New Zealand nursing students' perceptions of biosciences: A cross-sectional survey of relevance to practice, teaching delivery, self-competence and challenges

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ABSTRACT

Background: Bioscience subjects are one of the most discussed nursing curricula contents in terms of the longed known teaching and learning challenges for nursing students. Recent studies examined the specific use of technology as teaching strategies. However, there are still significant gaps around nursing students' perception of biosciences within nursing education and the significance of teaching delivery methods to these perceptions.
Objective: The study examined students' overall perception of biosciences within New Zealand undergraduate nursing programmes in terms of relevance to practice, teaching delivery, self-competence and challenges encountered.
Method: A descriptive, cross-sectional survey design on perceptions of New Zealand nursing students on biosciences was undertaken.
Results: Five hundred and forty students were included. Fifty-five percent (55%) preferred biosciences papers be taught classroom – based but using a blended learning delivery instead of an exclusively traditional classroom setting (55% vs. 21%). Perception towards the biosciences was positive and the mean perception of older students and those in Year 3 was higher compared to the other students. Overall, students believed biosciences had relevance to the practice of nursing.
Conclusion: Positive perceptions of bioscience become more evident when nursing students reach their final year in the nursing programme. The contemporary profile (age) of students studying nursing are sensitive to their preferred teaching delivery. A fully online teaching approach to biosciences for nursing students will most likely require a robust approach and careful decision making for implementation.

1. Introduction

Internationally, schools of nursing utilise varying curricula and educational frameworks (Lahtinen et al., 2014; Lusk et al., 2001). It is also widely noted that nursing qualifications are offered from programmes differing in terms of length of study, contents in the curriculum and the didactic foundations of the respective curricula (Råholm et al., 2010). Some institutions embrace new technologies in teaching delivery while others have limited or no access to these (Button et al., 2014; Hyland and Hawkins, 2009). Moreover, the delivery and teaching of theoretical concepts and practical skills in many nursing schools hugely differ. Bioscience subjects are one of the most discussed nursing

curricula contents in terms of the longed known teaching and learning challenges for nursing students.

Biosciences are one of the core foundational subjects in nursing education. Nursing students learn about the normal and altered human body structure and function, the causes of these changes and the indications or actions of different medications that are used as treatment. Understanding these key bioscience concepts enables nursing students to articulate the rationale for the provision of nursing care to clients. Moreover, with the emerging and expanding work scope and roles of registered nurses, the emphasis on integrating bioscience knowledge with nursing care delivery within the undergraduate nursing curricula is critical (Perkins, 2019). To date, several studies have been

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undertaken on nursing students' experiences of learning biosciences (Johnston et al., 2015; Montayre and Sparks, 2018). Studies exploring new teaching methods in the delivery of biosciences have also recently appeared and continue to increase within the nursing education literature (Craft et al., 2017; Swift et al., 2016).

Online teaching delivery of biosciences is becoming more common. Biosciences for nursing students, for example, Anatomy and Physiology courses, have been offered online in some nursing schools (O'Byrne et al., 2008; Raynor & Iggulden, 2008). Some of the bioscience courses sit outside the actual nursing programmes as preparatory modules (Hilbelink, 2009; Mowforth et al., 2005). Counter arguments directed at fully online delivery of biosciences included the contexts of being an impersonal approach, non-interactive and detached teaching strategy (Attardi et al., 2016; Green et al., 2006). On the other hand, those who recognise the equal advantages of online delivery and face-to-face classroom teaching have endorsed the 'blended approach' (Glogowska et al., 2011). Although blended mode of delivery was defined in different ways (Garrison and Kanuka, 2004; Johnson et al., 2010), bioscience courses taught at a blended-approach utilised both online and conventional classroom sessions. Blending became increasingly popular in nursing courses, with the aim to balance and limit online and face-to-face interactions between learners and teachers. While these new studies examined the specific use of technology as teaching strategies, there are still significant gaps around nursing students' perception of biosciences within nursing education and the significance of teaching delivery methods to these perceptions.

2. Research objectives

The study examined students' overall perception of biosciences within the undergraduate nursing programmes. Specifically, it reports the answers to the following questions:

a. What is the level of bioscience perception according to age, year level and preferred teaching delivery?
b. What is the level of bioscience perception in four bioscience components, namely, Bioscience and Nursing Practice (BNP), Bioscience and Perceived Self-Competence (BPSC), Bioscience and Delivery in Nursing Programme (BDNP) and Bioscience and Difficulty/ Challenges (BDC)?
c. Is there a significant difference in the level of perception among the four biosciences components?
d. Is there a significant difference in the level of perception among the four biosciences components according to age, year level and preferred teaching delivery?

3. Methods

3.1. Research design

A descriptive, cross-sectional survey design was undertaken. The current study was the first New Zealand survey on perceptions of nursing students about biosciences from a nationally represented sample. The need to collect the demographic profile of nursing students was considered essential to the aim of this study. Therefore, a descriptive quantitative approach was utilised.

3.2. Questionnaire

The survey tool utilised was modified and adapted with permission from authors (Friedel and Treagust, 2005). The questionnaire was adjusted accordingly to include terminologies familiar to New Zealand nursing students and contexts relevant to contemporary New Zealand nursing education. The questionnaire has two parts. Part A is the profile section and Part B asks students to rate their level of agreement using a 5-Point Likert Scale with 1 as the lowest level of agreement and 5 as the

highest rating. The scale measured nursing students' perceptions of bioscience in relation to four components: Bioscience and Nursing Practice (BNP), Bioscience and Perceived Self-Competence (BPSC), Bioscience and Delivery in Nursing Programme (BDNP) and Bioscience and Difficulty/Challenges (BDC). Bioscience in relation to nursing practice (BNP) included items on perceived importance of nurses' bioscience knowledge and its application to future nursing practice. Students were also asked to rate their level of agreement on their perceived self-competence to biosciences (BPSC) based on their bioscience interest and their past and current knowledge. The delivery on nursing programme (BDNP) items asked students varying technical aspects of bioscience delivery, which included time allocation, resources, and teaching strategies. The last component asked nursing students questions about difficulties, challenges and stressors associated in learning biosciences (BDC).

3.3. Ethics

This study obtained ethical approval from Auckland University of Technology with the reference number 18/19. Data commenced after ethics approval was granted.

3.4. Data collection and sample

Data were collected from a national online database of New Zealand Nurses Organisation National Student Unit (NSU). The electronic survey was sent to 1890 nursing student members. The survey collected a total of 540 completed responses, which accounts to the 29% response rate. The survey was open for two months. Consent was implied by the completion and online return submission of the survey questionnaire. These nursing students are currently enrolled in undergraduate baccalaureate nursing programmes from different tertiary providers in New Zealand. An undergraduate baccalaureate nursing degree programme in New Zealand is of three years duration.

3.5. Data analysis

Descriptive and inferential statistical analyses were undertaken aided by Statistical Analysis System (SAS) software version 9.4 (SAS Institute Inc., Cary, NC, USA). Table data are expressed as mean $\pm$ SD and proportions for categorical data. A one – way analysis of variance (ANOVA) was used to determine differences among student profiles. Post – hoc comparisons using Scheffé method was used for significant results. A p value of < 0.05 was regarded as significant. Responses to negatively stated survey items were reverse coded. Reverse coding was important to capture inconsistent and invalid responses to negatively-framed survey questions.

4. Results

4.1. Participants

Five hundred and forty nursing undergraduate students from the National Student Unit Database participated in the survey. The average age of students is 27 years (SD = 8.87). Almost a third (163) of them are 20 years old and below and around 59 students are more 40 years old. Approximately 80% of the students belonged to higher levels of a nursing programme (40.19% and 41.30% from Year 2 and Year 3, respectively).

The students were asked about their preferences for bioscience teaching delivery (fully online and blended). Most of the them preferred that biosciences papers be taught as classroom – based instead of fully online (55% vs. 21%) but taught using a blended learning delivery instead of a solely traditional classroom setting (66% vs. 11%) (Table 1).

Table 1

Distribution of participants according to age, year level and preferred teaching delivery.

Characteristics	Frequency (N = 540)	Percentage (%)
Age		
≤ 20	163	30.74
20 < age ≤ 30	237	43.89
30 < age ≤ 40	78	14.44
> 40	59	10.93
Year level		
Year 1	100	18.52
Year 2	217	40.19
Year 3	223	41.30
Preferred teaching delivery: fully online		
No	299	55.37
Unsure	129	23.87
Yes	112	20.74
Preferred teaching delivery: blended		
No	59	10.93
Unsure	127	23.52
Yes	354	65.56

4.2. Overall perception of biosciences

Students were asked their level of agreement using a 5-point Likert Scale (Strongly Disagree – 1, Disagree – 2, Neutral – 3, Agree – 4, Strongly Agree – 5) on a twenty – item questionnaire with negatively – worded items reverse - coded. Higher scores indicate a more positive perception on each item.

Table 2 shows the mean ratings for each question. 12 out of the 20 items in the questionnaire scored a higher level of agreement or more positive perception. While the nursing students highly and positively perceived that it is very important to have a good knowledge of bioscience subjects (Mean = 4.44, SD = 0.77), they also believed that there is less allocated time for the amount of biosciences materials covered in class (Mean = 2.64, SD 1.12). But overall, the students have a more positive perception of the biosciences within the nursing programme (Mean = 3.47, SD = 1.02).

Table 3

Level of perception according to age, year level and preferred teaching delivery.

Characteristics	Mean (SD)	p values
Age group		0.0203
≤ 20	3.40 (0.31)	
20 < age ≤ 30	3.51 (0.37)	
30 < age ≤ 40	3.51 (0.37)	
> 40	3.44 (0.42)	
Year level		0.0415
Y1	3.49 (0.36)	
Y2	3.43 (0.36)	
Y3	3.51 (0.36)	
Preferred teaching delivery: online		0.0062
No	3.52 (0.36)	
Unsure	3.42 (0.36)	
Yes	3.41 (0.36)	
Preferred teaching delivery: blended		0.6236
No	3.52 (0.36)	
Unsure	3.47 (0.34)	
Yes	3.47 (0.37)	

4.3. Level of perception according to age, year level and preferred teaching delivery

There were significant differences in overall perception when students are grouped according to age and year level, including preference for online learning (Table 3). Post hoc comparisons further revealed that younger students, aged 20 or less, perceived biosciences less positively than those who are aged between 20 and 40 (Mean = 3.4, SD = 0.31 vs. Mean = 3.51, SD = 0.31). Year 3 students have significantly more positive perception than Year 2 students (Mean = 3.51, SD = 0.36 vs Mean = 3.43, SD = 0.36). Students who have less positive overall perception of biosciences are also more likely not to prefer an online teaching delivery of bioscience courses.

4.4. Level of perception in four components

The levels of perceptions were measured on four bioscience components, namely, Bioscience and Nursing Practice (BNP), Bioscience and Perceived Self-Competence (BPSC), Bioscience and Delivery in Nursing Programme (BDNP) and Bioscience and Difficulty/Challenges (BDC). Fig. 1 compares the levels of perceptions of the four components. A one – way analysis of variance shows there are significant
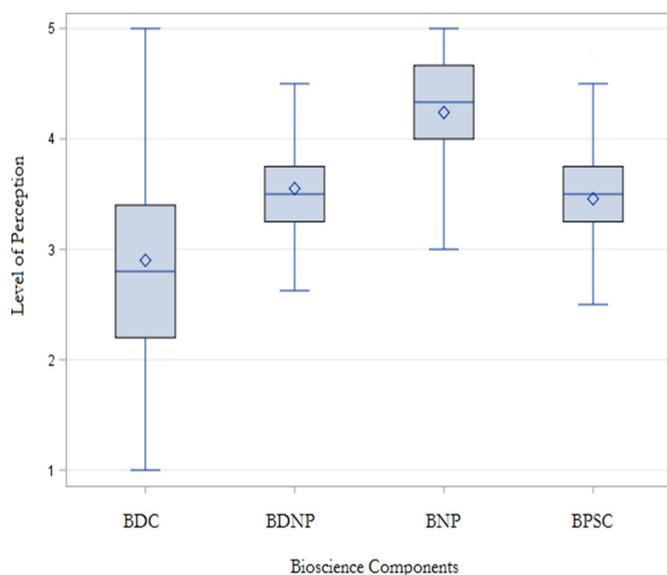
Table 2

Mean ratings for biosciences statements.

Item	Statements	Mean (SD)
1	I believe that bioscience knowledge forms the basis of nursing practice	4.17 (0.88)
2	My science background is not good enough for me to understand all the bioscience needed for the bioscience study I have to do	3.34 (1.12)
3	I believe it is very important for practising nurses to have a good knowledge of bioscience subjects	4.44 (0.77)
4	I personally, would like to have a better knowledge of bioscience subjects than I have at present	4.09 (0.85)
5	I find it difficult to see how the bioscience we learn can be applied to nursing practice	4.11 (0.97)
6	I am generally more interested in nursing subjects such as fundamentals of nursing knowledge/skills and professional practice than in the scientific basis of nursing	2.69 (1.03)
7	There is too much classroom time allocated to bioscience subjects in the nursing programme	3.88 (0.92)
8	I find bioscience study stressful	2.74 (1.17)
9	I worry about my bioscience results	2.49 (1.19)
10	I think that a basic knowledge of science subjects should be a requirement for entry to the nursing programme	3.88 (1.02)
11	The time I spend studying bioscience subjects is more than I spend on other nursing subjects	3.66 (1.02)
12	The amount of bioscience material to be covered is too much for the time allocated	2.64 (1.12)
13	Bioscience is difficult because it is very abstract and I find it difficult to visualize	3.30 (1.15)
14	The bioscience material in the nursing course is covered in too much depth	3.64 (0.96)
15	The reading we have to do for bioscience is difficult	3.12 (1.04)
16	The language and terminology of biosciences makes it hard to learn	2.85 (1.05)
17	I think that nursing students should study bioscience in Year 3 as well as in Years 1 and 2	3.61 (1.03)
18	I believe there should be more nursing-related science as part of the nursing programme	3.76 (0.83)
19	I used to have a better knowledge of bioscience than I do now	3.70 (1.11)
20	I appreciate more about biosciences if they were taught by a nursing lecturer	3.33 (1.13)
	Overall	3.47 (1.02)

Fig. 1. Level of perception for each bioscience component.

differences, F (3,2156) = 113.02, p < 0.001. Post hoc analyses using the Scheffé post hoc criterion for significance indicated that the means for all the four components are statistically significantly different from each other. The level of perception for Bioscience and Nursing Practice (BNP) was significantly higher (M = 4.24, SD = 0.66) than Bioscience and Perceived Self-Competence (BPSC) (Mean = 3.45, SD = 0.46), Bioscience and Delivery in Nursing Programme (BDNP) (Mean = 3.55, SD = 0.39) and Bioscience and Difficulty/Challenges (BDC) (Mean = 2.90, SD = 0.88).

4.5. Level of perception on biosciences components according to age, year level and preferred teaching delivery

Tables 4.1–4.4 show the level of perception on the four components of the bioscience programme according to age, year level and preferred. Except for BPSC, different age groups significantly have varying perceptions of biosciences on the other three components. Older students, aged above 40, are less likely to agree with the statements related to importance of bioscience knowledge to nursing practice (BNP) and to the different strategies of integrating bioscience in the nursing curricula (BDNP). Younger students, aged 20 and below tend to believe less in the statements related to bioscience delivery (BDNP) and challenges to bioscience learning (BDC). Significant post hoc comparisons were revealed only for the BDC component, with students aged above 20 and 40 having significantly positive perception of biosciences than students aged 20 and below.

There was a significant difference on perception on BDNP according to year levels [F (2, 537) = 5.62, p = 0.0038]. A post hoc Scheffé showed that perception between Year 2 and Year 3 groups differed significantly at p < 0.05 (Mean = 3.50, SD = 0.41 vs. Mean = 3.62, SD = 0.38).

The students who do not prefer an online delivery of the bioscience courses tend to agree more positively with the statements related to BNP, BDNP and BDC. However, significant variation in perception is only present on the BNP and BDNP components.

5. Discussion

This study examined nursing students' perceptions of biosciences in terms of relevance to nursing practice, perceived self-competence, delivery approaches within nursing programmes, and perceived difficulties and challenges. The New Zealand nursing students' profile was also analysed in relation to their overall perceptions of biosciences in those four areas.

New Zealand undergraduate nursing students recognise the importance of bioscience knowledge to their future nursing practice. An earlier New Zealand study supports this cohorts' perceived importance of bioscience knowledge to future practice. Although undertaken among practicing registered nurses (RNs), van Wissen and McBride-Henry (2010) study reported increased confidence among RNS after undertaking bioscience post-graduate courses. While nurses considered biosciences to be equally important as other components needed in providing nursing care (Lyne and Prowse, 2000), it was never easy to learn (Ralph et al., 2017). Findings from this study around difficulties in studying biosciences support current literature on learning barriers such as the lack of time allocated, too much content covered, varying methods of delivery and associated student anxieties (Jensen et al., 2018). The difficulty of learning biosciences has been implicitly noted within the types of study materials recommended for nursing students. For many years, easy-to-read versions of textbooks written for nurses and nursing students have been published. Textbooks and modules designed to be visually stimulating and illustrated with creative visual aids have been noted in bioscience learning resources (Goldberg, 2002; Herlihy, 2017; Park et al., 2011). These innovative resources have resulted in seeking the 'light bulb' or the potential solutions to known difficulties in learning biosciences. The key for nursing students to appreciate bioscience concepts has been found through the linking and application of the concepts to actual nursing practice. The need to connect with practical application resonated with the findings of this study, where nursing students positively reported the great importance of biosciences to future nursing practice. The findings justify the need to emphasise inclusion of case-study format in study materials for biosciences (i.e. textbooks or classroom and online activities) with easily identifiable, practical and everyday examples seen in practice.

Differences in perceptions for biosciences between young and mature nursing students have also been significantly related from these study findings. For example, young school leavers coming from a particular school may have had better access to technology. Therefore, they are more accustomed to the self-directed learning platforms for biosciences in the nursing programme compared to others. Some mature or older students may have been in different professions or work roles and the return to study causes challenges in terms of accessing study materials and in navigating technology linked to bioscience courses. However, regardless of nursing student's age, a more positive perception of biosciences occurs as they reach a near completion of nursing education (comparing Year 1 to Year 3 nursing students). These are arguably the result of exposure to clinical placements and practical experiences in nursing. The actual experiences allowed critical thinking and analysis in using bioscience concepts, which suggests that bioscience should be taught across year levels, from the start to the last semesters or year levels in the nursing curriculum. The majority of nursing schools in NZ, teaches biosciences in the first year or even prior to enrolling in the undergraduate baccalaureate nursing programme.

In terms of bioscience delivery in nursing curricula, those nursing students who have lower perceptions of the delivery in the nursing programmes are most likely not to prefer fully online teaching methods. Instead, a classroom-based method and blended delivery were the top choices. There has been a varying opinion about online approaches to teaching in nursing courses (Twomey, 2004). However, it was noted nursing students are more accepting towards web-based approaches for bioscience delivery despite the difficulties encountered (Koch et al., 2010). Video-streaming and online learning software have been popular among nursing students as well (Johnston et al., 2018; Montayre and Sparks, 2018). From the findings, these perceptions of bioscience delivery have no significant differences between mature and young students, although these two groups have different preferences on teaching platforms (fully online and blended).

Overall, nursing students regarded biosciences as important.

Tables 4.1–4.4
Four components perception with respect to respondents' profiles.

Components	Age group				p values
	≤ 20 (n = 166)	20 < age ≤ 30 (n = 237)	30 < age ≤ 40 (n = 78)	> 40 (n = 59)	
BNP	4.19 (0.61)	4.33 (0.63)	4.18 (0.63)	4.09 (0.84)	0.0416
BPSC	3.46 (0.42)	3.43 (0.50)	3.50 (0.45)	3.51 (0.41)	0.5192
BDNP	3.52 (0.35)	3.59 (0.40)	3.57 (0.39)	3.44 (0.45)	0.0402
BDC	2.70 (0.78)	2.97 (0.87)	3.05 (0.94)	3.00 (1.03)	0.0046

Components	Year level			p values
	Year 1 (n = 100)	Year 2 (n = 217)	Year 3 (n = 223)	
BNP	4.27 (0.62)	4.19 (0.69)	4.27 (0.63)	0.3872
BPSC	3.54 (0.46)	3.47 (0.46)	3.41 (0.44)	0.0645
BDNP	3.51 (0.36)	3.50 (0.41)	3.62 (0.38)	0.0038
BDC	2.97 (0.87)	2.81 (0.86)	2.95 (0.91)	0.1301

Components	Preferred delivery-online			p values
	No (n = 299)	Unsure (n = 129)	Yes (n = 112)	
BNP	4.32 (0.60)	4.12 (0.74)	4.15 (0.69)	0.0051
BPSC	3.46 (0.45)	3.47 (0.43)	3.45 (0.49)	0.9768
BDNP	3.60 (0.40)	3.49 (0.36)	3.48 (0.39)	0.0034
BDC	2.95 (0.89)	2.85 (0.84)	2.83 (0.89)	0.3632

Components	Preferred delivery-blended			p values
	No (n = 59)	Unsure (n = 127)	Yes (n = 354)	
BNP	4.41 (0.63)	4.21 (0.67)	4.22 (0.65)	0.1143
BPSC	3.38 (0.47)	3.44 (0.44)	3.47 (0.46)	0.2967
BDNP	3.62 (0.36)	3.56 (0.40)	3.53 (0.40)	0.3347
BDC	2.93 (0.93)	2.91 (0.88)	2.89 (0.88)	0.9651

Although, by age groups, this study's cohort of older students has lower perceptions of biosciences knowledge in relation to nursing practice. This is attributed to the perceived difficulty and complex nature of learning biosciences. The majority of mature students seek for the practical applications and relevant utilisation of their knowledge to practice (Davis, 2010; Jordan, 1994). This was explained by the lack of interest and low levels of appreciation in linking complex science concepts to practice (Ralph et al., 2017). Instead the practical, easy-to-learn approaches are more valued than the minute details associated with bioscience learning (Masters and Christensen, 2000). On the other hand, younger students find biosciences more difficult than mature students. Part of that is the perceived lack of time allocated in teaching the subjects in the classroom. While modern educational pedagogies have embraced the idea of 'independent adult learners' and 'self-directed learning' (Levett-Jones, 2005; O'shea, 2003), it can be argued that some subjects like biosciences for nurses do not perfectly fit these categories due to complex nature of learning the subject matter. Although the nursing students from this study were more inclined to blended delivery than the fully online approach, further research is required to explore students' perceptions of the 'self-directedness' of the online component in blended approach. Overall, nursing students have generally positive perceptions with biosciences that also improve as they progress in their education. However, from this study, further research is needed to ascertain the utility of fully online or blended approaches in teaching biosciences.

6. Limitations

A major limitation of this study is the nature of the data collected from a self-report survey. However, the survey was administered online and returned anonymously which encouraged genuine responses. Cause and effect relationships between variables were not examined in this study, being a cross-sectional design. Lastly, there was no data collected on the curriculum types of tertiary institutions/universities where students study bioscience, therefore an inference towards curriculum differences and students' perceptions was not explored. Despite these limitations, the study had a national scope and representative sample reflecting nursing education and the bioscience course in New Zealand nursing programmes. The findings of this study pose the potential for international comparison.

7. Conclusion

Nursing students perceive bioscience subjects as important to nursing practice yet very challenging to learn. The perceived importance of biosciences and learning difficulties experienced vary between younger and mature students. Positive perceptions of bioscience become more evident when nursing students reach their final year in the nursing programme. The contemporary profile (age) of students studying nursing are sensitive to their preferred teaching delivery. A fully online teaching approach to biosciences for nursing students will most likely require a robust approach and careful decision making for implementation. Factors like self-competence and learning difficulties for biosciences will determine acceptance and uptake of a specific teaching delivery.

Conflict of interest statement

The authors declare no conflict of interest.

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