Health Sciences and Practice Mini Project

Using a think-aloud protocol to evaluate an on-line resource for nursing students

November 2005

Karen Gresty and Debby Cotton
University of Plymouth

Using a think-aloud protocol to evaluate an on-line resource for nursing students
Dr Karen Gresty and Dr Debby Cotton: LTSN mini-project final report

Acknowledgements
This project would not have been possible without generous funding from the HEA Health Sciences and Practice Subject Centre. The authors would also like to express their thanks to all the student participants who enabled this research to take place.

Introduction
Computer-based learning, or e-learning, is increasingly being employed in educational settings and the health professions are no exception to this trend (see Adams, 2004). This is in part a response to the *Dearing Report* (1997) which emphasised the growth of technology in higher education and in part due to the need to teach increasing numbers of student with decreasing resources (Maye, 1998). The recent white paper, *The Future of Higher Education*, also advocated an increase in e-learning in order to provide more flexible learning opportunities in the context of widening participation (DFES, 2004), and a national e-learning strategy has recently been published (DFES, 2005).

The development of web-based resources for higher education is a particularly prolific area, offering students the opportunity to access a wide range of information sources at a time and place convenient to them. Such resources have the potential to offer students access to 'open learning', a process described by Race (1994) as involving learning which is: at your own pace; at times and places of your own choosing; when you are in control of how you learn - in terms of methods, structure and revision (p. 23-4). However, some web-based resources replicate didactic teaching methods or text books without offering any substantial advantages and many lecturers simply use the web to post information for students to access. It is clear that advances in technology will not automatically lead to learning enhancement.

Evaluation of e-learning resources is increasingly being viewed as a crucial issue in teaching and learning in HE (Oliver *et al.*, 2002; Crowther *et al.*, 2004), yet it has

.

often taken a secondary role as project funding is primarily directed at development of such resources. Nonetheless, the fundamental question remains - does the technology actually enhance student learning (Conole, 2004)? There are many claims of considerable benefits to both students and tutors if appropriate e-learning strategies and modes of delivery are adopted (see Atack & Rankin, 2002; Broad *et al*., 2004; Cook *et al*., 2004; Gresty & Cotton, 2003; Phillips, 2005; Sit *et al*., 2004; Twomey, 2004), but conflicting evidence is also notable in the literature. For example, Adams (2004) argues that '… often only low level learning is achieved as a result of using these materials', whilst Kekkonen–Moneta & Moneta (2002) conclude that '... carefully designed interactive e–learning modules foster higher–order learning outcomes'. Enhancing teaching and learning by use of learning technologies is a key aim of many educators but claims for success need to be validated before they can be widely adopted.

A key UK government report on e-learning provides strong encouragement for action research in higher education settings, with the aim of developing a better understanding of "what counts as effective e-learning" (DFES, 2003 p.24). The report emphasises the importance of adequate evaluation of on-line resources, including the "intensive evaluation of learning experiences to balance large-scale studies" (p. 25). Armstead (1999) and Lousberg & Soler (1998) advocate action research as an appropriate evaluation methodology and report studies which provide some insights into student engagement with e-resources. Evans & Sabry (2003) describe a heuristic approach to evaluating the quality of the interface (interactivity) with web-based learning systems, although they use experts rather than student subjects for their study. Appropriate evaluation of internet sites is a major issue, particularly in the area of health resources for students, tutors and patients where inaccurate and misleading information abounds. Tsai & Chai (2005) highlight the importance of choosing reliable methodological tools which allow both information content and style of transmission to be considered. However, they do not reflect on the type or level of learning taking place whilst using such resources. In consequence, although some useful studies have been carried out (Hoskins & van Hooff, 2005; Concannon *et al*., 2005) there is a lack of rigorous evidence about the effectiveness of much e-learning.

.

Aims and Objectives

Our study aimed to address some of these evaluation issues by using an alternative methodological approach - a think-aloud protocol - in which students were observed using an on-line resource. We also aimed to add to the more general e-learning research literature by considering the ways and extent to which using this resource enhances student learning. In this report we therefore contribute to both the methodological and e-learning debates, by providing both empirical data and personal reflections on our experience of using a think-aloud protocol to evaluate an e-learning resource for student nurses.

The specific objectives of the project were to:

- Investigate the use of an on-line biological resource for student nurses ('Headstart in Biology'), using an innovative methodology (the 'think-aloud protocol')
- Analyse the ways in which students navigate the resource and link this to their verbal comments about strategic decision-making.
- Understand the ways and extent to which students develop their knowledge and understanding of biological concepts via using the resource.
- Provide wider insights into how healthcare students use on-line resources and the ways in which future e-developments could be improved and made more accessible.

The on-line resource

This project involved a detailed evaluation of an on-line biological resource for student nurses ('Headstart in Biology'), developed at the University of Plymouth. The Headstart package is aimed at stage one nursing (and healthcare) students prior to, and during, their first year of higher education. It aims to offer additional support material and guidance about biosciences within a nursing context, to help students acquire the background knowledge that they will need in order to build a deeper understanding of the subject, and to increase student confidence and motivation. Modelled on the Indonesian Buddhist temple at Borobudur, the resource is structured as a hierarchical pyramid with a series of themed galleries. 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 explored. Each gallery contains a multiple-choice quiz with instant feedback which can be completed by the students, but which is not compulsory. (Further details about the resource can be found in Gresty & Cotton, 2003).

Methodology

Previous research has used a variety of methods for evaluating e-learning resources, most commonly some form of retrospective account such as a questionnaire or focus group discussion of the perceived value of the resource (see Wharrad *et al.*, 2001; Concannon *et al.*, 2005; Cook *et al.*, 2004; Gresty & Cotton, 2003). Whilst these data are of potential interest and can provide information on barriers to the use of e-resources, such accounts are somewhat limited being based on an individual's recollection of their actions. These methods also tend to produce rather vague, generic information about for example, 'Usability', 'Clarity', 'Appeal' (see Cook *et al.*, 2003). Other projects have used additional information collected automatically by computer tracking, (Wharrad *et al.* 2005; Heffner & Cohen, 2005) which may be of some interest in itself, but offers little insight into why a resource was used in the manner detected and is often unreliable. Jones (1998) makes a case for ethnographic techniques to be used as a way of evaluating group work in an online conference environment, although the research casts doubt on the reliability of conference transcripts for this purpose.

In this study, we decided to pilot an alternative method of evaluation using a 'think-aloud protocol'. This method involved observing and video-taping ten students whilst they used the on-line resource, noting their navigational decisions and asking them to articulate their thoughts and feelings as they used the resource. The development of the think-aloud protocol is usually attributed to Ericsson and Simon (1984) and it has been widely used in cognitive psychology research subsequently, often to investigate problem-solving. More recently, the approach has been used to study human-computer interactions (e.g. Janosky *et al.*, 1986; Essens *et al.*, 1991) and in other educational contexts (e.g. Baumann *et al.*, 1993; Oster, 2001). The think-aloud approach enables access to the thought processes or decision-making of someone performing a specific task. In this study, we encouraged the participants to verbalise

.

their thoughts or feelings as they navigated the resource in their usual manner, in order to understand their behaviour. The advantages and disadvantages of utilising this methodology to evaluate an on-line resource are discussed by Cotton & Gresty (in press).

The students were selected by means of an initial questionnaire, administered to the entire cohort of nursing students (see appendix 1). This questionnaire elicited information about previous biological qualifications, IT experience (and experience of using Headstart), age and gender, in order to aid selection of a range of students. The questionnaire asked for volunteers who would be willing to be involved further in the research project, in return for a small fee to cover expenses. A group of ten students with varied backgrounds were invited to participate in the main project phase. (Appendix 2 provides some background information about the selected students.) The composition of the sample broadly reflected that of the overall cohort, in terms of age and IT experience. However, the proportion of males in the sample was slightly higher than that of the cohort as a whole. Ethical approval from the Faculty of Science Ethics Committee (see appendix 3) was gained prior to starting any fieldwork, and all participants in the main study gave written consent to their data being used for the project.

Analysis

Video-tapes of the observation sessions were transcribed in their entirety. Themes were identified through an iterative process, with the aid of QSR N6 (qualitative data analysis software). The software was used to formulate initial categories, using an inductive approach. These categories were further developed with a view to:

- investigating students' navigational decisions
- evaluating the advantages and disadvantages of the resource
- assessing the evidence that learning was taking place

In the final stage of analysis, a series of propositional statements were developed and tested against the entire data-set to ensure that they provided an accurate reflection of the data therein (see Silverman, 1993 for a full description of this approach). A table was also constructed which summarises the strength of evidence in support of each proposition (see appendix 4).

.

Findings

1. Students' navigational decisions

The students navigated the resource in a variety of ways, often at considerable speed, choosing areas based on personal interest, perceived difficulty and relevance. Some followed a more or less linear route through each gallery in turn, whilst others were more selective in their viewing of different pages. Previous enjoyment or a positive learning experience of a particular topic enhanced the chances of students actively seeking more information from the resource, whilst boredom encouraged fast-paced 'flicking' through different pages:

It's something that I find very un-interesting it is in-depth, it is a lot of writing and it's pretty compact which is why I was steaming through it fast.. (S3: 190-192)

Let's see what's in there…that looks interesting. Oh wow, fantastic! I love all the information that's available. (S7: 186-187)

There is some evidence that the presentation of material is crucial in getting students to engage with the resource – text size, images and also the labelling of different topics were all identified as part of the appeal or rejection of different topics

I mean if that was labelled 'interesting topics' I might actually have gone in there! …. But now I know what's in there, there's actually some quite interesting topics in there. So I think that would be worth changing that to grab someone's attention. (S4:164-168)

Several students noted that their navigational decisions were guided by their perceptions of the difficulty of various parts of the resource. This often meant avoiding sections which they thought would be hard (frequently mathematical concepts), although some students specifically revisited areas which they had found hard to understand:

Anything I see to do with Maths I don't like, it's like aagh it scares me. So I'll go back and choose something I like. Let's see - no I don't like atoms and molecules I'm afraid, it's like chemistry, I just like the human biology side, it's a bit naughty really isn't it? (S6: 14-18)

If I felt I really didn't understand it then I would actually go back through and go back through the slides …(S4: 122-3)

.

From a tutor perspective, there was a clear logic behind the order of topics in the resource. However, one student in particular felt that the mathematical concepts should be placed later in the resource rather than confronting students on first entry to the site:

You see this is the bit with the measurements. This is the bit I'm most worried about. So to face this one at the beginning is very daunting. And it puts you on a very uncertain level (S9: 26-9)

Most students found the resource fairly easy to understand, though some felt that it could be overwhelming if you had little biology background. This was confirmed by some of the students who had used the resource prior to the course and had found it quite daunting:

But I have to say that when I did first access this before I started the course, I did think, 'oh my goodness' … But I do think it would be quite beneficial for it to be quite earmarked before you start because I haven't got much biology background at all. (S8: 96-102)

These findings demonstrate the difficulty of providing a comprehensive resource which both addresses the known weaknesses in biological and mathematical understanding of nursing students, and yet is not overwhelming for the weaker students who stand to gain the most from such a resource. They also illustrate a potential problem with the model of Headstart as a pre-course learning experience, in that it may actually reduce students' confidence in their own abilities if they have struggled to understand this material:

hi starting sept 04 am really nervous, found out about this course and decided to have a go, god what have i let myself in for, feel even more out of my depth now, think i need to have some maths lessons before i start college, did anybody else feel the same way. (Posted 11/06/04)

This comment (listed on the resource discussion board rather than being collected as a specific part of this project) clearly illustrates this dilemma, although it was followed up by a reassuring reply from another student. Nonetheless, the ability to access the resource prior to starting university was mentioned as a benefit by students in this study, on the grounds that course preparation can start at a time when they may have more time available and are feeling particularly motivated.

.

The final explanation given by students for their page navigation within the resource was the degree of relevance – either in terms of healthcare practice or in terms of what it was most important to understand to pass assessments:

This one's relevant, about nutrition and got blood pressure, how to do it and … (S1: 22-23)

Right, gallery 2. This seems a bit more relevant. (S7: 20-21)

There was also some evidence of sections being ignored because students could not see how they fitted into the course structure or the students' personal learning objectives:

I'm not saying that health issues aren't relevant because they are. But the field I want to go in is people with learning disabilities being integrated back into society. So it's not something I've worked really hard at with the biology. (S9: 104-109)

I'm just trying to think why I didn't do the Bioviews. I suppose I just though that the galleries and the topics in the galleries were the heart of information and I just skipped everything else out (S4: 158-161)

There is also some evidence of an instrumental approach to learning in which any information which doesn't have direct and obvious relevance to the course is ignored:

I'm just wondering would they be useful to read these before doing your lectures or are they more for your own personal knowledge, that it's something you'd like to learn anyway? (S4: 153-56)

This particular student admitted that he probably wouldn't look at sections which were perceived as being purely for personal interest.

2. Advantages of the online resource

There were a wide variety of views on how the on-line resource compared with more traditional learning methods. Students were specifically asked about how the resource compared with using a book, though many raised other wider issues during the observation period. Reasons cited for preferring the resource to a text book included, ".. it grabs your attention" (S4), it is "jargon-free" (S10) and is "easy and quick" (S1). The on-line tests or quizzes were identified as one of the most important benefits provided by the resource. Students identified the ability to assess their own

.

understanding and retention of information in an unthreatening environment as key issues. Instant feedback was also mentioned as crucial, as was the ability to return to questions several times in order to correct any wrong answers:

I do like the interaction with this, the fact that you do have a goal to set, you've got a quiz you can take, it gives you a result at the end of it, you can go back. With a book obviously there's nothing there interactive to test you on what you've looked at … with this you do capture some things you might miss. (S4: 334-40)

The role of the quizzes in enhancing confidence was mentioned specifically as important by one student:

I think the main thing with this is confidence. Because you have little tests and they're multi-choice as well and you can play with them, that builds up your confidence, and anything you don't know you can look up. (S9: 171- 175)

However, an alternative perspective on the quizzes was raised which suggests that they were not always perceived as boosting confidence:

I found them useful, a little depressing! (laughs) It made me realise I'd have to study a bit more than I thought I might have to. (S2: 46-7)

Confidence in biological knowledge is a major issue for healthcare students (See Gresty & Cotton, 2003) and a key aim of the resource was to encourage and foster this but evidently it was not always successful.

The glossary (hyper-linked throughout the text) was also mentioned as a benefit by two of the students:

It's certainly got everything you want to know here hasn't it? (S7: 25-6)

Ah, that is a good idea. That's great, that really is good. You don't need a nurse's dictionary these days do you? (S10: 274-5)

Clearly there were differences between the responses of different students in the study, and to some extent this was explained by level of computer literacy. Perhaps surprisingly for a group which included several mature students, most of the students were fairly familiar with using computers and several felt that they were becoming quite dependent on the facilities offered by on-line resources, such as search engines and the ability to learn interactively:

.

With a book you have to go through so many different areas to find what you're looking for. And maybe I've just become so dependent on a computer and it's just easier to pop in something to search for and it finds it in a relatively short period of time. (S2: 170-3)

I'm not really too keen on books I must say, I'm more of a computer person … I just find it easier in that you can save certain pages and it's usually more broken down and you've got sections and things whereas in a book you've just got all these things to read. You can skim read but then you miss things. (S5: 277-283)

However, there was one student who mentioned that her lack of experience may have hindered her use of the resource. She commented on how her children would love the resource but seemed unwilling to engage wholeheartedly with it herself:

.. whether it's because I'm not familiar with computers, but I find it all a bit overwhelming sometimes. (S7: 96-8)

There was also one student who, through navigational naivety, had been unable to access a large proportion of the resource. Such students act as a timely reminder that we cannot assume that all students have sufficient computer literacy to engage with e-learning materials as the designer or tutor intended.

3. Disadvantages of the online resource

Despite general enthusiasm for the resource (and overwhelmingly positive feedback from previous questionnaire evaluations), there were some students who expressed a preference for other learning methods, such as books, videos or more lectures:

I prefer books to be honest. No offence to anyone but I prefer to read out of a book (S1: 121-122)

However, this student actually changed his opinion after finding out about the quizzes available within the resource. Another student argued that she couldn't learn from a computer screen and expressed a preference for videos or printed materials:

I go into the library and I get all the videos and I can watch them while I'm doing me ironing or something. I'm always doing two things at once but it's surprising what sticks! (S9: 75-78)

.

However, she concluded that, "*… the more different ways of learning you have, the better*". One student argued strongly for having more lectures, or longer lectures, rather than any form of independent learning:

If I had to pick one from reading a book or picking the internet, I don't know. I definitely wouldn't pick a book at all … I'm better off coming into a lecture and then asking (the tutor) something (S8: 273-78)

This illustrates a more general concern about the perceived lack of tutor guidance available with either e-learning or learning from books:

I can't ask a computer a question … and I can't ask a book a question (S8: 282-5)

Although the resource does allow students to 'ask the tutor' by e-mail, few students took advantage of this facility. One student explained as follows:

You see I always think about people and I know that (the tutor) is a very busy person, and I know if I flag up a question I'm sure she would answer it but, you know, you don't tend to bother the tutors. (S9: 210-213)

In the current climate of increasing student numbers and a push towards e-learning as a means of reducing contact time for lecturers this is an extremely interesting remark! Another student felt that an e-mail response might not be sufficient to clarify the situation:

… if it's that sort of complex that you really are in a rut, I think if you e-mail you can lose exactly what you're asking … although we're in a tech age, it's sometimes nice to get a personal approach and get exactly what you want. So would I e-mail the tutor? Probably not! (S4: 222-30)

This student said that he would probably ask the tutor personally after a lecture, but might try e-mailing if he was out on placement or unable to contact the tutor in person.

Another student concern regarding e-learning more generally was the difficulty of ensuring that you have found all relevant material. This was a valid concern about Headstart, given that one student had overlooked major parts of the resource, and more so with the university's student portal as described below:

.

I don't know whether I've always got all of the information. And I think this is a general flaw really. Even when I go into the portal, different lecturers label their lectures differently and you never know whether you've got it all or not. And there's often this debate going on – oh did you find so and so, where did you find it? And everybody seems to have a different way. (S7: 267-73)

This student argued that very clear instructions were needed to ensure that all students knew what was available and had equal access to it.

Finally, there was some evidence that students had a tendency to 'flick through' the resource at a fast speed, thus reducing the possible educational benefits:

I'm whizzing through this, just skating over the surface. I think if I was going to do it properly, I'd give myself a lot more time to read through it … I'm being a bit naughty and skipping through this again. (S7: 37-9)

This was also supported by the tracking data (see appendix 2) which shows the average time spent per page of the resource by each student. Five of the students spent an average of less than 30 seconds per page which, given the density of text, suggests that they were skimming through the material. Several students also noted in the observation sessions that they seemed to have missed a lot of the information when they had previously used the resource:

There seemed to be a lot of information on the page that I just didn't notice like this text on the left here. I've only just realised … obviously I didn't pay much attention to those as well (S4: 271-4)

This may be a result of moving around the resource at high speed (one student was found to have spent an average of only 18 seconds on each page viewed during the observation) leading to only a small proportion of the text registering with the user.

4. Evidence of learning taking place

For the students, there were two key aspects of learning which they felt were enhanced by the resource, namely remembering and understanding. The first of these, **remembering**, was rated highly by many of the students reflecting the importance they place on memorising factual information for exams. Familiarity was key to students' ability to remember material, with 'reinforcement of lectures' and 'revision for exams' the two secondary concepts identified. One student summed it up with the words:

.

It's like anything else, if it becomes familiar then you learn it don't you? It's just having the time. (S9: 192-3)

A number of students mentioned the direct links between their use of the resource and the material covered during lectures. The resource provided a supportive environment that they could engage with at their own time and pace to enable reflection on lecture material, confirm their understanding of the subject matter and to help them retain information:

I remember (the tutor) lecturing it all, it's just going over it again and remembering it. It's all very interesting it's just going in and then staying there that's the problem! (S10: 200-203)

Two students mentioned using the resource prior to lectures and noted the benefit of some pre-course preparation:

There was a few things on here that … maybe had been taught in my A level which came back to me. So it sort of blunted the blow of going back into lectures because they are quite hard-core lectures … she has to get a lot of information across in a short amount of time. (S4: 129-133)

The resource was also referred to in terms of a revision aid by half the students investigated. The ability to access chunks of information and then take a quiz (with immediate feedback) was also valued with regards to motivating the revision process:

I think it's a revision aid because each section, each gallery like you've got here - the chemistry of life, the quiz is relevant to all those there. So you could sit and read that and then go through the quiz. And then you'd remember it more. (S1: 162-165)

Well what I usually do is go straight to the quiz and answer all the questions and see what I need to revise. (S5: 10-11)

The quizzes were used both as an entry point to the resource by some students, as well as a formative test of knowledge after engagement.

The second aspect of learning enhancement which became evident from the think-aloud data was students' **understanding** of biological concepts. One significant benefit mentioned by many students was enhanced understanding of relevant terminology - a key issue for some of the students who found the complex scientific terms difficult to understand. Understanding terminology can be viewed as a basic

.

level of understanding, without which it is difficult to progress further and as such, is crucial to developing higher level understanding:

.. because it's like learning a different language isn't it. I think the most important thing is getting the base, and if you get that right, and people have got time to use it, then that's brilliant. (S9: 388-391)

.. when you read it. It's just knowing the terms .. terminology .. the jargon .. But pretty important in nursing .. to understand terminology (S10: 168-70)

Another important issue for the students was to understand the biology within a healthcare context. One of their major concerns was with the application of biological concepts to their practice placements, to help them understand how the human body works and to provide better care through this knowledge. This had been a primary aim of the Headstart resource during its development and was mentioned as a benefit by a number of students:

.. this is more relevant this one - the metabolisms and things like that. Because obviously we'll be dealing with a lot of like issues around that .. in the hospital. Like infections and how you metabolise drugs and things like that (S1: 98-102)

I'm the type of person that likes to know, I mean, in practice, what I'm doing, how it's going to affect the body as a whole. I want to know beyond the immediate how it's going to affect ... (S7: 257-259)

However, it is important not to overstate the direct usefulness of the resource in these terms. Most of the students in this study felt that the resource would be more useful for their biology exams than their nursing practice. Furthermore, one student felt that the resource was not particularly helpful in putting the biological information into context and that the links have to be made "in your own mind" (S5: 274).

A major benefit of the resource in terms of developing understanding was the way in which complicated ideas could be broken down into small sections, to make them easier to digest. Students felt that it was important to grasp concepts in small chunks, but also to be able to see the links between different areas:

And it's quite simply laid out, it's not bombarding you with information so there's like pages and pages, it's just like nice short explanations (S1: 71-73)

.

.. you know the areas that you're not sure on, you know where you haven't made the link between one thing and another, or you're not clear about that ... certainly I was getting the impression that .. how everything was inter-related. (S7: 250-261)

An online resource is ideally suited to breaking down text into smaller sections, and creating links between different concepts. However, analysis of the think-aloud data revealed only one comment (S7 above) which related to building links between different parts, despite quotes from several students who appreciated the way that information was broken down. This raises questions about whether all students had the ability to make links between the different concepts, or whether further support might be required.

Summary of findings: The propositional statements

The table in appendix 4 provides a summary of the propositional statements developed relating to the themes above. This table also illustrates the extent of agreement with each statement from within the group of ten students. Clearly, since the observation and think-aloud was fairly unstructured, we would not expect all students to make the same points. However, statements were excluded from the table if they were not supported by at least 2 students in order to emphasise points of similarity in responses. Interestingly, those students who were rated as having a low level of IT literacy appeared to be no less positive about the resource than those with a high level. With the small size of the sample it is evident that these data should be treated with caution; however, they do illustrate the extent of agreement between these students on many common issues.

Discussion

This study investigated how selected healthcare students were using an online resource (Headstart in Biology) and considered the ways and extent to which use of the resource enhanced student learning. In undertaking the study, we were guided by three key e-learning evaluation issues identified by Milton and Lyons (2003). These are:

a) Interface usability (is it easy to use?)
b) Content validity (does it make sense?)
c) Educational utility (do they learn from it?)

.

In the case of Headstart, the answer to the first two questions seems to be 'yes'. In general the resource was felt to be straightforward to use, even for a group of students who reportedly lack confidence in computer use (Sultana, 1990; Kenny, 2002). Moreover, there was a great deal of praise for the clear language and accessibility of the resource content. Despite the widespread perception of biological sciences as a 'difficult' subject (Sutcliff, 1992; Davies *et al*., 2000; McVicar & Clancy, 2001), feedback from these students was overwhelmingly positive, showing that students with a range of previous biological qualifications find the resource useful.

In common with previous research (Caon & Treagust, 1993; Trnobranski, 1996; Thornton, 1997), this study illustrates the importance of providing contextualised information which students perceive as relevant to their practice. 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). Kyriacos *et al*., (2005) noted three main reasons for qualified nurses seeking out extra information on biological subjects. These reasons were personal knowledge, clinical relevance and personal development. It is evident that nursing students are equally strategic in seeking information and are drawn to resource areas that they perceive will be of direct benefit to their studies.

In terms of supporting healthcare curricula, one of the primary aims of developing the resource (that of providing biological understanding and knowledge in a practice context) seems to have been successfully achieved and provides a clear motivating factor for the students using the resource. The resource provides benefits both in terms of academic knowledge and preparation for practice – though some students felt that links to practice were not always made explicit. It may be that clearer links to practice would make certain areas of the resource more accessible to these students. However, it could also reflect their dependence on tutor-led teaching methods to structure their learning. Salamonson & Lantz (2005) found that students expressed a strong preference for traditional teaching methods, with a perceived reliance on teacher-based instruction. Hughes & Daykin (2002) also found students unwilling to engage in on-line dialogue with each other, preferring to contact lecturing staff instead. It

.

would appear that students require a high level of tutor support in order to move towards more independent on-line learning.

Previous research also offers a possible explanation for the widespread approval of the quizzes. For example, 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. Those students having access to Headstart are now able to review and test their bioscience knowledge before they embark upon their studies, encouraging them to start seeking help and to develop effective learning strategies at an early stage in their studies. Other research on e-learning also highlights the importance of having interactive elements to an on-line resource, in order to engage students' interest and promote active learning (Concannon *et al.*, 2005; Phillips, 2005).

Whilst students clearly like using the resource, the issue of educational utility (do they learn from it?) is much harder to pin down. However, there are indications that learning is taking place on a number of levels. In particular, there is plentiful evidence of lower level or 'surface' learning (see Biggs, 1999; Prosser and Trigwell, 1999), such as memorisation of information and basic comprehension. There is also some evidence of higher level learning, such as synthesis, reflection and application of information – but this evidence is less widespread in our sample. According to Biggs, this dominance of surface learning approaches should be considered undesirable and even prevented by tutors:

"The low cognitive level of engagement deriving from the surface approach yields fragmented outcomes that do not convey the meaning intended by the encounter, whereas the deep approach is more likely to help the student construe the meaning. The surface approach is therefore to be discouraged, the deep approach encouraged …" (Biggs, 1999, p.13)

However, such theories have come in for serious criticism in recent years, especially in scientific subject areas. Haggis (2003) challenges the fundamental assumptions of the deep and surface learning dichotomy. She notes that there is considerable research

.

evidence which demonstrates that: a) students are highly resistant to changing their approaches to learning, and b) surface learning can lead to highly successful results (see p. 92-3). Therefore, perhaps it is the model of learning which needs revision, rather than the learning styles of the students.

Much e-learning explicitly or implicitly sites itself in the social constructivist paradigm, in which deep learning is a crucial element (Adams, 2004, p.11). However, in many disciplines, there are underlying facts which need to be memorised prior to engaging in deeper levels of learning. Criticisms of constructivist approaches in science education argue that students cannot construct afresh their own individual understanding of the discipline – when an agreed understanding already exists:

"Constructivism has always skirted round the actual learning of an established body of knowledge ... students will find that words are used in new and standardised ways: problems which were never even seen as being problems, are solved in a sense which needs to be learned and rehearsed." (Solomon, 1994, p. 16)

Even advocates of this approach acknowledge that there are issues for which a personal construction is not sufficient:

"Learning science involves being initiated into the culture of science. If learners are to be given access to the knowledge systems of science, the process of knowledge construction must go beyond personal empirical enquiry." (Driver *et al*., 1994, p. 6)

The same rationale applies to healthcare students. The basic principles of biology are not open to argument; they simply need to be learnt and understood and - at a later date - applied. At the stage for which this intervention was designed (i.e. prior to and in their first year of higher education), a deep approach to learning ('reflecting', 'theorizing' etc.) in such a context seems over-ambitious. Haggis (2003) also notes that the model of deep learning "… assumes that students who come to university are already 'at a level' where they can engage with text, ideas, debates etc. in the way that academics expect" (p. 97). This is clearly questionable in the context we studied, given that the students may have no prior qualifications in biology and little or weak

.

understanding of basic scientific and mathematical concepts. Previous research on nursing students by Rutishauser & Stephenson (1985) suggests that the poor performance of students with little previous biological experience may be due to lack of familiarity with scientific language, concepts or the nature of scientific thinking. The Headstart resource therefore enables such students to gain an understanding of those concepts and terms that they will need in order to continue their studies, and it does so in a way which is broadly accessible to all.

The indications in the data of the kind of higher level thinking which is generally associated with 'deep learning' included: synthesis, making links between concepts, and transferring knowledge to a new context. However, this kind of thinking appears to be limited to a small number of students who have perhaps gone beyond the stage of understanding the terminology and can therefore start to use their knowledge in a wider context. Paradoxically, the opportunities for deep learning may be limited if usability and accessibility take priority during design, as Mayes (2001) notes that it is not necessarily the "... most usable learning environments which promote deep learning" (p. 470). In common with Hughes & Daykin (2002), our findings suggest that more explicit scaffolding is required to encourage students to display higher level thinking. An inherent problem with on-line resources is that the educational benefits of breaking down key ideas into smaller sections can be easily achieved but without an explicit structure, some students cannot build these pieces up into a coherent picture.

Conclusions

There were a number of positive findings from this study, relating to the benefit of using Headstart to supplement learning. These included the ability to understand biology in a practice context, to get to grips with complex scientific terminology, and to test knowledge and understanding through the on-line quizzes. However, there were also a number of issues which arose from the study. These included the avoidance of certain sections of the resource considered 'difficult' by some students, the tendency to 'flick through' the resource at high speed and student concerns about getting tutor feedback if problems arose. Understanding the impact of such a resource on students' learning is complex (see Oliver and Harvey, 2002). However, there is

.

evidence that this resource enhances learning in a variety of ways, including basic memorisation of information, and – for some students – building links between different subject areas. It is possible that the resource could be improved by providing a more explicit framework to scaffold learning, thereby enabling the weaker students to achieve these higher level outcomes too.

Limitations of the study and implications for future research

This research involved a detailed investigation of a small number of students at one institution in the UK. By undertaking a small-scale case study, we were able to explore the ways in which selected students used an on-line resource and analyse their comments in considerable depth. The study yielded insights into the use of the think-aloud protocol in this context and provided a wealth of data about the nature of student learning which appeared to be taking place. However, given the size of the sample, the findings discussed herein should be considered provisional in nature and would benefit from a wider investigation. Nonetheless, the practical utility of the findings, together with the lack of similar research, gives the work value as an exploratory study.

Some of the issues arising from this work appear to have provided more questions than answers. For example – what is the impact (if any) of the fast-paced flicking which appeared such a strong feature of students' use of this resource? Can learners absorb the required information whilst moving through electronic resources at high speed? What measures (if necessary) could be taken to encourage students to slow down and take in information more carefully? Further research is needed to investigate the impact of speed of navigation on retention of information. Another question relates to how students can be encouraged to engage with parts of the subject which they find difficult. In educational terms, spending more time on areas which you find difficult seems the most sensible strategy. However, this was relatively unusual amongst our sample. A more common reaction was to avoid difficult topics entirely or flick through at high speed. Further research is needed to investigate how such avoidance strategies can be reduced in the context of independent on-line learning. The authors hope to be able to address some of these questions in their future research.

.

References

Adams, A.M. (2004) Pedagogical underpinnings of computer-based learning. *Journal of Advanced Nursing*, 46(1) 5-12.

Armstead, P. (1999) Designing, embedding and evaluating C&IT through action research. *Active Learning 11*, 22-26.

Atack, L. & Rankin, J. (2002) A descriptive study of registered nurses' experiences with web-based learning. *Journal of Advanced Nursing 40(4)* 457-465

Baumann, J.F., Jones, L.A., & Seifert-Kessell, N. (1993). Using think alouds to enhance children's comprehension monitoring abilities. *The Reading Teacher, 47,* 184-193

Broad, M., Matthews, M. & McDonald, A. (2004) Accounting education through an online-supported virtual learning environment. *Active Learning in Higher Education,* 5(2) 135-151.

Biggs, J. (1999) Teaching for Quality Learning at University. Buckingham: SRHE and Open University Press

Caon, M. & Treagust, D. (1993) Why do some nursing students find their science courses difficult? *Journal of Nursing Education* 32 (6), 255-259.

Clancy, J., McVicar, A. & Bird, D. (2000) Getting it right? An exploration of issues relating to the biological sciences in nurse education and nursing practice. *Journal of Advanced Nursing* 32 (6), 1522-1532.

Concannon, F., Flynn, A. & Campbell, M. (2005) What campus-based students think about the quality and benefits of e-learning. *British Journal of Educational Technology* 36(3) 501-512

.

Conole, G. (2004) The role of research in informing practice. *Exchange*, issue 6, Spring 2004, 30-31.

Cook, E., Wharrad, H. and Poussa, C. (2003) *Putting post-registration nursing students on-line: Important lessons learnt from a small-scale study* (LTSN HSAP mini-project)

Cook, G., Thynne, E., Weatherhead, E., Glenn, S., Mitchell, A. & Bailey, P. (2004) Distance learning in post-qualifying education. *Nurse Education Today*, 24(4), 269-276

Cotton, D.R.E. & Gresty, K.A. (in press) Reflecting on the think-aloud method for evaluating e-learning. *British Journal of Educational Technology*.

Crowther, M.S., Keller, C.C. & Waddoups, G.L. (2004) Improving the quality and effectiveness of computer-mediated instruction through usability evaluations. *British Journal of Educational Technology* 35 (3), 289-304.

Davies, S., Murphy, F. & Jordan, S. (2000) Bioscience in the pre-registration curriculum: finding the right teaching strategy. *Nurse Education Today* **20** 123-135

Dearing, R. (1997) *Higher education in the Learning Society: The Dearing Report* (National Committee of Inquiry into Higher Education) London: HMSO.

DFES (2003) *Towards a Unified e-Learning Strategy: Consultation Document*. Nottingham: DFES Publications.

DFES (2004) *White Paper: The Future of Higher Education* [WWW document] URL: http://www.dfes.gov.uk/hegateway/strategy/hestrategy/foreword.shtml (accessed 28/09/05)

.

DFES (2005) *Harnessing Technology: Transforming learning and children's services* [WWW document] URL: http://www.dfes.gov.uk/publications/e-strategy/docs/e-strategy.pdf (accessed 28/09/05)

Driver, R., Asoko, H., Leach, J., Mortimer, E. & Scott, P.: 1994, 'Constructing Scientific Knowledge in the Classroom', *Educational Researcher*, **23**(7), 5-12.

Ericsson, K.A. and Simon, H.A. (1984) *Protocol Analysis: Verbal Reports as Data* (Revised edition) London: MIT Press

Essens, P.J.M.D., McCann, C.A. and Hartevelt, M.A. (1991) An experimental study of the interpretation of logical operators in database querying. Acta Psychologica 79 (1-3), 201-225.

Evans, C. & Sabry, K. (2003) Evaluation of the interactivity of web-based learning systems: principles and process. Innovations in Education and Teaching International, 40(1) 89-99

Gresty, K.A. & Cotton, D.R.E. (2003) Supporting biosciences in the nursing curriculum: development and evaluation of an online resource. *Journal of Advanced Nursing, 44(4)* 339-349.

Haggis, T. (2003) Constructing Images of Ourselves? A Critical investigation into 'Approaches to Learning' Research in Higher Education. *British Educational Research Journal*, 29 (1) 89-104

Heffner, M. & Cohen, S.H. (2005) Evaluating student use of Web-based course material. *Journal of Instructional Psychology 32 (1) 74-81*

Hoskins, S.L. & van Hooff, J.C. (2005) Motivation and ability: which students use online learning and what influence does it have on their achievement? *British Journal of Educational Technology*, 36(2) 177-192

.

Hughes, M. & Daykin, N. (2002) Towards Constructivism: Investigating students' perceptions and learning as a result of using an online environment. *Innovations in Education & Teaching International*, 39(3) 217-224

Janosky, B. Smith, P.J. and Hildreth, C. (1986) On-line library catalog systems: An analysis of user errors. International Journal of Man-Machine Studies 25 (5), 573-592

Jones, C. (1998) Evaluating a collaborative online learning environment. *Active Learning 9*, 31-35.

Kekkonen–Moneta S. & Moneta G.B. (2002) E–Learning in Hong Kong: comparing learning outcomes in online multimedia and lecture versions of an introductory computing course. *British Journal of Educational Technology*, 33 (4), 423-433

Kenny, A. (2002) On-line learning: Enhancing nurse education? *Journal of Advanced Nursing* 38 (2) 127-135

Kyriacos, U., Jordan, S. & van den Heever, J. (2005) The biological sciences in nursing: a developing country perspective. *Journal of Advanced Nursing* **52(1)** 91-103

Lousberg, M. & Soler, J. (1998) Action research and the evaluation of IT projects. *Active Learning 8*, 1-5.

McKee, G. (2002) Why is biological science difficult for first-year nursing students? *Nurse Education Today* 22, 251-257.

McVicar, A. & Clancy, J. (2001) The biosciences and fitness for practice: a time for review? *British Journal of Nursing* 10 1415-1420

Maye, T. (1998) Teaching, technology and talk. *The Psychologist, 11*, 375-377

Mayes, J.T. (2001) Quality in an e-university. *Assessment and Evaluation in Higher Education* 26 (5) 465-473

.

Milton, J. and Lyons, J. (2003) Evaluate to improve learning: Reflecting on the role of teaching and learning models, *Higher Education Research and Development* 22 (3) 297-312

Oliver, M. and Harvey, J. (2002) What does "impact" mean in the evaluation of learning technology? *Educational Technology and Society* 5: 18-26

Oliver, M., McBean, J., Conole, G. & Harvey, J. (2002) Using a toolkit to support the evaluation of e-learning. *Journal of Computer Assisted Learning*, 18 (2), 199-208.

Oster, L. (2001). Using the think-aloud for reading instruction. *The Reading Teacher, 55*, 64-69.

Phillips, J.M. (2005) Strategies for active learning in online continuing education. *Journal of Continuing Education in Nursing*, 36(2) 77-83.

Prosser, M. & Trigwell, K. (1999) Understanding learning and teaching: the experience in higher education. Buckingham: Society for Research into Higher Education and Open University Press.

Race, P. (1994) *Open Learning Handbook: Promoting Quality in Designing and Delivering Flexible Learning*. London: Kogan Page.

Rutishauser, S. and Stephenson, P. (1985) The feasibility of students with a predominantly arts educational background coping with the physiology component of a university degree programme. *Journal of Advanced Nursing*, 10 (6): 559-566

Salamonson, Y. & Lantz, J. (2005) Factors influencing nursing students' preference for a hybrid format delivery in a pathophysiology course. *Nurse Education Today* **25** 9-16

Silverman, D. (1993) *Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction*. London: SAGE Publications.

.

Sit, J.W.H., Chung, J.W.Y., Chow, M.C.M. & Wong, T.K.S. (2005) Experiences of online learning: students' perspectives. *Nurse Education Today* 25(2) 140-147.

Solomon, J. (1994) The rise and fall of constructivism. *Studies in Science Education*, 23: 1-19.

Sultana, N. (1990) Nurses' attitudes towards computerisation in a clinical practice. *Journal of Advanced Nursing* 15: 696-702

Sutcliff, L. (1992) An investigation into whether nurses change their learning styles according to the subject area studied. *Journal of Advanced Nursing* 18, 647-658

Thornton, T. (1997) Attitudes towards the relevance of biological, behavioural and social sciences in nursing education. *Journal of Advanced Nursing* 26, 180-186.

Trnobranski, P. (1993) Biological sciences and the nursing curriculum: a challenge for educationalists. *Journal of Advanced Nursing* 18, 493-499.

Tsai, S-L. & Chai, S-K. (2005) Developing and validating a nursing web site evaluation questionnaire. *Journal of Advanced Nursing 49 (4)* 406-413

Twomey, A. (2004) Web-based teaching in nursing: lessons from the literature. *Nurse Education Today*, *24*, 452-458.

Wharrad, H., Kent, C., Allcock, N. and Wood, B. (2001) A comparison of CAL with a conventional method of delivery of cell biology to undergraduate nursing students using an experimental design, *Nurse Education Today* 21: 579-588

Wharrad, H.J., Cook, E. & Poussa, C. (2005) Putting post-registration nursing students online: important lessons learned. *Nurse Education Today*, 25(4) 263-271.

.

Appendix 1: Questionnaire

EVALUATING AN ON-LINE RESOURCE FOR NURSING STUDENTS

COHORT SEPTEMBER 2004: INITIAL CONFIDENCE AND EXPERIENCE SURVEY

Debby Cotton and Karen Gresty

This survey forms part of a research project which aims to evaluate an on-line resource for nursing students. All information provided as part of this research will be treated as confidential, and will have no impact on your University education. You do not have to take part in the research, and you may choose to withdraw at any stage, but it would help us greatly if you could try to answer all the questions as fully as you can - feel free to add extra comments if you wish. Please note that there are no 'right' or 'wrong' answers, as all information supplied is perfectly valid! *Thank you.*

1. How would you rate your current level of anxiety regarding the study of Biology in your nursing course? *(Please circle one box only)*

Not anxious	**Quite anxious**	**Very anxious**

2. How confident are you that you will pass Biology in your first year?
(Please circle one box only)

Not confident	**Quite confident**	**Very confident**

3. What level of biological knowledge do you consider you currently have?
(Please circle the highest level achieved below.)

None	**GCSE/'O' Level**	**'A' Level**	**Above 'A' level**	**Other** (please specify)

……

4. Do you have experience of using the following IT resources to support your learning?
(Please circle all which apply)

Internet	**CD-ROM**	**Intranet** (e.g. student portal)	**Other** (please give details)

……

5. How confident are you about using computers to support your study?
(Please circle one box only)

Not confident	**Quite confident**	**Very confident**

6. Have you used the on-line Headstart package yet? **Yes** **No**
*If you answered 'Yes' please proceed to **question 8**.*

7. If you answered 'no', please outline any particular reasons:

……

*Now please proceed to **question 12**.*

.

Below are a number of statements about the Headstart resource. Please indicate your agreement or disagreement with each one, giving additional information where possible: *(please circle one box only)*

8. Headstart provides a good introduction to Biology

Strongly agree	Agree	Neutral	Disagree	Strongly disagree

Please explain your response:……

……

……

9. I had problems using Headstart

Strongly agree	Agree	Neutral	Disagree	Strongly disagree

Please explain your response:……

……

……

10. I found Headstart easy to use

Strongly agree	Agree	Neutral	Disagree	Strongly disagree

Please explain your response:……

……

……

11. I would prefer to use a Biology text book instead of Headstart

Strongly agree	Agree	Neutral	Disagree	Strongly disagree

Please explain your response:……

……

……

12. Please indicate your gender: **Male** **Female**

13. Please circle one box below which corresponds to your age group:

20 and under	21-30	31-40	41-50	Over 50

14. Would you be willing to be involved further in this research project (in return for a small fee)? If so, please add your name and contact details below:

Name ……
E-mail ……
Phone ……
Mobile ……

Please note: All information on this form is confidential and will only be reported in an anonymous form.

Thank you for your co-operation

.

Appendix 2: Background information about participants

Number	Gender	Age	IT literacy	Headstart experience	Total time of observation	Av. time per page
S1	M	21-30	HIGH	No	29m 43s	37 secs
S2	F	41-50	HIGH	Yes	29m 36s	18 secs
S3	M	21-30	LOW	No	48m 49s	28 secs
S4	M	21-30	HIGH	Yes	31m 28s	26 secs
S5	F	= 20	MEDIUM	Yes	1h 0m 21s	45 secs
S6	F	31-40	LOW	Yes	34m 23s	98 secs
S7	F	31-40	LOW	No	40m 48s	26 secs
S8	F	31-40	HIGH	Yes	32m 7s	40 secs
S9	F	41-50	LOW	Yes	40m 29s	58 secs
S10	F	31-40	LOW	Yes	57m 25s	20 secs

The figure for IT literacy was devised by multiplying the score on questions 4 and 5 of the questionnaire (both coded as 1, 2 or 3)[1]. Low was rated as an overall score of 1 or 2, medium as 3 or 4 and high as 6 or 9.

[1] The category 'other' in question 4 was not included in the analysis as those respondents who used it all added 'text books' rather than other IT resources

.

Appendix 3: Application for ethical approval

UNIVERSITY OF PLYMOUTH

FACULTY OF SCIENCE

Human Ethics Committee

APPLICATION FOR ETHICAL APPROVAL OF RESEARCH INVOLVING HUMAN PARTICPANTS

Name of Principal Investigators: **Dr Karen Gresty & Dr Debby Cotton**

TITLE of Research project: **Using a think aloud protocol to evaluate an on-line resource for nursing students.**

---

1. Nature of approval sought (please tick one box)

STAFF should tick one of the three options below.

Specific project ☑

Tick this box if you are seeking approval for a specific study, or set of studies, with methods that are explained fully in the sections below. This form of approval is appropriate for funded projects with a clear plan of work, and limited duration.

Thematic programme of research ☐

Tick this box if you are seeking approval for a programme of work using a single paradigm. This form of approval is appropriate for pilot work, or routine work that is ethically straightforward. Note, the maximum period of approval for thematic ethical clearance is 3 years.

Practical / Laboratory Class. ☐

Tick this box if you are seeking approval for a teaching activity which involves student involvement in the role of an experimental participant.

POSTGRADUATE STUDENTS should tick one of the two options below.

Taught Masters project ☐

M.Phil / PhD by research. ☐

UNDERGRADUATE STUDENTS should tick one of the two options below.

Student research project ☐

Practical / Laboratory Class where you are acting as the experimenter. ☐

.

Investigators

STAFF / RESEARCH POSTGRADUATES

	Name	**School / External affiliation**
Principal Investigators:	Dr Karen Gresty	Biological Sciences
	Dr Debby Cotton	EDaLT
Other researchers:	_____	_____
	_____	_____
	_____	_____
	_____	_____

UNDERGRADUATES / TAUGHT MASTERS STUDENTS.

	Name	**School**
Student	_____	_____
Supervisor / Module	_____	_____
Leader	_____	_____
	_____	_____

Please indicate School of each named individual, including collaborators external to the Faculty. Please continue on a separate sheet if required.

---

3. Funding body (if any)

HEFCE Special Projects (LTSN Centre/ Health Sciences and Practice Network)

---

4. Start & end date for research for which ethical clearance is sought.
Note, maximum period for thematic clearance is 3 years.

Start date: **October 2004** End date: **December 2005**

---

5. Aims and objectives of research for which ethical clearance is sought.

To investigate the use of an on-line biological resource ('Headstart') for student nurses using a think aloud protocol. The project will analyse the ways in which students navigate the resource and link this to their verbal comments regarding strategic decision making.

.

6. Description of research methods and procedures for which ethical clearance is sought. Please provide details for each section below, using separate sheets where necessary.

Participant sample to be tested. Where vulnerable groups are to be involved, this must be explicitly stated.

Cohort of Nursing Diploma students, in first year of programme.

Method of recruitment including inclusion / exclusion criteria for participation.

A brief questionnaire will be administered to the students to select willing volunteers for the study. Participants will be selected on the basis of previous computer experience, biological qualifications, gender and age. We expect to select a small group of 8-10 students, who will be offered a one-off payment of £10.00 (plus travel expenses) for their involvement.

The means of obtaining informed consent. You should either provide a copy of a consent form (see sample attached) OR explain why informed consent is not required.

Consent form attached

How participants will be made aware of their right to withdraw at any time.

Verbally, before the questionnaire and the actual observation, and also documented on the questionnaire itself.

How confidentiality will be maintained, including archiving / destruction of primary data where appropriate, and how the security of the data will be maintained

Due to the nature of this form of data collection (video), then anonymity is not possible. However, confidentiality will be assured as the video will only be used for research purposes by the project investigators and will not be distributed. It will be kept in a locked drawer/room and each volunteer will be assigned a number/pseudonym to identify them on the video. No names will be published and no video footage will be distributed.

The procedure that participants will engage in.

.

Volunteers will be observed and videoed (individually) in a non-public space, using the 'Headstart' on-line resource with one of the principal investigators (Debby Cotton). Volunteers will be encouraged to articulate their thoughts, as they navigate through the package and both objective information (e.g. Which pages were visited) and subjective information (e.g. Did the information they accessed make sense to them) will be collated from each observation. A standard protocol for data collection (e.g. Questions/Prompts to be asked) will be developed to use with each volunteer, to ensure parity of experience.

Identify potential risks of harm or distress associated with participation in the research, and the steps taken to minimise such risks, including actions to be taken in the event that harm or distress occur as a result of participation.

No risk to participant is inherent in research methodology. If students do not want to answer/return questionnaire or take part in the study, then no further action taken. If students do not want to complete observation exercise after it commences, then they can withdraw with no penalty. There will be explicit assurance that this research is not linked to their course or assessment.

Does your research involve deception? Yes ☐ **No ✔** ☐

If "Yes", you need to explain why the following conditions apply to your research:

a) Deception is completely unavoidable if the purpose of the research is to be met.

N/A

b) The research objective has strong scientific merit.

N/A

c) Any potential harm arising from the proposed deception can be effectively neutralised or reversed by the proposed debriefing procedures (see section below).

N/A

The means by which participants will be debriefed, if appropriate.

Verbal information at end of session

In cases where valid informed consent is not part of the procedure, please say why, and the steps taken to ensure ethical standards are maintained. N/A

In cases where additional evidence is required (e.g. police clearance for work in schools, ethical clearance from health authority), ethical clearance will be contingent upon provision of such evidence. Please state whether such evidence is has been applied for, and the body to whom the application has been made. N/A

Where ethically sensitive, please attach copies of materials to be used (questionnaires, video tapes, test materials etc). **Questionnaire attached.**

7. Professional bodies whose ethical policies apply to this research

None

Give details of any application made to such bodies and of the outcome.

.

8. Ethical Protocol & Declaration

To the best of our knowledge and belief, this research conforms to the ethical principles laid down by the University of Plymouth and by any professional body specified in section 7 above.

This research conforms to the University's Ethical Principles for Research Involving Human Participants with regard to each of the following:
(Please tick appropriate box)

(a)	Openness and honesty	✔ **Yes** ☐	No	☐
(b)	Protection from harm	✔ **Yes** ☐	No	☐
(c)	Right to withdraw	✔ **Yes** ☐	No	☐
(d)	Debriefing	✔ **Yes** ☐	No	☐
(e)	Confidentiality	✔ **Yes** ☐	No	☐
(f)	Informed consent	✔ **Yes** ☐	No	☐

Sign below where appropriate:

STAFF / RESEARCH POSTGRADUATES

	Signatures	**Date**
Principal Investigators:		
Other researchers:	_____	_____

Staff and Research Postgraduates should the send completed and signed copy of this form to Alison Perry, Secretary to the Science Human ethics Committee, Faculty of Science Office.

UG / TAUGHT POSTGRADUATES

	Signature	**Date**
Student	_____	_____
Supervisor / Adviser	_____	_____
	_____	_____
	_____	_____

Undergraduate and Taught Postgraduate students should pass on the completed and signed copy of the form to their School Representative on the Science Human Ethics Committee.

.

UNIVERSITY OF PLYMOUTH

FACULTY OF SCIENCE

Human Ethics Committee Consent Form

CONSENT TO PARICIPATE IN RESEARCH PROJECT

Names of Principal Investigators**: Dr Karen Gresty & Dr Debby Cotton**

Title of Research:

Using a think aloud protocol to evaluate an on-line resource for nursing students

---

Level of Work

- □✔ **Staff research project**
- □ M.Phil / PhD project
- □ Project for taught Masters / Doctoral programme
- □ Undergraduate Project
- □ Exercise forming element of taught programme

Brief statement of purpose of work

To investigate the use of an on-line biological resource ('Headstart') for student nurses using a think aloud protocol. The project will analyse the ways in which students navigate the resource and link this to their verbal comments regarding strategic decision making.

PLEASE TICK AS APPROPRIATE, AND SIGN & DATE THE FORM

The objectives of this research have been explained to me.

I understand that I am free to withdraw from the research at any stage, and ask for my data to be destroyed if I wish.

I understand that my confidentiality is guaranteed, unless I expressly state otherwise.

I understand that the Principal Investigators of this work will have attempted, as far as possible, to avoid any risks, and that safety and health risks will have been separately assessed by appropriate authorities (e.g. under COSSH regulations)

Under these circumstances, I agree to participate in the research.

Name: …….

Signature: .....…….. Date: .....……..

.

Appendix 4: Propositional Statements & Evidence from Think Aloud Research

	Students										
Statement	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Navigational Decisions											
Most students navigate based on level of personal interest in each topic	Y		Y	Y		Y	Y		Y	Y	7
Some students navigate based on degree of topic familiarity			Y	Y	Y				Y		4
Most students navigate based on their perception of topic difficulty	Y		Y	Y	Y	Y		Y	Y	Y	8
Some students navigate based on degree of perceived relevance	Y			Y			Y				3
Developing Knowledge & Understanding											
For half of the students …											
Learning is enhanced by familiarity with the terminology	Y				Y		Y		Y	Y	5
Contextualising biology in practice enhances understanding	Y						Y	Y	Y	Y	5
Breaking down information into small chunks aids learning	Y			Y	Y		Y			Y	5
Remembering is enhanced by reinforcing lecture material		Y	Y					Y	Y	Y	5
(Online) quizzes are highly valued as a revision aid	Y		Y		Y	Y				Y	5
Reinforcing lecture material is key to retaining information		Y	Y					Y	Y	Y	5
The availability of a tool for focused revision is strongly valued	Y		Y		Y	Y				Y	5
Advantages/Disadvantages of Online Resources											
Some students perceive the online resource to be better than a book		Y		Y	Y				Y	Y	5
Most students value the opportunity to assess their learning and get instant feedback	Y		Y	Y	Y	Y		Y	Y		7
Lack of tutor guidance and not wanting to bother academics is an issue for some students				Y				Y	Y		3
Lack of computer experience can be overwhelming when trying to learn online							Y			Y	2
No. of statements supported by each student =	9	3	8	8	8	5	6	6	10	11	