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Addressing the Issue of Biosciences in the Nursing Curriculum:

The Contribution of an Action Research Project (Headstart)

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Abstract

Aims. The aim of this project was to develop and evaluate an on-line resource designed to improve biosciences knowledge of pre-registration nursing students.

Background. A number of studies have identified lack of biological subject knowledge, and anxiety about studying biosciences, as serious problems for nursing students. The availability of a contextualised biological information resource prior to and early in their studies might help to reduce the fear and anxiety currently experienced by many nursing students in relation to this discipline.

Research Methods. The project used an action research approach, involving an initial analysis of the extent of the problems with biosciences encountered by nursing students at the University, followed by the development and evaluation of a biology-based open learning resource (entitled Headstart) in collaboration with pre-registration nursing students and nurse educators.

Findings. The students in this study expressed a high level of concern regarding studying biology, and perceived this to be the most difficult aspect of their nursing course (significantly more difficult than nursing practice). A significant correlation was also found between previous level of biological qualification and confidence in passing module tests. Evaluation of the new on-line resource illustrated the willingness of nursing students to utilise such a package, and general approval of its content and mode of delivery, despite a number of problems related to computer access and students' inexperience with IT.

Conclusions. This project has provided further evidence of the need for additional resources in biosciences for nursing students. It has also illustrated the way in which a targeted on-line resource has the potential to provide substantial benefits in terms of supporting the nursing curriculum. Whilst further evaluation is needed, the findings

suggest that Headstart has the potential to address a number of issues identified both by this study and by previous research in nurse education.

Keywords: nursing education; health sciences education; biological sciences; nursing curriculum; supporting biosciences; pre-registration nursing; action research; on-line resource; student confidence; learning support.

Introduction

The teaching of biosciences in the nursing curriculum has long been identified as a problem and a source of anxiety by teachers, students, and even nurse practitioners (e.g. Courtenay, 1991; Wharrad *et al.*, 1994; Nicoll & Butler, 1996; Wynne *et al*., 1997, Jordan *et al.* 1999, Choi-Kwon *et al*., 2002). Teachers involved in nurse education have disagreed about a number of issues, including the amount of time which should be devoted to biological science in the curriculum (Trnobranski, 1996; Jordan *et al.*, 1999), appropriate content and depth of knowledge required (Trnobranski, 1993), suitable tutors (academic scientists or nurse teachers) (Chapple *et al*., 1993; Thornton, 1997), and the value of different teaching strategies (Davies *et al*., 2000). A number of studies have concluded that the level and depth of biological science taught to nursing students is inappropriate, and that many teachers are inadequately prepared for teaching this subject (Courtenay, 1991; Akinsanya, 1987; Akinsanya & Hayward, 1980).

Students, for their part, typically perceive biological sciences to be a 'difficult' subject from the onset of their courses, possibly due to negative experiences earlier in their school careers (Sutcliff, 1992). They perceive biology as being an important part of the course, but few feel that they have an adequate level of knowledge (Courtenay, 1991). Unsurprisingly, previous biological experience has been found to influence performance in Biological Science (Rutishauser & Stephenson, 1985; Wharrad *et al.*, 1994; Jordan *et al.*, 1999, McKee, 2002). Rutishauer & Stephenson (1985) suggest that this may be due to lack of familiarity with scientific language, concepts or the nature of scientific thinking. Despite this evidence, a biological qualification is not a pre-requisite for acceptance onto a nursing course. This results in a wide range of

abilities within each cohort and frequently the inclusion of a number of students with no prior qualifications in a subject that is to be covered at tertiary level. The students are aware that they will be assessed in biosciences, and must pass in order to progress with their course. They are also conscious that some of their peers are demonstrating high levels of biological knowledge in class discussions. Thus the scene is set for high subject-related anxiety.

Background to the project

The idea for this project arose from a discussion with a group of nursing students about factors that might influence progression on their course. The students came up with a range of responses, as summarised in Figure 1. Further reflection on this discussion, in the light of the problems with biosciences identified by previous research, suggested that access to an on-line study resource prior to and in the early stages of their course might provide a number of potential benefits. For example, students could be given access to a review of course materials, helping them to remember details of lectures and important points. Such a resource might also enable students to check their understanding of the subject by undertaking formative assessments on-line. Planning study time would be aided by reducing reliance on library resources, and enabling more home study – an important issue for many mature students, of which nursing attracts a disproportionately high number with concomitant needs (Caon & Treagust, 1993; Kevern *et al.*, 1999). Furthermore, the availability of a biological information resource early in their studies might help to reduce the fear and anxiety currently experienced by many nursing students in relation to this discipline.

Figure 1: Student concept map outlining factors that might affect academic progress

Further support for utilising some form of CAL support package came from informal discussions with other teaching staff in the department, who felt that the great disparity in biological knowledge within each cohort of students caused a number of problems. (See Table 4 for an example of the range of qualifications held by one cohort of students). A number of lecturers reported that large amounts of contact time were being spent on 'levelling up', in order to ensure that all members of the cohort were at a similar standard by the end of the module. They felt that this time could have been better spent by exploring theory-practice links, or by dealing with issues arising from the module material. Whilst this variation in ability and associated concern is by no means unique to Plymouth (see Nicoll and Butler, 1996; Thornton, 1997), no transferable solutions had previously been offered. An action research project which considered the feasibility of providing additional on-line support material was therefore proposed, in order to allow students to access information as and when required, and in their own homes.

Research Questions

This project attempted to address the following research questions:

1. What were the nature and extent of the problems with biosciences experienced by these nursing students?
2. How might the support of biosciences be changed in order to address these problems?

3. In what ways and to what extent did the development of the Headstart resource help address these problems?

Methodology

Since one of the main objectives of this project was to improve the experience of learning biology for nursing students, an action research model was considered essential. Following Nolan and Grant's (1993) description of action research, this involved: diagnosing a problem area (nursing students' biological knowledge and confidence); developing a plan of action (the use of an on-line resource); implementing the action (introducing the resource to a group of students); and evaluating its effects (assessing the ways and extent that nursing students had used the resource and their evaluations of its utility). In line with the participatory nature of action research, the principle researcher actively involved in the project was the practitioner concerned with delivering this aspect of the nursing course. The views of students and staff were also sought and acted upon, to encourage a sense of stakeholder involvement.

Although, for the purposes of clarity, these procedures are described as a series of consecutive steps, the reality of doing the project was less straightforward. The resource developed was the result of the teachers' experiences of delivering biosciences to nursing students, personal reflection, in-depth reading of the literature, and informal discussions with students and staff as well as the more formal evidence-gathering presented here. The action research cycle took place throughout the development of the resource (and is still on-going), as sections were tested, problems identified, and changes made to the structure and layout. The final resource arose from the research focus and questions, insights from the literature, and evidence in the data.

Before any development work was initiated, a *student needs analysis* was carried out, with the help of existing nursing students towards the end of their first year Diploma course at the University of Plymouth. The aim of this exercise was to discover nursing students' perceptions of their own scientific and biological knowledge prior to starting to the course, and the amount and type of help they would have liked before the course began. Focus group discussions with the students revealed a number of subject areas which they considered to be particularly important, and this information was used to guide the development of a questionnaire, which was then distributed to all nursing students in this cohort, during a timetabled session. The questionnaire enabled triangulation of the focus group data, gathered information about the students' prior level of scientific and biological knowledge, and provided formal evidence about the subject areas with which they required extra help.

At this stage, a review of existing computer-based educational packages was undertaken. This indicated that currently available packages were either aimed at the medical market (too advanced), or the biological market (typically containing plant material or pitched at degree level), rather than providing support for nurse education. Personal contacts with nursing teachers and with the CTI Nursing Centre in Sheffield (now the LTSN centre for Health Sciences and Practice at King's College, London) also failed to reveal any existing packages, but raised a great deal of interest in the project proposal. It was clear therefore that the need for a specific biological learning package directed at nursing students was not being met by existing provision in the market, and that any resource used would need to be developed on-site.

The information provided by the *student needs analysis* was therefore used to guide the development of the Headstart package. The focus groups and questionnaire results suggested that many nursing students felt that their understanding of biology was poor, and most felt that additional help would have been beneficial earlier in their studies (see Tables 1 & 2). Subjects which they wanted help with included: science and measurement; chemistry and physical concepts; molecules of life (biochemistry); general arrangement of the body; and body requirements. Further piloting suggested that a suitable virtual learning environment might be a hierarchical pyramid style (based on the Indonesian Buddhist temple at Borobudur), this being preferred by students over other suggested options (or learning metaphors) such as a Russian doll, a bridge or stairs, a journey, an island, or an obstacle course. The chosen temple format utilises a series of galleries, with optional quizzes, along the 'road to enlightenment'. The lower galleries cover the more basic aspects of biological sciences, building up to the more complex issues in the higher levels and culminating in the 'Bioviews' section in which some contemporary issues in Biology are discussed.

The aims of the Headstart package were to:

- Offer extra support material and guidance about biosciences, within a nursing context;
- Provide a resource which was approachable and not intimidating for students to use;
- Provide information in an accessible format (i.e. searchable and easily navigated, even by those with little experience of computer use).

- Enable self-testing of course material (on-line quizzes with instant feedback available);
- Increase student confidence and motivation with regard to studying the biosciences;
- Build a good science foundation for the rest of their nursing studies;
- Support student-centred learning by offering web discussion pages and e-mail access to teachers for individual support or information as required;
- Encourage further use of IT for lifelong learning.

A small grant from a RATIO initiative enabled the resource to be developed, and the package was completed and made available on-line in 1999.

The original intention for the Headstart package was that newly accepted students would access the on-line course prior to starting their studies at the University. However, to assess its impact, the resource was used and provisionally evaluated by existing nursing students. An initial questionnaire (the *confidence survey of existing students*), aiming to gather some background information, was therefore distributed to a cohort of nursing students during the first lecture of their course. The main aim of the questionnaire was to assess students' preconceptions about the relative difficulty of various aspects of the nursing course, their anxiety about starting to study each of these areas, and their confidence that they would pass the module exams. Students were asked to rank five subjects, nursing theory (NT), nursing practice (NP), psychology (PSY), biology (BIO), and sociology (SOC) on a scale of one to five (where 1 = not difficult/ not anxious/ not confident about passing, and 5 = very difficult/ very anxious/ very confident of passing). The questionnaire also asked about

their level of biological qualification, and any previous use of computers for learning. A final question asked students whether on-line learning appealed to them, and why.

A second questionnaire (the *on-line learning survey*) was given to these same students approximately one month after arriving at the university. Students were asked whether they had used the Headstart package, about any particular benefits they felt it might convey, and about any problems they had encountered. This questionnaire used largely open-ended questions in order to obtain some more detailed feedback from students about the Headstart package. The quotations used in the findings section below are designed to illustrate the breadth of opinions expressed by respondents to these questions.

Findings

1. Student Needs Analysis

Table 1 illustrates that in the initial student needs analysis, 54% of the nursing students surveyed (N=101) perceived their own understanding of biology to be below average prior to starting the course (indicated by marks on a horizontal scale). Only 4% of the students considered themselves to have a good (above average) understanding of biology. One student noted that their prior knowledge was ‘very good’ and two other students stated that their prior knowledge was ‘none’.

Table 1: Table to show students’ own perception of scientific understanding

With regards to the amount of help that students would have liked with certain subject areas before they started the course, the following information was collected from the same cohort of students (again indicated by marking on a horizontal scale):

Table 2: Table to show students' preference for help/support in a range of disciplines

One student noted that they did not feel in need of any help with Science & Measurement and another student that they were not in need of any help with Chemistry & Physics. However, the vast majority of students felt that they needed at least some extra help in all of these subject areas. On the basis of this information and the focus group discussions, five subject areas were selected to be the main Biogalleries of the Headstart package (see Table 3).

Table 3: Biogallery content in the Headstart resource

2. Confidence survey of existing students

Echoing the findings of a number of other studies (Wharrad *et al.*, 1994; Nicoll & Butler, 1996; Jordan *et al.*, 1999), the students in this study expressed a high level of concern regarding studying biology, and perceived this to be the most difficult aspect of their nursing course. Since both the perceived difficulty of a subject, and anxiety about studying it may be linked to poor examination performance, these are serious issues which need to be addressed. After biology, (in ranked decreasing order), psychology then nursing theory and sociology were considered to be the most difficult, with nursing practice being rated with the lowest level of perceived subject difficulty by the majority of students (Figure 2a). However, a one-way ANOVA

revealed the only statistically significant difference to be between the perceived difficulty of biology and nursing practice ($F_{4, 320} = 3.31$, $P = 0.0113$), perhaps due to the small numbers involved. In addition, although the mean level of anxiety for biology was ranked the highest (Figure 2b), there was no statistical significance in the students' levels of anxiety (or confidence – Figure 2c) with regards to passing the separate subject disciplines at the end of their first year.

Figure 2 a) Histogram to show level of subject difficulty perceived by nursing students for nursing theory (NT), nursing practice (NP), psychology (Psy), biology (Bio) and sociology (Soc) (* indicates a significant difference)

2 b) Histogram to show level of subject anxiety perceived by nursing students for above disciplines

2 c) Histogram to show level of confidence regarding passing assessments in the above disciplines by nursing students

The most commonly held Biological qualification in this cohort of students was GCSE/ O level, with only a few students having no prior biological qualification (see Table 4).

Table 4: Table to show level of prior biological qualification before commencing Dip. H.E. Nursing studies in one cohort of students

In support of other research studies (e.g. McKee, 2002), a significant positive correlation (using Spearman's Rank Correlation) was found between previous

biological qualification and level of confidence regarding passing module tests ($r = 0.215$, $P < 0.05$). Students with a GCSE qualification (or lower) in biology were the least confident about passing future bioscience tests. However, there was no significant correlation between previous biological qualification and perceived subject difficulty or level of anxiety. It would appear that even if the students have completed A level or GNVQ Biology, they display a similar level of concern regarding studying the subject to those with lower qualifications, although they appear more confident about their chances of success.

The initial questionnaire also revealed that 71% of the students had previously used computers to help them learn, and 91% said that learning on-line appealed to them. Those who were not keen to undertake on-line learning cited a dislike of IT (computers), lack of accessibility, inexperience and nerves, and time constraints as influencing factors. Although the proportion of students expressing these concerns was low, they should nonetheless be taken into consideration, and attempts made to support those learners to whom this mode of delivery does not appeal. However, in general, the results suggested that the development of an on-line resource, used prior to the start of their university course, would be of considerable benefit to a large number of students.

3. On-line learning survey

The results of the second survey showed that, one month after arrival at university, almost half of the students (45%) had already accessed the Headstart package. However, of those students who had used Headstart, over half (54%) had experienced some problems, including difficulty in getting access to a computer at peak times,

password difficulties (due to case sensitivity), and navigation problems due to early glitches in programming:

> "I would like to use it more if it wasn't so difficult getting onto a free computer."
>
> "Easier than I thought it would be, if a little infuriating at times (due to problems with log on password)"
>
> "Could not get past Gallery 1. I read the information and did the quizzes. Would like to learn on-line again - enjoyable and productive."

~~(evidence?? **).~~ The students used Headstart in a number of ways including reading around the subject for general interest, reinforcement of lectures, and self-assessment using quizzes. 88% felt that Headstart had encouraged them to use IT and learn on-line, and praise was given for the extra resources and benefits of quizzes:

> "Started with the quizzes and then worked back to revise any uncertain areas or queries. Familiar with IT and Internet but had not previously used it as a 'learning tool'. Very helpful to be able to use it out of hours"
>
> "Wasn't actually 'as bad' as first anticipated, as I have very little IT skills"
>
> "It has given me confidence to use the computer. The info has been great because I haven't done biology for quite a while"

Those students who felt that using Headstart had not encouraged them to learn on-line had been put off by the perceived time-consuming nature of the resource, a lack of computer access at home, or a need for more instruction and personal tuition to be available:

> "I find it time-consuming and am discouraged by the wait for a computer terminal and the fact that I have no access at home"

Of those students who had not used Headstart, most simply had not got round to it (perhaps due to the pressures of work and adapting to university life in the first month

of term), though three students had attempted to register but been unable to access the resource. Encouragingly, 96% of this group were still interested in learning on-line. These students included a range of positive comments concerning the benefits of having additional relevant information available, easily accessible, and being able to assess their own level by self-testing:

> "More up to date information, relevant level to our course. Like the idea of a test at the end of each stage"
>
> "I feel it will help me to understand the subject better, I am going to try and use the package soon"

A number of these students commented that the use of an on-line resource would be preferable to using a book, due to ease of access, clarity, and interest:

> "An easy way to learn and more interesting than just revising from a book"
>
> "It is another source of information, especially at home and can't get to the library, also it's more enjoyable"
>
> "Visual representation tends to be clearer sometimes on-line rather than in a text book"

These remarks support the view that nursing students are generally in favour of the idea of using a focused on-line learning package.

Discussion

Advocacy of computer-based learning is a common feature of many HE programmes, and there is little doubt that the use of IT can bring substantial benefits to other aspects of the health-care profession (Downing, 2001; Jones *et al*., 1999). However, Davies *et al.* (2000) reported that only 9% of their nursing students found computer software to be a useful learning format, a finding that they attributed to the students' conservative learning approach. In contrast, of the students surveyed in this study, 45% had accessed Headstart within a month of starting their course, and feedback

from these students was very favourable. Even those students who had not accessed the resource were still intending to do so, and cited lack of time rather than lack of interest as their reason for not having done so. A possible explanation for these disparate results is that the software used in the study by Davies *et al.* (2000) was a commercial biosciences-related product, rather than being one specifically designed for nursing students. Evidence in support of this explanation is provided by one of the students in the current study who reported that Headstart was much more useful than the well-known commercial packages, due to its clear relationship to the module material. This indicates that direct and contextualised links are very appealing to students and may actually enhance the take-up of software packages with the target audience.

Previous research has shown that nursing students need to be convinced of the relevance of the science they are studying in order to perform successfully in exams (Caon & Treagust, 1993; Thornton 1997). Trnobranski (1996) states that:

"A common issue in the literature is that meaningful application of biological knowledge to clinical practice is not effectively achieved." (p. 1073)

This has been acknowledged by Clancy *et al.,* (2000) who clearly state that "… the emphasis for education is on providing the conceptual links between the biological sciences and nursing practice" (p. 1523). In other words, in order to appreciate the relevance of the (science) theory they are studying, students need to be able to see how their university-based study relates to their practice in healthcare settings. Headstart was developed with the aim of reducing this 'theory-practice gap' in order

to enhance the students' learning process. Thus it contextualises complex scientific concepts, such as osmosis and tonicity and demonstrates their nursing importance for example, in relation to administering saline drips (Biogallery 2). This integration of biological concepts within a nursing context should help nursing students appreciate the value and relevance of sound biological knowledge.

Other problems with the teaching of biosciences in nurse education have also been identified by previous research. Nicoll & Butler (1996) found that poor resources for biology were a source of anxiety for Project 2000 nursing students. They also suggest that insufficient time is allocated for the study of biology within the nursing curriculum. Attempts to increase both the level of resourcing and the teaching time for biological sciences in Nicoll & Butler's study were met with approval from the students. Whilst increasing contact time may not be a practical option in many institutions, increasing the level of resources is substantially easier to achieve. The use of learning packages has been advocated as a means of supporting students' learning in large class sizes (Gibbs *et al.*., 1997), which are becoming the norm in many HE institutions. A package such as Headstart, which provides an additional learning resource and can be used by students in their own time, provides a simple (and relatively cheap) solution.

McKee (2002) identifies poor study skills as contributing to students' difficulties with the biological sciences and suggests that increased formative assessment and independent student learning might be helpful to some students. Furthermore, Ofori & Charlton (2002) found that support-seeking behaviour of nursing students was more predictive of student performance than entry qualifications and that support-avoidance

was a real problem particularly for younger students. Those students having access to Headstart are now able to review and test their bioscience knowledge before they embark upon their nursing studies, possibly allowing them to start seeking help and developing learning strategies at an early stage in their studies. Individual support is available directly from the teacher via an e-mail link, which may be less threatening for new students than approaching the teacher in person.

Further evaluation is being undertaken to determine if this resource can help to give students a more realistic understanding of their own abilities – and whether it genuinely increases or reduces students' anxiety levels. It is possible that having a greater awareness of the extent and importance of the biosciences in nursing may generate anxiety about the subject matter to be covered:

> "I have just completed gallery 2 of the programme, and have so far found it all really useful (and daunting!). I am really looking forward to starting at uni in 3 weeks time, and can't wait to sart (*sic*) learning. HOWEVER! I have found some of the terminology a little difficult to memorise. Do we have to learn it all before the course starts? or will we learn it in depth as the course progresses? HELP!"

However, contrary to expectations, Ofori & Charlton (2002) also found that moderate academic anxiety and slightly pessimistic outcome expectancies are good predictors for academic success, as these appear to negate against over-confidence. So it would appear that anxiety, *per se*, is not necessarily a bad thing and we should try to differentiate between eustress and distress (Selye, 1976) when considering students' concerns.

McKee (2002) makes a number of suggestions about possible solutions to the problems encountered by nurse educators in relation to teaching biosciences. This author argues that:

"One way to achieve a suitable standard (in biological science) while not overloading is to establish the level of base knowledge required before starting the course." (McKee, 2002, p. 257)

Making it compulsory to have a biological science background would prove unpopular, since it would limit the potential intake substantially (Payne, 1999), and equally, it is regarded as inappropriate to increase the amount of basic biological science taught at university (Rutishauser & Stephenson, 1985). Nicoll and Butler (1996) also found student resistance to the idea of introducing remedial lessons in biology, due to an unwillingness to demonstrate ignorance to the teacher. One possible solution is to introduce an intensive course during the summer vacation; however, this is costly to implement and may not be accessible to all students (many of whom are in full time work prior to taking up their places on nursing courses). Therefore, the use of a package such as Headstart may provide a realistic strategy to enable universities to bridge the gap between the level of biological knowledge which is necessary to succeed as a competent practitioner, and that which many nursing students have obtained prior to the course.

Conclusions

These findings provide evidence of the need for additional support and resources in biosciences for nursing students, demonstrate a willingness amongst these students to

attempt on-line learning, and show general approval of the resource which was developed in this project. The findings suggest that Headstart has the potential to address a number of the issues identified both by this study and by previous research in nurse education. Headstart was developed by (specialist) nurse educators, in conjunction with educational developers and IT technicians, and involved integrating biological concepts into a nursing context. It is freely available via the Internet at http://www.headstartinbiology.com, and the tracking facility confirms that it has had 1,590 users to date. Data from on-line feedback forms available on this site, have not been formally analysed yet but responses (from students and teachers across the UK) have been overwhelmingly positive and interest in the resource has been intense, as the comments below illustrate:

> "Thanks very much. It has taken the sting out of getting back into learning"
>
> "I think this course is fantastic and so much simpler to understand than a book or tutor"

However, a number of problems did arise during the development of this project, which might be of interest to others considering a similar approach. Some of these revolved around the inexperience of students with IT use (for example, failing to use passwords correctly). This is perhaps a particular problem in nurse education with its high proportion of mature students and students without traditional qualifications, but it also has implications for on-line learning more generally. Other problems arose in relation to a lack of access to correctly set-up computers, both at home and also at the University, where pressure on resources made it difficult for students to access machines at times that were convenient to them. This is an aspect which needs to be considered in relation to any efforts to increase IT use in a higher education environment, since an inability to access computers as and when necessary may

reduce the incentive for students to utilise on-line resources. Nonetheless, despite these drawbacks, this project has illustrated the way in which a well-designed and targeted on-line resource has the potential to provide substantial benefits in terms of supporting the curriculum in higher education.

Limitations of the study and implications for future research

The value of this study lies in its role as an action research project that involved developing and evaluating a practical solution to some of the problems experienced by nursing students in relation to the biological sciences. This particular contribution has been made possible by the intensive study of a single institution, using a relatively small number of students. Action research, by definition, entails the involvement of the practitioners themselves, and therefore does not make the same claims to objectivity as traditional scientific research (Kemmis, 1993). The findings of this study should therefore be considered provisional in nature and would benefit from further investigation. However, the potential practical utility of the findings, together with the current lack of similar projects in this area, gives the work value as an exploratory study.

As always, the project has raised a number of questions which have the potential for further research but which could not be dealt with fully in this study. In particular, the Headstart resource would benefit from further evaluation in order to judge its true potential. It is clear that, since a primary aim of the Headstart package was to provide a resource which students could use *prior* to starting university, further evaluation of the package in relation to this aim is necessary. The next cohort of students will have had access to the package prior to starting their degree and further evaluation will be

carried out using this group. Other areas which appear worthy of further consideration include investigation of the types of students who use the resource, the ways in which it is used, and the impact of its use on students' biological subject knowledge and level of anxiety. Investigation of alternative ways of improving and supplementing nursing students' bioscience knowledge might also prove fruitful. The authors hope to be able to address some of these questions in their future research.

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Figure 1: Student concept map outlining factors that might affect academic progress

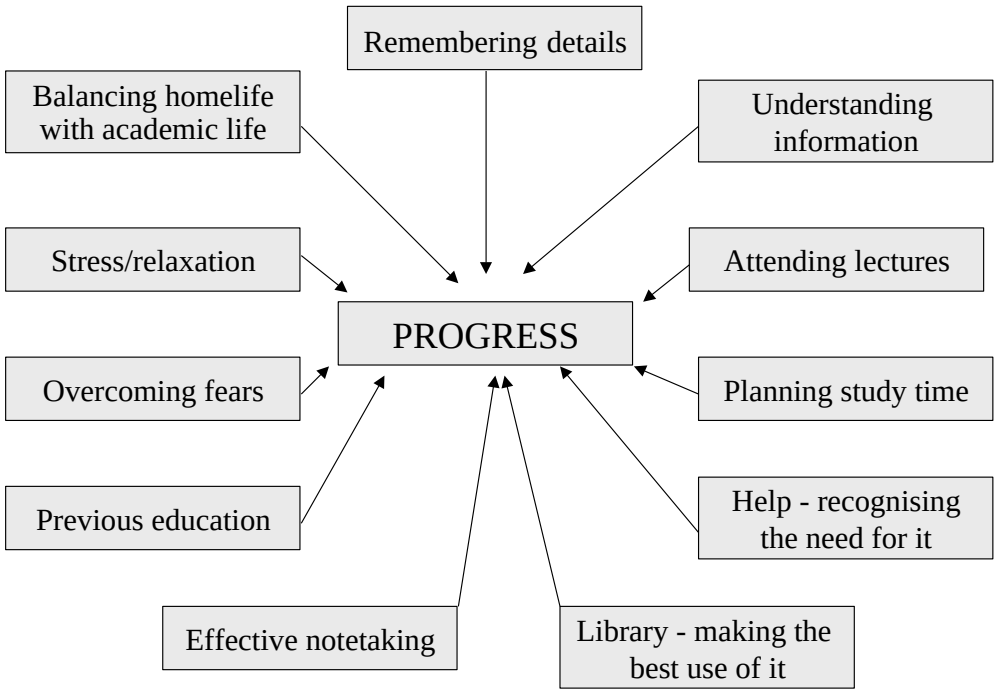

Table 1:

	Below average understanding	**Reasonable understanding**	**Good understanding**
Science generally	65 students (64%)	32 students (32%)	4 students (4%)
Biology	55 students (54%)	42 students (42%)	4 students (4%)

Table 2:

	Would like little help	**Would like some help**	**Would like a lot of help**
Science & Measurement	21 students (21%)	53 students (52%)	27 students (27%)
Chemistry & Physics	15 students (15%)	52 students (51%)	34 students (34%)
Molecules of Life (Biochemistry)	18 students (18%)	52 students (51%)	31 students (31%)
Body Layout	31 students (31%)	57 students (56%)	13 students (13%)
Body Requirements	23 students (23%)	61 students (60%)	17 students (17%)

Table 3:

Biogallery 1: Science & Measurement
Headstart assumes that you are not familiar with biology, or for that matter, with science. Therefore, it begins with a brief insight into the process of scientific observation and measurement**,** and takes a look at what makes science different from other sources of knowledge; this is Biogallery 1. In this section, topics such as calibration, S.I. base units, fractions and multiples, units of measurement in nursing (e.g. calories/joules and blood pressure readings) and simple statistics are all covered; setting the scene for the role of science in nursing. There is an optional multiple-choice quiz at the end of this section to reinforce the material covered in Biogallery 1. The results are provided immediately, and then the learner has the option of re-visiting the material or moving up to the next level.
Biogallery 2: Atoms and Molecules
This section is an introduction to the material world of atoms, molecules, and chemical interactions. It highlights the importance of chemicals to the body (e.g. the role of trace metals and deficiency diseases) as well as covering topics such as pH, solutions, ions & electrolytes and osmosis & tonicity (e.g. explaining why saline drips and not pure water are used to treat some patients). At the end of this Biogallery, there is the option of a multiple-choice quiz or the learner may proceed directly to level 3.
Biogallery 3: Chemistry of Life
This Biogallery introduces some aspects of biochemistry, with specific reference to those polymers of vital importance to the body: carbohydrates, lipids, nucleic acids and proteins. Protein macromolecules are further explored in the context of enzymes, and the impact of temperature (e.g. fever) and pH change are examined. At the end of this Biogallery, there is the option of a multiple-choice quiz or the learner may proceed directly to level 4.
Biogallery 4: Arrangement of the Body
This Biogallery reviews the hierarchical arrangement of the human body. The internal components of cells are examined, before considering the different types of body tissues (with histological sections) and the various body systems. This level is the largest of all the Biogalleries and contains many links and diversions, which help the learner to explore different aspects of body arrangement and better understand structure and function. At the end of this Biogallery, there is the option of a multiple-choice quiz or the learner may proceed directly to level 5.
Biogallery 5: Activities of Life
This is the last Biogallery and it aims to assemble the previous ideas outlined in the lower levels, and explores the various activities of a living person. The main themes covered here are those processes more likely to be encountered whilst practicing as a nurse, for example inputs/outputs of the body; homeostasis; movement; communication, and life cycle. At the end of this Biogallery, there is the option of a multiple-choice quiz or the learner may proceed directly to the Bioviews.
Bioviews: Contemporary Issues
This section is situated at the 'top' of the Headstart resource and it covers a selection of contemporary issues in biological and scientific research, such as the Human Genome Project. The Bioviews are not intended to be comprehensive reviews of current developments, but they do outline the importance and relevance of these exciting subject areas to our everyday life. There is no quiz associated with this level since it was anticipated that students would access this level out of interest rather than necessity.

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Figure 2:

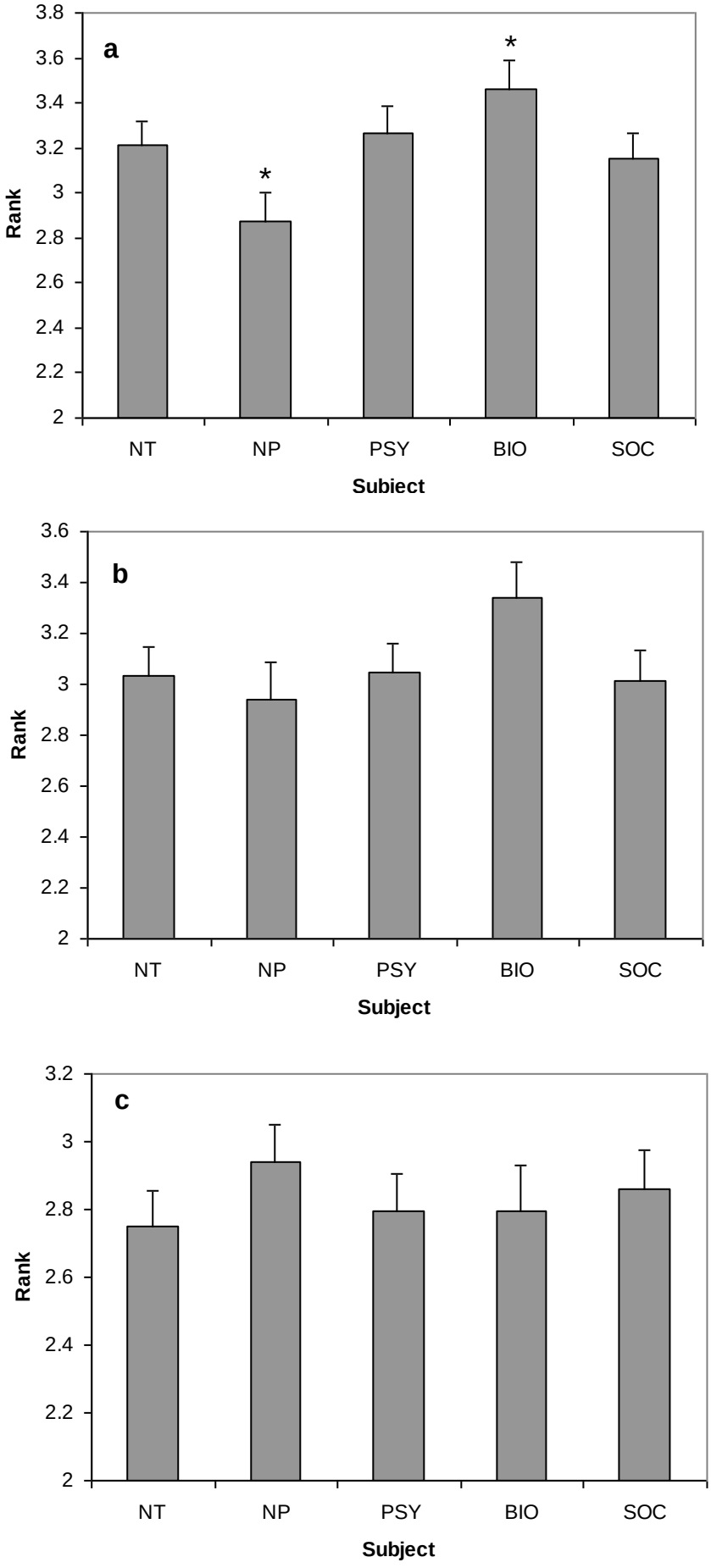

Table 4:

Level	Number	Percentage
No prior qualification	5	8
GCSE or 'O' level	29	45
Access course/ GNVQ	19	29
'A' level	12	18

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