midwifery and Health Visiting (Eraut *et al.* 1995) that investigated the use of scientific knowledge in nursing education and practice settings. These authors make a strong case for the importance of 'mediation' of scientific knowledge. However, they comment that

... in general, students come into contact with few staff who are skilled in mediating biological knowledge into practice ...

(Eraut *et al.* 1995 p. 103)

and furthermore

Observational studies of student nurses ... revealed cases where lack of biological knowledge in particular affected the quality of care. In some cases, this applied to qualified nurses as well as students.

(Eraut *et al.* 1995 p. 102)

This study suggested that mediation of scientific knowledge from everyday nursing practice to theory is rarely observed. More recent work (Eraut 2004) has suggested that the types of knowledge and the modes of cognition used in professional settings may be very different from those expected in an

educational context. Eraut suggested that one reason for the difficulty in transfer of knowledge and skills from one setting to another may be related to this difference in types of knowledge and modes of cognition.

Nursing is viewed as a 'caring' profession, which is very different from scientific professions that are objective and factual. There are few nursing teachers who have both science and nursing qualifications, and even fewer nurses who are involved in nursing research from a biological perspective (Hinshaw, Sigmon & Lindsey 1991; Cowan *et al.* 1993). There have been suggestions that students in nursing programmes are being presented with two very different models of the human body 'the social body and the biomechanical body' (Brown & Seddon 1996) which need to be integrated, if a holistic approach to nursing practice is to be achieved.

Conclusions

The *intended* curriculum that is determined by the Nursing Council of New Zealand, and specified in detail by individual institutions (the *prescribed* curriculum), expects that the graduate nurses who emerge from these nursing education programmes will have enough knowledge of biological sciences and pathophysiology to practise safely as nurses. The results of this study suggest that, in spite of high academic and science entry criteria, these aims are not always being achieved.

The use of this conceptual framework to investigate perceptions of nurse educators and nursing students, in particular the use of focus group discussions, has added valuable information to ongoing discussion of the 'bioscience problem'. The preliminary results of this study suggest that there is a difference between the intended and prescribed curriculum and the perceptions of nurse educators and nursing students – the *perceived* and the *experiential* curriculum. Nursing students perceive that a good knowledge of bioscience is important for safe nursing practice, but also perceive that they may not be getting enough support to use this knowledge and to apply it to their practice. Academic and clinical nurse educators also perceive that bioscience knowledge is important, but also perceive that they themselves do not always have enough scientific knowledge to

help the students, and that the necessary clinical support for the application of this knowledge is not always available. The problem that nursing students have with bioscience subjects has been evident for many years and, in spite of the increased level of nursing education, the problem still seems to exist. It seems likely that this problem will continue to exist until the scientific knowledge-base of *all* those involved in nursing education is improved.

One possible solution to this problem would be co-operative teaching with nursing and science teachers sharing the responsibility for mentoring students. It is also important that nursing students should have a good basic science education before they commence their nursing programme. Finally, it is important that graduate nurses should be encouraged to continue their bioscience education after graduation so that they will be able to improve their application of bioscience knowledge to their practice and be able to mentor the next generation of nurses.

Significance of the study

The significance of this study is that doctors, patients and significant others assume that nurses have a good understanding of the procedures and treatments that they administer, but, although their procedural knowledge may be acceptable, nurses' scientific understanding may not be as good as these people expect. If nursing is to improve its status, nurses need to be credible members of the multidisciplinary team, and the scientific knowledge of new graduate nurses needs to improve to achieve this, which implies that nursing programmes must reappraise the way science is presented to pre-registration nursing students and the way this knowledge is mediated in clinical practice. As this problem has been identified world-wide, these findings have implications for nursing students, and for the safe clinical practice of nurses, not just in this one institution, or just in New Zealand, but in many countries.

Acknowledgements

The authors would like to gratefully acknowledge the support and assistance of Professor Barry Fraser at

the Science and Mathematics Education Centre, Curtin University of Technology, Perth, Western Australia and Dr Louise Rummel, Ms Debbie Penlington and Dr Annie Mills at the Department of Nursing and Health Studies, Manukau Institute of Technology, Auckland, New Zealand, in the initiation and implementation of this research.

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