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The development and impact of a web-based student centred learning package

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This research project examined three aspects of a web based teaching package on risk assessment.

1. An assessment of the use of knowledge elicitation in developing the content of the risk assessment package by bringing together experts
2. An evaluation of the impact of the package on the students using it, and
3. An examination of student opinions on the strengths and weaknesses of traditional lecture-based and web-based delivery.

Introduction

During the past two decades, educators have invested extensive time and resources introducing computers and web-based courses into universities (Yazon *et al.*, 2002). However, many academics appear to use the technology merely as an extension of the chalkboard or overhead projector and do not use its potential to re-evaluate their approaches to teaching and assessment (Harris, 1999). Unfortunately, this traditional pedagogy reinforces students' passive and rote learning strategies. Although a constructivist student-centred learning paradigm is desirable in the University setting, post-secondary teaching methods continue to focus on teacher-directed activities. As critics and advocates alike clamour for a justification of computer-rich classrooms, there is a need for educators to critically investigate how instructional technologies can be used more effectively to improve teaching and enhance learning. An essential part of that investigation involves examining teachers' and students' pedagogical perspectives and roles in courses where technology is extensively used. An examination of these experiences and perspectives may lead to a deeper understanding of technology's potential role as a catalyst for initiating changed teaching and learning in the university classroom. In this paper we describe a study that begins to address these issues.

The aim of the risk assessment web site was to enable students to develop the knowledge and skills to conduct a risk assessment of health and safety hazards in the workplace. Risk assessment is a tool to assist in the identification of risks and to guide decisions requiring a balancing of safety and resources. Its aim, in health and safety management, is to assist duty holders in complying with the legislation by ensuring they are doing all that is reasonably practicable to control risks. It also enables duty holders to produce decisions, which are consistent, reliable and objective.

Health and safety in Residential Care Homes was selected as the context in which students would learn about and develop their skills in the application of risk assessment. A case study of a typical residential care home was developed with the cooperation of a large organization which specialized in the provision of residential care.

Knowledge elicitation

The process of knowledge elicitation enables the knowledge and experience of experts to be analysed to discover how they apply their domain expertise in areas such as problem solving, judgement and decision making. Knowledge elicitation is therefore the process of locating, collecting and refining the knowledge relevant to a particular domain (Ericsson & Simon, 1985; Garzy & Ibbs, 1990; Beynon-Davies, 1993; Wood & Ford, 1993). This process was utilised to develop the content of the risk assessment website because the aim of the training was to develop skill, professional judgement and disseminate good practice. It is recognized that experts have difficulty in explaining what goes into making them an expert however they are usually able to explain their approach through using examples of how they tackle different situations (Benyon- Davies, 1991).

Eight experienced health and safety professionals from a variety of employment backgrounds, proficient in undertaking risk assessment were recruited. In order to explore the way in which experts conduct risk assessment an example of the application of risk assessment was used as the basis for the web site.

The information supplied to the experts, included a detailed description of the premises, information about organisational structure, and a series of photographs illustrating the different areas in the residential home and the layout of equipment and furniture. The experts were asked to assume that no previous risk assessments had been conducted. Risks which are typically encountered in residential care homes include slips, trips and falls, manual handling, legionnaires disease (from hot and cold water systems) and scalding. These are accentuated as a consequence of the various degrees of dependency and infirmity of residents.

Details of the case study were sent out in a workbook and each expert was asked to describe the strategy they would adopt in undertaking a risk assessment. A workshop was then convened bringing these experts together for the first time. The type of knowledge and quality of judgements acquired from experts in a group setting differs from information gathered when individuals are questioned (McGraw & Harbison-Briggs, 1989). Grabowski *et al* (1992) suggest that the use of such groups as an element of knowledge acquisition can offer significant advantages over interviews with individuals, as a group can provide a wider range of information, insights and ideas than can be obtained from individuals.

The experts were divided into two sub-groups (each with a facilitator) and asked to debate their proposed actions in undertaking a risk assessment and where possible to reach a consensus. The facilitator encouraged the experts to verbalise their decision-making processes and particularly to express how these decisions were influenced by external factors (for example local/national guidance) and/or previous experiences. All of the discussions were tape recorded.

The two subgroups were then brought together in order to fulfil the following aims:

1. To identify areas of consensus and divergence amongst the subgroups.
2. To highlight omissions or extraneous information within the case study.

On completion of the workshop, the tape recordings were analysed to establish:

- (i) the principles involved in risk assessment;
- (ii) the key knowledge, skills and attitudes required by risk assessors;
- (iii) the insights into the ways experienced risk assessors undertake risk assessment and
- (iv) the common prompts, influencing factors and other considerations which affect professional judgment and decision making in the field of risk assessment.

The website was developed using the information obtained through the knowledge elicitation exercise. The case study was used and the materials pertaining to the case were displayed on the website, e.g. photographs and simulated safety documentation. The main components of undertaking a risk assessment as articulated by the experts were incorporated into the training package. Key questions were posed to the users and feedback was given to enable them to understand how the experts tackled different components of the risk assessment process.

A discussion forum was included to encourage the students to converse much as they would on a traditional training course and to enable them to discuss issues of interest or concern.

STUDENTS

A large proportion of the final year students following the BSc in Environmental Sciences, for which this package was designed, will have experience of the health and safety risks typically found in residential care through their sandwich year professional placements in local

authority environmental health services. In this capacity they are likely to have accompanied officers undertaking inspections of residential care homes to monitor compliance with health and safety legislation. Consequently the students would be familiar with the types of hazards and risks that are routinely encountered but they would have little experience of undertaking a risk assessment for themselves. Thus the web site was concerned with enabling users to apply their knowledge to identify and assess risks in residential care homes and then to recommend appropriate controls to eliminate or reduce them to an acceptable level.

Methods

A total of 37 final year students participated in the research. The majority (86%; n = 32) were full-time students. Forty-three percent (n=16) were male and 57% (n=21) were female. All had successfully completed a Level 2, 20 credit module in Health and Safety and the majority (84%, n = 31) had undertaken an environmental health training placement (either during their third year for those on a thick sandwich, or, for part time students, during the 4 years of their undergraduate programme).

Students were asked to complete two questionnaires, a 'glitch' form and a user log. The first questionnaire was completed immediately after the initial introduction to the package and the second was submitted after they had completed the assessed assignment incorporated in the risk assessment web site. The user log and glitch forms were completed during the times when students used the package and were submitted with the assignment.

IMPACT OF THE PACKAGES.

Following completion of the risk assessment web training package, students were asked questions about 6 aspects of the package and asked to attach an overall score to each (using a 1-10 scale; 10 being excellent and 1 poor). Results are presented in Table 1.

ASPECT	RANGE	MEAN SCORE
Usability	5-10	7.68
Effectiveness	5-10	7.65
Effectiveness	5-10	7.64
Acceptability	4-10	7.59
Acceptability	3-10	7.06
Realism	5-9	7.30
Flexibility	2-10	7.03
Reliability	4-10	6.70

The high mean scores obtained for each of the aspects confirmed that the students were very satisfied with the content of the website and with using the web as a means of learning about risk assessment. Further detailed analysis of each aspect was undertaken and quantitative and qualitative analysis for each is presented in the following sections.

Usability

Students were asked to consider 3 statements related to the usability of the package and results are presented in Table 2.

Aspect	Yes		No	
	n	%	n	%
Package was easy to use	31	91	3	9
Package engaged my interest	28	90	3	10
I had the necessary IT skills	30	88	4	12

Typical comments included:

'Only minimal computer knowledge was required and movement around the site was well planned'

'The case study was interesting and realistic'

'You have to think about the issues as well as reading on-line'

'I'm not a qualified 'computer buff' but felt happy with this system'

'No knowledge of internet system makes it difficult at first'

Effectiveness

Students were asked to consider 4 statements related to the effectiveness of the package and results are presented in Table 3.

Aspect	Yes		No	
	n	%	N	%
Were the objectives clear?	30	88	4	12
Did it enable you to achieve the learning objectives?	33	97	1	3
Was it pitched at the right level?	32	94	2	6
Able to apply the knowledge gained in the future?	32	94	2	6

Typical comments included:

'The package usually gave clear instructions on what to do'

'Requires a lot of time to be spent on the website and with no internet access from home, means regular visits into the University'

'the package is aimed at instructing anyone who needs to carry out a risk assessment, therefore it was ideally pitched'

'I believe that if I applied the knowledge gained from this package in the future, I would not go far wrong'.

'It is better than just reading the information as it's more practically based, with visual assessments'

Acceptability

Students were asked to consider 3 statements related to the acceptability of the package and results are presented in Table 4.

Aspect	Yes		No	
	n	%	n	%
Did you enjoy the training?	28	85	5	15
Would you like to use web-based training again?	27	82	6	18
Did you encounter obstacles in using the website?	18	53	16	47

Typical comments included:

'Sometimes work such as this assumes we are all at the same level re computers and we're not! This takes away some of the enjoyment out of such packages'

'A fun and imaginative way of learning different from the norm'

'Prefer traditional training of use of guidance books etc. and group discussion'

Realism

Students were asked to consider 4 statements related to the realism of the package and results are presented in Table 5.

2. TABLE 5: STUDENT RESPONSES TO REALISM				
Aspect	Yes		No	
	n	%	n	%
Was the internet an appropriate medium for this case study?	32	94	2	6
Did website present RA in a realistic manner?	27	90	3	10
Did movement around the site help in your understanding?	31	91	3	9
Did hyperlinks encourage you to look for further information away from the main site?	29	85	5	15

Typical comments included:

*'It is no longer a **future** learning tool it is a **now** learning tool. Therefore it must be embraced and developed'*

'Yes, particularly as all the available supporting information is internet based'

'About as realistic as possible without being there'

'If there was a problem, or something I didn't understand, I could go back to various parts for reference'

'I used the hyperlinks and have now included them in my 'favourite' section for future reference'

Flexibility

Students were asked to consider one statement related to the flexibility of the package and results are presented in Table 6.

3. TABLE 6: STUDENT RESPONSES TO FLEXIBILITY				
Aspect	Yes		No	
	N	%	N	%
Was it convenient to be able to undertake the training at any time?	23	70	10	30

Typical comments included:

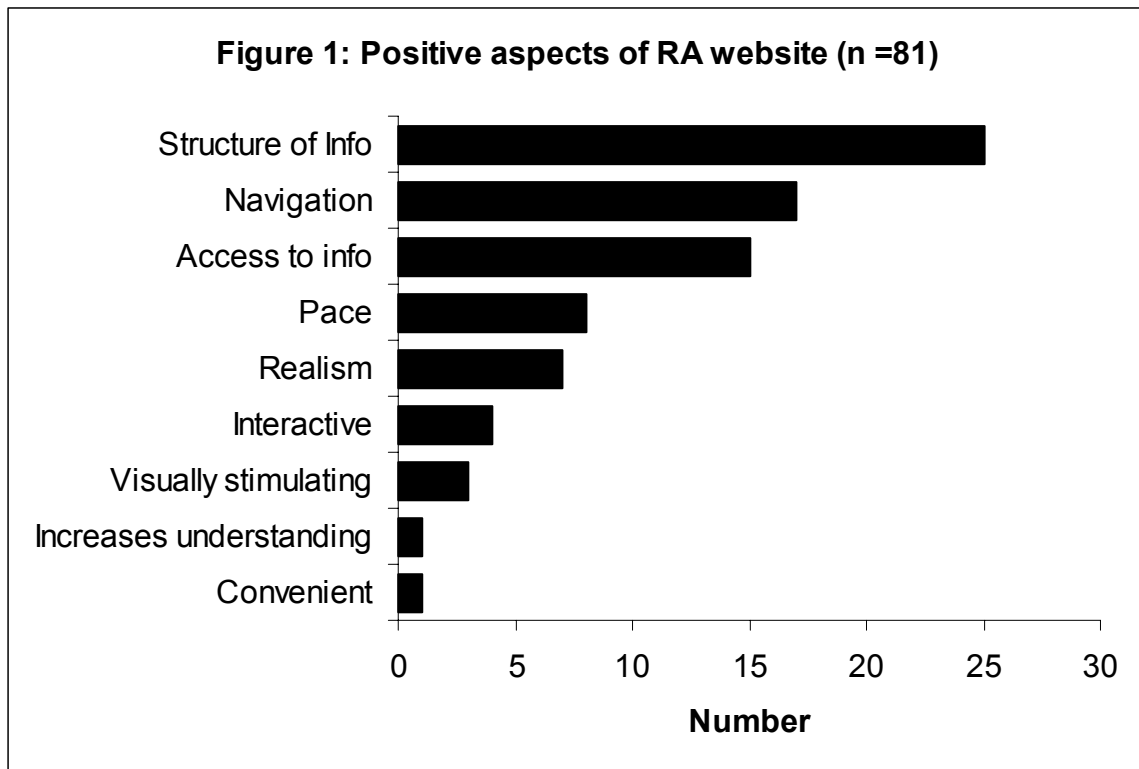
'It would have been convenient if I could access at home but I had difficulty doing this'

'Had easy access to computers at university and also Internet access at home, so able to use it when convenient'

Seventy percent (n = 23) of students felt that it was convenient to undertake the training at any time. Again there was a gender difference on the overall scores attributed to flexibility. Amongst male students the mean overall rating was 7.25 with a range between 3-10, compared with an overall mean of 6.82 and a range between 2-10 for female students.

Positive and negative aspects of the risk assessment web site

Students were given the opportunity to comment on up to three positive and three negative aspects of the risk assessment web site. Eighty-one positive comments and forty-three negative comments were received. Results are presented in Figures 1 and 2 below.



Users were most enthusiastic about the structuring of the information presented in the web site. Typical comments included:

'set out a clear framework to help someone undertake a risk assessment in a clear and methodical way'

'Broken down into smaller components – seems not so daunting'

'it is a resource that provides practical experience in a classroom environment'

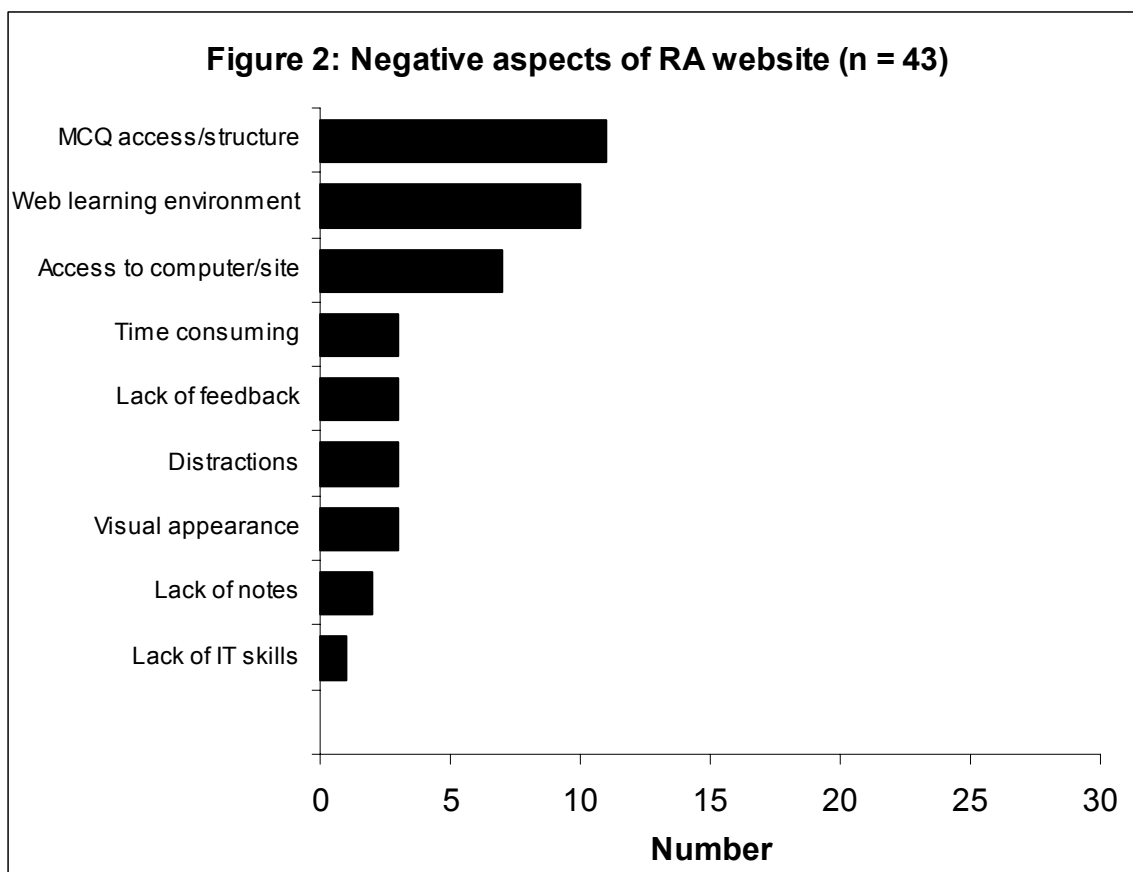
Students were also positive about the navigation of the site and the access to information.

'Excellent links to other web sites which gave useful information'

'Easy to access and find info, with good links to external sites'

These comments confirmed the strengths of using knowledge elicitation as a mechanism for collecting and structuring information.

Students made fewer negative comments about the website and the most frequently cited criticism related to the Multiple Choice Question bank. This used Perception software which had been recommended by the web designers. However, the main difficulty reported by students was the structure of multi-part questions. They were frustrated by the marking system, where multi-part questions were failed if one element was incorrect.



The next most frequently cited problem related to the web environment and their previous experience of it.

'For anyone as computer illiterate as me, maybe a page explaining the order of how to begin the package'.

'Very confusing – leads off in many directions'.

Access to computers was also a problem for some and does require careful consideration. Whilst web-based material may provide a flexible mode of delivery, it does require students to have the ability to access it remotely. This did appear to be problematic for part-time students who did not have internet access from work and for students with family commitments and /or no computer/internet access from home.

'No internet access at home causes major difficulty as I have to get into the University to use it'

'Need access to a computer and internet – this is hard in my workplace'

'Website is time consuming, it may help if a paper copy was available to read from to refer to at a later time'.

'Questions and queries don't get answered'

This last point raises an important issue regarding feedback to students. Whilst it is straightforward to seek clarification in a traditional lecture setting, queries during on line sessions may be more problematic, with a time delay in responses. This comment was made by a part-time student, who had no opportunity to access the website when she was not at the University. Responses to any queries raised would therefore result in a delay of up to a week. Students appeared unwilling to use the chat rooms set up on site to discuss problems

they had encountered with each other. In this particular trial it was not surprising as most students had accessed the web site during a timetabled slot. Use of these chat rooms may initially need to be a compulsory part of the exercise to encourage students to use them.

Overall rating of their experience of the risk assessment web site

Students were asked to rate their overall experience as either excellent, good, fair or poor. Results are presented in Table 7.

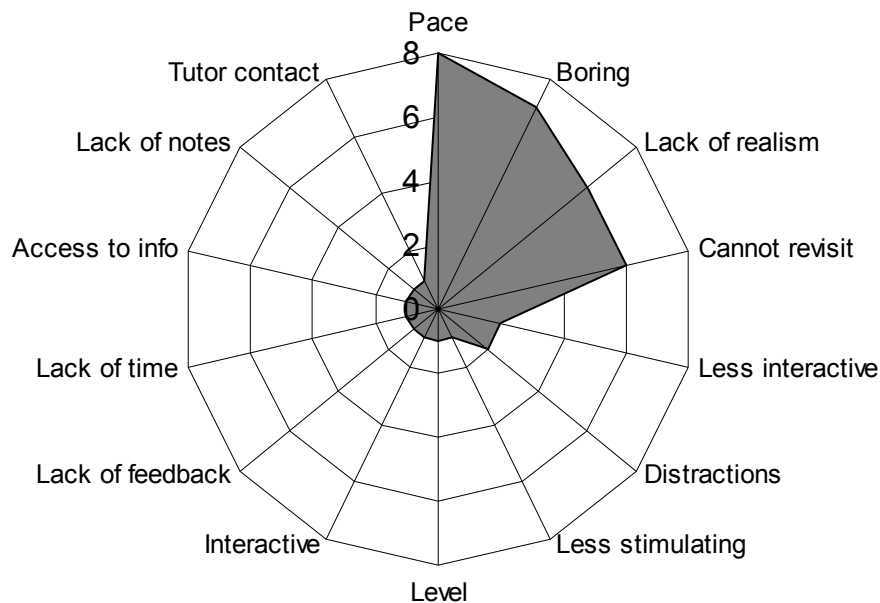
Table 7: Overall rating of the website for total sample, male and female students						
Rating	Total sample		Male students		Female students	
	No	%	No	%	No	%
Excellent	5	14.7	4	26.7	1	5.3
Good	24	70.6	10	66.7	14	73.7
Fair	5	14.7	1	6.7	4	21.0
Poor	-		-		-	
TOTAL	34	100	15	100	19	100
Missing	3		1		2	

Although the majority of students were very positive about the web-site and their use of it, a small group seemed critical of many of the aspects they were questioned about. Responses were examined and students who had consistently given negative responses were examined. Five students were found to be consistently negative about the package. Of these, four were mature female students and one was a mature male student. Identifying students who may be uncomfortable about the technology should be an important part of web based delivery, so that at least some of their anxieties can be explored and if possible addressed before use of such a package.

STRENGTHS AND WEAKNESSES OF WEB-BASED AND TRADITIONAL LECTURING

Each student was asked to identify up to three strengths and weaknesses of traditional lecturing and web-based delivery. The results are presented in Figures 3-6. The interesting feature of these results lies in the extent to which the strengths of one mirrored the weaknesses of the other form of delivery and vice versa. Thus, in traditional lectures, students most frequently cited 'pace' as a weakness (mostly because they as individuals had little control over it) and it was most frequently cited as a strength of the web (presumably because they could decide upon the pace at which they proceeded, depending on their previous experience and understanding of the area). The most frequently cited strength of the traditional lecture was the contact with the tutor and the lack of tutor/human contact was the most frequently cited weakness of web-based delivery.

Figure 4: Weakness of traditional lectures (n = 39)



These results suggest that it is important to give consideration to the balance of delivery modes within a given module. Whilst some subjects may be well suited to complete web delivery, others may not be. Consideration of the nature of the material being covered is therefore important and certainly in this module it was clear that a mix of delivery modes was the most likely format to meet with student approval. This also raises important pedagogical issues around the ways in which students learn and the way in which they approach learning.

DISCUSSION

KNOWLEDGE ELICITATION

The technique of knowledge elicitation to gather information and build a web site worked well, with students giving the aspect of 'realism' a mean score of 7.3. However, it must be acknowledged that the resources involved in the planning and development of the workbooks sent to the experts before their meeting was considerable. The need to provide a constructive framework for them to work in was essential so that relevant information could be incorporated into the web site. The process of reviewing the data they provided was also resource intensive. The process did yield reliable information from which the web site could be constructed and it was the element that the students were most enthusiastic about in their feedback (see Figure 1). The expertise of the lecturer was then used to structure the website. Following this, the information was given to the designers to build the website. However, they needed thorough guidance in the framework and ordering of the information to be used. The process was labour intensive and required several trials before the structure was finalised.

IMPACT ON THE STUDENTS

Feedback from the students who trialled the web site was very positive and confirmed that they believed it had added to their learning experience. However, it was also clear that a small number of students did struggle with use of the web and found the technology difficult. It is therefore essential that students feel well prepared before they attempt to use such technology. Although it is difficult to generalise, those who seemed to struggle most tended to be mature female students who attended on a part time basis. It is not particularly surprising that they may have encountered obstacles as their mode of attendance means that they are heavily taught whilst in attendance at the University and have little opportunity to familiarise themselves with the use of IT outside the University. Indeed it has been found that this group are unlikely to use the web to pick up general e-mail messages from the School.

Most did not have access to web technology during their work and therefore had little opportunity to familiarise themselves with it. Many had entered at Level 2 of the programme and missed the basic IT courses offered to first year students following this programme of study. This issue raises an important issue regarding initiatives such as Widening Participation. Students who are not IT/computer literate, may be recruited and it is essential that potential difficulties that they may face are assessed early on, so that they have the opportunity to use the facilities that the University may offer to their full potential. Whilst 'standard' students who have had the opportunity to experience such technologies may adapt quickly, mature students may struggle. The part time students may have limited opportunity to develop these skills and therefore feel disadvantaged by the use of such technology. The existence of technophobia (Brosnan, 1998) cannot be ignored and it is essential that mechanisms are in place to support these individuals. However, there may remain a small minority for whom technology holds serious fears and for whom a more active and 'therapeutic' approach to support may be necessary (Dewhurst et al, (2000).

IT SUPPORT MECHANISMS

The use of the web in delivering the curriculum may entail difficulties for academics particularly if they wish to develop bespoke learning packages. Whilst it is accepted that they are knowledgeable about their area of expertise, it seems that they may also need to become expert in developing and delivering teaching using novel technologies. The availability of an efficient and effective support network is essential if the University does want a shift towards the use of web based material. Whilst placing notes on the web may be straightforward, it does not exploit the potential of the web for teaching and learning. The University may need to consider establishing basic templates for web sites so that their development becomes more economically viable and have support mechanisms in place to ensure that those wishing to develop more complex sites have the technical support available to facilitate this.

IMPACT ON THE TUTOR

Whilst the role of the tutor in traditional lecturers is obvious, the way in which they contribute to delivery via the web is less clear. Issues such as their accessibility to students need to be managed so that it is clear to both students and tutors when and how they will be available for consultation. Whilst their subject expertise is essential, translation of this expertise for web-based delivery will require significant support. Workshops on the use of IT may be required to support this work and give them the opportunity to see how others have used this delivery mode within modules. A community of web developers is essential in supporting this transition from classroom to web based delivery to ensure that common pitfalls are avoided and the lessons learned from previous and current developments can be disseminated appropriately.

TRADITIONAL AND WEB DELIVERY

Garrison (1993) argues that if we want to discourage students from passively assimilating information, course activities and assessment must provide opportunities for students to enact new and effective approaches to learning. The computer-mediated communication that is inherent in web-based courses has broad implications for educational researchers attempting to compare the learning outcomes of on-line versus conventional classes. A recent review of hundreds of sources concluded that there were no differences in learning outcomes across various instructional formats (Russell, 1999). In fact, Russell (1999) referred to this equivalency of learning outcomes as the 'no significant difference phenomenon'. However, some researchers (Merisotis and Phipps, 1999) have observed that different learning and communicative styles may be masked when only learning outcomes are compared. For instance, it has been shown that on-line collaboration is prevalent among web-based learners and that this collaboration can contribute to higher performance in the virtual classroom (Wang and Newlin, 2002). Consequently, educators who ignore the effects of cyber-learning communities may be overlooking significant differences in the learning processes of students in on-line versus conventional classrooms.

CONCLUSIONS

Knowledge elicitation, although resource intensive, proved to be a useful methodology in collating and organising material for this web based package. The web site proved to be a useful learning tool because the content was well structured and the web designers were fully briefed about the design, format and navigation requirements. Students who were familiar with the use of the web and internet technologies were most enthusiastic about the package and were very positive about the use of web-based activities within this module. However, a small group of students did experience some difficulties with this mode of delivery and it is important that provision is made to ensure that they are encouraged to develop the skills required to use web-based activities to their full potential. The nature of the subject also has an important impact on the modes of delivery through this module. In several instances the strengths of the web were identified as the weaknesses of traditional lectures and vice versa. It is clear from the feedback received from this cohort that the best delivery mechanism was a careful balance between formal lectures and use of the web. More widespread use of web-based delivery is inevitable, but it is essential that the University carefully considers the needs of staff and students to ensure that web based delivery enriches the student experience.

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