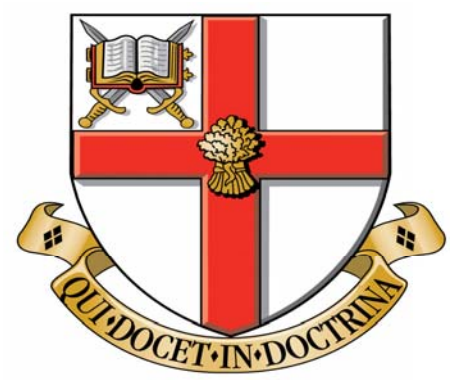

University of Chester

A critical evaluation of students' attitudes to electronic learning at the University of Chester

Linda Anne Rayner

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Abstract

The research described in this thesis reports the results of a study into the adoption of e-learning strategies based on the use of the World Wide Web (WWW) and Internet. Through an extensive and critical literature review, it exemplifies how higher education uses intranets to deliver learning and support services to their student population.

The overall aim of this research was to investigate how e-learning at the University of Chester might more effectively support students' learning needs, thereby improving their experience of e-learning. Students were given a mode of study, either face-to-face (64 subjects) or experimental using online intranet delivery (66 subjects). The course used for this study was a 13 week, Level Two undergraduate computer course taken by non-computing students. Quantitative and qualitative data were collected and analysed.

The results reveal significant differences between the performance of the e-learning and face-to-face groups with e-learning students performing poorly when compared to their face-to-face peers. A lack of responsiveness in tutor support and student motivation were established as being major contributing factors as well as differences in the students' individual learning profiles.

The research concludes that e-learning, although promoted as being anytime and anywhere is limited in its flexibility and responsiveness in the context in which it was assessed. Most e-learning activities at the University of Chester can be described as 'one size fits all'. They require students to read printed text, carry out further work, research or exercises, and post written comments to a discussion board. There is little evidence that individual student needs and preferences are being considered or supported. With the move towards blended learning in educational institutions, e-learning strategies are being used as a regular part of the curriculum to enhance the student experience. This research provides alternatives for the development and delivery of more individually tailored e-learning courses and provides strategies for supporting students in virtual environments more effectively. The thesis concludes by proposing a new model for e-learning based on these results coupled with a self-critical review and proposals for further research.

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I would also like to thank all my friends and colleagues at the University of Chester. Without their encouragement, friendly advice and patience I would have given up long ago. There are too many of you to name.

Lastly, I would like to thank my children, Stephanie, Ashley, Jason and Nicholas for keeping me sane and believing in me. Thank you for always being there.

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List of abbreviations

BSc – Bachelor of Science
CD – Compact Disk
CITS – Communication and Information Technology Services, University of Chester
CO2250 – "Multimedia Skills for Study and the Workplace", course code for the pedagogical case study
COM021 – "The Techniques of Multimedia", course code for the technical case study
DSSW – Directed Self-study Week
ECDL – European Computer Driving Licence
FAQ – Frequently Asked Questions
FE – Further Education
GLM – General Linear Model
HE – Higher Education
HEFCE – Higher Education Funding Council for England
HESA – Higher Education Statistics Agency
HMSO – Her Majesty's Stationery Office
HND – Higher National Diploma
IBIS – University of Chester intranet – Internet Based Information System
ILS – Index of Learning Styles
Kbps – Kilobits per second
LSI – Learning Style Inventory
LSQ – Learning Style Questionnaire
LSTN – Learning Teaching and Support Network
MLE – Managed Learning Environment
MSc – Master of Science
n – Number
ns – Not significant
p – Probability
PCA – Principal Components Analysis
PDF – Portable Document Format
Sig – significant
SIS – Student Information System
SMS – Short Message Service
SPSS – Statistical Package for the Social Sciences
U – Mann Whitney U test result.
VLE – Virtual Learning Environment
WIMP – Windows, Icons, Menus and Pointing
WWW – World Wide Web

Chapter 1: Introduction and background to the study

1.1 Introduction

The growth in the use of computer technology and more particularly the growth in the World Wide Web (WWW) and Internet mean that they can be used for everyday activities, e.g. banking, shopping etc. Education has not been immune to this growth and computers are now being used throughout the educational system. In the UK, wider issues have ensured that the use of the Internet to deliver education to a wider audience is being recommended as the solution to these e.g. widening participation, retention, larger student-to-tutor ratio, improved access to course materials. This thesis investigates the nature of e-learning and its effect on undergraduate students with particular emphasis on the quality of student experience and student performance.

E-learning in the context of education is the use of any computer technology to support learning. This includes and is not limited to the use of whiteboards and PowerPoint slideshows within a traditional face-to-face environment and at the other extreme online delivery of entire programmes of study via the use of a Managed Learning Environment (MLE) or Virtual Learning Environment (VLE). E-learning has been defined as "learning facilitated and supported through the use of information and communication technology" (JISC, 2004). However, for the purposes of this research e-learning is the delivery of courses entirely by web-based methods, with little or no face-to-face contact with a tutor.

E-learning has its beginnings in computer-based training and then distance learning, which was first undertaken via postal correspondence between student and tutor, where tutors and students were physically separated by distance. As telecommunications developed, learning materials could be delivered through television and radio. More recent developments in computer technology have increased interactivity and spontaneity. Many universities now run e-learning courses, with synchronous (simultaneous) and asynchronous (non-simultaneous) elements. It has been established that traditional courses cannot simply be published electronically as text documents, static web pages or PowerPoint slideshows, (Rowntree, 1992). They need adapting and new learning strategies developed. Because the benefits and disadvantages of traditional education are well documented, it seems that those involved in early e-learning courses tried to recreate those exact benefits online. Sherry (1995) and Schlosser and Anderson (1994) stated that e-learning should artificially recreate the teaching-learning interaction. However, more

recent research argues that we should go much further with e-learning ensuring that courses supported in this way are fit for purpose with sound pedagogic underpinning (Adams, 2004).

It has also been found that simply using the same traditional classroom methods and converting them for e-learning courses, for example adapting text material to online material, is unsatisfactory. Tutors and students react and interact in a different way online, with different needs and expectations. Holzl (1999) found that how individuals react to e-learning would depend on their role. Bozarth et al (2004) agree and highlight the need for tutors and students to understand the time and commitment e-learning will require.

1.2 Rationale

With the pressure on universities to widen participation and increase retention, alternative ways to support students with widely differing needs and expectations have had to be found. E-learning is one of these methods. The Dearing report (1996) states the requirement for increased participation of non-traditional groups of students in Higher Education (HE), and the Higher Education Funding Council for England (HEFCE) strategy for e-learning suggests that e-learning needs to be "embedded in Higher Education .... to enable institutions to meet the needs of learners and their own aspirations for development" (HEFCE, 2005).

As a result, universities are increasingly incorporating VLEs and MLEs into the fabric of the institution (Agre, 1999). They are becoming both the primary means of communication and huge information depositories. Students are encouraged to access these facilities not only to revisit learning materials, but also to find assessment marks, check timetables and contact tutors via email and discussion boards. Many routine practices are now undertaken via these online facilities. With this in mind, it is essential that students are familiar and comfortable with using computer technology. They should also have easy access to facilities as this has implications for their progress, and could affect their perception of their experience of university.

The University of Chester has not been immune to these pressures and in response has developed its own intranet, IBIS, rather than using a commercially developed system, such as Blackboard or WebCT. IBIS allows tutors and students access to a large library of resources including learning resources, published by tutors, as well as corporate documents that are publicly available, and communication systems. In addition, tutors and students

have access to the library catalogue, their own timetable and a personal progress file that they can update.

Whilst it is true students are comfortable using computer and mobile technologies for communication or to find information, most students still have little experience of using these technologies for learning. The growth of e-learning in the private sector for training suggests that students will almost certainly be expected to undertake further training using online training tools. Industry and commerce find this a cost and time effective method of training largely because employees can carry out the training in their own time and do not need to be released from their primary task (Brogan, 1999). However, at universities, although it would appear that students do expect materials to be accessible via a VLE or MLE, they also expect face-to-face support from tutors in a familiar and comfortable environment. Inconsistencies between disciplines and departments can cause problems when students are studying a multi-discipline programme. The University of Chester encourages tutors to make learning materials available via IBIS and students expect to be able to review materials in this way.

Studies carried out on student performance found that e-learning methods had little impact on the performance of students and in some instances student performance improved (Saunders and Klemming, 2003; Koshal et al, 2004; Pugh et al, 2005). It should be noted that much of the research of this nature has relied upon students' self-selecting to take part in the e-learning course, which would suggest a predisposition to this method of learning, and this may have affected the results.

E-learning methods are increasingly being used for students on undergraduate programmes of study who have chosen to follow a conventional face-to-face course. These methods are often included as blended learning or only a small proportion of the course, but in these cases students are not given the choice. These methods are included either as an additional method of support for a course that students traditionally find difficult (e.g. computer programming) or to allow greater flexibility to tutors and students (e.g. to allow for the provision of field trips in biology). This makes students more responsible for their own learning (Jones and O'Shea, 2004).

Another impact of the use of VLEs and MLEs is the pressure on tutors to include additional online materials for students to use during private study, when completing assessments and for revision. In most cases tutors are expected to do this in addition to producing materials for face-to-face lectures and tutorials.

Those tutors who decide to include e-learning methods as a part of their course do it largely on their own initiative, although many universities now encourage all tutors to make course materials available online. This necessitates becoming familiar with the technology and learning the relevant skills. "The most important factor for distance learning is a caring concerned teacher who is confident, experienced, at ease with the equipment, uses the media creatively and maintains a high level of interactivity with the students" (Sherry, 1995). This is highlighted further in more recent work carried out by Salmon (2001; 2002) in her work developing models for e-tivities and e-moderators. E-learning courses can fail if tutors do not have the relevant expertise or access to the necessary support (Jones and O'Shea, 2004).

Not only do tutors need to learn how to use new software to produce e-learning materials, they need to learn new skills in the design and delivery of e-learning courses.

When designing e-learning courses it is important to establish the form the course is going to take before any other decisions are made, either synchronous or asynchronous. This will affect the method of course delivery and support. It will also have a huge impact on the types of technology that could be used and therefore the cost. For example synchronous learning in the form of videoconferencing is costly and highly technical both for the institution and students (Lisewski and Joyce, 2003). It should be used when there are sound pedagogic reasons for its inclusion.

During delivery of e-learning courses, fast and useful feedback is vital. The Open University believes that retaining and motivating students depends on this rapid feedback (Eisenstadt, 2000). Feedback should include marks and constructive criticism from assignments. It can be difficult getting feedback in face-to-face classes, although peer support often alleviates this. Without easy access to peer support, feedback in e-learning is essential to increase motivation and to ensure that students are engaged with the course (Salmon, 2001).

Access to technology can be an issue for students. On campus, computer networks support the VLE or MLE and any hardware and software requirements used on a student's programme of study. Problems arise when students require access to the same facilities off campus. Technical support with configuration issues is not available. It is impractical to assume that the range of systems students may use could or should be supported by the institution. Students therefore require a certain level of computer skills in order to set up their home computer. Any hardware, software and connection costs have to be met by the student. Internet connections are becoming faster and more economical, but the cost of

updating hardware and software can still be a significant obstacle to using e-learning technologies (O'Donoghue et al, 2004; Heemskerk et al, 2005).

As an undergraduate student, I was required to use some e-learning materials as part of my course. I experienced many of the problems identified above; lack of access away from campus, engagement with the material, lack of previous e-learning experience and no communication with the tutor; as a result I felt my learning suffered and that my performance was adversely affected. As a new tutor in the computer science department being encouraged to put large quantities of course materials online, I did not want the students on my course to have the same negative experience. Even though I already had many of the skills needed to produce and publish e-learning materials and was used to communicating via email and chat rooms I experienced particular difficulty communicating online in the role of tutor. At the start of this research the teaching and learning theory that had been written was focussed on helping tutors design and deliver courses for traditional face-to-face environments. This is no longer the case and there are now many resources available to tutors designing and delivering e-learning courses, for example the book "E-tivities - the key to active online learning", by Salmon (2002). At first I thought that the difficulties I experienced may be due to my own personal teaching and learning preferences, but further investigation suggested that the problems I encountered were far more complex and not only a result of my individual characteristics.

As a result of my experience and early reading, this research was primarily focussed on the issues affecting the students' experience of e-learning with specific attention to factors that could improve this experience particularly when they are unable to choose the method of learning.

1.3 Project aims

"E-learning has been criticized for being technology led, with a focus on providing materials and has only relatively recently focussed on the learner" (HEFCE; 2005). The primary aim of this thesis was to investigate how e-learning at the University of Chester might more effectively support students' needs, thereby improving their experience of e-learning.

However, from a review of previous research (see Chapter 2) several issues were identified that could affect the students' experience: the tutors, the technology and the students themselves. Studies have been undertaken that investigate each of these issues (Jones

and O'Shea, 2004; Cowan, 2005; Keller and Cernerud, 2002), but there is little research that considers more than one issues or how they relate to each other.

The secondary aims of the research were:
1. To identify issues that affect a tutor's ability to design and deliver e-learning courses and how these issues impact on the technological and student aspects of e-learning. For example, would a tutor's lack of skills influence student motivation?

2. To investigate the technological implications of e-learning systems. This research set out to establish how a rich e-learning environment can be created and then implemented as case study examples from the plans. Current technology was used to allow easy and reliable access to course materials and communication software.

3. To investigate students' characteristics and the issues that affect their motivation and performance on e-learning courses, together with how the students' experiences of e-learning could be improved.

O'Donoghue et al (2004) have identified a lack of skills and knowledge by tutors in both the design and delivery of e-learning courses. This is compounded by the time it takes to develop such courses (Hodson et al, 2001) and the need for tutors to incorporate both the additional training and development alongside their usual duties. This could be alleviated by greater technical support (O'Donoghue et al, 2004) and a recognition at a managerial level of the time involved (Salmon and Jones, 2004). Wrench and Punyanunt (2004), Carswell et al (2000) and Ehrlich (2002) have suggested that a tutor's characteristics will impact on their interaction with the e-learning communication systems which can result in tutors being seen as elusive or too formal by students. The most important characteristics tutors can possess for successful tutoring online are enthusiasm and empathy (Entwistle, 2000).

Technical issues may be different for tutors and students, but in both cases have been found to affect the interaction and communication of tutors and students with the e-learning system and each other (Sherry, 1995). Students have found that their needs are not met by the technology. E-learning systems were often slow and unreliable (Irons et al, 2002). Technical support for configuration problems on home computers was and still is unavailable from the institution (Williams, 2002) and until recently the cost of a fast Internet connection, together with the need for high-specification hardware and the latest versions of software was out of reach of most students (Carswell et al, 2000; Irons et al, 2002). The

development of materials and the use of streaming media caused particular problems (Sclater, 1997; Shephard, 2003).

The factors affecting students' interaction with e-learning courses have been researched and a range of demographic and learning characteristics has been identified as impacting upon students' learning. Students' performance, as already mentioned, has been shown to be either better or at least comparable to the face-to-face equivalent (Saunders and Klemming, 2003; Koshal et al, 2004; Pugh et al, 2005). Characteristics that have been found to affect students' satisfaction with e-learning are: motivation confidence, independence (Katz, 2002), prior experience, computer skills (Lee, 2003), access (McMahon et al, 1999) and socio-economic characteristics (MacDonald and Stratta, 2001). Lowe and Cook (2003) suggest that students entering HE are not prepared for the level of independent learning expected of them. Furthermore, widening participation is increasing the numbers of students who are still dependent learners. This may be attributable to a student's experience prior to entering HE, but successful e-learning requires that students use independent learning strategies.

1.4 Research methodology

In order to assess the above aims both quantitative and qualitative research methods were adopted. A population was identified and issues relating to ethics, reliability and validity of the study addressed before data collection tools and methods of analysis were considered. Methods used in previous studies were evaluated in order to establish good practice in this field of research. A case-study approach had been used in the past and was considered the most appropriate for this study e.g. DeLacey and Leonard (2002), Kozma and Anderson (2002) and Cappel and Hayen (2004).

Case studies were developed that supported a variety of different learning styles and encouraged students to become independent learners. As suggested in Boddy (1999) and Wheeler et al (1999) students' needs were considered, as well as the social context in which the students live. Sherry (1995) emphasises this saying that it is essential to consider students' ages, cultural and socio-economic backgrounds, interests and experiences, educational levels and their familiarity with e-learning methods and delivery systems.

The project took into account recent research when developing the Experimental course and incorporated elements as appropriate rather than just text-based materials (Tucker et al, 1997; Lee, 1999).

Traditional teaching in HE is largely didactic in nature, with lectures and tutorials or seminars. These are now supplemented by assignments and exercises that foster other styles of learning. These can include for example presentations, experiential projects, group work and use of web technologies. Much of the interesting work of late in e-learning has been to incorporate some of these different learning activities in online courses.

A technical case study was undertaken to identify possible weaknesses in the delivery of e-learning courses at the University of Chester to ensure that any technological issues pertaining to the design and delivery of a multimedia e-learning course were resolved before the second pedagogic evaluation case study. A postgraduate course on multimedia lasting ten weeks was used as a vehicle for the technical case study. Students taking the course were registered on the Master of Science (MSc) in Information Systems and chose to take the course knowing they would be using e-learning methods. All were experienced computer users. Questionnaires and interviews were used to collect quantitative and qualitative data, these included course evaluations, the Honey and Mumford (1986) Learning Style Questionnaire (LSQ) and semi-structured interviews on completion of the course. Results from the first case study were positive and led to the design of the course on multimedia that was used for the second pedagogic evaluation case study.

The second case study, pedagogic evaluation, considered a thirteen-week course on multimedia designed for a large group of Level Two undergraduate students. These students were not studying computer science as their main subject, but were taking the course in order to gain key skills in information technology. The cohort of 130 students was divided into seven sets. Three sets were taught using traditional face-to-face methods and four sets by e-learning methods. Students were not given the opportunity to select their mode of study, although they could withdraw from the study if they wished. All theoretical material, practical tasks and assessments were identical for both the Control (face-to-face) and Experimental (e-learning) groups.

A number of hypotheses (quantitative) and questions (qualitative) were identified and a range of tools used to collect the relevant data. Questionnaires were completed during the course including the course evaluations and LSQ used in the pilot study; in addition, students completed a pre-test computer skills questionnaire. Demographic data was collected from the University of Chester student database and a record kept of attendance, discussion board use and assessment marks. Qualitative data was collected from post-test interviews with eight students identified by a factor analysis of the quantitative data and from

comments on the course evaluation questionnaires. Finally, the content of the discussion board was analysed both quantitatively and qualitatively.

Descriptive and frequency statistics were produced to compare the two groups for differences in demographics. A range of appropriate statistical tests was then carried out to test the hypotheses. Qualitative data was analysed for common themes and issues to answer the questions posed.

A number of factors and issues were identified from this analysis and a model produced demonstrating how the factors involved were related to and affected each other.

1.5 Conclusion

The case studies used as vehicles for the research were highly practical courses that included the use of images, sounds and video media. A high level of technical support was given by the University of Chester and the tutors involved in the courses, allowing the course to support the students and this research.

This study emphasises the need for e-learning courses to be fit for purpose and responsive to students' needs. A model that demonstrates the main themes concerned in the design and delivery of e-learning courses and how they interact with each other is suggested. Face-to-face teaching and learning have factors relating to tutors and those relating to students which are not affected by the use of technology. E-learning courses have the additional layer of technology between tutor and student making the learning process more complex as the technology can act as a barrier.

The following chapters discuss the relevant literature and this study in detail. Chapter 2 discusses the recent literature concerned with this research in particular that relating to tutor and student issues and the technology. Chapters 3, 4 and 5 discuss the design of the methods that were used for this research and the results of the case studies. Chapter 6 discusses the statistical results found from the quantitative data collected during Case Study 2, while Chapter 7 adds depth to the findings reporting on the qualitative analysis. Chapter 8 is a discussion of these results and includes an explanation of the model of e-learning put forward in this thesis. Finally, Chapter 9 emphasises the main findings from the study, its strengths and weaknesses and suggests further work that could be undertaken in the future.

Chapter 2: Literature review

2.1 Introduction

Carroll and Swattman (2000) stress the importance of a literature review in the planning of research; this is placed within the context of building a conceptual framework on which to balance the interests of effectiveness and efficiency. They argue that the review should be multidisciplinary in order to gain a broader perspective of the subject under study. Consequently this chapter reviews recent research from the field drawing out the main issues relating to the use of e-learning in HE, with particular emphasis on the themes identified in Chapter 1.

Sherry (1995) reported that "unfamiliarity with and fear of distance education technologies represents the single biggest problem in distance learning today". This was rather a simplistic view although accurate at the time. Since then the growth in the Internet and the use of computers in every aspect of our daily lives means that this is no longer the case. However, despite extensive research into the use and effects of e-learning many issues are still unresolved.

E-learning courses are now commonplace with many universities using technology to repackage lectures and tutorials (Gerrard, 2002), but as Hewitt-Taylor (2003) warns e-learning is not a 'quick fix'; inexperience and cultural issues as well as higher expectations from students make successfully developing and delivering e-learning courses a complex and uncertain enterprise (Carswell et al, 2000).

2.2 Theoretical background

The expansion of VLEs and e-learning courses, have an impact on the institution delivering them. Conversely, wider issues both in the sector and institution affect the way in which e-learning is supported at institutional level. These need to be considered in research undertaken concerning e-learning in HE.

2.2.1 E-learning strategies

As people favour different learning styles, traditional learning environments use varied learning strategies (Riding and Rayner, 1998) such as presentations, experiential projects, group work and the use of web technologies. E-learning may have the potential to offer the

same opportunities for students to use different learning styles and acquire independent learning skills, but in order to support a wide range of teaching and learning styles, but strategies have to be identified and included as part of the course. Bork (2001) argues that e-learning courses still largely support the learning paradigm of information transfer. Usually the aim is to save money and encourage more students onto the course. This can lead to increased costs where technology is used simply as 'an add-on'.

However as teaching and learning have moved from instructor-driven to more learner-centred methods, the emphasis is on helping learners to think more effectively and develop problem-solving and reasoning skills. Constructivism has recently attracted the attention of educational technologists (Leung, 2003), "partially because of the ways information technology is impacting on life, learning and work and partially because it offers an innovative approach to instructional design" (Lapadat, 2002). Constructivism advocates learning in the context of working on specific problems so that students can discover knowledge for themselves in situations that relate to the real world. These are mediated through social interactions for specific purposes (Lapadat, 2002).

Several learning strategies used in traditional environments have been used within e-learning courses and research done to establish their effectiveness.

Vicarious learning is an indirect teaching style where students learn by watching the interaction of a student and tutor, in a classroom setting or a master class. This learning strategy, almost entirely ignored by e-learning tutors, was investigated by Lee (1999) who found that distance-learning students had a better understanding of a subject after watching vicarious learning material stored in a shared workspace. It was found that these students were modelling the tasks and language used in these materials.

Collaborative group work is an important learning strategy as it promotes the learning of transferable skills that are useful in the workplace. Tucker et al (1997) say, "There are several commonly identified benefits to creating projects to be undertaken by a group of students. Notably co-operative skills are developed, more complex tasks can be attempted and mutual support helps the group to achieve better results". Fowell et al (1995) found that group work by distance learners aided the acquisition of other skills, such as self-management and communication skills.

'Role Play' is another teaching strategy that encourages active learning through dialogue and debate. This can be difficult to incorporate in e-learning courses because of the nature

of communication used by participants, but Burke (1999) found the inclusion of role play in an online course encouraged the important skills of critical thinking and analysis that are required elements in HE. The pedagogical implications are that students learn by discovery and that experiential or creative learning is encouraged in the form of 'role play'.

Writing is the primary learning strategy used in most e-learning courses. Writing will increase the students' understanding provided that it has a clear purpose (Salmon, 2002). Care needs to be taken in the design of writing tasks to ensure that the topics are "substantive, meaningful and important to the participants" (Lapadat, 2002).

2.2.2 E-learning in HE

Teaching in HE was historically didactic in nature, with lectures and tutorials or seminars. Assignments and exercises which foster other styles of learning are now the norm. These include presentations, experiential projects, group work and use of web technologies. This allows all learners to use a range of learning strategies. E-learners need the same opportunities to use different learning styles; particularly important is the need to acquire independent learning skills (Dewhurst et al, 2000). In order to do this they need to experience a wide range of learning activities.

Traditionally students in HE were expected to be independent learners. They would be expected to listen to a largely didactic lecture and then work independently to build on the material covered in the lecture for their assessments. With widening participation tutors have to accept that most students have other reasons than simply to learn for coming into HE. For many it is to improve career prospects and financial security, and in many cases students have to work full-time hours in paid employment to pay for their degree. Each student has an individual learning style and approach to learning.

Research by Laurillard (1993), Ramsden (1992) and others suggest that students are more versatile than simply being serialist learners, those who work step by step in a linear way, usually only pulling together a complete picture at the end or holistic learners, those who put a whole picture together at the start and fit the details in later. An individual's learning style is more complex than this. It does not however mean that students always select appropriate learning styles for the material rather than choosing learning styles with which they feel most comfortable. Biggs (1999) goes even further to describe students' learning strategies along a continuum from 'superficial' or surface to 'learning for understanding' or deep.

Ramsden (1992) describes students as participating in either deep or surface learning and suggests that deep learning is preferable. Surface learning is an approach to learning where knowledge is committed to memory in order that it can be reproduced for the necessary assessments. Deep learning is used when students memorise discrete facts (Miller et al, 1998) and link them to their wider knowledge and skills.

Ally (2002) suggests that behaviourist, cognitive and constructivist theories of learning should all be used when designing e-learning courses to promote learning at different levels. Behaviourist strategies are used to teach the facts; cognitive strategies are used to teach the principles and processes and constructivist strategies that contextualise learning.

The behaviourist theorists see the mind as a "black box" in the sense that a response to a stimulus can be observed without taking into account the thought processes involved. These theorists look for overt behaviours and measured indicators, such as exams, as indicators of learning (Good and Brophy, 1990).

Cognitivists see learning as an internal process that involves memory, thinking, reflection, abstraction motivation and metacognition. The cognitive theorists recognise the importance of individual differences and of including a variety of learning strategies in e-learning to accommodate those differences (Biggs, 1999).

Recently there has been a move in HE towards constructivism. Constructivism theorists claim that learners interpret information and the world according to their personal reality, and that they learn by observation, processing, and interpretation, and then personalise information into knowledge (Wilson, 1997). A major emphasis of constructivists is situated learning therefore learning activities that allow learners to contextualise information should be used in e-learning. Learners should be allowed to construct knowledge rather than being given it through instruction (Duffy and Cunningham, 1996).

Ally (2002) suggests that in order for e-learning to support all types of learner throughout the process it will become "increasingly diverse to respond to different learning cultures, styles and motivations".

2.2.3 Institutional issues

Jones and O'Shea (2004) say that strategic changes need to be made for e-learning to be successfully incorporated into HE. Teams of experts need to be involved in the

development and delivery of e-learning courses and these should include managerial, academic, technical and administrative staff. Ensminger et al (2004) add that the successful implementation of technology in learning environments relies heavily on management support and a recognition of the skills (technical and academic) needed, for these skills to be rewarded and for there to be access to the necessary resources.

The blurring of boundaries between technical and academic expertise has resulted in academics feeling threatened and insecure. There is a concern amongst some academics that staff development, legal issues (copyright, data protection and intellectual property rights), pedagogy and the financial costs of e-learning may in the future affect contracts. In addition there is little empirical research concerning the time it takes to develop and moderate e-learning courses (Ensminger et al, 2004). Universities will need to ensure that strategies are in place to support the necessary changes in administrative, pastoral and educational systems (Jones and O'Shea, 2004).

Changes in funding and an increase in part-time students have led to an increased demand for e-learning courses. HE has been slow to respond to e-learning and it is still a largely for-profit activity run by industry. Wealthier universities have been able to respond more quickly. Funding is also a problem for the poorest students as they cannot afford access to the necessary technology although this is less of a problem as computers and Internet access are becoming more affordable and with the expansion in the number of public access points to technology, e.g. via Internet cafes and public libraries (O'Donoghue et al, 2004).

2.2.4 Widening participation

Following the report by Dearing (1996) on widening participation and the expansion of post-16 education, students from traditionally non-participating groups in HE are increasing in number. This is having an impact on the teaching and learning policies of the institutions and on the range of cultures, perceptions and experience of the student body (MacDonald and Stratta, 2001).

Laing et al (2005) agree with Palmer (2001) and Pugh et al (2005) that performance and retention are affected by academic preparedness, academic experience, institutional expectation and commitment, academic and social match, finance and employment, family support and commitment. Non-traditional groups of students are affected by many of these (Laing et al, 2005). E-learning can be both an advantage and a disadvantage to these

students (Parnham, 2001). It allows students greater flexibility to fit their learning around other responsibilities, but reduces the opportunities for them to participate in the wider university culture.

Retention is a critical issue in HE and a particular problem when considered alongside the British government's policy of widening participation.

Palmer (2001) undertook a study which investigated the causes of student drop out in Further Education (FE) and HE and found that it was largely caused by the external environment. Factors included prior attainment, achievement rate, financial and personal pressures. Palmer (2001) also found, particularly in FE, that many students are opportunists who enter university until something 'better' comes along. He concludes that drop-out is not caused by the quality of guidance and teaching at university, but by external factors relating to the students.

One of the disadvantages of e-learning identified by Wheeler et al (1999) is the 'psychological gap'. They found that the more remote the student was from the learning centre, the greater degree of support they expected and the more likely they were to leave the course. These students relied more heavily on the tutor's support for encouragement and academic guidance. Boddy (1999) however suggests that distance is not so important, and that the success or failure of students taking e-learning courses depends largely on whether each individual student's needs are met by the course. They established that a greater problem was the limited number of learning styles supported by this mode of learning.

In their large scale study of undergraduate students, Carswell et al (2000) compared traditionally taught students with those taking the same course online. They found that the drop-out rate for e-learning students was slightly higher (20%) than for traditional students (16%), although the difference was not significant and other factors that might have led to the differences could be identified.

2.3 Technological background

Current technology needs to be seamlessly integrated into e-learning courses in order to promote the use of different learning strategies. The starting point for many e-learning courses is the WWW. 'Virtual Classrooms' are produced which allow students access to many facilities. Online registration forms collect information. Course materials are

presented that allow students to navigate through the material as they wish. Conference or discussion boards which allow multi-threaded asynchronous discussions can also be accessed twenty-four hours a day (Fowell et al, 1995).

2.3.1 E-learning materials

The production of e-learning materials is usually the responsibility of academics. The structure of the materials can be crucial to the ease with which students use the materials and learn from them. Graff (2003) argued that short segmented pages allow for improved linkages between theory and practice compared with the longer pages which are more closely related to traditional learning. The study compared e-learning students using long pages, where scrolling was required, to those using segmented ones, to their cognitive style. The authors used cognitive styles analysis (Riding and Rayner, 1998) and found that students possessing certain cognitive styles were better suited to segmented web pages than others. They suggest that there is a case for offering both types of web page during course delivery.

Technologies including multimedia authoring make the construction of electronic learning resources easier and they enable the creation of environments to explain and demonstrate complex concepts (Leung, 2003).

As Ingram et al (2000) say, copyright is a particular problem with e-learning. Materials used strictly for educational purposes are subject to the copyright laws within the country of delivery, but e-learning courses and the materials that support them are available to students worldwide. The protection of educational material is only partly overcome by the security measures adopted by organisations. Access to materials and systems can be controlled with the use of login names and passwords.

2.3.2 Streaming media

Another form of computer technology that is infrequently used at present is video conferencing. Although it is improving, there can still be technical problems with regard to the speed of communication. Sclater (1997) has found that video communication encouraged students to share ideas and take part in vicarious learning. Broadband has made the streaming of media on a regular basis much easier. Streaming video is faster than downloading the complete file before viewing. In addition streaming video has

advantages over conventional video. It can be used to create play lists and allow access to chat rooms, discussion boards and other communication tools (Shephard, 2003).

Shephard (2003) has used video successfully for many years and found it to be a powerful medium, with short video clips maximising students' concentration. Klemm (1999) argues that passive conditioning by TV and traditional teaching creates 'lurkers' and students transfer this strategy to e-learning without realising how more effectively they might learn by participating.

Gold et al (2002) effectively used video to create visual lectures which were integrated into an e-learning course. The video clips were short and were developed and delivered using tools familiar to most computer users.

2.3.3 Communication systems

Communication systems can be synchronous (all participants are online at the same time) or asynchronous (participants access the systems at times convenient to them). Synchronous communication tools, such as chat rooms are popular with many students for informal communication with each other. Recent developments in technology and increasing bandwidth allow audio and visual communication within these environments. This provides users with many of the subconscious cues used in face-to-face communication, e.g. body language and tone of voice. Asynchronous communication systems such as email and discussion boards would seem to encourage more formal communication.

Email facilities are proving highly successful for students and tutors. Kear (1999) and Fowell et al (1995) found that the 'psychological gap' experienced by distance learners was lessened by the use of such asynchronous communication. The messages became more 'chatty' as the course progressed and students felt more at ease with their tutor's 'personality'. Tucker et al (1997) also found that email facilities allowed easy communication between group members. Chat rooms were found to be less successful as they relied on all participants being available at the same time.

Wognum and Aber (2001) say that developing a communication system should not be a one-shot approach as people are part of the system with their own goals, preferences and expectations. Different communication needs will require different communication systems. The proprietary VLEs, Blackboard and WebCT, are sold with communication systems as

part of the package. Institutions with custom-built systems often do not implement synchronous communication systems, but concentrate firstly on email facilities then threaded discussion boards.

Lapadat (2002) states that discussion boards allow equal participation, unlike face-to-face environments where the tutor dominates the discussion. The asynchronous nature allows students to participate as much or as little as they like. However, Klemm (1999) says that many threaded discussion boards make active learning difficult as the discussion loses focus and the context is lost particularly if many of the messages are very short. He suggests eight strategies to improve the usefulness of discussion boards. Tutors should: require participation, form learning teams, make the activity interesting, not settle for unsubstantiated opinions, structure the activity, require a deliverable, include tutor involvement and incorporate peer grading.

High levels of technical support are required to ensure that communication systems work efficiently and are effectively managed. Many students use free email addresses, from for example Hotmail or Yahoo, for email and chat room communication, but this has resulted in issues of authenticity, confidentiality and data protection. As a consequence institutions now give students and staff corporate email addresses.

2.3.4 Shared workspace

A shared online workspace is another means of communicating. It is particularly relevant for collaborative group work. Tucker et al (1997) in their project encouraged the use of a shared workspace for groups to keep joint files and problem solving logs. The problem solving logs successfully acted as vicarious learning materials for other students.

2.3.5 Access to technology

Access to technology was an issue identified by Carswell et al (2000), however they found that students were tolerant of technical problems as long as they were resolved quickly. Additionally, students reported that telephone support was important in the early 'setting up' stage as this is when most technical problems occur. Improved efficiency and dissemination of technical information and twenty-four hour access were advantages of e-learning identified by Williams (2002), but the lack of technical support to students and tutors together with systems being unavailable due to maintenance and unexpected problems, e.g.

an overloaded network, were serious disadvantages. These were found to be more important to tutors who felt that they were 'at the mercy' of the system.

Bozarth et al (2004) suggest that students find it difficult to apply lessons directly to their home computers even if they have had an induction or undertaken the work previously on computers at their institution. This may be due to the availability of suitable software or problems related to the version of standard software, e.g. e-learning materials may include instructions on producing a web site using Microsoft FrontPage 2003. Students may have older versions of the software and may be unable to buy an up-to-date copy. The vast range of computers, hardware and software make it impossible for institutions to offer technical support for home computers and students cannot request help with configuration issues on their home computers.

The cost of access to the Internet was considered to be an additional barrier to students. Carswell et al (2000) and Williams (2002) argue that the cost of access and availability accentuate social inequalities because students from non-traditional groups are unable to afford either the cost of suitable computers or Internet access.

2.3.6 Cost of technology

E-learning courses require a large initial spend for new technology and for the tutors, facilitators and technicians that are needed to develop and maintain the course. Ongoing costs are those of communication, broadband Internet connections and printing costs where necessary (Irons et al, 2002). Who pays for these is often a cause of some debate and is one of the issues of concern to students. The highest costs are met by the institution, e.g. onsite computer facilities, technicians and Internet access. Departments may be responsible for specialised equipment, software and some printing. Students are entirely responsible for costs associated with home computers and increasingly costs of printing.

2.4 Tutors' issues

Tutors incorporate e-learning strategies into their courses to support students, make additional resources available and allow students to revisit material covered in face-to-face classes. It is often left to the tutor's own initiative to learn new skills and manage their own time in order to publish materials in a suitable format for online delivery. Increasing use of e-learning several issues will need to be addressed if the incorporation of e-learning becomes an essential rather than an additional or voluntary alternative.

2.4.1 Time

Time is the single biggest issue tutors face in relation to e-learning. In a study carried out by O'Donoghue et al (2004) 78% of tutors claim it (e-learning) involves more time and effort than expected. Both developing course materials and supporting students online would appear to take more time than in a traditional teaching environment. Hodson et al (2001) say that development time is an issue, but as development tools become more robust and the learning curve not so steep this should improve. The preparation and enthusiasm of the tutor is critical to the success of e-learning courses (O'Donoghue et al, 2004).

Teaching at a distance can be more time consuming with one-to-one emails and tuition. Salmon and Jones (2004) suggests that tutors need to be given time and recognition for the activities they are doing. E-learning courses require continual activity by tutors, with students expecting quick responses to emails and discussion board messages (Hewitt-Taylor, 2003). Since lecturers' time is valuable and most have long teaching hours, the answer may be to have full-time facilitators or technicians. This would allow students a more immediate response to questions and problems (Salmon and Jones, 2004).

2.4.2 Skills

Many tutors do not have the skills necessary to successfully implement e-learning courses (Sherry, 1995). As tutors face larger workloads with far more administration, it becomes difficult to find the time to learn new skills and methods. The new methods then become of secondary importance because they are not considered of central importance to the learning. Many tutors are reluctant to learn new skills when they are not directly relevant to their specialist subject, and the initial effort does not have a corresponding reward (Brogan, 1999).

O'Donoghue et al (2004) say that there is insufficient access to advice and technical expertise, but Harvey et al (2002) argue that even when tutors have received training and gained new skills they do not feel confident using them. Different skills are required when delivering courses online and these skills are undervalued and often go unacknowledged (O'Donoghue et al, 2004).

2.4.2.1 Materials and technical support

As face-to-face contact may be limited or non-existent the quality of material is of paramount importance for e-learning courses. The quality of materials could make the difference

between success and failure of the learning. Tutors need to be able to create materials using a variety of software, from a web site and text documents to interactive multimedia using sound and video. Hewitt-Taylor (2003) suggests that tutors have to decide how best to present material so that students can learn successfully. E-learning courses often contain more information than their face-to-face equivalents (Cook and Dupras, 2004). This is because it is simple to link materials to supporting material from other Web sites. Hughes et al (2002) says that tutors should include photos and biographies as this personalises the learning experience for students.

The range of teaching materials and systems that need to be developed for the successful delivery of an e-learning course requires good technical support (Williams, 2002). This is especially true when materials have to be uploaded to a server. The choice of format is often crucial and tutors need guidance as to the best format to use and the relative benefits and drawbacks of, for example, Microsoft Word documents.

2.4.2.2 Communication

In order to develop relationships with students and minimize the effect of the isolation caused by distance and lack of face-to-face contact, tutors need to include 'chatty', more personal comment into their discourse with students (Lake, 1999), but this is a matter of individual teaching style.

In their study on the student-tutor relationship Wrench and Punyanunt (2004) point out that the quantity of communication and a caring attitude positively affected students' perception, but that tutors' communication competency was found to be less important. Surprisingly, Carswell et al (2000) found that tutors were considered more elusive to conventional students than to e-learning students. However, to communicate successfully tutors needed to adopt good practice. Hughes et al (2002) suggest that tutors should respond to every enquiry promptly, post comments every week, monitor participation and send gentle email reminders to non-participating students. Carswell et al (2000) add that tutors should try to keep the group together. They report that lurkers did not participate because they were confused as to their role and that explanation of the tasks they should carry out were ambiguous. E-learning students were found to contact their tutors and peers more often than face-to-face students and that problem sharing done during face-to-face tutorial sessions moved to email for e-learning students.

Walker (2004) suggests using web-based communication for argumentative discussion and critical thinking, and discusses the ways in which tutors can encourage this type of interaction with strategies such as probing, challenging, informing, justifying, encouraging and controlling. Tutors were found to favour probing, challenging, informing and encouraging strategies, but the most successful ones were open and challenging strategies. The informing strategy was less likely to encourage student participation. Walker (2004) goes on to say that web-based communication places a high cognitive load on tutors and without explicit knowledge of the strategies mentioned above, facilitating effective discussion may be difficult. E-learning needs skilled tutors to support it and tutors must assist students to engage with the learning process to avoid the perception that communication is an optional extra (Hewitt-Taylor, 2003). Furthermore, Ehrlich (2002) points out that many of the interactions between tutors and students are social, and include recognition, greeting students and soliciting comments.

Salmon (2001) has created a five-step model for supporting students through web-based communication: access and motivation (quick and easy access and quick response by tutors to students' online activity), online socialisation (help students find the confidence to participate by lurking first, as a normal part of the process), information exchange (tutors need to create stimulating and well-prepared activities, addressing the problem of information overload), knowledge construction (more interactivity between participants, so that they learn from each other) and development (students become responsible for their own learning and act as e-moderators to each other). Salmon (2001) emphasises the need for induction into web-based communication before students start using it.

2.4.3 Tutors' characteristics

To be a successful e-learning tutor, Katz (2002) identified the following five characteristics; independence, creativity, tough-mindedness, sociability and a risk-taking attitude. Whilst Entwistle (2000) suggests that level, pace, structure, clarity, explanation, enthusiasm and empathy of teaching are important. What has been established is that tutors are influenced by prior knowledge, capacity for learning, teaching style, attitude and emotions and sociological factors (Brogan, 1999).

Gerrard (2002) emphasises that for tutors to have the time, skills, flexibility, and staff development they require, a commitment is needed from high management levels to the development and delivery of e-learning courses.

2.5 Students' issues

Various factors in the e-learning environment and in the students themselves affect the way students learn. The increase in e-learning courses has led to their being taken by people from all sectors of the United Kingdom (UK) population for different reasons. E-learning is very useful for certain students, for example those in the armed forces, the disabled and those living in remote areas. Many students decide to take e-learning courses because they have not studied for many years and are not in the habit of learning (Wheeler et al, 1999). They may also choose e-learning because they can drop out without losing face.

2.5.1 Performance

Studies undertaken to compare the performance of e-learning students to that of students on a traditional course would suggest that e-learning does not adversely affect performance and indeed in many cases improves performance, albeit not significantly (Saunders and Klemming, 2003; Koshal et al, 2004; Chou and Liu, 2005; Davies and Graff, 2005; Pugh et al, 2005).

Collins' (2000) small scale study compared e-learning and lecture-based versions of a Level Two biology course and found that e-learning students scored lower than mean marks, though this was not statistically significant. Women usually outperformed men, however the study by Cook et al (2002) of undergraduate computing students showed a reverse trend. Men outperformed women with an over-representation of women in the fail category.

Performance and retention are affected by academic preparedness, academic experience, institutional expectation and commitment, academic and social match, finance and employment, family support and commitment (Palmer, 2001; Laing et al, 2005; Pugh et al, 2005).

Age, qualifications, attendance, hours of paid employment, hours of academic study, the pressure of family expectations and a successful match of course to student/institution will also have an effect on retention. Laing et al (2005) go on to point out that some factors such as attendance, hours of paid employment and hours spent on academic pursuits may be related to a student's time management skills.

2.5.2 Skills

2.5.2.1 Technical skills

"Technophobia is currently the biggest problem in distance learning" (Sherry, 1995). Barriers to students' computer usage are the subject of a study carried out by McMahon et al, (1999), who not surprisingly found "that situational factors (e.g. access, training and time) influence the extent to which students use computers". The results of the study suggested that the answer is increased attention to the students' perspective rather than to factors that are important to academic staff. Students need adequate training from experts rather than from student colleagues and this should include support and information as they are needed. Students also need time and access to computers away from regular classroom hours. Eisenstadt (1999) agrees and goes on to say that the lack of computer confidence is a problem for many e-learners as they are often returning to learning after a long break.

There is a difference in the level of computer skills and confidence of males and females (Marks et al, 2003). Lee (2003) reports that although the computer skills of female students have improved between 1998 and 2000, they are still behind their male peers. However, Johnston (2000) found students' computer confidence and skills improved after taking part in e-learning regardless of gender. Students with lower prior knowledge gained more from the web-based tutorials and examples were found to be particularly important (Mitchell et al, 2005). Students also expect tutors to be able to help with their technical problems (O'Donoghue et al, 2004), although Tisdell et al (2004) found that, over time, students acquired problem solving skills and the necessary skills to overcome technical problems.

McMahon et al (1999) in a study of first-year undergraduates found that computers represented a problem for most students because of limited access at university and lack of experience using computers. The Dearing report (1996) called for a greater emphasis on the computer literacy of students. This is supported by McMahon et al (1999) who argue that students need more time to use computers and should be encouraged to use them throughout their studies.

2.5.2.2 Academic skills

One of the necessary skills for study at university is time management. Bozarth et al (2004) and Lowe and Cook (2003) both found time management to be a key issue for students at Level One. This was found to affect male students more than females. Yair (2000)

suggests males have poorer study skills and levels of motivation whereas mature students were found to make better choices and be more focused.

Furthermore, teaching and learning in secondary schools encourages the development of a particular set of skills, but these are not always relevant to the independent learning skills expected in higher education, and more particularly in e-learning. This difference can lead students to 'drop out' of HE (Lowe and Cook, 2003). They found that 31% of students reported having difficulty adapting to a more independent style of studying. Students are most dependent when they start at university. This is supported by a study by Laing et al (2005) who say that not only do students lack the skills to become independent learners, they also have no means of acquiring them. Dependent learners were found to prefer interactive synchronous video conferencing, and reported higher levels of satisfaction and greater control, but more independent learners preferred the Internet-based asynchronous approach. The former more closely resembles traditional teaching (Katz, 2002). When e-learning materials are available, independent learners are able to opt out of face-to-face sessions without any disadvantage, but only if they accessed the materials consistently throughout the course and not only when assignments were due (Saunders and Klemming, 2003).

2.5.3 Communication

Cox et al (2004) state that web-based communication should be included as part of an e-learning course otherwise students will not see the need to participate. They found that students' learning styles and communication styles and expertise were key influences and that change in the style of the facilitator impacted on the effectiveness of the communication. Group dynamics affected student participation with online synchronous communication found to be more suitable for encouraging social cohesion.

Rovai (2001) found that strong feelings of community increased the flow of information among students. A sense of community is encouraged by good tutor support, commitment to group goals, cooperation between students and satisfaction with group efforts. This study placed a high emphasis on course discussion including 20% of the course mark awarded for use of the discussion board. The sense of community increased over the time of the study.

As already stated, Ehrlich (2002) points out that much of the interaction between tutors and students is social interaction and says that feedback from tutors is a major concern for students. Ross and Schulz (1999) report that students need dialogue and interaction

between the subject expert and the student. Students commented that they could more easily develop a relationship with a tutor in a face-to-face setting than via e-learning. The importance of non-verbal cues was highlighted as a reason for this (Ehrlich, 2002).

Brown et al (2004) in a study of web-based communication apprehension state that "computer anxiety has been shown to have a negative influence upon an individual's use of information technology". They found that web-based communication anxiety was a combination of computer anxiety, oral communication anxiety and previous experience with web-based communication, but not written communication anxiety. The purpose of the communication is an important factor: social or informal uses were found to cause less anxiety.

Students have time to think about and construct their responses when using discussion boards; this encourages the shy and less confident students to post messages as they cannot be 'talked over'. Tutors can post messages that are directed either at the group or an individual. The most significant problem is lack of participation; students can feel intimidated or inadequate. To encourage student communication tutors need to participate equally in the discussions (Williams, 2002). Saunders and Klemming (2003) found that there was more communication at the start of the course and inappropriate contributions to discussion boards increased as the course went on (Williams, 2002)

E-learning tutors should be sensitive to the different communication patterns used by their students and should adapt their teaching in ways that facilitate the interaction in diverse groups and accommodate individual and group differences (Rovai, 2001).

2.5.4 Students' characteristics

Katz (2002) identified several students' characteristics for successful e-learning: positive self-image, independence, self-confidence, level of control, creativity and motivation. Similarly, Entwistle (2000) mentions the following characteristics: prior knowledge, intellectual abilities, learning style, personality, attitude towards the course, motivation, work habits and study skills.

E-learning is more suited to mature students because they do not generally need the social support most younger students find essential (Osbourne et al, 2004). This is because mature students generally have a developed social circle often including jobs, family responsibilities and friends or interests outside of university (Carr, 2000). Mature students

attend universities local to home whereas younger students use the opportunity to move away from home for the first time, thereby needing support socially. In addition, those mature students who work may find that their employers will not release them for further study and employers may be suspicious of the quality of e-learning qualifications (O'Donoghue et al, 2004). The Carswell et al (2000) study of undergraduate students found that neither age nor gender affected a student's choice to participate in e-learning.

Hodson et al (2001) cites motivational issues as a big problem for students using e-learning and emphasises the need for tutors to provide a range of learning opportunities with differing viewpoints in order to encourage deep learning and ensure that students are engaged in the learning process and motivated to continue. Bozarth et al (2004) agree, but suggest that students have problems with time management. They also note that tutors have different expectations of students. Tutors expect students to have greater problems with computer skills and technical issues rather than study skills.

O'Donoghue et al (2004) argue that "e-learning will create a better educated workforce and allow those in full-time employment to study for higher qualifications and improve their prospects".

2.5.5 Attitudes and expectations

More students are taking e-learning courses and these students are influenced by setting, prior knowledge, capacity for learning, learning style, attitude and emotions and sociological factors (Brogan, 1999). As a result of this experience, students expect more polished materials not only when they are working online, but for any course they take. Students are making the transition from face-to-face to e-learning and it is affecting their overall experience of HE and their expectations (Oravec, 2003).

Students entering HE expect moderate academic demands and an exciting social life and that the nature of learning will not differ much from school (Lowe and Cook, 2003; Laing et al, 2005). Males were found to be more likely to experience problems than females, with students who live at home also finding integration more difficult (Lowe and Cook, 2003). Widening participation has resulted in a growth in the number of students entering HE. Research suggests that many students from non-traditional backgrounds have unrealistic expectations of HE (Laing et al, 2005), with inaccurate perceptions about the amount of time they will need to study; students expect university to be like school and to rely on tutors for

their learning. They do not expect to have to take responsibility for their own learning (Lowe and Cook, 2003).

The level of students' satisfaction for e-learning courses would appear to depend on several issues. Russo and Benson (2005) found that students' satisfaction and attitudes correlated to the tutor's presence; the more visible the tutor the higher the levels of satisfaction. The use of photographs and biographies of students and tutors increased satisfaction and helped to encourage a climate of trust (Cogburn and Zhang, 2004). Rainbow and Sadler-Smith (2003) report a positive disposition to e-learning irrespective of age or gender or educational background, but in their study instructional features were rated more highly than tutorial features, with younger students rating instructional features more highly than more mature students.

Irons et al (2002), Valenta et al (2001) and Williams (2002) have identified issues that negatively affected students' satisfaction. Access to computers was found to be an issue for some groups of students: the better the access then the higher the levels of satisfaction (Irons et al, 2002). Valenta et al (2001) and Williams (2002) found that limitations on interactivity, technical problems (both access to new software and service breakdowns), increased workload and costs would affect levels of satisfaction.

Lastly, Gilroy et al (2001) point out that a critical factor in ensuring the quality of a student's experience is the degree to which a course meets that student's expectations.

2.6 Learning styles

Davidson (1995) defines a learning style as an individual's "predisposition to adopt a particular learning strategy regardless of the specific demands of the learning task". "Individuals do differ in the ways in which they gather and absorb data, and in how they process such data" (Zwanenberg and Wilkinson, 2000). The latter go on to say these differences "are important and may have consequences for how successfully different students, for example, perform on a variety of educational programmes".

2.6.1 An outline of learning style theory

Educational theorists agree that there are different styles of learning that students adopt. Pask (1976) identifies two strategies: serialist and holist. Serialist learners use a linear form of progression, in many ways similar to a lecture. Holism is a more complex strategy where learners use exploratory techniques to solve problems. These learners use a more global

approach where knowledge is 'grazed'. Gardner (1983) conceived the theory of Multiple Intelligences where learning styles can be classified in seven ways: linguistic (verbal), logical mathematical, bodily-kinaesthetic (using physical movement), musical, spatial (visually oriented), interpersonal and intrapersonal (independent). Gardner (1983) suggests that most of us learn by blending several styles, but usually prefer just one or two. The Constructivism theory, referred to in Section 2.2.1, developed from the work of education reformer John Dewey, states that students learn more by doing than by observing (Pask, 1976). Learners bring previous knowledge into the experience allowing them to reflect on new learning and form their own opinions.

Whilst Kolb (1984) classifies learners as Convergers, Divergers, Assimilators or Accommodators, Honey and Mumford (1986) define four different learning styles: activist ("here let me do that"), theorist ("Yes, but how do you justify it?"), pragmatist ("as long as it works") and reflector ("I need time to consider that"), (Rowntree, 1992). Felder and Silverman (1988) have produced the Inventory of Learning Styles (ILS) as an instrument to assess students' preferences in their model of Learning Styles. They classify learners along four continuums,

- Active – Reflective
- Sensing – Intuitive
- Visual – Verbal
- Sequential – Global.

Boddy (1999) has said the success or failure of students taking distance learning courses depends largely on whether the individual student's needs are met by the course. This study focused on a course for middle management, which included a high level of student-to-student and student-to-tutor interaction. It was established that a major problem was the limited number of learning styles supported by the course.

Research into learning styles is fragmented as individual researchers all offer good reasons to support their own model. This lack of cohesion leads to weaknesses in reliability and in the validity of measurement tools. Studies have been done to identify and classify the varied and different learning styles individuals adopt in their approach to learning. These studies contradict each other as often as they agree. This is because people do not 'fit' learning styles perfectly.

In comparing the literature it becomes apparent that no single model can be used as a reliable and all encompassing method to establish an individual's preferred learning style. However, more recent developments in e-learning suggest that a blended learning model that uses e-learning together with face-to-face strategies may be more successful.

Loo (1999) analysed Kolb's Learning Style Inventory (LSI) to investigate if the two dimensions and four learning styles were clearly identified using this instrument. His analysis shows that even though Kolb revised his original version of the LSI in 1985 the two dimensions and four learning styles are not supported. However, he goes on to argue that the usefulness of the LSI should not be ignored as a "pedagogical tool to help management graduates improve their own learning".

When Sabry and Baldwin (2003) used Felder and Silverman's ILS with online learners against three interaction types: learner-information, learner-tutor and learner-learner they found that despite current practice emphasising the need for learner-tutor interaction, the most used interaction was learner-information. Students in the study also perceived this interaction to be the most important and useful. The ILS was not found to predict the type of interaction preferred by students.

Zwanenberg and Wilkinson (2000) compared the suitability of Felder and Silverman's ILS with Honey and Mumford's Learning Style Questionnaire (LSQ) for predicting the performance of undergraduate students. Predicting academic performance scores with the ILS was found to be unreliable. In fact, their findings showed correlations so close to zero as to suggest that no relationship exists. The LSQ appears to show weak correlations with performance. Furthermore, the ILS was shown to have poor internal reliability; the LSQ was more robust with higher internal reliability. The lack of correlation could have been due to the unreliability of the instruments or that the range of learning styles is being provided for by a wide range of learning experiences. Reynolds (1997) points out that the validity of Honey and Mumford's LSQ has not been as heavily criticised, "because far less effort has been made to attest to its validity." This is despite the LSQ being developed from Kolb's work. The research carried out by Hayes and Allinson (1996) compared the LSI with the LSQ and found the LSQ to be more reliable.

Whilst Kolb's LSI and Honey and Mumford's LSQ are two widely used inventories (Robotham, 1995) more recent research has concentrated on constructivism and the approaches to learning adopted by students. Johnston (2000) reviews work done on learning by Marton and Saljo (1976), Biggs (1987), Entwistle (1981) and Ramsden (1992),

and notes Ramsden's point that it should not be assumed that weaker students choose a surface approach and stronger students a deeper approach. Atherton (2004) adds that students may adopt different approaches according to the task or the course they are taking. Although in his research Johnston (2000) found that students' deep learning declined after their first year at university and stopped altogether after students took part in an e-learning course. He goes on to suggest that group work may be one way to overcome this.

Sonnenwald and Li (2003) focused on learning styles based on social interaction, preferences of cooperation, competition and individualistic styles. The cooperative style had been previously found to be the most suitable for all students in a traditional environment, but they found that while all learning styles used in this evaluation could be successfully supported online, learning environments to support all types of learner are currently unavailable.

Finally, Bannister and Hanson (2002) say that a self-directed or independent learner will choose from their own skills portfolio and select the most appropriate skill for the task. E-learning relies heavily on a student's independent learning skills and these students are more likely to succeed (Handal and Herrington, 2004). It is worrying that research into students entering HE has found that students are still largely dependent learners (Dewhurst et al, 2000; MacDonald and Stratta, 2001; Lowe and Cook, 2003).

2.6.2 Learning styles summary

Learning style theory suggests that individuals have different ways of learning and that learning can be enhanced if teaching methods that support these learning styles are adopted. Kolb (1984) argues that certain professions encourage and emphasise the use of particular learning styles, conversely Felder (1995) writes that during their careers people are expected to use whichever learning style best supports the job to be done. He says "functioning effectively in any professional capacity however requires working well in all learning style modes". He uses the examples of engineers and scientists (Felder, 1995).

Davison et al (1999) acknowledge that differing learning styles can be found grouped in different subjects, although there will still be some variation in the types of learning style found within a group. They say that because of this, delivery styles of learning media should be varied. In addition, they state that as most traditional forms of education are sequential in nature and many learners prefer to learn globally, well-designed e-learning educational material has the potential to be more powerful than traditional education. However,

Martinez (2001) says that "even when common sense, research and experience suggest that people learn differently (i.e. unique emotions, intentions and social interaction) many professionals continue to treat learners as a homogenous audience with a 'one-size-fits-all' approach". Martinez (2001) goes on to say that sound learning theories are incomplete or unrealistic if they do not include a whole-person view. These individual differences have a significant effect on a learner's behaviour.

Lastly, just as students have preferred learning styles, so do tutors have preferred teaching styles, which may lead them to teach using methods which predominantly support the learning styles with which they are most comfortable (Riding and Rayner, 1998). Felder (1995) argues that this will lead to some students becoming bored, dropping out of classes and attaining low grades as the teaching and learning methods adopted by the tutor are uncomfortable for them.

2.7 Conclusion

It was only possible to sample a small part of the overall corpus of literature available within this rapidly changing field and much of the literature reviewed for this study is from the United Kingdom. In principle a wider review would have included research from further afield particularly Australia and the United States.

Opinions remain divided as to the benefits and long-term potential regarding e-learning despite the fact that e-learning is moving up the agenda for HE. The advantages of e-learning are the greater and more flexible opportunities for people to access education; especially as those who cannot access HE in the normal way are able to choose the location, time and pace of study to suit them. In addition, shy, inhibited students may benefit from this method of learning. The disadvantages are: the risk of isolation, technological issues (Internet access, bandwidth, accessibility and multimedia support) and lack of skills (O'Donoghue et al, 2004).

The important point for the research carried out in this thesis is that individuals (for whatever reason) use various styles of learning and that in order for e-learning to be successful it is necessary to ensure that students are given the opportunity to use the learning styles that are most comfortable for them, as they should in a face-to-face learning situation. If this can be achieved it may reduce the drop-out rate of e-learning students (who take courses) and make the experience more successful for those students forced to work online as part of a more traditional course. However, it should not be assumed that students have immovable

learning styles. As Laurillard (1993) says, "it would be hazardous for an investigation of learning to proceed on the assumption that learning is a process that is independent of external factors or that students possess inherent invariant styles of learning".

Based on an analysis of the literature each of the primary themes within the conceptual framework has been discussed at length. How these affect student attitudes and success when studying online were investigated during this study.

Chapter 3: Research methodology

3.1 Introduction

Initially, this study was interested in exploring the use of e-learning with students who were geographically distant and unable to attend university in the usual way.

The potential of e-learning was highlighted by reading a series of articles discussing various aspects of e-learning, for example the notion of vicarious learning where students learn by watching the interaction between a tutor and other students without participating (Lee, 1999), the use of discussion boards to enable group work in an e-learning environment (Kear, 1999) and the use of video conferencing to replace lectures (Brown et al, 1999).

Further reading of the literature identified an array of issues of which learning styles was a small part and led to a recognition that e-learning is a complex process, more complex than learning in a traditional sense since the technological medium adds another level of complexity. From the literature it was decided to explore some of the factors that would seem to impact on e-learning. As these factors emerged my narrow exploration began to widen to include three main themes: tutor-related factors, issues related to the technology and factors related to the students.

The general inquiry of this research was therefore an exploration of the most important factors or combination of factors that seemed to affect the performance of undergraduate students using e-learning methods as part of their programme of study.

3.2 Theoretical framework for the research

The research reported in this study uses both orthodox social scientific analyses employing a traditional hypothetico-deductivist paradigm together with case studies and a qualitative analysis using a 'grounded theory' approach which derives conclusions inductively from a corpus of data. This means that the resulting theory at least fits one dataset though there may be limitations on generalisability (Glaser and Strauss, 1967).

Grounded theory takes a case rather than variable perspective, although the distinction is nearly impossible to draw. This means in part that this research takes different cases to be wholes, in which the variables interact as a unit to produce certain outcomes. A

case-oriented perspective tends to assume that variables interact in complex ways, and is suspicious of simple additive models, such as ANOVA with main effects only.

The grounded theory approach, particularly the way Strauss and Corbin (1990) develop it, consists of a set of steps whose careful execution is thought to 'guarantee' a good theory or model as the outcome. Strauss (1987) would say that the quality of a theory can be evaluated by the process by which a theory is constructed. This contrasts with the social scientific reductionist perspective that the quality of a theory is determined by its ability to explain new data.

The basic idea of the grounded theory approach is to observe a textual database (such as the communication traffic of users) and 'discover' or label variables (called categories, concepts and properties) and their relationships. The ability to perceive variables and relationships is termed 'theoretical sensitivity' and is affected by a number of things including the researcher's reading of the literature and the use of techniques designed to enhance sensitivity.

Open coding is the part of the analysis concerned with identifying, naming, categorizing and describing phenomena found in the text. Essentially, each line, sentence, paragraph etc. is read in search of the answer to the repeated question "what is this about? What is being referenced here?"

These labels refer to things like problems encountered, information gathering and failure to communicate. Part of the analytic process is to identify the more general categories that these things are instances of, such as institutional context, work habits of students and preferred learning styles.

The process of naming or labelling things, categories, and properties is known as coding. Coding can be done very formally and systematically or quite informally. In grounded theory, it is normally done quite informally. For example, if after coding much text, some new categories are invented, grounded theorists do not normally go back to the earlier text to code for that category, but in this thesis the researcher has recoded earlier data in the light of new categories.

Axial coding is the process of relating codes (categories and properties) to each other, via a combination of inductive and deductive thinking. To simplify this process, rather than look for any and all kinds of relationship, grounded theorists emphasise causal relationships, and fit

things into a basic frame of generic relationships. The framework consists of the following elements (see Table 3.1).

Table 3.1: Elements of axial coding (Glaser, 1992).

Element	**Description**
Phenomenon	This is what in schema theory might be called the name of the schema or frame. It is the concept that holds the bits together. In grounded theory it is sometimes the outcome of interest, or it can be the subject.
Causal conditions	These are the events or variables that lead to the occurrence or development of the phenomenon. It is a set of causes and their properties.
Context	Hard to distinguish from the causal conditions. It is the specific locations (values) of background variables. A set of conditions influencing the action/strategy. Researchers often make a distinction between active variables (causes) and background variables (context).
Intervening conditions	Similar to context, one can identify context with *moderating* variables and intervening conditions with *mediating* variables.
Action strategies	The purposeful, goal-oriented activities that agents perform in response to the phenomenon and intervening conditions.
Consequences	These are the consequences of the action strategies, intended and unintended.

Selective coding is the process of choosing one category to be the core category, and relating all other categories to that category. The essential idea is to develop a single theory or model that can explain the phenomena under observation.

The purpose of the research carried out for this thesis was that it would lead to a greater knowledge and understanding of e-learning, its benefits and disadvantages. This would allow tutors and students to exploit the technology to enhance learning and improve their experience and encourage researchers to investigate e-learning further.

In order to identify the factors that affect student performance a variety of both quantitative and qualitative techniques were employed to obtain data that went some way towards

understanding of the nature of the problem. Blaxter et al (1996) define quantitative research as the collection and analysis of data in numeric form and qualitative research as the collection and analysis of information in as many forms, chiefly non-numeric, as possible.

As time and access to subjects were both primary concerns the main research method used was the case-study method. Case-study methods are commonly used in research for education, information systems and e-learning. "A case study is a detailed examination of one setting or one single subject, or one single depository of documents or one particular event" (Wellington, 1996). It is a study in depth rather than breadth (Verma and Mallick, 1997). Broad et al (2004) and McCune and Hounsell (2005) both use case study methodologies in their research of e-learning. In addition, this was an appropriate method as the researcher had easy access to the participants during and after the course, a prior knowledge and experience of e-learning and a need for a better insight into e-learning.

The particular type of case study used in this research was an instrumental one because the nature of the research was to provide an insight and clarification into e-learning. The main methods of data collection used for case studies are observation, interview, use of documents and records as well as other techniques including the use of questionnaires (Wellington, 1996).

The main weaknesses of case studies are their lack of generalisability, validity and sampling. Every care was taken during analysis to retain objectivity, but as much of the data collected was qualitative in nature, analysis could be seen as more subjective therefore the findings from this research may not be considered generalisable and not externally valid. For this research to have greater external validity sampling would need to have been systematic and purposive with a wider range of courses and institutions providing data. Having said this, case studies provide rich and interesting results that are easily understood by researchers, educationalists, and students often in a familiar narrative form (Wellington, 1996). Since the results of this research are not intended to lead to a generalisation at this time, it is hoped that the outcomes of this study will stimulate further research.

Questionnaires were used extensively during the research to collect quantitative data from the students. Questionnaires can provide large amounts of data economically and this data can be analysed statistically to allow for comparisons to be made across groups. The more highly structured the questionnaire the easier this becomes, but the data collected does not have the richness or depth of a less-structured questionnaire (Cohen et al, 2000). For this research, questionnaires were used to gather data about students' learning styles, computer

skills and their opinions about the programme during and after the course. Open-ended questions were included on all but Honey and Mumford's (1986) LSQ to enable students to add their own comments. The LSQ consisted of eighty closed questions that allowed analysis of the students' learning styles. It was chosen because of its accessibility, ease of administration and because it was designed for use with managers, of which students from the first case study belonged. Furthermore, it has been used by the University of Chester work-based learning course with all Level Two undergraduate students for five years. The computer-skills questionnaire consisted of a series of closed questions followed by four ranked questions with the open-ended question for further comments. Finally, the course-evaluation questionnaires consisted of a series of ranked questions with an open-ended question for comments. The main disadvantage of questionnaires is the limited response rate or the number of successfully completed questionnaires (Wellington, 1996; Cohen et al, 2000). Previous research in the field has successfully used questionnaires in this way. The questionnaires used in this study were those already available within the Computer Science Department at the University of Chester and in most cases the data collected was a requirement of the University.

Interviews were used to add depth to the study and to collect qualitative data. "The purpose of an interview is to clarify meanings, to examine concepts or to discover areas of ambiguity" (Wellington, 1996). The disadvantages of using interviews are that they are time consuming to carry out, transcribe and analyse. Researchers have to make decisions about the responses to questions and these by their very nature are less objective than quantitative methods as the researcher may unknowingly allow personal prejudices and previous experiences when interpreting the results. The advantages are that large amounts of data are collected and opportunities are gained for clarification (Cohen et al, 2000). The interviews used in this study were semi-structured in nature and, whilst ensuring that the same broad themes were covered in each interview, allowed the opportunity for detailed discussion on issues important to individual students. Interviews and questionnaires are often used in the same study, the questionnaire providing 'hard' data and interviews making it possible to explore, in greater depth, particularly important issues (Verma and Mallick, 1997).

In addition to the two main tools discussed above, observational data was collected from the discussion board and emails between tutor and students. "The observational method is a tool for collecting information without direct questioning on the part of the researcher" (Verma and Mallick, 1997). Unfortunately, no comparative observation of face-to-face students was done apart from that noted in an informal way during classes. More structured

observation of the face-to-face group in the main study would have strengthened the qualitative analysis so this could be considered a possible weakness of the research design. However, it was considered too time consuming for the tutors involved in the study, given their already significant input into the design and creation of new learning materials.

Quantitative data was collected from the University of Chester student information system (SIS), for example, students' date of birth and from data collected during the case study, for example, assessment marks and attendance details. "The general objective of statistical methods of analysis is to understand the patterns of individual or collective behaviour, the constraints that affect it, the causes and explanations that can help us understand our societies and ourselves better and predict the consequences of certain situations" (Antonius, 2003). Quantitative methods are largely objective and this reduces the bias often found in qualitative approaches.

Some data collection methods yielded both types of data, e.g. the course evaluation questionnaires and the discussion board. The methods of data analysis and reporting were different for the first and second case study as the earlier study informed the later one, these are discussed below. The mixed-method approach used in the study increased the depth of the research and the statistical analysis was supported by insights from the interviews and discussion board analysis.

3.3 Case Study 1: A technical evaluation

A course was designed and implemented in order that any technical issues that may have affected the results of Case Study 2 were resolved and to test the tools used for data collection and analysis.

The course used for this case study was an e-learning course for students on the MSc in Information Systems at the University of Chester. It was a ten-week postgraduate course in the techniques of multimedia delivered using e-learning methods (COM021). The previous year the same course had been delivered using traditional face-to-face methods.

3.3.1 Sample population

The sample was taken from the total population of students on the MSc in Information Systems. The number of students on the programme was 170. The number of students that took part in the pilot study was eight. This sample is a sample of convenience, the sample

was taken from students to which the researcher had easy access, as explained in Cohen et al (2000) and was the type of sample used in many of the case studies carried out in education. This sampling technique however cannot be used for generalising theories tested to a wider population and for the purposes of this research a case study approach was considered appropriate.

3.3.2 Validity and reliability

The reliability and validity of Case Study 1 was weakened due to the simplistic approaches taken during analysis. The concept of reliability has to do with the how well the research was carried out and whether another researcher asking the same questions in a similar situation would arrive at the same answers. Validity is concerned with the methods and approaches used to measure the issues being explored (Blaxter et al, 1996).

3.3.3 Ethical considerations

"Ethical considerations need to be taken into account by all researchers as the research may produce undesirable psychological side effects" (Verma and Mallick, 1997). Students should have the right to withdraw from the study and the right to remain anonymous. Ethics are discussed in detail for the main study, but during the pilot study, as the students participating chose to take the course knowing that it would be taught using e-learning methods, many of the ethical issues were satisfied. However, these students were given the right to withdraw from the study and for the purposes of the research remained anonymous. Additionally, after the completion of the course, students were debriefed to allow for any negative impact to be addressed.

3.3.4 Methods of data collection and analysis

All students on the course completed a total of three questionnaires. The LSQ was completed during the first week of the course and students asked if they agreed with the assessment of their dominant learning style. Mid-Semester Questionnaires were completed during week six of the course and ensured that students knew the course learning outcomes and where to find resources and gather students' first impressions of both the course and their interaction with the tutor. On completion of the course, students completed an End-of-Course questionnaire which followed a similar pattern. The response rate was not found to be a problem during the pilot study with all students completing and returning all three questionnaires despite the fact that they were all in full-time employment and studying the course on a part-time basis.

Semi-structured interviews with three of the students on the pilot study were carried out after the course was completed. The interviews considered the students' expectations of the course and whether these had been met. Questions were asked relating to their scores from the LSQ, about their relationship with the tutor and any technical problems they may have encountered either from the delivery of the course or completing the practical assessment. The students interviewed were articulate and able to answer questions quickly and thoroughly although they did suggest that it would have been helpful to have had a list of the areas to be discussed at the interview in advance in order to give fuller answers.

Records were kept of the email contact with the tutor. These records noted the date of the email and its content, the date of the response and likewise the content. Furthermore, dates of the completion of formative exercises were recorded. This allowed the tutor to provide support where necessary and ensure that students were able to complete the work.

The data that was collected compared the students taking part in the pilot study to students who took the same course via traditional learning the previous year. The quantitative and qualitative data were analysed using simple methods. The average marks were compared, highest and lowest, and percentage of students completing the course. The frequency of email contact with the tutor and the completion of formative exercises were considered. Results and discussion from Case Study 1 are reported in Chapter 4.

3.4 Case Study 2: A pedagogic evaluation of e-learning

3.4.1 Sample population

The students taking part in Case Study 2 were full-time Level Two undergraduate students at the University of Chester. These students were registered on non-computer programmes (Higher National Diploma, HND and Bachelor of Science,BSc) run by the Biological Sciences department. The number of students taking the course in Semester 1, (2002-2003) was 130. The course used for this Case Study 2 was a thirteen-week course on multimedia (code CO2250) a mandatory key-skills course for these students.

This study was designed to be a comparative one, comparing students taking the course using face-to-face methods with those taking the course via e-learning. A method of dividing the students into two groups was considered. With 130 students registered for the course the University of Chester allocated students to seven tutor groups. Students in the main study were not given the opportunity to select their method of study thereby replicating the 'real' situation encountered by students. Three tutor groups (64 students) became the

control group and took the course using traditional face-to-face forms of teaching and learning, including whole-group lectures and tutor-group practical workshops. The remaining four tutor groups (66 students) became the Experimental group and took the course using e-learning methods, lectures, technical information and tutorial exercises delivered through the use of web pages, images, sound and video. Peer support was given via a discussion board and emails to tutors.

3.4.2 Validity and reliability

Timetabling and assigning students to tutor groups is outside the scope of this project as it is centrally controlled by the University of Chester. The most suitable division between the face-to-face and e-learning groups was to consider the nature of the students taking the course, the degree programmes they were following and their entry points at Level One, with their average performance at Level One. The number of students in each tutor group was also examined to ensure that (as far as possible) groups could be considered equivalent. Statistical analysis of the groups carried out after the course showed them to be very similar (see Chapter 6).

3.4.3 Ethical considerations

Ethical considerations required that students were made aware of the study and their part in it. Although students were not being exposed to anything that could be considered psychologically or physically dangerous, there were issues relating to the sensitivity of information collected and stored, and also how the study would impact on a students' performance therefore affecting the overall outcome of their degree, albeit to a very limited extent. Additionally as students were not being allowed to self-select the mode of learning they would follow, it increased their vulnerability (Cohen et al, 2000).

The following criteria identified by the British Psychological Society (2004) were considered in advance of the main study and addressed:

- Consent – all students signed a consent form after the nature of the research had been thoroughly explained to them.
- Deception – no information was withheld from the students; all students were assured on numerous occasions throughout the course that assessment marks would be carefully monitored to ensure that the study would not affect their overall degree classification.

- Debriefing – the last session of the course was a face-to-face session for all students to allow feedback of their experiences, in order to give reassurance where necessary.
- Withdrawal – students were allowed to withdraw from the study at any time by contacting the course leader.
- Confidentiality – students' names and identification numbers (ID) numbers have not been used in any documentation relating to this study and data has been stored following the Data Protection Act guidelines (UK Parliament, 1998).
- Protection of participants – intervention in the form of two additional face-to-face sessions for e-learning students were scheduled to give reassurance the week before assessment deadline.

3.4.4 Quantitative data collection and analysis methods

Quantitative data was collected from the students who took part in the study. This data was divided into three categories, personal data, information collected during the time of the course and data about students' learning styles - as categorised by the LSQ (Honey and Mumford, 1986).

Secondary demographic data was collected from the University of Chester SIS. This included: the student's identification number, date of birth, distance travelled to university, gender, which programme of study was being followed, the average mark at Level One and the number of entry points to university at Level One.

Primary data collected during the time of the course included: attendance data, assessment marks, use of the discussion board, mode of learning, tutor group, LSQ scores, course evaluations (Mid-Semester and End-of-Course) scores and scores from the computer skills survey.

All data was entered onto an SPSS data sheet for analysis. Although all data on the sheet can be attributed to individual students, analysis and reporting of the results was not done on an individual basis thereby ensuring students' anonymity.

Unlike Case Study 1 (where all students completed the evaluation forms) the response to the Mid-Semester and End-of-Course evaluations on Case Study 2 was only 60%. This was considered a large enough sample to be used for analysis.

The self-reporting computer skills survey was included as the students participating in the main study were not computing students and it was felt that their prior knowledge and experience of computers may have had an impact on the study - as reported by Lee (2003).

Frequency and descriptive techniques were used on the data to establish if the two groups could be considered statistically equivalent for the purpose of the research. Once their comparability had been established appropriate inferential statistical techniques were employed to test the hypotheses and establish which factor or combination of factors affected performance. These included the parametric and non-parametric techniques of correlation, MANOVA, factor analysis, t-test, Mann-Whitney U test and principal components analysis (see Chapter 6).

3.4.5 Qualitative data collection and analysis methods

Issues that arose during the delivery of the course and results identified from the statistical analysis caused concern for the tutors primarily because the performance of the e-learning students had been affected by the study in a negative way. As a result the mixed methods used for this research became particularly important.

Qualitative data was collected from:

- Comments on Mid-Semester Questionnaire
- Comments on the End-of-Course Questionnaire
- Feedback from tutors
- Discussion board postings
- Interviews with students

The criteria for selection of the students to take part in interviews were initially:

1. E-learners (Experimental group) vs. Face-to-face learners (Control group)
2. Learning styles groups. Factor 1 those students who scored highly on the activist learning style and Factor 2 those who scored highly on the reflective, theorist and pragmatist learning styles.
3. Gender.
4. Animal behaviour students vs. Students on other Programmes of study (BSc and HND).

The above criteria gave a sample of sixteen groups. The intention was that one student from each group would be randomly selected to participate in an interview. Unfortunately,

some groups had no members therefore the criteria were revisited. The final decision to leave gender out of the list of criteria was made after statistical analysis suggested that gender was not a significant contributor to students' performance and because very few males were included in the original population. Eight groups were finally identified and one student interviewed from each group.

The 30-minute interviews were semi-structured. Each interviewee was asked the same broad questions and these were left open to allow each individual's preferences and opinions to be collected. The interview process followed models of good practice suggested by Cohen et al (2000) and Wellington (1996). Interviewees were thanked for participating and permission sought for the interview to be taped. Participants were also reassured that any information they gave would be anonymous which encouraged them to raise any issues important to them.

Following the interviews the qualitative data from all sources was coded manually into a table: e-learning vs. face-to-face, positive vs. negative (see Appendix E). The use of qualitative analysis software was considered and two products were evaluated (Nudist and Atlas) but the cost and limited amount of qualitative data collected meant that this was uneconomical.

The process of coding followed the mechanism suggested by Coffey and Atkinson (1996). Data was firstly divided between that relating to face-to-face and e-learning students. Further coding into subcategories was then undertaken into the three main themes before being coded further in answer to the research questions posed. Patterns and linkages between the categories were then identified. This analysis is reported in Chapter 8. It should be noted that as Coffey and Atkinson (1996) suggest, each instance of qualitative data was revisited on numerous occasions to ensure that all data had been considered and that some responses were used to answer more than one question, e.g. comments from students concerning the difficulty of working in groups online was considered important both to communication and motivation.

3.5 Conclusion

The methods chosen for research are critical to ensure that any results reported are useful for the intended audience. As has been reported in this chapter, the methodology for the

case studies developed over a period of time and was affected by the sample available and institutional procedures.

The mixed-method approach was successfully administered and it was considered that the method adopted for Case Study 2 were reliable and internally valid. As with most case-study research the results reported in Chapters 7 and 8 cannot be generalized.

The following chapters discuss the delivery and results of Case Study 1 and the design of Case Study 2.

Chapter 4: Case Study 1- A technical evaluation

4.1 Introduction

From the literature review it became clear that for an e-learning course to be successful, careful consideration needs to be given to its design and delivery. As the intention was for the pedagogic evaluation study to be an undergraduate course on multimedia with high technical content, the pilot study needed to ensure that any technical issues that might affect the results were identified and resolved beforehand. It was decided that a postgraduate course on multimedia was the most suitable choice for Case Study 1 as the groups are generally small (less than 12 students) making it easier to support and the high level of technology used for multimedia would fully test the computer systems. In addition it was anticipated that this course could form a model that other tutors at the University of Chester could adapt and replicate.

Students taking part in the pilot study were enrolled on a part-time postgraduate course in Information Systems. This was a modular programme offered by the Department of Computer Science and Information Systems at the University of Chester. The course on multimedia had been traditionally offered as part of the program using face-to-face lectures and tutorials. The students opted to take the e-learning course largely because work commitments prevented them from attending university for a number of weeks. All students were experienced computer users and it was felt that they would be able to identify and overcome any technical or academic issues as they arose without jeopardising their performance.

The goals of the course on multimedia delivery were: to allow the tutor to develop online relationships with the students, encourage a sense of community within the group, allow students to manage their own learning week by week, provide frequent tutorial support and answers to students' questions, to let students communicate with each other and to attract and retain students who have a variety of learning styles.

In order to do this Laurillard (2000) has defined the media forms needed for successful distance learning. They are: narrative, for example PowerPoint slideshows or lecture notes; communicative, for example email and discussion boards; adaptive, for example formative exercises with tutor feedback and access to peer's responses; and productive, for example

assignment work. The design and delivery of the pilot study addressed each of the aforementioned learning strategies.

4.2 Development and delivery of Case Study 1

4.2.1 Technical philosophy

In order to support the students and the tutors', careful consideration was given to the hardware and software that was used during the studies. All the software and hardware tools selected were readily available and relatively cheap, e.g. the video camera used to record the lectures cost £900.

Menu-driven point-and-click software made development of the e-learning materials fast and efficient. The tutor worked closely with the technicians to prepare course materials and make them available to the students. The course material was delivered in a variety of formats with the intention of supporting a wide range of learning styles (Laurillard, 2000). The formats included: streamed video, PowerPoint presentations, text-based tutorials and formative practical exercises. All materials were accessed through the University of Chester intranet system, IBIS, and could be viewed as web pages. Figure 4.1 shows a screen dump from the COM021 web site accessed via IBIS. The tutor's photo was used to encourage the development of an online relationship between tutor and student.

4.2.2 Design

The course on multimedia was designed to be easy to use and attractive to students. Screen design and navigation were consistent with other web pages used within the Department of Computer Science and Information Systems and were familiar to the students. Web pages were designed to fit the screen without the necessity of horizontal scrolling, at the time the typical screen resolution at the University of Chester was 640 x 480 pixels. Images were kept to a minimum on the web pages to ensure fast loading times (Sherry, 1995). Students were given the option to download the files with video and sound as required.

The use of video was included as a 'talking head'. Every week the tutor would introduce the material, highlighting any issues that had arisen during the previous week and encouraged the students to see and 'get to know' the tutor. This initial introduction is a familiar method of starting a traditionally taught face-to-face lecture. Additional sound was included as

narration to support the lecture slides. Most of the theoretical material for the course on multimedia was presented in this way.

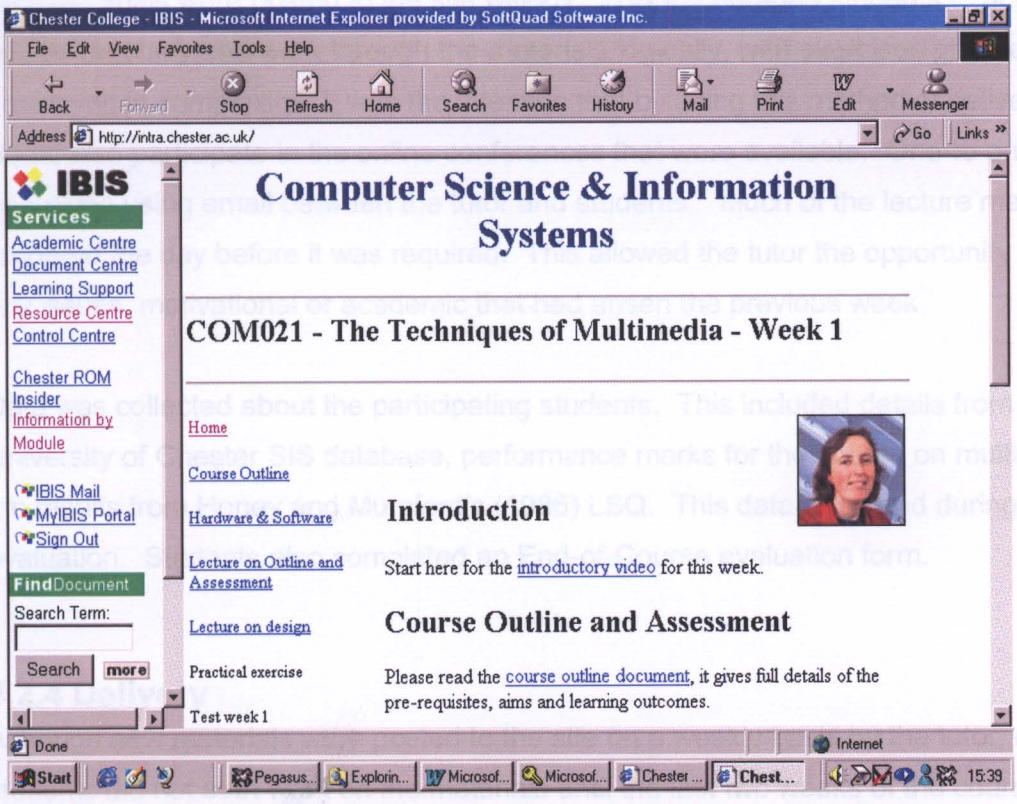


Figure 4.1: Screen dump of COM021 web site accessed using IBIS.

The weekly exercises and tasks set by the tutor were designed to introduce students to the techniques and skills of multimedia production. This included the production of images, sounds, video and using a multimedia development tool, in this case Macromedia Director. Students were expected to provide pictures and sound material that would allow their tutor to get to know them.

The assessment, which was in two parts, required students to build a multimedia system on a subject of interest to them and link this practical work to theoretical issues covered in the course in an essay.

4.2.3 Implementation

The web pages were built using Dreamweaver 3, a commercial software package for developing web pages. This package was chosen as it offered good site management

facilities. Links to the course materials were built into each page, both down the left side of the page and within the text (see Figure 4.1).

New materials were posted to the site weekly. This encouraged students to access the course regularly and work through the materials logically, with exercises gradually increasing in complexity. It was the intention that by using this method of delivery, students would also participate in the online conferences that were available. One-to-one support was given using email between the tutor and students'. Much of the lecture material was prepared the day before it was required. This allowed the tutor the opportunity to address any issues, motivational or academic that had arisen the previous week.

Data was collected about the participating students. This included details from the University of Chester SIS database, performance marks for the course on multimedia and the results from Honey and Mumford's (1986) LSQ. This data was used during the course evaluation. Students also completed an End-of-Course evaluation form.

4.2.4 Delivery

Although new materials were posted to the site on a weekly basis by the tutor, many students did not start work on the materials until the last two weeks of the course, when the assignments were due (see Table 4.1).

The students used email to communicate with the tutor on a regular basis, but very limited use was made of the discussion board.

Early responses to the course were limited, but enthusiastic. As the course progressed more students contacted the tutor with sound files, pictures and general comments. When the tutor received completed exercises from students (e.g. edited images and sound files) these were linked to course web pages and made available for all students.

4.3 Course evaluation

To assess the success of the pilot study, data collected during the course was examined. As the number of students on the course was relatively small, a qualitative evaluation of the course was undertaken.

The evaluation looked at issues raised during the pilot study, the problems faced and their solutions. It considered feedback from the tutor, students and the course team in a variety

of forms and analysis of email and discussion board postings. Additional information was collected from interviews with three students.

Table 4.1: Table showing completed exercises received by the tutor.

Exercise	Which project is best?	Week 1 question naire	Times image	Silly picture	Bean Factory	Rising Sun	Sound file
Student A	9 May	8 May		email problem	Done	Done Some problem s	
Student B	16 May			Done	Agreed not needed	6 Jun	
Student C	28 May	28 May	28 May	28 May	Done	3 Jun	3 Jun
Student D	31 May	8 May	31 May	31 May	31 May		
Student E		17 May					
Student F		8 May					
Student G	6 May	6 May	14 May	12 May	21 May	4 Jun	4 Jun

4.3.1 Comparative marks

Eight students started the course in April 2002. Final work was submitted at the end of August from five students, one student left the course and one had been in hospital and was therefore unable to complete the course. The marks ranged from 58-70%.

The marks from the assignments were compared with marks from the previous year when the same content was taught by traditional face-to-face methods (see Table 4.2). The learning outcomes and assessments were the same for both groups of students.

As can be seen from the table the average mark for the e-learning course is higher than the mark for the traditionally taught course, but the range of marks is much narrower, this could be due to the small number of students taking the course. The highest mark for both courses is a distinction (70% e-learning, 72% face-to-face). This is equivalent to previous work carried out by Pugh et al (2005), Davies and Graff (2005) and Knox (2005).

The percentage of students completing the course is higher than for the traditional course. This is not supported by recent studies which have suggested that there is a higher drop out rate from e-learning courses due to the isolation felt by students and the lack of student-to-student and tutor-to-student support (Thompson, 1997; Boddy, 1999; Carr, 2000).

Table 4.2: Comparative results of assignments for MSc Information Systems course on multimedia.

	E-learning (2000-2001)	Traditional Learning (1999-2000)
Number of students registered on course.	8	19
No. of assignments submitted	5	10
Average Mark	68%	51%
Highest Mark	70%	72%
Lowest Mark	58%	40%
Median	58%	56.5%
Percentage of students completing the course.	62.5%	52.6%

4.3.2 Contact grid

The contact grid (see Table 4.1) was used for several purposes. Initially, it was employed as a register to satisfy university procedure and to establish any patterns in the students' work rate. This course (despite being run over a specific period with new lectures and exercises being made available every week) allowed students to work at their own pace. One student in particular worked steadily throughout the course and kept up with the work. Other students worked sporadically for a variety of reasons, some because of employment, others because their preferred way of covering the material was in large blocks.

4.3.3 Tutor-to-student relationships

Each week the course included an introductory video of the tutor introducing the subject of the week's lecture, giving students encouragement and feedback of exercises they had completed. The tutor also used these videos to personalise the course. The students that were interviewed felt that these videos were not very helpful, but this was not reflected in the End-of-Course questionnaire. The video, although not useful for passing on course content, was helpful as it allowed the students to form a relationship with the tutor without having met her. This was clearly demonstrated when one of the students met the tutor for the first time. The student approached the tutor with some familiarity as if the tutor and student had been attending traditional lectures.

During the course students were given two exercises that increased the tutor-to-student interaction and helped to develop relationships. These exercises, the picture and sound tasks, required students to use a photo of themselves and a voice recording to produce files that would later be included on the 'Silly pictures and sounds' page. The tutor found that she had interests in common with some of the students and this gave her the opportunity to develop a more natural relationship as would have been the case in a traditionally taught course.

Email conversations between tutor and students began in a formal way, with both the tutor and students signing their emails with their full name. As the relationships developed between the tutor and the students so the emails became less formal and more 'chatty', with both tutor and students signing just their first names (Clouse and Evans, 2003).

4.3.4 Student-to-student relationships

Students found it strange meeting other class members face-to-face at the hand-in session in September, 2001. Peer interaction was missing during the important process of working on the assignment. If the discussion board had been used earlier in the course, this problem may have been overcome. It was noticed that during the hand-in session this interaction did take place with students discussing problems that had arisen and how they overcame them.

The discussion board although used by only a few members of the class did allow for discussion. Students advised each other and started to participate in problem-solving activities, these were the type of problems students would usually discuss in a traditional classroom setting. The discussion board also gave other members of the course team (technicians and other multimedia tutors) the opportunity to help solve problems and take part in discussions as necessary. This element of the course would not have been available in the traditional course and over a period of time other peoples' expertise became invaluable as reported by Tricker et al (2001).

4.3.5 Technical issues

As expected, technical issues caused problems during the course. This supports issues reported by Sherry (1995). Many of the students found that the thirty-day trial versions of software they were expected to download and use for their assignments were not

appropriate. Access to specialist software can be expensive and many universities expect students to buy any necessary software. Trial versions can often be a cheap alternative. Thirty days was not considered long enough for them to learn how to use the software and complete their assignments. Some students reported problems in downloading and installing the software.

Initially students viewed the PowerPoint lectures online, but this proved a slow process for many students and sound files did not function as expected. The reason for this was identified as the slow Internet connections available to some students. During the later part of the course, students were given the choice of viewing online, via streamed media or downloading the original PowerPoint file. This successfully overcame the problem.

Although the course team helped students overcome many of their technical problems, one in particular could not be solved as it involved security systems set up at a student's place of work. This caused serious problems and prevented access to the course web site while at work.

Despite these technical problems, the course did run smoothly. The video content (in particular) was recorded on a weekly basis, to make it relevant to feedback from students the week before, and uploaded to the university's streaming-video server without any problems.

The discussion board at this time was not heavily used. This may in part have been due to the fact that the IBIS discussion board is outside the main web pages therefore making navigation to it more complicated. A second conference board with chat rooms was set up within the course on multimedia web pages to alleviate this confusion for future use.

4.3.6 Administration matters

Administration matters were dealt with by the Postgraduate Administrator in the Department of Computer Science and Information Systems. As the course on multimedia was one part of a larger programme of study and the students involved already registered for the programme, administration did not cause any additional problems. It is worth noting that most students taking the course were in full-time employment and most of the administrative support was in the form of telephone conversations and emails, with formal letters at appropriate times.

4.3.7 End-user interface design and course content

Students reported no problems with the end-user interface apart from the occasional hyperlink not working. These were corrected as soon as they had been reported. A twenty-four hour delay in the technology meant that new pages and corrected hyperlinks were available the following day.

Students reported that the level of material was of a high standard and the material covered reflected their expectations. Students were asked to cover issues such as multimedia sound, the use of pictures, copyright law and the use of video in the production of multimedia systems. The creation of video clips was the only part of the course for which any of the students had to use the university facilities, rather than work from work or home. This problem had been identified before the course began, but the course team could find no way of solving this problem without the students having to buy expensive software and in some cases hardware.

4.3.8 Learning Styles Questionnaire (LSQ)

All students took part in the LSQ. The questionnaire included all 80 questions used in Honey and Mumford's (1986) original questionnaire and took approximately 25 minutes to complete. The results from the LSQ gave the students a score for each learning style and information about their preferred learning style.

The results from the LSQ showed that all students except one, a pragmatic learner, were reflective learners. The post-course questionnaire revealed that students who had completed the LSQ at this time agreed that it had accurately reflected their personal learning style.

Post-course interviews were conducted with three students and the same questions posed to each. These questions asked the students which learning activities they preferred in traditional learning environments and asked them to reflect on the exercises from the course on multimedia.

4.4 Students' evaluation of the course

4.4.1 Student A

Student A, a reflective learner, agreed that the description of a reflective learner was an accurate indication of his learning preferences. He reported that in a traditional learning

environment he preferred more didactic forms of learning and tasks where he could work at *his own pace, being given time to reflect on the material being presented before answering questions or contributing ideas. He found it difficult to participate in discussions without* being given the opportunity to prepare in advance.

Student A felt that the online course did offer a variety of learning activities and found the online PowerPoint lectures most helpful, with the practical exercises giving him time to put theory into practice. The use of the discussion board gave him the chance to build student-to-student relationships, despite the discussion board only being available late in the course. This student also reported that the discussion board was less intimidating than a similar discussion in the classroom as he was able to prepare his contribution first.

The biggest disadvantage for this student was the technology. Although this problem had been anticipated by the course team, it still caused this student considerable problems which were only solved by a combination of emails between the student and the tutor and perseverance on the part of the student. This course took more time to complete than traditional courses and was therefore thought to be harder work.

Overall the student said that the course had been successful for him and he would consider future e-learning courses. This student has since registered for a second e-learning course and continued to work steadily.

4.4.2 Student B

Student B, also a reflective learner, preferred traditional didactic lectures, but was comfortable participating in discussions without preparation time. He was part of a team at work, but was just as comfortable working alone. This student said the definition was mostly accurate differing only in the belief that he had a more flexible approach to learning and willingly tried any learning activity that was appropriate. His scores in the LSQ supported this. Student B's scores for all learning styles were very close in the mid-range of the possible scores.

During the e-learning course this student reported that he was less comfortable with the discussion board than Student A and managed to solve many of the technical problems he encountered without contacting the tutor. He too preferred the PowerPoint lectures, but felt that the discussion board was not helpful and did not enjoy using it. He felt that he did not need the support from either tutor or other students although he did report that he felt a

sense of security knowing that a tutor was available. This student did have one problem that could not be overcome, despite help from the course team. The problem was one of access to the university web site from his workplace. The company he worked for used firewalls (security systems) that meant he could not load the course web pages at work.

Overall, although this student enjoyed the course he did not feel that he would prefer this method of learning over the more traditional methods. This may have been due to the lack of contact with others on the course and with the tutor although Student B did not think so.

4.4.3 Student C

This student was a pragmatic learner and when interviewed felt that this accurately identified his preferred learning style. For much of the course this student was working abroad and so was unable to take a more traditionally run course. His reasons for choosing to take this course in the first place therefore differed from the other students who had chosen to take the course out of either an interest in multimedia or to experience a different type of learning.

Student C agreed that he was a pragmatic learner and preferred the learning activities identified as those pragmatic learners employ, such as, searching out new ideas and seeing if they work in practice. Importantly, he reported a need to try out new skills and get immediate feedback from an expert. This student also reported a need for any learning that took place to be relevant to his own job and be able to implement them.

This student dropped out early on in the course and stated a lack of motivation on his part rather than any problems associated with the technology, or lack of time, which could have been another issue. Student C did report that not being required to attend lectures was a serious factor in his not completing this course and, when asked, felt that some synchronous elements that were a requirement of the course may have helped. This student stated that the experience although not a bad one, has confirmed a previously held belief that e-learning was not suitable for him.

4.5 Conclusion

The pilot study can be considered successful in that five students completed the course gaining higher than average marks with only one student failing to complete the course

because of motivational reasons. Relationships between students and the tutor did develop over the period of the course although sound and video were not found to significantly improve either the learning or the experience of the students.

Technical problems identified were in most cases resolved easily. Those issues that could not be resolved were noted and addressed during the design of the course for the main study. Of particular interest was the range and selection of hardware and software available for use by the student either from the University of Chester or from the WWW at no cost.

Chapter 5: Case Study 2 - A pedagogic evaluation of e-learning

5.1 Introduction

This chapter discusses the design and delivery of the case-study course CO2250, Multimedia Skills for Study and the Workplace in the Spring/Summer of 2003. The course was first taught in 1999, but was redesigned to up-date it and make it more relevant. All aspects of the course needed to be considered for redesign for both modes of teaching and learning, i.e. face-to-face and e-learning. Comparability of the learning experience was important and this chapter describes how this comparability was achieved.

Rowntree (1992) suggests the following teaching and learning strategies to support Honey and Mumford's (1986) identified learning styles:

- Activists respond well to new problems, being thrown in at the deep end and working in teams.
- Reflectors respond well to thinking things through, research and detached observation.
- Theorists respond well to interesting concepts, structured situations and opportunities to question.
- Pragmatists respond well to relevance to real problems, immediate chances to try things out, and experts they can emulate.

Laurillard (2000) proposes that to support all learning styles effectively with e-learning, materials and activities should include the following:

- Narrative activities. These are one-way lectures, no feedback. These can be text-based materials, video lectures or PowerPoint slideshows.
- Communicative activities. Two-way communication. This can be via the use of discussion boards, chat rooms and email facilities. More advanced systems may include audio or video conferencing.
- Interactive activities. This is tutorial and interactive material. These can include quizzes, step-by-step tutorial materials or games.
- Adaptive activities. These are simulations of real-life environments. These can be role play or group work.

- Productive activities. Tasks and assignments with a final product or output. These can be included in the form of formative tasks and summative assignments.

Table 5.1 shows which activities are best suited to particular learning styles. As can be seen from the table all learning styles can be supported through a carefully structured e-learning environment.

Table 5.1: Laurillard's (2000) online learning activities supporting Honey and Mumford's learning styles.

		Honey and Mumford's Learning Styles (1986)			
Laurillard's model (2000)		Activist	Reflective	Theorist	Pragmatist
	Narrative		X	X	
	Communicative	X			
	Adaptive				X
	Interactive	X		X	X
	Productive	X	X	X	X

Laurillard (1993) suggests that the "best approach to the design of online content is likely to require an integrated combination of several media" and Rowntree (1981) says "to achieve the maximum learning among the maximum number, students need to be offered a variety of things and make possible a variety of approaches". These strategies were adopted for the redesign of the CO2250 material. It was also essential in the redesign that the media used for both modes of learning supported all different learning styles, as far as possible.

The redesign of the course followed a typical methodology of course design (see Figure 5.1). This ensured that quality was maintained and appropriate learning outcomes were set that could be met by students following either mode of learning. Additionally the incorporation of a range of key skills had to be considered as students taking this course were non-computing students updating their key skills in information technology.
The course was redesigned so that students following the e-learning and face-to-face modes of learning covered the same material, and had the same exercises and assessments. Method of delivery and tutor support were the only differences. In the case of producing the materials, two sets were developed: E-learning materials in web format, face-to-face materials as Word documents (see Section 5.5). Sherry (1995) says that "in designing effective distance instruction, one must consider not only the goals, needs, and characteristics of teachers and students, but also content requirements and technical constraints". This was equally relevant to the face-to-face development of the course.

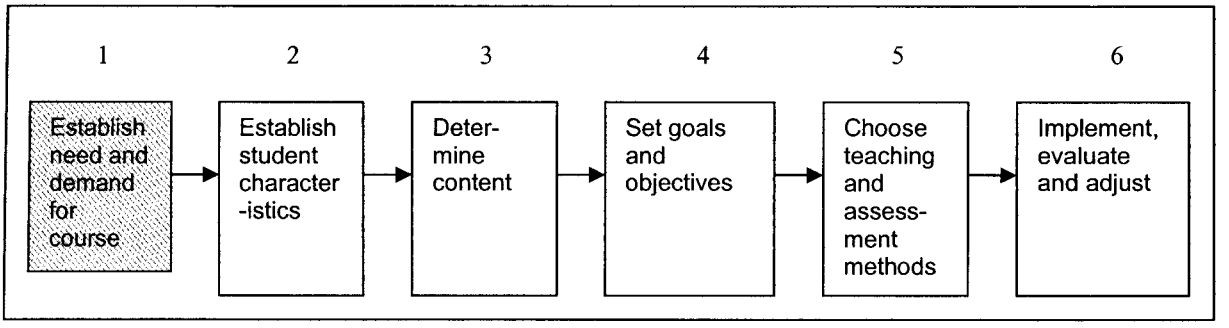


Figure 5.1: A typical method of the course design process (Toohey, 1999).

Minor changes were made to the design of the course as it progressed. This was largely due to procedural issues raised during the tutorial sessions.

5.2 Learning outcomes

"Learning outcomes are specific statements which define the learning students are expected to have acquired on completion of a course. They are also used to guide the choice of teaching, learning and assessment strategies for the course" (Fry et al, 1999).

The course descriptor which outlines the aims and objectives of the course, the mode of learning and the assessment had been designed by the Department of Computer Science and Information Systems at the University of Chester prior to the study. Stages 1 and 2 of the course design were therefore already completed.

The learning outcomes of the course on multimedia were quite generic, for example: "the course will enable students to develop essential skills in research, presentation and communication, both as part of a group and as an individual". The computer science industry is one of rapid change and development; the generic learning outcomes allow up-to-date material and resources to be used without the need to regularly change the course documentation, without limiting the depth of learning.

The learning outcomes were written to follow the four domains recommended in Fry et al (1999): knowledge and understanding, key skills, cognitive skills and subject-specific skills.

5.3 Key skills

Key skills are transferable, in that they are not subject specific, rather general knowledge and working skills and are an increasingly important element of HE. The Department of

Computer Science and Information Systems at the University of Chester builds key skill elements into all of its programmes ensuring that the range of skills covered during a three-year degree will enable students to acquire the necessary skills and knowledge. Other departments within the university use the alternative method of including a separate key skills course within their programme. The course on multimedia was one of the latter.

Although Information Technology is seen as a key skill of its own, this course was designed to encompass the other key skills of communication, personal skills, working with others and improving own learning and performance (Drew, 1998). Students increased their Information Technology (IT) skills using a range of software, working individually and with others to create multimedia artefacts presenting information and evaluating the suitability of IT tools (Drew, 1998).

5.4 Hardware and software

Boddy (1999), Kear (1999) and Lockwood and Gooley (2001) suggest that student access to hardware and software should be assured before including their use in a course. They go on to recommend that technical support is also available throughout the course. The choice and support of hardware and software was seriously considered during the design to support face-to-face and e-learning students.

All students had access to computers in the Department of Computer Science and Information Systems which supported all the hardware and software needed for the course. To allow some students the opportunity to work 'at a distance' it was essential that the same or equivalent hardware and software could be used off-campus to complete the course.

The creation of multimedia artefacts (digital images, animation, sound and video) is a highly specialised and technical area of computer science and the course included detailed tutorials for software available in both the Department of Computer Science and Information Systems and on the university network. The image and sound creation software caused particular problems. The university network supported only Microsoft PhotoEditor, Paint and Sound Recorder programs. These are very basic programs, but were considered adequate for the level at which the students would need to use them.

Additional software that could be downloaded from the course web site was found to help students working at home (see Figure 5.2). This included sound editing software that was powerful enough to carry out the required tasks. The image manipulation software used in

the tutorial was expensive and no suitable alternative could be found. E-learning students either used software already available to them on their home computers or used Microsoft PhotoEditor and Paint. A similar problem to this was encountered when students studying face-to-face used Macromedia's Dreamweaver to produce web pages. Again this software was very expensive and unavailable to students working away from the department; Microsoft FrontPage which was available on the university network was supported as an alternative. E-learning students were offered tutorial material for these sound, image and web page design packages.

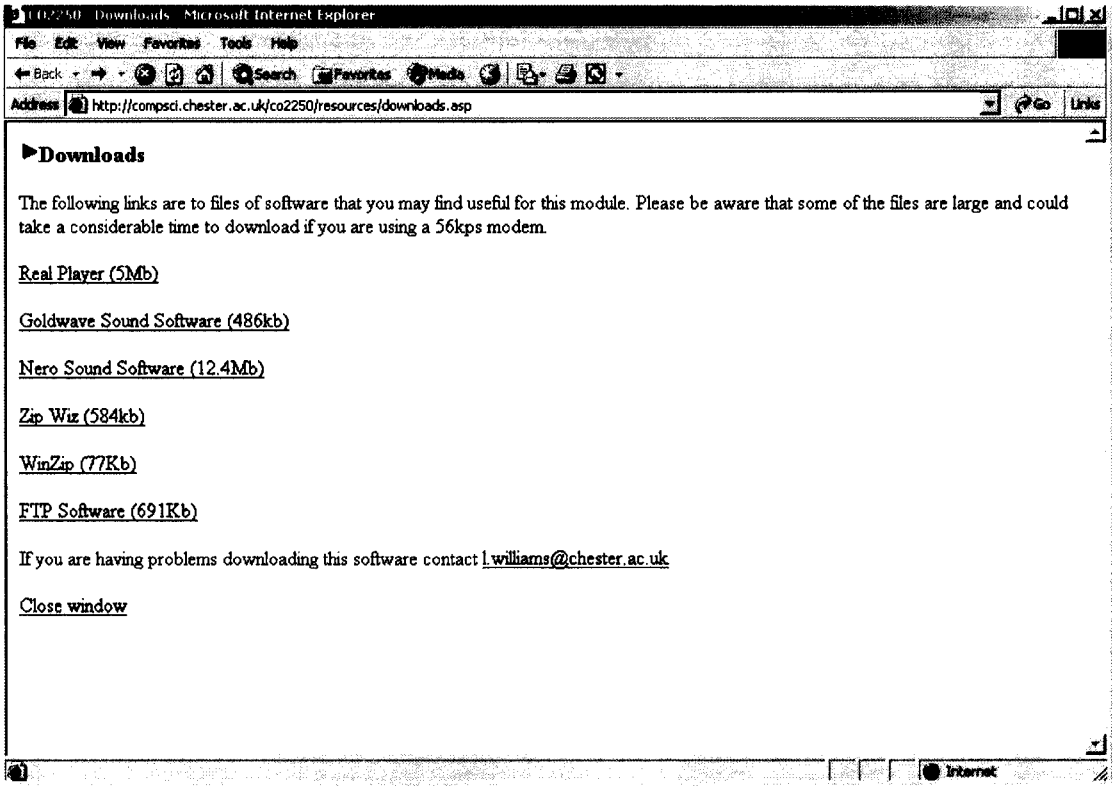


Figure 5.2: List of downloadable resources for e-learning.

5.5 Course materials

The content was designed to allow students to learn the theory of designing multimedia systems and then to put their acquired knowledge and skills into practice. For example, students learnt the theory behind the creation and use of sound, then used computer hardware and software to create their own sounds/narration before including these in a multimedia system. Without understanding the theory students might have created sound files that were too large or were in the wrong format.

The relatively large number of different programs that were used was a challenge for most students. Students on the course on multimedia were generally expected to use more than

one package each week. For example, the workshop exercises for Week 2 (learning about images) required the generation of images that were then put into slideshows. Students were expected to learn not only how to use software and hardware that was unfamiliar to them, but additionally, they had to build a presentation in PowerPoint. It was anticipated during the design that the number and varied nature of computer software that students were expected to use might cause problems as Level One computer science students often find this aspect of multimedia difficult initially.

5.5.1 Theoretical content of the course

Narrative content that would suit the theorist and reflective learning styles would normally be given during formal lecture sessions, or require students to read printed or electronic-text materials.

The theoretical content of the course was designed and given during lectures using PowerPoint slides to face-to-face students. E-learning students viewed the same PowerPoint slides online supported by narration and sometimes video. Lockwood (1994) suggests that the more sophisticated the media used, the longer the development time. For this study it allowed resources to be reused saving tutor's time in preparation and ensuring the consistency of the material covered. Opting for a text-based choice alone may have increased the drop out rate (Lockwood, 1994).

The only exception to this format was the lecture about 'the importance of video' (Week 9). Face-to-face students attended the lecture as usual and their PowerPoint slideshow was supported by long video clips to demonstrate the theory covered. Hence they also experienced an enhanced lecture. Video was an essential element of this lecture and therefore had to be included (Race and Brown, 1993).

Downloading PowerPoint slideshows containing a high level of video content would have taken over one hour and possibly longer with a slow modem (56 kbps). As a result a series of web pages were designed and built which included short video clips. The video clips were downloaded as required and offered in two qualities.

One important point to mention which might have had some impact on the data collected is, as Lockwood and Gooley (2001) says, that students should be given a clear indication of the length of time, hours per week, it should take to cover the material. This was not explicit in the material, either for the face-to-face or the e-learning courses. Rowntree (1992) argues

that e-learning students may cover less material in the same time as students in a face-to-face environment.

5.5.2 Formative practical tasks

Formative practical exercises for students to work on during practical sessions or in their own time were created for both face-to-face students and e-learners. These tasks were designed to suit active and pragmatic learners or the interactive and adaptive elements of Laurillard's (2000) design for e-learning, and were established common practice in the face-to-face teaching.

The practical tasks were designed to increase the students' knowledge of the variety of artefacts that need to be considered in multimedia systems and the creation of images, sound and video.

The workshop exercises underpinned the course theory, for example, images and compression theory linked to creating original images in various formats depending on their intended use. The practical tasks were supported by the theory. They were also used as a way of assessing student progress and identifying students' strengths and weaknesses. Students that would need additional support were also identified. As Freeman and Lewis (1998) suggest, formative tasks can highlight difficulties that students have as they are encountered, and can be used as a means of checking the attendance of e-learning students.

Formative exercises that would increase students' knowledge, skills and confidence were included weekly. Face-to-face students completed these exercises during a timetabled teaching session and formative feedback was given by the tutor. E-learning students worked in their own time and used a discussion board to communicate with the tutor about any problems or issues as they arose. These were based on the model suggested by Salmon (2001; 2002) on delivering and moderating activities using e-learning environments.

Feedback can take many forms and is essential if students are to improve and become independent learners (Fry et al, 1999). Two methods of feedback were built into the design of this course: formative feedback (given casually to either the group or individuals in class or on the discussion board as discussed above) and summative feedback (see Section 5.8.3).

5.5.3 E-learning materials structure and access

A web site was produced to allow the e-learning students to access the course materials and the discussion board. The web site could be accessed from the online learning page of the course from IBIS (the usual student virtual learning environment), it did not simply mirror the face-to-face version (Lockwood and Gooley, 2001). Stephenson (2001) says that learners find e-learning difficult not because it is, rather because it is a new way of learning.

The web site was designed with navigation facilities down the left side of the screen on a Week 1, Week 2 etc basis. E-learning has the flexibility for students to work through the material at their own pace and in an order that suits them, but students were encouraged to follow the syllabus in the order it was presented. This is confirmed by Lockwood (1994) who suggests providing material using topic-by-topic sequencing, but points out that students may become confused by the relationship between the topics. In a complex subject such as multimedia this would almost certainly have been the case.

The online learning materials for each week consisted of: a covering sheet (web page), a lecture (the PowerPoint slideshow) and a workshop with practical tasks (web pages with printable Portable Document Format (PDF) copies). The index page for each week acted as a covering sheet for the week's work, this is as recommended by Race and Brown (1993). The learning objectives were explicit (Race and Brown, 1993).

As with many courses the first week was largely an introduction to the course and its content. Also covered during this week were analyses of the students' learning preferences and an explanation of why the research was being undertaken. As already discussed the first week was a face-to-face session for all students. Race and Brown (1993) suggest making the course content and previous examples of assessment available to students before the course commences. The course descriptor was available through IBIS to all students, but was made explicit during the first week.

In order for e-learning students to have a full week to work on the materials the web pages needed to be complete and uploaded to the server by Friday afternoon of the previous week. Although it was acknowledged during the design that this would again add pressure to the tutors' workload it was considered essential to give students the best service.

5.5.4 Face-to-face materials structure and access

All teaching materials for the face-to-face students were printed and handed out during lectures and workshop sessions. Additionally, they were stored on a public area of the Department of Computer Science and Information Systems network, the J: drive. Tutors and students had access to material on this drive. All materials had to be produced to support and enhance the quality of the learning (Ellington et al, 1997). These materials could be considered as mass instruction techniques which, "encompasses all techniques that involve the expository teaching of a class" (Ellington et al, 1997).

A PowerPoint slideshow was used for lectures and a reference copy put in the folder for the relevant week on the J: drive. PDF and Microsoft Word documents gave details of the practical tasks to be completed and how to use the software. Many of the resources explained the basics of the computer network used within the Department of Computer Science and Information Systems.

The many different types of file, that was used, made it confusing for students (see Figure 5.3). Ellington et al (1997) say that a vast range of materials can be bewildering to tutors and students. Fortunately, face-to-face students did not have to rely on these resources as printed materials were available.

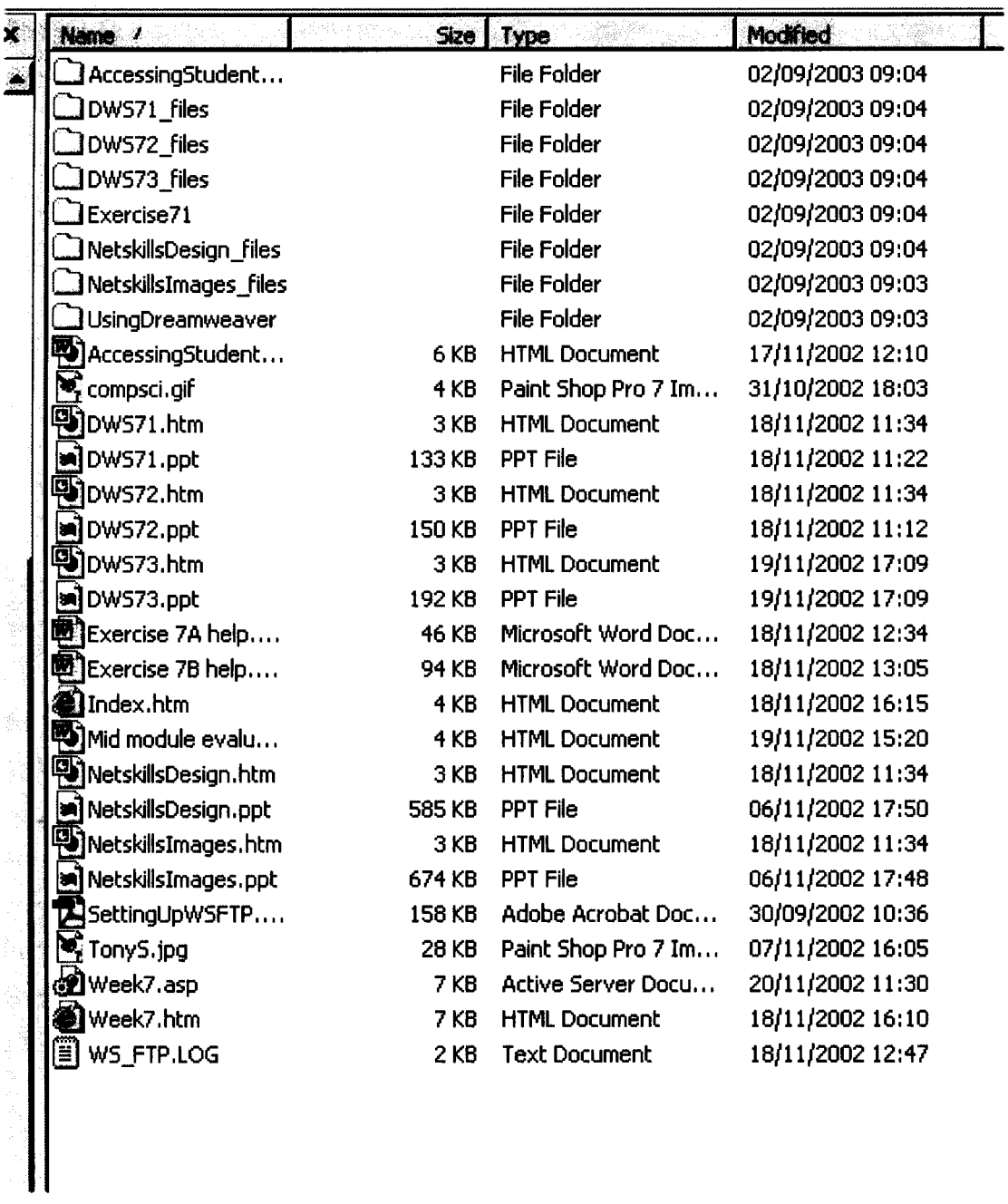
5.6 Tutor and peer support

Tutor and peer support was designed to be available to students during timetabled classroom sessions for face-to-face students and via the use of a discussion board for e-learning students. This essential element satisfies Laurillard's (2000) communicative element and supports theorist as well as active learners.

5.6.1 Technical support

Technical support was available to all students from:

1. Tutors during workshop sessions (face-to-face students), via the discussion board and email (e-learning students).
2. The Department of Computer Science and Information System's technicians, face-to-face, and email.
3. The University of Chester technicians and help desk.



Name	Size	Type	Modified
AccessingStudent...		File Folder	02/09/2003 09:04
DWS71_files		File Folder	02/09/2003 09:04
DWS72_files		File Folder	02/09/2003 09:04
DWS73_files		File Folder	02/09/2003 09:04
Exercise71		File Folder	02/09/2003 09:04
NetskillsDesign_files		File Folder	02/09/2003 09:04
NetskillsImages_files		File Folder	02/09/2003 09:03
UsingDreamweaver		File Folder	02/09/2003 09:03
AccessingStudent...	6 KB	HTML Document	17/11/2002 12:10
compsci.gif	4 KB	Paint Shop Pro 7 Im...	31/10/2002 18:03
DWS71.htm	3 KB	HTML Document	18/11/2002 11:34
DWS71.ppt	133 KB	PPT File	18/11/2002 11:22
DWS72.htm	3 KB	HTML Document	18/11/2002 11:34
DWS72.ppt	150 KB	PPT File	18/11/2002 11:12
DWS73.htm	3 KB	HTML Document	19/11/2002 17:09
DWS73.ppt	192 KB	PPT File	19/11/2002 17:09
Exercise 7A help....	46 KB	Microsoft Word Doc...	18/11/2002 12:34
Exercise 7B help....	94 KB	Microsoft Word Doc...	18/11/2002 13:05
Index.htm	4 KB	HTML Document	18/11/2002 16:15
Mid module evalu...	4 KB	HTML Document	19/11/2002 15:20
NetskillsDesign.htm	3 KB	HTML Document	18/11/2002 11:34
NetskillsDesign.ppt	585 KB	PPT File	06/11/2002 17:50
NetskillsImages.htm	3 KB	HTML Document	18/11/2002 11:34
NetskillsImages.ppt	674 KB	PPT File	06/11/2002 17:48
SettingUpWSFTP....	158 KB	Adobe Acrobat Doc...	30/09/2002 10:36
TonyS.jpg	28 KB	Paint Shop Pro 7 Im...	07/11/2002 16:05
Week7.asp	7 KB	Active Server Docu...	20/11/2002 11:30
Week7.htm	7 KB	HTML Document	18/11/2002 16:10
WS_FTP.LOG	2 KB	Text Document	18/11/2002 12:47

Figure 5.3: A list of materials available to the face-to-face group.

5.6.2 Tutor support for e-learners

Tutorial support for e-learning students was given in three ways.

1. A discussion board was used as the primary means of communication between tutors and students.
2. E-learning help pages.
3. Email correspondence with tutors.

5.6.2.1 Discussion board

The discussion board was designed to offer the same types of communication as could be expected by the face-to-face students. Each tutor group had its own board, moderated by the tutor and which could only be viewed by students in that tutor group. An informal 'café' board was available to all e-learning students on the course. This was moderated by the students representatives and allowed students to discuss anything whether it was related to the course or not. Finally, a course discussion board was created for all students and tutors on the course to discuss any common issues and problems related to the course.

During the design it was decided that tutors should visit the discussion board twice a day, so that students could be guaranteed a response within 24 hours to any problems occurring. In reality all tutors visited the board far more frequently, some even at weekends. Jolliffe et al (2001) emphasise this point when they say that "tutors should have the time to be able to moderate. Moderating a discussion board can take a great deal of time, so moderators must allow for it".

5.6.2.2 E-learning Help Pages

It was identified from Case Study 1 that much of the tutor support for e-learning students was in the form of identifying and providing help and resources on using the software and problem solving.

Some e-learning help documents were created as part of the initial design (see Figures 5.4 and 5.5), but as a result of problems encountered early in the course, additional support tutorials and resources were included in the web site.

5.6.2.3 Email correspondence

E-learning students emailed their tutor with any issues or problems they felt unable to post on the public discussion board.

The original design was for students to have as little face-to-face contact with the tutors as possible. During the design only one face-to-face session was built into the course (Week 1) with the proviso that more would be added at strategic points if they were needed. This intervention proved to be necessary and two additional face-to-face sessions were included just before assignments were due.

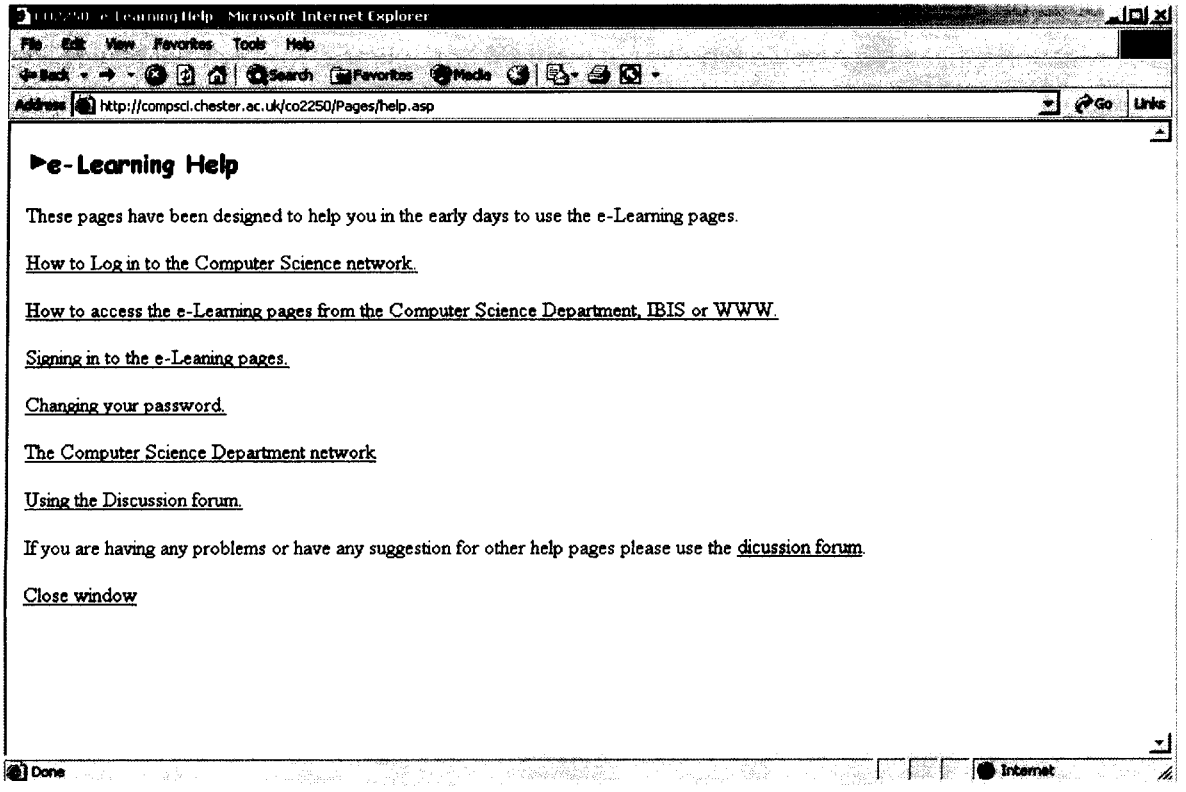


Figure 5.4: E-learning help screen with links to relevant documents.

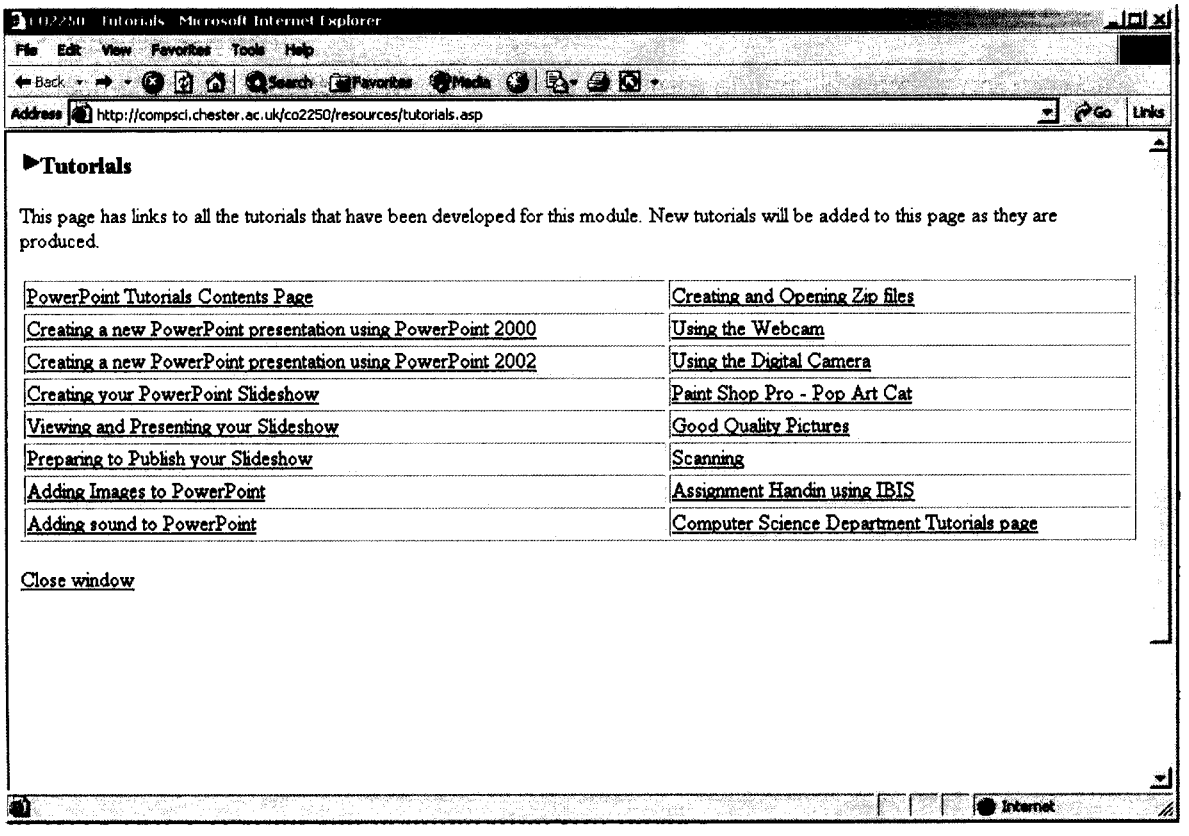


Figure 5.5: List of additional tutorial materials.

The Week 1 tutorial allowed students to meet their tutors and fellow students, to become familiar with the mode of learning and for them to undertake some necessary housekeeping tasks (Benfield, 2000). The other face-to-face sessions were included later in the course when the teaching team considered students needed additional tutor contact particularly near assignment submission dates. This decision was taken after feedback from the students, the high numbers on the course and to ensure that students were not disadvantaged because of the experimental nature of the course.

5.6.3 Tutor Support for face-to-face students

Tutor support for face-to-face students was done during classroom sessions and included feedback on formative tasks, additional information regarding assignments and help using the hardware and software.

Any necessary one-to-one communication between students and tutors was done by face-to-face students arranging a meeting at the end of or outside of classroom time; occasionally students used email to contact tutors for an appointment.

5.7 Assessment

Assessment is the means by which students' progress and achievements are measured and recorded. It is undertaken to provide systematic indications of the quality of students' learning for both tutors and students. It also helps to maintain standards in professional education and in HE generally. Finally, it motivates students (Miller et al, 1998). The experimental nature of the course meant that it was essential for the assessment to be a fair reflection of the course content.

Assessments were designed to "reflect truthfully some combination of an individual's abilities, achievements, skills and potential" (Fry et al, 1999). They should also reflect the intended learning outcomes and allow a judgement to be made on a student's progress (Jarvis, 2002). The assignments for this course required that students explicitly showed their understanding of materials and not simply reproduce work from notes they have been given. The assignments were designed so that the level of learning and progress was apparent.

5.7.1 Group work

A group assignment was designed as Assignment One for the course on multimedia and incorporated important transferable skills, explicitly detailed on the course descriptor. Students worked in groups of four or five to create a kiosk PowerPoint presentation that included a range of media images, sounds and animations.

5.7.2 Individual assignment

Assignment Two required the students to produce a web site and reflective essay. The web site included various suitable media. This allowed students to demonstrate their own skills, but also increased their knowledge of the differences in the media. For example, many images, sounds and video clips that they may have used for their PowerPoint presentation were not suitable for web-based multimedia either because of the format of the images, sounds and video or because the files were too large and therefore slow to load.

The reflective essay asked the students to reflect on the development of their website and link this process to theoretical material covered throughout the course and further reading. This type of exercise is consistent with undergraduate Level Two work, expecting students to examine their own learning in relation to learnt theory.

5.7.3 Assignment submission

Assignments for both groups of students were submitted using the standard IBIS electronic submission system (see Figure 5.6). Student submissions were identified by the ID number only. This allowed the teaching team the unique opportunity of marking all assignments anonymously therefore allowing direct comparison to be made of the students following the face-to-face and e-learning modes. Race (1995) says that marking assignments (particularly group projects) cannot be anonymous in the usual way therefore it is difficult to be objective. This method of hand-in made marking more objective. In theory it would have been possible to look up the names of the students, but this did not happen. Tutors were randomly assigned assignments to mark.

5.8 Course administration

Systems were already in place to support face-to-face teaching of the course, but some issues needed to be addressed in order for e-learning students to be monitored and supported to the same level. These issues were: attendance, parity and feedback for formative and summative work.

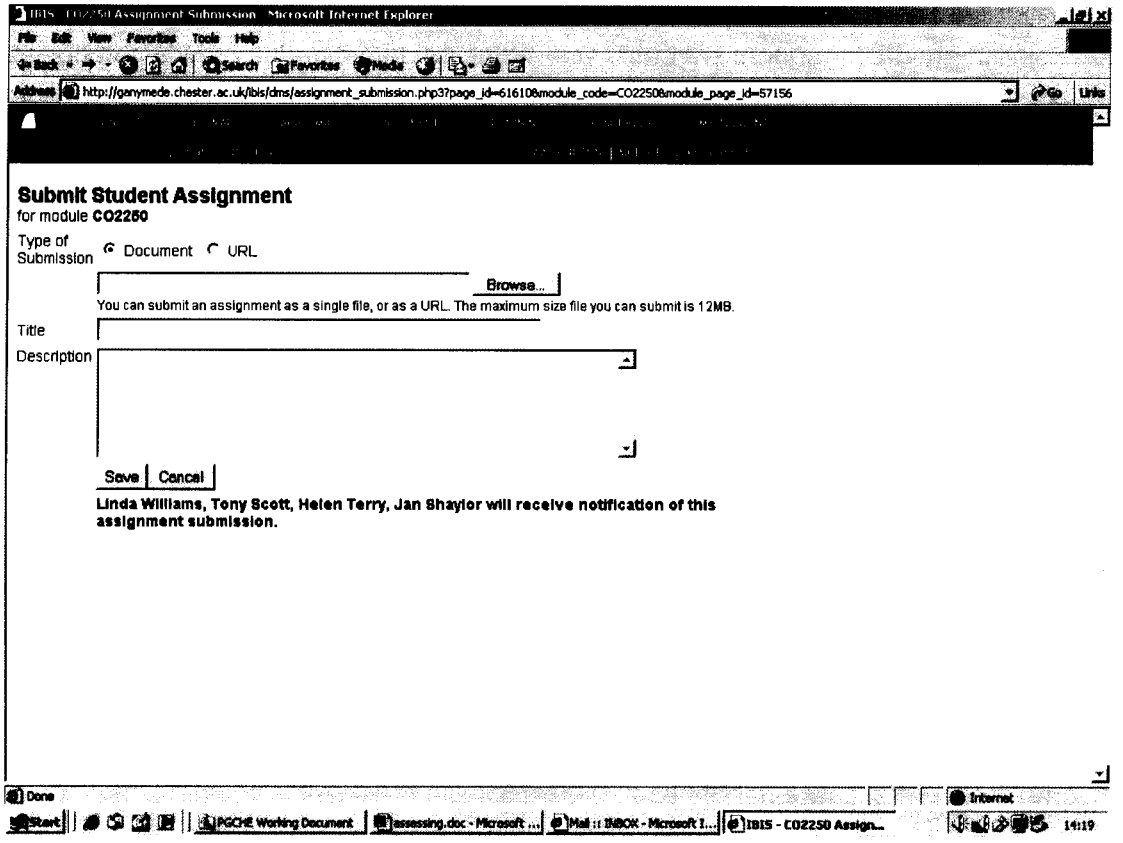


Figure 5.6: IBIS interface for electronic student assignment submission.

5.8.1 Attendance

During traditional class-based sessions a register of students attending was taken, primarily to identify those frequently missing who may need additional support or help. This issue of attendance was considered to be of even greater importance for e-learning students who had little or no face-to-face contact with their tutor. The Department of Computer Science and Information Systems at the University of Chester has a well developed system for contacting students who do not attend classes to offer support and guidance if needed.

As a result, registers were taken in the normal way for face-to-face students, whilst e-learning students were required to post at least one message to the discussion board each week to get their attendance mark. Non-attendance letters were then sent out to face-to-face students in the usual way. E-learning groups were contacted initially via email by the tutors in the first instance as an informal way of encouraging students.

5.8.2 Assignment marking

The teaching team of four tutors each marked an equal number of assignments. As all assignments were submitted in the same way using the standard IBIS electronic submission system (see Section 5.7.3) no differentiation was made between e-learning and face-to-face assignments.

Common practice at the University of Chester is to second mark 25% of all assignments. This was carried out with tutors working in pairs providing a range of assignments for their marking partner to second mark. All second marking was undertaken anonymously, without second markers knowing the grade awarded.

5.8.3 Summative feedback

E-learning students received summative feedback for their assignments via email from the tutor who marked the assignment. This ensured that the maximum number of students received feedback from Assignment One before completing Assignment Two.

In comparison, summative feedback for face-to-face students was left in the Computer Science department office for students to collect. This saved the tutors' time, but meant that many students did not receive feedback for marked assignments, as they often choose not to collect it.

5.9 Conclusion

This chapter has looked at the design and development of the materials for the course on multimedia used in this study. All theory, formative tasks and assignments were identical for both groups, face-to-face and e-learning, and delivered in the same thirteen-week time frame. Additionally all assignments were marked randomly by tutors without their prior knowledge of the mode of learning.

The design of this course demonstrated that courses can be run in two different modes at the same time, but the time taken to produce two almost entirely different sets of materials would not be feasible on a regular basis.

Tutor support for both modes was particularly successful, with students from both modes requesting elements from the alternative mode. For example, face-to-face students would have appreciated access to the e-learning tutorial materials for PowerPoint, Dreamweaver

and FrontPage. E-learning students required more face-to-face access to their tutor and peers.

The assignments were successfully designed, delivered and marked by the teaching team. Administrative issues were addressed and ensured that all students taking the course were treated equally and offered the same level of support, whilst allowing data to be collected for this thesis.

Chapter 6: Statistical analysis

6.1 Introduction

Primary data collected during the study was added to secondary data collected earlier about the participants. The data sources for this analysis included:

- Learning styles questionnaires to assess the students' learning preferences
- Assessment marks from Assignment One and Assignment Two completed during the multimedia computer course (CO2250). The marks from Assignment One and Assignment Two and the overall mark were used as an indicator of students' performance
- Academic performance at Levels One, Two and Three. These were calculated as an average from data held on the University of Chester student database. Each level consisted of eight thirteen-week courses (known as modules)
- Student data from a database about students that was held by the University of Chester e.g. date of birth, distance travelled to university
- Attendance data and discussion board data
- Results from the Mid-Semester and End-of-Course Questionnaire forms
- A computer skills survey completed at the beginning of the evaluation

The hypotheses considered the performance of students in the Experimental (e-learning) group compared with students in the Control (face-to-face) group in relation to a number of factors. These were:

- Gender
- Age
- Attendance (face-to-face or virtual via discussion board use)
- Programme of study
- Academic performance at Levels One, Two and Three (see above)
- Computer skills
- Learning styles
- Course evaluation scores

Null Hypothesis 1.0: There is no correlation between the gender of the students and their overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 1.1: There is a correlation between the gender of the students and their overall performance on the multimedia computer course (CO2250).

Null Hypothesis 2.0: Gender does not affect differentially the overall performance of students studying in either the Control (face-to-face) or Experimental (e-learning) groups.

Alternate Hypothesis 2.1: Gender does affect differentially the overall performance of students studying in either the Control or Experimental groups.

Null Hypothesis 3.0: There is no correlation between the age of the students with reference to their overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 3.1: There is a correlation between the age of the students with reference to their overall performance on the multimedia computer course (CO2250).

Null Hypothesis 4.0: There is no correlation between the Control and Experimental groups with reference to the age of the students and their performance on the multimedia computer course (CO2250).

Alternate Hypothesis 4.1: There is a correlation between the Control and Experimental groups with reference to the age of the students and their performance on the multimedia computer course (CO2250).

Null Hypothesis 5.0: There is no difference between the Control and the Experimental populations with reference to their overall academic performance on completion of their degree.

Alternate Hypothesis 5.1: There is a difference between the Control and the Experimental populations with reference to their overall academic performance on completion of their degree.

Null Hypothesis 6.0: There is no difference between the Control and Experimental groups with reference to their performance on Assignment One on the multimedia computer course (CO2250).

Alternate Hypothesis 6.1: There is a difference between the Control and Experimental groups with reference to their performance on Assignment One on the multimedia computer course (CO2250).

Null Hypothesis 7.0: There is no difference between the Control and Experimental groups with reference to their performance on Assignment Two on the multimedia computer course (CO2250).

Alternate Hypothesis 7.1: There is a difference between the Control and Experimental groups with reference to their performance on Assignment Two on the multimedia computer course (CO2250).

Null Hypothesis 8.0: There is no difference between the Control and the Experimental groups with reference to their overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 8.1: There is a difference between the Control and the Experimental groups with reference to their overall performance on the multimedia computer course.

Null Hypothesis 9.0: There is no difference in the Experimental group in relation to their performance in Assignment One and Assignment Two on the multimedia computer course (CO2250).

Alternate Hypothesis 9.1: There is a difference in the Experimental group in relation to their performance in Assignment One and Assignment Two on the multimedia computer course (CO2250).

Null Hypothesis 10.0: There is no difference between the performance of HND students studying a multimedia computer course (CO2250) via e-learning compared with the Control and the Experimental groups.

Alternate Hypothesis 10.1: There is a difference between the performance of HND students *studying a multimedia computer course (CO2250) via e-learning compared with the Control* and the Experimental groups.

Null Hypothesis 11.0: There is no correlation between the academic performance at Levels One, Two and Three of students on their course of study with reference to their overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 11.1: There is a correlation between the academic performance at Levels One, Two and Three of students on their course of study with reference to their overall performance on the multimedia computer course (CO2250).

Null Hypothesis 12.0: There is no correlation between the Control and Experimental groups with their overall performance on the multimedia computer course (CO2250) and academic performance at Levels One, Two and Three on their course of study.

Alternate Hypothesis 12.1: There is a correlation between the Control and Experimental groups with their overall performance on the multimedia computer course (CO2250) and academic performance at Levels One, Two and Three on their course of study.

Null Hypothesis 13.0: There is no correlation between the Control and Experimental groups with reference to attendance on the multimedia computer course (CO2250).

Alternate Hypothesis 13.1: There is a correlation between the Control and Experimental groups with reference to attendance on the multimedia computer course (CO2250).

Null Hypothesis 14.0: There is no correlation between the Experimental group with reference to their use of discussion board and their overall mark on the multimedia computer course (CO2250).

Alternate Hypothesis 14.1: There is a correlation between the Experimental group with reference to their use of discussion board and their overall mark on the multimedia computer course (CO2250).

Null Hypothesis 15.0: There is no correlation between the Control and Experimental groups with reference to the score on the Mid-Semester Questionnaire.

Alternate Hypothesis 15.1: There is a correlation between the Control and Experimental groups with reference to the score on the Mid-Semester Questionnaire.

Null Hypothesis 16.0: There is no correlation between the Control and Experimental groups with reference to the score on the End-of-Course evaluation questionnaire.

Alternate Hypothesis 16.1: There is a correlation between the Control and Experimental groups with reference to the score on the End-of-Course evaluation questionnaire.

Null Hypothesis 17.0: There is no correlation between students' dominant learning style with reference and overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 17.1: There is a correlation between students' dominant learning style with reference and overall performance on the multimedia computer course (CO2250).

Null Hypothesis 18.0: There is no correlation between the Control and the Experimental groups with reference to learning style and overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 18.1: There is a correlation between the Control and the Experimental groups with reference to learning style and overall performance on the multimedia computer course (CO2250).

Null Hypothesis 19.0: There is no correlation between the Control (face-to-face) and Experimental (e-learning) groups with reference to the score on the Computer Skills Questionnaire.

Alternate Hypothesis 19.1: There is a correlation between the Control and Experimental groups with reference to the score on the Computer Skills Questionnaire.

A range of statistical tests were used to analyse the data, early analysis explored the frequency and distribution patterns within the population to establish the differences and commonalities between the Experimental (e-learning) and Control (face-to-face) groups (see Appendix D). The following statistical tests were used in this thesis.

- Wilcoxon signed rank test
- Chi-Squared test
- Analysis of variance (ANOVA) and General Linear Model (GLM) multivariate analysis

- Mann-Whitney 'U' test
- Factor analysis
- Cluster analysis
- Correlation
- Spearman's correlation coefficient

An explanation of their purpose and the particular reasons for their use is given in Appendix C.

6.2 Comparison of students' demographic data

Initially, it was important to ensure that the Control and Experimental groups were comparable as far as possible to ensure the reliability/validity of the results. Further, before selecting the statistical tests to be used, the groups were tested for normal distribution. The Kolmogorov-Smirnov test for normality on all students in the study as well as the Control and Experimental groups separately was carried out and found that the groups were not normally distributed. Non-parametric tests were therefore chosen.

A total of 136 students enrolled for the course. The total number of students used for analysis was130; with 64 in the control group taking the course in a traditional face-to-face mode and 66 in the Experimental group taking the course via the e-learning mode. Students were put in either the face-to-face or e-learning group (see Section 3.4.1). All the students participating were campus based and were not given the opportunity to choose their mode of study (see Chapter 3). Two students requested a change of group during the study, a further four students failed to submit assignments, these six students were removed from the study.

6.2.1 Gender

A total of 99 females (76.2%) and 31 males (23.8%) took part in the study.

The Experimental group consisted of 66 students, 24 male and 42 female. The control group had 64 students, 7 male and 57 female.

The mean Level One academic performance across all modules for all students, males 53.9%, females 54.2% and the Level Two academic performance for, males 52.5%, females 53.9% were as expected and fell within normal bounds. The groups were thus considered equivalent before taking the course on multimedia .

Table 6.1: Comparison of attributes for e-learning and face-to-face groups.

Attribute	E-learning group (n=60)	Face-to-face group (n=64)
Gender		
Male	24 (36.4%)	7 (10.9%)
Female	42 (63.6%)	57 (89.1%)
Age		
Mean	22 years	21 years
Minimum	19 years	19 years
Maximum	37 years	41 years
Level One Academic Performance	52.7%	55.6%

6.2.2 Age

The minimum age of students in both groups was 19 years. The maximum was 37 years for the e-learning group and 41 years for the face-to-face group. The mean age was 22 years and 21 years, respectively. The groups were considered equivalent and therefore age should not impact on the results (see Table 6.1).

The majority (60%) of students in both groups were students entering university straight from school or sixth-form College (19 and 21 years). Young mature students (21-25 years) and mature students (over 25 years) were also very similar. A chi-squared test was done and this suggested that both groups could be considered equivalent (see Table 6.2); $\chi^2=0.327$, df=2, p=0.849.

6.2.3 Qualifications

Although there was a slight difference in the average performance of students in the groups it was not significant. The expected average mark for students at the University of Chester is usually considered to be in the range of 52% to 58%. This equates to a 2:2 degree classification. All average performance marks fell within this range.

The groups did show a difference when the number of points on entry to the University were examined. The face-to-face group had a greater number of students with 200/220 points on entry (32 students, 50%) compared to the e-learning group (20 students, 30%). The

e-learning group had a larger number of students with fewer points on entry. This was a result of one e-learning set comprising students taking an HND which had lower entry requirements.

Table 6.2: Age groups and distributions of students.

Face-to-face group	Standard Young mature Mature	40 (62.5%) 13 (20.3%) 11 (17.2%)
	Total	64
E-learning group	Standard Young mature Mature	40 (60.6%) 16 (24.2%) 10 (15.2%)
	Total	66

6.2.4 Experience

87 students (67%) completed a computer skills questionnaire at the beginning of the multimedia computer course (CO2250). Questionnaires were completed by 51 of the students (80%) studying by the face-to-face mode (80%) and 36 of those (55%) studying via e-learning. The questionnaire was designed by the Department of Computer Science and Information Systems to establish prior knowledge of students on business programmes of study taking computer courses at Levels One and Two.

The self-reporting survey consisted of 36 questions to assess students' understanding of computer terminology and 30 questions to assess their basic skills. Students were asked to tick the terms they understood and tasks they could perform confidently. They were also asked to rate their competence (beginner, basic user, competent user or expert). Finally, students were asked to comment on what they expected to gain from the computer course and how they were best motivated to learn. These latter items form part of the qualitative data analysis (see Chapter 7).

6.2.4.1 Computer terminology

Analysis of the questionnaires revealed that the scores for all students taking part in the study the overall mean score was 25.72 out of a possible 36 for their understanding of computer terminology. The mean scores for the groups were: face-to-face students 25.51, e-learning students 26.03. The lowest and highest scores were: face-to-face students lowest 13 (n=2), highest 36 (n=2). E-learning students lowest 9 (n=1), highest 36 (n=1).

It can be seen from Table 6.3 that a high percentage of students in both groups understood a large number of technical terms. Significantly, students did not understand the terms file server and user area. Students were required to understand these terms when creating their web pages for Assignment Two on the computer course.

The sample was not normally distributed so a non-parametric test for independent samples was carried out to identify any significant differences between the groups. The Mann-Whitney 'U' test established that there were no significant differences between the face-to-face and e-learning groups.

Frequencies of the scores were also calculated to investigate any gender differences and showed that males scored a mean of 28.7% and females 25.2% which suggests that males had a better understanding of computer terminology. However, both groups of students scored a mean of less than 50.0% for the terms file server and user area (see Table 6.3).

6.4.4.2 Basic skills

Analysis of the questionnaires revealed that the scores for the Basic skills (for all the students) were high with an overall mean of 26 out of 30. The mean for the face-to-face students was 25.97 and that for the e-learning students 26.03. The lowest and highest scores were: face-to-face students lowest 16 (n=1), highest 30 (n=11). E-learning students lowest 15 (n=1), highest 30 (n=3).

The lowest scores in the Basic skills section were in the creating and changing directories category, with less than 50.0% of all students unable to carry out these tasks. The scores for these basic tasks suggest a lack of understanding about the nature of file management, essential when building web pages and for creating and manipulating multiple file types. Although not below 50.0%, many students (66.0%) in the face-to-face group report being unable to copy files, whereas students in the e-learning group did not identify this as a weakness (86.0%). These skills were continually needed on the computer course and many of the problems reported during the later part of the course confirm this lack of skills (see Table 6.4).

Table 6.3: Computer terminology scores.

Terminology	Overall	Face-to-face group	E-learning Group	U	P	Sig
Hardware	73 (83.9%)	41 (80.4%)	32 (88.9%)	840	.291	Ns
Software	83 (95.4%)	47 (92.2%)	36 (100.0%)	846	.087	Ns
CPU	65 (28.7%)	12 (23.5%)	13 (36.1%)	802	.204	Ns
RAM	53 (60.9%)	29 (56.9%)	24 (66.7%)	828	.359	Ns
Byte	48 (55.2%)	27 (56.9%)	19 (52.8%)	880	.708	Ns
Bit	27 (31.0%)	15 (29.4%)	12 (33.3%)	882	.699	Ns
Hard Disc	76 (87.4%)	47 (92.2%)	29 (80.6%)	812	.111	Ns
Floppy disc	87 (100.0%)	51 (100.0%)	36 (100.0%)	918	1.00	Ns
Network	73 (83.9%)	45 (88.2%)	28 (77.8%)	822	.194	Ns
File Server	28 (32.2%)	13 (25.5%)	15 (41.7%)	770	.114	Ns
Terminal	43 (49.4%)	25 (49.0%)	18 (50.0%)	909	.929	Ns
User area	28 (32.2%)	15 (29.4%)	13 (36.1%)	857	.512	Ns
Directory	37 (42.5%)	19 (37.3%)	18 (50.0%)	801	.239	Ns
Program	71 (81.6%)	40 (78.4%)	31 (86.1%)	848	.365	Ns
Data	77 (88.5%)	44 (86.3%)	33 (91.7%)	869	.440	Ns
Backup	59 (67.8%)	36 (70.6%)	23 (63.9%)	857	.512	Ns
PC	79 (90.8%)	46 (90.2%)	33 (91.7%)	905	.816	Ns
VDU	31 (35.6%)	17 (33.3%)	14 (38.9%)	867	.596	Ns
Peripherals	17 (19.5%)	12 (23.5%)	5 (13.9%)	830	.267	Ns
DOS	40 (46%)	23 (45.1%)	17 (47.2%)	899	.846	Ns
WIMP	6 (6.9%)	3 (5.9%)	3 (8.3%)	896	.659	Ns
Mouse	86 (98.9%)	51 (100.0%)	35 (99.9%)	893	.234	Ns
Window	82 (94.3%)	49 (96.1%)	33 (91.7%)	878	.387	Ns
Dialogue	42 (48.3%)	23 (45.1%)	19 (52.4%)	848	.483	Ns
Icon	83 (95.4%)	48 (94.1%)	35 (97.2%)	890	.498	Ns
Menu	86 (98.9%)	51 (100.0%)	35 (97.2%)	893	.234	Ns
Button	82 (94.3%)	50 (98.0%)	32 (88.9%)	834	.073	Ns
Input/Output	56 (64.4%)	31 (60.8%)	25 (69.4%)	839	.409	Ns
Title Bar	72 (82.8%)	43 (84.3%)	29 (80.6%)	884	.650	Ns
Menu Bar	80 (89.7%)	48 (94.1%)	32 (88.9%)	870	.380	Ns
Scroll Bar	78 (89.7%)	46 (90.2%)	32 (88.9%)	906	.845	Ns
Click	87 (100.0%)	51 (100.0%)	36 (100.0%)	918	1.00	Ns
Double Click	87 (100.0%),	51 (100.0%)	36 (100.0%)	918	1.00	Ns
Drag	87 (100.0%)	51 (100.0%)	36 (100.0%)	918	1.00	Ns
File	85 (65.4%)	50 (98.0%)	35 (97.2%)	911	.803	Ns
Filename	86 (98.9%)	51 (100.0%)	35 (97.2%)	893	.234	Ns

No significant differences were found between the face-to-face and e-learning groups.

Frequencies were calculated to compare males and females and no difference between the basic skills mean score was found. However, all female students reported that they did not know how to turn the computer on or log onto and off the network.

Table 6.4: Basic skills scores for the face-to-face and e-learning groups.

Basic Skill	Overall	Face-to-face group	E-learning Group	U	P	Sig
Switch on the computer	87 (100.0%)	51 (100.0%)	36 (100.0%)	918	1.00	Ns
Log on to the network	86 (98.9%)	50 (98.0%)	36 (100.0%)	900	.401	Ns
Log off the network	86 (98.9%)	50 (98.0%)	36 (100.0%)	900	.401	Ns
Change password	66 (75.9%)	37 (72.5%)	29 (80.6%)	845	.393	Ns
Format floppy disc	50 (57.5%)	31 (60.8%)	19 (52.8%)	845	.393	Ns
Start up program	77 (88.5%)	44 (86.3%)	33 (91.7%)	869	.440	Ns
Save files to the network	77 (88.5%)	43 (84.3%)	34 (94.4%)	825	.147	Ns
Save files to disc	87 (100.0%)	51 (100.0%)	36 (100.0%)	918	1.00	Ns
Retrieve (open) files	83 (95.4%)	48 (94.1%)	35 (97.2%)	890	.498	Ns
Change drive	52 (59.8%)	30 (58.8%)	22 (61.1%)	897	.831	Ns
Create directories	19 (21.8%)	12 (23.5%)	7 (19.4%)	881	.652	Ns
Change directory	26 (29.9%)	14 (27.5%)	12 (33.3%)	864	.557	Ns
Copy files	65 (74.7%)	34 (66.7%)	31 (86.1%)	740	.041	Ns
Open a window	82 (94.3%)	49 (96.1%)	33 (91.7%)	878	.387	Ns
Close a window	82 (94.3%)	49 (96.1%)	33 (91.7%)	878	.387	Ns
Move a window	73 (83.9%)	44 (86.3%)	29 (80.6%)	866	.477	Ns
Enlarge a window	80 (92.0%)	48 (94.1%)	32 (88.9%)	870	.380	Ns
Shrink a window	78 (89.7%)	45 (88.2%)	33 (91.7%)	887	.607	Ns
Minimise a window	83 (95.4%)	49 (96.1%)	34 (94.4%)	903	.722	Ns
Maximise a window	83 (95.4%)	49 (96.1%)	34 (94.4%)	903	.722	Ns
Scroll horizontally	80 (92.0%)	48 (94.1%)	31 (88.9%)	870	.380	Ns
Scroll vertically	82 (94.3%)	49 (96.1%)	33 (91.7%)	878	.387	Ns
Switch between applications	72 (82.8%)	45 (88.2%)	27 (75.0%)	797	.110	Ns
Select text	83 (96.5%)	48 (94.1%)	35 (100.0%)	840	.146	Ns
Cut a selection	82 (94.3%)	49 (99.9%)	33 (97.1%)	809	.230	Ns
Copy a selection	85 (97.7%)	50 (99.9%)	35 (98.0%)	911	.803	Ns
Paste a selection	84 (96.6%)	59 (99.9%)	34 (94.4%)	885	.368	Ns
Print a document	86 (98.9%)	51 (100.0%)	35 (97.2%)	893	.234	Ns
Send and read email	86 (98.9%)	51 (100.0%)	35 (97.2%)	893	.234	Ns
Search on the Internet	86 (98.9%)	51 (100.0%)	35 (97.2%)	893	.234	Ns

6.2.4.3 General skills

Analysis of the questionnaires revealed that the scores for the general skills section the overall mean was 10.65 out of 16, with the mean score for face-to-face students 11 and e-learning students 10.17. The lowest and highest scores were: face-to-face students lowest 7, highest 16. E-learning students lowest 4, highest 16.

Students considered their general skills very good. They reported high competency levels in using both the keyboard and mouse, with only a small minority assessing their skills as beginner. However there was a difference in the level of computer knowledge reported by the groups with 61% of e-learning students reporting either beginner or basic levels

compared to 39% of face-to-face students. Confidence levels across the groups were similar and suggest that students were able to use computers for familiar and routine tasks (see Table 6.5).

Table 6.5: General skills scores.

General Skills	Competency	Overall	Face-to-face Group	E-learning group	Wilcoxon (2 tailed)
Keyboard skills	Beginner Basic user Competent user Expert	1 (0.8%) 28 (32.2%) 53 (60.9%) 5 (5.7%)	0 (0.0%) 13 (25.5%) 35 (68.6%) 3 (5.9%)	1 (2.8%) 15 (41.7%) 18 (50%) 2 (5.6%)	ns 0.438
Mouse skills	Beginner Basic user Competent user Expert	2 (2.3%) 12 (13.8%) 59 (67.8%) 14 (16.1%)	0 (0.0%) 6 (11.8%) 34 (66.7%) 11 (21.6%)	2 (5.6%) 6 (16.7%) 25 (69.4%) 3 (8.3%)	ns 0.25
Computer knowledge	Beginner Basic user Competent user Expert	5 (5.7%) 42 (48.3%) 38 (43.7%) 2 (2.3%)	1 (2.0%) 24 (37.5%) 25 (49%) 1 (2.0%)	4 (11.1%) 18 (50%) 13 (36.1%) 1 (2.8%)	ns 0.25
Confidence	Beginner Basic user Competent user Expert	6 (7.0%) 32 (37.2%) 44 (51.2%) 4 (4.7%)	2 (4.0%) 19 (36.1%) 27 (54%) 2 (4.0%)	4 (11.1%) 13 (36.1%) 17 (47.2%) 2 (5.6%)	ns 0.25

Figure 6.1 below shows the results discussed above in diagrammatic form.

Gender was not found to make a difference to either of the mean values. The scores for computer knowledge were the lowest for both males and females.

6.2.4.4 Total Scores

Analysis of the questionnaires revealed that the mean for the total scores were 62.4 out of 82 (76.0%). This high score would suggest that students had high computer competency levels at the start of the computer course, but that these were general skills that students would be expected to use on a regular basis throughout their studies. A more detailed survey targeted at specific terminology and skills related to the computer course may have given a more accurate profile of student knowledge and abilities. However, the survey did suggest that students did not have advanced skills as evidenced by the lack of knowledge and skills in the important area of file management. Students themselves were aware of this limitation and this is reported by the scoring of their computer knowledge as basic or beginner.

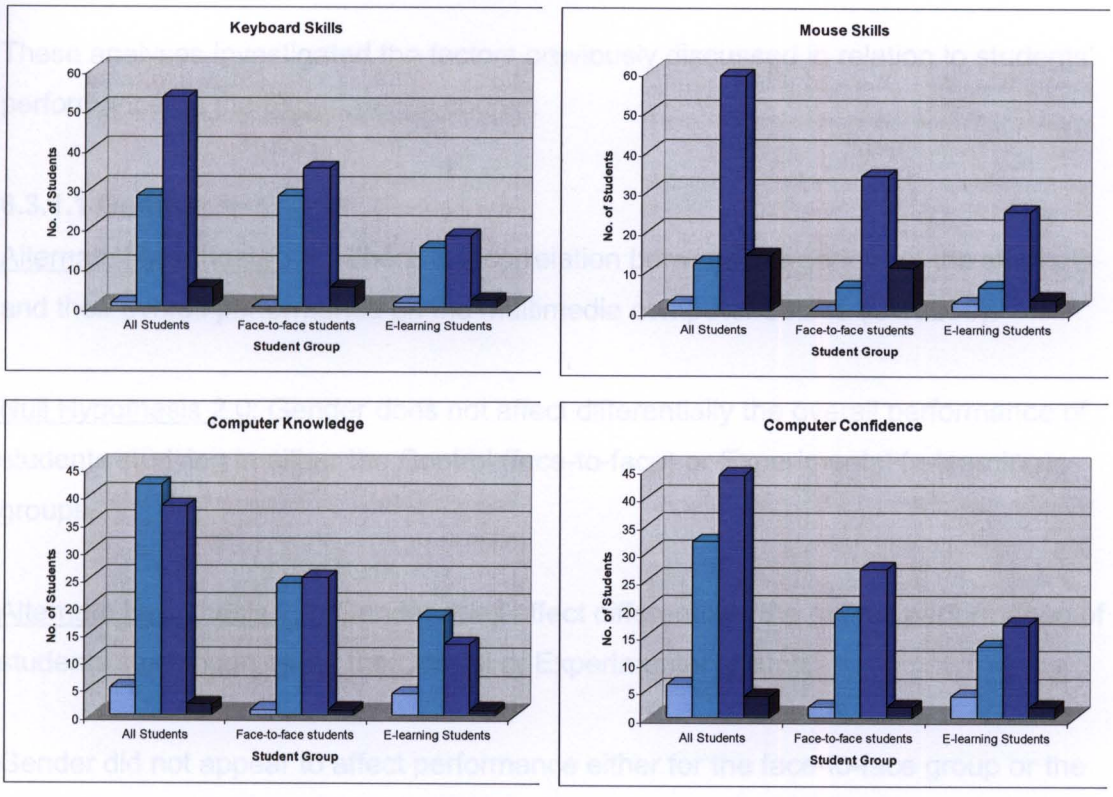


Figure 6.1: Chart of general skills scores.

6.2.5 Summary

Both groups were found to be equivalent in their distribution of gender, age, qualifications, experience and learning styles. A minor difference was found in the entry qualifications, attributable to students taking an HND rather than a BSc and only the e-learning group contained students taking an HND. This anomaly is examined further in Section 6.3.

6.3 Outcomes

The previous section established that the populations of the e-learning and face-to-face groups were comparable and could be considered equivalent for the purposes of the study. The results from the study were analysed using statistical tests appropriate for the questions being asked.

6.3.1 Results

Correlation and ANOVA statistical analyses were carried out. Correlations were used to measure how variables or rank orders are related and analysis of variance (ANOVA) was used to test the hypothesis that several means are equal.

These analyses investigated the factors previously discussed in relation to students' performance on the Experimental course.

6.3.1.1 Gender

Alternate Hypothesis 1.1: There is a correlation between the gender of the students and their overall performance on the multimedia computer course (CO2250).

Null Hypothesis 2.0: Gender does not affect differentially the overall performance of students studying in either the Control (face-to-face) or Experimental (e-learning) groups.

Alternate Hypothesis 2.1: Gender does affect differentially the overall performance of students studying in either the Control or Experimental groups.

Gender did not appear to affect performance either for the face-to-face group or the e-learning group. Although the difference in performance, particularly for Assignment One (males 45.75%, females 53.02%) was larger for the e-learning group (see Table 6.6). This difference was still not significant.

Some differences were found in the pattern of means. In the e-learning group females performed better on Assignment One than males and worse than the males in Assignment Two. This may suggest that females preferred the support of working with other students to working alone when studying online.

The face-to-face group differences are small, but show the opposite trend. Males scored slightly better than females on Assignment One and worse on Assignment Two. Overall marks showed little difference between males and females for either group.

Females were more dissatisfied with the course than males in the face-to-face group, but more satisfied in the e-learning group. The difference is not significant, but the largest difference can be seen in the End-of-Course evaluation for the face-to-face group where males were less dissatisfied than males in the e-learning group. The higher the score the more dissatisfied the students reported being with the course (see Table 6.7). There are no statistics for face-to-face students using the discussion board as this facility was only available to the e-learning group.

Table 6.6: Mean scores for the assessments.

Attribute	Mean Score	
	E-learning Group (n = 60)	Face-to-face group (n = 64)
Assignment One		
Males	45.75%	66.00%
Females	53.02%	64.96%
Assignment Two		
Males	41.08%	55.57%
Females	38.00%	57.60%
Total overall mark		
Males	42.48%	58.70%
Females	42.51%	59.81%

Table 6.7: Comparison of means for the satisfaction levels of students.

	Mean Attendance	Mean Total for Mid-Semester Questionnaire	Mean Total for End-of-Course Evaluation	Mean Discussion board Postings
Face-to-face Group				
Males	7.33	11.00	33.25	
Females	9.05	10.42	28.52	
E-learning Group				
Males	6.87	12.23	26.50	1.31
Females	7.60	12.55	28.66	1.46

There were a large number of females compared to males and this imbalance in populations may have resulted in the overall performance for students in the e-learning group being lower than that for the face-to-face group. For computer courses generally, this is not the norm. Siann and Callaghan (2001) report that women are under represented on science courses, engineering and physical sciences, mathematics and computer science. However, in some areas of science women are over represented. These subjects include biological, veterinary and medical sciences. The great majority of students involved in this study were from biological and animal behaviour courses - this may explain the observed bias.

Cook et al (2002) found that there were some gender differences in overall grade scores. The trend in UK universities is for women to outperform men, with women now gaining a greater number of 'First-Class Degrees' (HESA, 2003). Cook et al (2002) also found that this trend was reversed with an over representation of women failing in courses such as computer science.

The reasons for this imbalance could be that males have greater access to computers at home (Cook et al, 2002) and that males rate their IT skills higher than females (Lee, 2003). It can also be argued that the IT skills of males are more likely to be different in nature than those of females. Males are more likely to have experience with less formal computing activities, such as computer gaming.

The success of male students was polarized with students either performing very well or quite poorly. Only male students failed to submit assignment work. This trend was reflected in the use of the discussion board where male students were either very active, or failed to post even a minimal number of messages. This could be a result of differing communication styles of males and females.

Differences in prior computer use between males and females may no longer be as important an issue as it once was because of better general access at school and home. However, the different ways in which males and females use computers may vary and could cause differences in their ability to study online (Cook et al, 2002).

6.3.1.2 Age

Null Hypothesis 3.0: There is no correlation between the age of the students with reference to their overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 3.1: There is a correlation between the age of the students with reference to their overall performance on the multimedia computer course (CO2250).

Null Hypothesis 4.0: There is no correlation between the Control and Experimental groups with reference to the age of the students and their performance on the multimedia computer course (CO2250).

Alternate Hypothesis 4.1: There is a correlation between the Control and Experimental groups with reference to the age of the students and their performance on the multimedia computer course (CO2250).

Most students taking the multimedia computer course were young adults who were continuing their education in HE directly from schools and sixth-form colleges, with a modal age group of between 19-21 years.

There was no correlation between the age of the students and their performance for Assignment One, Assignment Two or their overall mark. This was reflected in the results from the e-learning and face-to-face groups.

Age was not found to affect students' performance significantly. This, and the fact that both groups in the study were comparable, supports the findings of Carswell et al (2000) who carried out a similar study on 300 students studying at the Open University. The literature suggests that more-mature students would prefer working online as this allows them to work at their own pace and to fit their learning around other responsibilities. Saunders and Klemming (2003) found that mature students accessed learning materials more frequently especially when family responsibilities prevented them from attending timetabled tutorials.

The literature reports conflicting views on the impact of age on learning. Hodson et al (2001) suggest that mature students are more likely to be highly independent learners and are often better motivated than their younger counterparts. Hodson et al (2001) and Rainbow and Sadler-Smith (2003) state that mature students may not have the computer skills to learn online and that the learning curve would be steeper than that for younger students who have grown up in the computer age. Rainbow and Sadler-Smith (2003) and Guernsey (1998) argue that mature students were more comfortable with e-learning as it allows them greater independence. Guernsey (1998) goes on to say that younger more tutor-dependent students reported greater difficulties with e-learning courses whilst Lovie (1996) found that age did not affect a student's ability to use and learn online. With the increase of computer technology in every aspect of peoples' lives this is likely to become less of an issue.

6.3.1.3 Performance

Null Hypothesis 5.0: There is no difference between the Control and the Experimental populations with reference to their overall academic performance on completion of their degree.

Alternate Hypothesis 5.1: There is a difference between the Control and the Experimental populations with reference to their overall academic performance on completion of their degree.

A one-way ANOVA showed that there was no difference between the face-to-face and e-learning groups with reference to their academic performance on completion of their degree. Most students gained a second-class honours award, 30% achieved a 2:1, 36% obtained a 2:2 giving a combined a total of 66% of students. This is consistent with figures published by Higher Education Statistics Agency (HESA) which show that 45% of students obtained an upper second-class honours award and 32% obtaining lower second-class degrees in 2003 (a total of 77% of students), compared to 46% and 32%, total of 78% in the previous year (HESA, 2003).

Null Hypothesis 6.0: There is no difference between the Control and Experimental groups with reference to their performance on Assignment One on the multimedia computer course (CO2250).

Alternate Hypothesis 6.1: There is a difference between the Control and Experimental groups with reference to their performance on Assignment One on the multimedia computer course (CO2250).

Null Hypothesis 7.0: There is no difference between the Control and Experimental groups with reference to their performance on Assignment Two on the multimedia computer course (CO2250).

Alternate Hypothesis 7.1: There is a difference between the Control and Experimental groups with reference to their performance on Assignment Two on the multimedia computer course (CO2250).

Null Hypothesis 8.0: There is no difference between the Control and the Experimental groups with reference to their overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 8.1: There is a difference between the Control and the Experimental groups with reference to their overall performance on the multimedia computer course.

The mode of study did affect the performance of students on all assignments with students in the e-learning group performing worse than those in the face-to-face group (see Table 6.8). Assignment One, the group presentation, shows a mean of 50.4% for the e-learning group compared to a mean of 65.1% for the face-to-face group. The means for Assignment

Two, an individual project, are 39.1% for the e-learning group and 57.4% for the face-to-face group. This results in the difference for the overall performance being 17.9%.

Other studies (Carswell et al, 2000; Saunders and Klemming, 2003) have shown that studying online does not have a significant impact on performance. However, Carswell et al (2000) do suggest that their results were inconclusive. In both studies, students were self-selecting and, as Cogburn and Zhang (2004) point out, this may be misleading as self-selecting students may have a higher level of computer competency and be more comfortable with the concept of online learning. Alternatively this may have been because, as McMahon et al (1999) found, these students already had the prerequisite access, training and time to benefit.

Table 6.8: Comparison of the performance between the groups.

	E-learning group (n=60)	Face-to-face group (n=64)
Assignment One		
Mean	50.4%	65.1%
Minimum	0.0%	38.0%
Maximum	76.0%	83.0%
Assignment Two		
Mean	39.1%	57.4%
Minimum	0.0%	0.0%
Maximum	77.0%	81.0%
Total overall performance		
Mean	42.5%	59.7%
Minimum	0.0%	14.0%
Maximum	72.0%	82.0%

The pilot study for this thesis also suggested that the impact of e-learning would result in an improvement in performance although not a large one. It could be argued that as the sample was drawn from postgraduate students, other factors could have caused this difference as all had advanced IT skills.

Null Hypothesis 9.0: There is no difference in the Experimental group in relation to their performance in Assignment One and Assignment Two on the multimedia computer course (CO2250).

Alternate Hypothesis 9.1: There is a difference in the Experimental group in relation to their performance in Assignment One and Assignment Two on the multimedia computer course (CO2250).

For Assignment One the mean performance of e-learning students was 50.4%. This compared favourably with other computer science modules at the University of Chester. Their counterparts in the face-to-face group performing better than expected (65.1%). This suggests, as Khine and Louurdusamy (2003) argue, that students found it better to work in groups online as they encouraged, motivated and learnt from each other. Fowell et al (1995) found that group work of distance learners aided the acquisition of other competencies, such as self-management and communication skills.

However, working individually for Assignment Two may have discouraged students from discussing ideas and problems amongst themselves and may have increased feelings of isolation for e-learning students a phenomenon identified as a problem by Thompson (1997), Wheeler et al (1999) and Boddy (1999).

Null Hypothesis 10.0: There is no difference between the performance of HND students studying a computer course via e-learning compare with the whole population and the Experimental group.

Null Hypothesis 10.0: There is no difference between the performance of HND students studying a multimedia computer course (CO2250) via e-learning compared with the Control and the Experimental groups.

Alternate Hypothesis 10.1: There is a difference between the performance of HND students studying a multimedia computer course (CO2250) via e-learning compared with the Control and the Experimental groups.

Null Hypothesis 11.0: There is no correlation between the academic performance at Levels One, Two and Three of students on their course of study with reference to their overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 11.1: There is a correlation between the academic performance at Levels One, Two and Three of students on their course of study with reference to their overall performance on the multimedia computer course (CO2250).

Null Hypothesis 12.0: There is no correlation between the Control and Experimental groups with their overall performance on the multimedia computer course (CO2250) and academic performance at Levels One, Two and Three on their course of study.

Alternate Hypothesis 12.1: There is a correlation between the Control and Experimental groups with their overall performance on the multimedia computer course (CO2250) and academic performance at Levels One, Two and Three on their course of study.

In the initial analysis of all participating students, HND students were found not to have skewed the overall means. HND students had been expected to affect the means because of their academic qualification on entry to university ('A' level points (160) typically 120 points lower than their undergraduate counterparts). Students who performed well overall at Levels One, Two and Three performed well on the multimedia computer course. The higher overall average at Level Three was caused by the loss of the HND students as their courses were completed after two years.

6.3.1.4 Attendance

Null Hypothesis 13.0: There is no correlation between the Control and Experimental groups with reference to attendance on the multimedia computer course (CO2250).

Alternate Hypothesis 13.1: There is a correlation between the Control and Experimental groups with reference to attendance on the multimedia computer course (CO2250).

Attendance of both groups was monitored. Students in the face-to-face group attended lectures and workshops. E-learning students were considered to have attended when they posted messages and more importantly the formative tasks to the discussion board. Although not directly comparable, this method did ensure that all students attempted the work set on a weekly basis. Attendance significantly correlated with better performance for students in both groups (see Table 6.9). The more frequently students attended the better their performance was likely to be. It was expected that attendance would significantly affect the face-to-face group, but would have less effect on the e-learning group. Given the difference in the way attendance was measured a more appropriate correlation analysis of

the e-learning group was to consider students' performance in relation to their use of the discussion board (see Section 6.3.1.5).

Table 6.9: Correlation between attendance and assignment marks.

		E-learning group (n = 42)	Face-to-face group (n = 48)
Assignment One	Spearman Correlation Coefficient	.189	.251*
Assignment Two	Spearman Correlation Coefficient	.597**	.140
Total overall	Spearman Correlation Coefficient	.586**	.190

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Students' attendance on the course significantly affected the performance of both groups of students. The more frequently they attended the better their performance. This is in agreement with a study carried out by Koshal et al (2004). There was no difference between the groups in respect of their attendance when monitored in the usual way by completion of a register.

6.3.1.5 Virtual attendance

Null Hypothesis 14.0: There is no correlation between the Experimental group with reference to their use of discussion board and their overall mark on the multimedia computer course (CO2250).

Alternate Hypothesis 14.1: There is a correlation between the Experimental group with reference to their use of discussion board and their overall mark on the multimedia computer course (CO2250).

The pattern of use of the discussion board changed during the thirteen-week course (see Figure 6.2). A high number of postings in the early Weeks (1-4) were followed by two relatively quiet weeks. There was a rise again in Weeks 6 and 7 when Assignment One (the group assignment) was due to be completed. This pattern of usage was expected as was the fall in postings from Week 8 to 10, after Assignment One had been submitted, and during the Christmas break. Another rise in the number of postings was found during Weeks 11 and 12 when Assignment Two was being completed. Overall use of the discussion board dropped during the second half of the course particularly after Assignment

Two was given out. Attendance fell during Weeks 7-10 in the face-to-face group and increased when assignments were due.

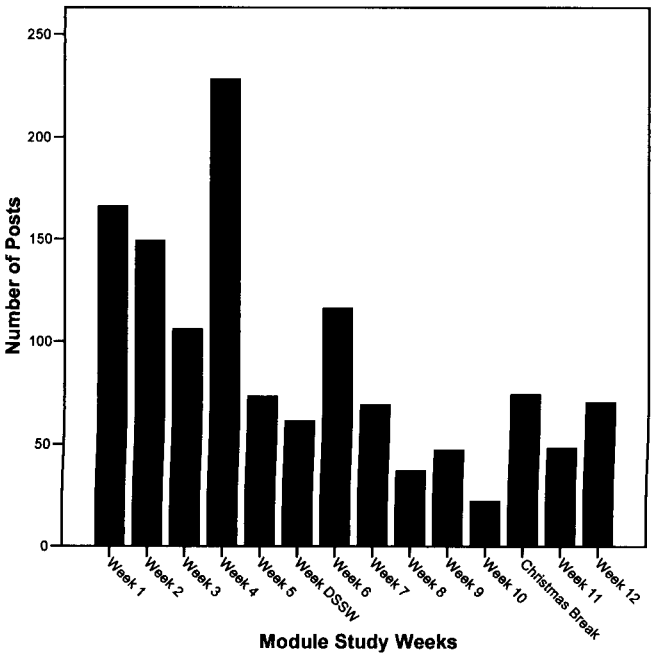


Figure 6.2: Chart showing the pattern of usage of the discussion board.

The total number of messages posted to the discussion board was calculated for the two assignment periods to establish any differences. All students from the e-learning group posted a minimum of one message during each assignment period (n=60). Table 6.10 shows the total number of messages posted up to Week 7 when Assignment One was handed in. A total of 906 messages, this is an average of 18 messages per student, were posted from Weeks 1-7. This dropped to 375 messages for Weeks 8-12, an average of 6 messages per student. It is worth noting again that performance for Assignment Two was lower than that for Assignment One.

Table 6.10: Number of postings on the discussion board relative to assignment submission.

	n
Weeks 1-7	906
Weeks 8-12 including the Christmas Break	375
Total	1281

Table 6.11 indicates that there is a significant correlation between use of the discussion board and performance and indicates that the more students used the discussion board, the higher their mark was likely to be. This explains the poorer performance of the e-learning group in Assignment Two (Table 6.11). The analysis suggests that if students had continued to make greater use of the discussion board in Weeks 8-12, this might have improved their performance.

Table 6.11: Correlation between use of discussion board with performance.

		E-learning group (n = 42)
Assignment One	Spearman Correlation Coefficient	.368**
Assignment Two	Spearman Correlation Coefficient	.535**
Total overall	Spearman Correlation Coefficient	.468**

** Correlation is significant at the 0.01 level (2-tailed).

Table 6.11 shows that greater use of the discussion board positively affected performance. One of the main reasons for the increased use of the discussion board for Assignment One was as a means of communication between group members. Students were encouraged to 'talk' to each other using the discussion board and some students made better use of this facility than others.

Eisenstadt (1999) says that a lack of computer confidence is a problem for many distance learners. This may have been a problem for students within the Experimental group as all communication was 'public'. Although the more students used the discussion board to communicate with their peers and the tutor the better was their performance.

Gender was not related to discussion board use in this study, but other studies have suggested otherwise. Lapadat (2002) writes that some researchers have reported gender differences in online interactions. Cook et al (2002) found that women made fewer postings than men. Flanagin and Waldeck (2004) are more specific and found that men contributed more and longer messages, initiate a greater number of topics and were more likely to argue.

Rovai (2001) in a graduate asynchronous forum course, found no difference in the number of postings, but a qualitative difference in type of message. The style of online messages was also found to be gender related (Lapadat, 2002). Women were more likely to offer encouragement to other participants: whereas men were more likely to be negative and critical. Women also demonstrated a higher degree of perceived classroom community.

In this study the number of discussion board postings correlated positively with performance. The more frequently the students posted messages the better they performed. Burke (1999) suggests that some students who did not participate in the online discussions felt threatened by the public and permanent nature of the online discussions in the same way that some students are intimidated by classroom discussions. Carswell et al (2000) reported large numbers of 'lurkers' in their study and Williams (2002) suggests that online discussions allow students time to reflect on the question and form an answer. Williams (2002) goes on to say that discussion boards encourage "shy and quiet students to join in as they cannot be 'talked over'". Whilst Case Study 2 did not collect quantitative data to establish the reasons for non-participation, informal comments by students at the time of the study would suggest that both of the above findings affected students on the course.

Burke (1999) found that students posted a greater number and more detailed messages as their confidence grew towards the end of the study. The reverse was found to be the case in this study when students posted messages more frequently during the first half of the course. Students at this time were unfamiliar with e-learning, were working in groups but were still fairly well motivated. The overall performance of students on the first assignment was higher than for the second when fewer messages were posted and students were working alone. They had gained confidence, but there appears to have been a drop in motivation and enthusiasm and this may explain the difference. This suggests that motivation can be improved by students working in groups. Carswell et al (2000) found that discussion board use actually encouraged greater communication between students.

6.3.1.6 Student satisfaction

Null Hypothesis 15.0: There is no correlation between the Control and Experimental groups with reference to the score on the Mid-Semester Questionnaire.

Alternate Hypothesis 15.1: There is a correlation between the Control and Experimental groups with reference to the score on the Mid-Semester Questionnaire.

Null Hypothesis 16.0: There is no correlation between the Control and Experimental groups with reference to the score on the End-of-Course evaluation questionnaire.

Alternate Hypothesis 16.1: There is a correlation between the Control and Experimental groups with reference to the score on the End-of-Course evaluation questionnaire.

The Mid-Semester Questionnaire comprised five questions which identified any early weaknesses in the course. It is a standard form used throughout the Department of Computer Science and Information Systems and asks students if they know: the aims and objectives of the course, where to find additional resources, how easy/difficult they are finding the course and if it meets their expectations. Students are also asked how many hours a week they spend working on the material outside of tutorial/workshop time. Students completed this form during Week 6 of the course.

The higher the overall score the less satisfied students are. The lowest possible total score is 5. The highest possible total score is 18. A total of 90 responses was received for this evaluation out of a possible 124. This was a 69% response rate from all the participants.

There were 48 (75%) responses from the face-to-face group with a mean total score of 10.48. The lowest score was 6 and the highest score was 16.

There were 42 (70%) responses from the e-learning group with a mean total score of 12.45. The lowest score was 7 and the highest score was 17.

There is little difference between the groups either in the response rate or their scores. This suggests that during the first few weeks e-learners were as satisfied with the course as their face-to-face counterparts. This was not the expected result as postings on the discussion board suggested that there was a higher level of dissatisfaction among the e-learning group (see Chapter 7).

Further analysis of the Mid-Semester Questionnaire reveals that more students in the e-learning group spent longer working on the course outside of tutorial/workshop time than students in the face-to-face group. Students in the face-to-face group spent three hours a week in face-to-face contact with tutors. It may be that e-learning students counted all hours spent working on the course rather than anything over 3 hours (Table 6.12).

The End-of-Course evaluation questionnaire had 17 questions relating to the course content, the assignments, the tutor and the resources. The last two questions asked students how many hours they spent working on the course and how many hours per week they spent in paid employment. Students completed this form during the two weeks immediately following the end of the study. The lower response rate was in part caused by a breakdown of technology during this period.

Table 6.12: Results for Question 5 on the Mid-Semester Questionnaire.

	E-learning group (n = 42)	Face-to-face group (n = 48)
How many hours a week do you spend working on this course outside of tutorial time?		
0-2 hours	9 (21.4%)	31 (64.6%)
3-5 hours	26 (61.9%)	13 (27.1%)
Over 5 hours	7 (16.7%)	4 (8.3%)

The higher the score, the less satisfied students were. The lowest possible total score was 17 and the highest possible total score was 52. A total of 104 responses were collected. This represented an overall response rate of 80%.

Of the face-to-face group 51 students (80%) responded to the questionnaire with a mean total score of 39.34. The lowest score was 34 and the highest score was 46.

Of the e-learning group 53 students (88%) responded to the questionnaire with a mean total score of 38.13. The lowest score was 33 and the highest score was 45.

Both the response rate and the mean for both groups are very similar. As with the Mid-Semester Questionnaire, qualitative data collected from the discussion board suggested that there was a higher level of dissatisfaction among students in the e-learning group than in the control group (see Chapter 7).

Table 6.13 shows that students in the e-learning group did not spend significantly longer working on the course than students in the face-to-face group, but as the performance of e-learners was quite poor in Assignment Two this suggests that e-learners might have had to spend longer working on the materials to achieve the same mark as students in the face-to-face group.

Students in the e-learning group also did more paid work during the course than students in the face-to-face group. This too could have an impact on their performance.

Table 6.13: Results for Questions 16 and 17 on the End-of-Course Questionnaire.

	E-learning group	Face-to-face group
How many hours a week did you spend working on this course outside of tutorial time?	(n=53)	(n=51)
0-2 hours	14 (26.4%)	14 (27.5%)
3-5 hours	29 (54.7%)	29 (56.9%)
0ver 5 hours	10 (15.2%)	8 (14.7%)
How many hours paid work a week did you do?	(n=52)	(n=50)
Not working	21 (40.0%)	17 (34.0%)
0-10 hours	7 (10.6%)	11 (22.0%)
10-20 hours	22 (42.3%)	18 (36.0%)
Over 20 hours	2 (3.8%)	4 (8.0%)

Students' satisfaction on the Mid-Semester Questionnaire does correlate with performance for face-to-face students on Assignment One. The more satisfied students were, the better they performed. This gives rise to the negative correlation in Table 6.14. Students' satisfaction within the e-learning group did not affect their performance. This would suggest that face-to-face students were affected to a greater degree than their e-learning counterparts to weaknesses in the course and its delivery.

Table 6.14: Correlation of students' satisfaction on the Mid-Semester Questionnaire and their performance.

		E-learning group (n = 60)	Face-to-face group (n = 64)
Assignment One	Spearman Correlation	.016	-.305*

The correlation identified in Table 6.14 does not continue when examined overall after the End-of-Course evaluation had been completed. There is no significant correlation between students' satisfaction and their performance for either group.

Table 6.15: Correlation between the End-of-Course Questionnaire and performance.

		E-learning group (n = 60)	Face-to-face group (n = 64)
Assignment One	Spearman Correlation	-.158	-.079
Assignment Two	Spearman Correlation	-.092	-.167
Total overall	Spearman Correlation	.029	-.184

Further analysis of specific questions on the End-of-Course evaluation did not highlight any issues that had a significant impact on the satisfaction or performance of either group of students.

Cogburn and Zhang (2004) and Oravec (2003) found no relationship between gender/mode of learning and satisfaction levels. The Mid-Semester Questionnaire for the multimedia computer course shows significant differences between the e-learning group and the face-to-face group with the e-learning group reporting lower levels of satisfaction. A reverse trend is reflected in the End-of-Course evaluation although the difference is less significant.

It could be argued that as students in the e-learning group became familiar with the learning environment, problems decreased and their levels of satisfaction increased. However, as students were working individually rather than in groups during the second half of the course they were less dependent on the learning environment and could work more independently.

Satisfaction with the tutor was high, with 22 out of 51 (43.1%) students in the face-to-face group and 26 out of 51 (49.1%) of students in the e-learning group reporting high satisfaction levels. Satisfaction with the quality of the learning materials was low, with 40 out of 51 (70.4%) students in the face-to-face group and 44 out of 53 (83.0%) students in the e-learning group reporting high levels of dissatisfaction. McMahon et al (1999) found that lack of information was one of the barriers to learning reported by students which increased dissatisfaction.

It would seem that students from both groups were unable to identify any benefit from taking the multimedia computer course. It is hoped that on reflection students will be able to

identify the benefits of taking part in the course on multimedia , particularly those in the e-learning group.

6.3.2 Factor analysis

In order to summarise and conceptualise the relationships between the variables, the data was subjected to principal component analysis (PCA). The initial PCA considered the variables relating to student demographics, performance and attendance, response to course and computer skills questionnaires (see Appendix B). Using the same variables, further principal component analyses were carried out for the face-to-face and e-learning groups. This allowed a comparison to be made between the groups and with the group as a whole. A final PCA was done for the e-learning group that included additional variables pertaining to the use of the discussion board.

6.3.2.1 Principal component analysis for all students

The PCA revealed the presence of thirty-one components with eigenvalues exceeding 1, explaining a total of 79.92% of the variance. Six components had eigenvalues exceeding .3; explaining 14.18%, 7.08%, 5.67%, 4.19%, 3.56% and 3.05% of the variance, respectively (see Table 6.16).

Component 1

Component 1 revealed a high loading of .985 for computer skills overall score. This was supported by high loadings in other variables that made up the overall score, specifically for computer confidence (.699), computer knowledge (.651), skills total (.839), terminology score (.905) and mouse skills (.669).

Component 2

Component 2 was highly loaded on the assessment for the course on multimedia : Assignment One (.565), Assignment Two (.746) and Total Overall Performance (.788). This component was also loaded highly for average attendance (.859) and average performance at Level Two (.614) suggesting that good attendance will improve performance.

Component 3

Component 3 had high loadings for the Mid-Semester Questionnaire and End-of-Course Questionnaire totals of .609 and .661 respectively. Other variables within these groups were high, notably Question 1 on the Mid-Semester Questionnaire (.626) and the End-of-Course Questionnaire Questions 10 (.533), 11 (.630), 12 (.654) and 13 (.651). High

scores on these questionnaires suggest dissatisfaction with the course throughout its duration.

Table 6.16: Principal component analysis for all students in the study.

Variables	Component					
	1	2	3	4	5	6
Academic Performance at Level Two		.614				
Assignment One performance		.565				
Assignment Two performance		.746				
Total Overall Performance		.788				
Average Attendance		.859				
Mid-Semester Questionnaire Question 1			.626			
Total for Mid-Semester Questionnaire			.609			
End-of-Course Questionnaire Question 10			.533			
End-of-Course Questionnaire Question 11			.630			
End-of-Course Questionnaire Question 12			.654			
End-of-Course Questionnaire Question 13			.651			
Total for End-of-Course Questionnaire			.661			
RAM	.628					
Byte	.533					
Bit	.569					
File Server	.517					
Terminal	.588					
User Area	.551					
Directory	.549					
Backup	.553					
PC	.502					
DOS	.571					
Input/Output	.562					
Title Bar	.525				-.552	
Menu Bar					-.531	
Scroll Bar	.561					
Terminology Score	.905					
Change Password	.536					
Format floppy disc	.525					
Create Directories	.540					
Change Directory	.531					
Copy Files	.547					
Open a Window				.601		
Close a Window				.601		
Move a Window	.530					
Enlarge a Window				.623		
Shrink a Window	.504					
Minimise a Window						.572
Maximise a Window						.572
Skills Total	.839					
Mouse Skills	.669					
Computer Knowledge	.651					
Computer Confidence	.699					
General Computer Competencies	.766					
Computer Skills Overall Score	.985					

Components 4, 5 and 6 reveal loadings on specific computer skills and understanding specific computer terms, e.g. Open a Window (.601), but not on the overall scores for computer skills.

Summary

This analysis suggests that the most highly loaded variables were those relating to computer skills and knowledge prior to participating in the study. It also suggests that attendance and performance were interrelated with a high score in one associated with a high score in the other. Lastly, levels of satisfaction would appear to be consistent during the course with high loading which suggests dissatisfaction throughout the course on multimedia .

6.3.2.2 Principal component analysis for students in the face-to-face group

The second PCA carried out included only students in the face-to-face group and revealed 29 components with eigenvalues exceeding 1, explaining 87.16% of the variance. Six components had eigenvalues exceeding .3; explaining 14.43%, 8.26%, 5.09%, 4.87%, 4.31% and 3.91% of the variance, respectively (see Table 6.17).

Table 6.17: Principal component analysis for students in the face-to-face group.

Variables	Component					
	1	2	3	4	5	6
Age of student in years		-.528				
Academic Performance at Level One		.529				
Academic Performance at Level Two		.647				
Assignment Two Performance		.632				
Total Overall Performance		.682				
Average Attendance		.674				.536
Mid-Semester Questionnaire Question 5						
End-of-Course Questionnaire Question 7		-.597				
End-of-Course Questionnaire Question 8			.507			
End-of-Course Questionnaire Question 9		.546				
End-of-Course Questionnaire Question 11		-.505				
End-of-Course Questionnaire Question 12		-.724				
End-of-Course Questionnaire Question 13		-.507				
Total for End-of-Course Questionnaire		-.548	.505			
RAM	.634					
Byte	.555					
Network	.584					

Table 6.17 (continued): Principal component analysis for students in the face-to-face group.

File Server	.524					
Terminal	.633					
User Area	.545					
Directory	.640					
Backup	.519					
VDU	.512					
DOS	.603					
Menu Bar				-.538		
Window				-.699		
Terminology Score	.911					
Change Password	.676					
Format floppy disc	.571					
Start up a program					.508	
Create Directories	.567					
Change Directory	.577					
Copy Files	.667					
Open a Window				-.669		
Close a Window				-.669		
Move a Window	.601					
Enlarge a Window					.642	
Shrink a Window	.514					
Minimise a Window				-.538		
Maximise a Window				-.538		
Scroll Horizontally						
Switch between Applications	.502					
Skills Total	.922					
Keyboard Skills			-.534			
Mouse Skills	.576					
Computer Knowledge	.610					
Computer Confidence	.593					
General Computer Competencies	.695					
Computer Skills Overall Score	.983					

Component 1

Component 1 revealed high loading for the computer skills overall score (.983) and subsets of this score: Skills Total (.922) and Terminology Score (.911). Other highly loaded scores are all variables that are components of these.

Component 2

Component 2 has high loads on Age of student in years (-.528) and Total for End-of-Course Questionnaire (.548), but with a high negative loading on assessment and attendance: Academic Performance at Level One (-.525), Academic Performance at Level Two (-.640), Assignment Two Performance (-.628), Total Overall Performance -.678 and Average Attendance (-.675). This complex component suggests that more mature students are likely

to attend less and have low levels of satisfaction. It could also suggest that their performance might be lower than that for younger students.

Components 3 and 4
Component 3 reveals high loading for a small subset of the computer skills questions: Window (-.699), Open and Close a Window (-.669). Whilst Component 4 suggests an relationship between Question 8 on the End-of-Course Questionnaire (.505) and the End-of-Course Questionnaire total (.511).

Component 5
Component 5 suggests an relationship between the Age of the student, attendance and satisfaction levels on the End-of-Course Questionnaire. It also shows that specific computer terms and skills are included in this component although not at the level of +/-.5.

Component 6
Component 6 reveals a high loading on Average Attendance (.536). Some additional relationships can be identified at a lower loading with scores on the Mid-Semester and End-of-Course questionnaires, and with a limited number of specific computer terms and skills.

Summary
This analysis main component reflects the analysis carried out for all students and reveals that the main influence on students is their computer knowledge and skills. All components that reveal high loadings on the Mid-Semester and End-of-Course questionnaires suggest high levels of dissatisfaction with the course. Attendance was found to be a relevant variable in three components and positively interrelated with attendance, gender and satisfaction. High levels of attendance are more likely to be found in younger female students.

6.3.2.3 Principal component analysis for students in the e-learning group

The third PCA of students in the e-learning group revealed 26 components with eigenvalues exceeding 1, explaining 86.79% of the variance. Seven components had eigenvalues exceeding .3, explaining 14.93%, 8.39%, 7.25%, 6.53%, 4.67%, 4.04%, 3.79% and 3.08% of the variance, respectively (see Table 6.18).

Table 6.18: Principal component analysis for students in the e-learning group.

Variables	Components						
	1	2	3	4	5	6	7
Academic Performance at Level Two		.630					
Assignment Two		.667					
Total Overall Performance		.698					
Average Attendance		.789					
Mid-Semester Questionnaire Question 1			.692				
Mid-Semester Questionnaire Question 2			.547				
Mid-Semester Questionnaire Question 3			.564				
Mid-Semester Questionnaire Question 4			.596				
Total for Mid-Semester Questionnaire			.668				
End-of-Course Questionnaire Question 7							.503
End-of-Course Questionnaire Question 10			.542				
End-of-Course Questionnaire Question 11		.572	.592				
End-of-Course Questionnaire Question 12			.520				
End-of-Course Questionnaire Question 14			.532				
Total for End-of-Course Questionnaire			.532				.554
RAM	.668						
Byte	.523						
Bit	.649						
Hard Disc	.631						
File Server	.541						
Terminal	.558						
User Area	.558						
Program	.683						
Backup	.577						
PC	.656						
VDU	.410				.514		
DOS	.511						
Input/Output	.643						
Title Bar	.679						
Menu Bar	.573				-.543		
Scroll Bar	.719						

Table 6.18 (continued): Principal component analysis for students in the e-learning group.

Terminology Score	.907						
Change Drive						-.604	
Create Directories	.506						
Open a Window				.654			
Close a Window				.654			
Enlarge a Window				.765			
Shrink a Window				.654			
Minimise a Window				.539			
Maximise a Window				.539			
Skills Total	.690			.582			
Keyboard Skills	.650						
Mouse Skills	.818						
Computer Knowledge	.727						
Computer Confidence	.820						
General Computer Competencies	.880						
Computer Skills Overall Score	.984						

Component 1

Component 1 follows the same pattern for e-learning students as it does for all students and face-to-face students with high loading on Computer Knowledge and Skills. The overall score for Terminology (.907), Mouse Skills (.818), Computer Knowledge (.727) and Computer Confidence (.820) are included in the loading for overall Computer Skills total of .984 (see Table 6.18).

Component 2

Similarly Component 2 reveals an relationship between levels of performance and attendance with high loadings on Assignment Two Performance (.667) and the Total Overall Performance (.698) together with high loadings on Average Attendance (.789).

Component 3

Component 3 revealed high loading on the Mid-Semester and End-of-Course Questionnaires. The Mid-Semester Questionnaire shows that high levels of dissatisfaction with the course relates to poor attendance. On the Mid-Semester Questionnaire, Questions One to Four and the Total Score have loadings higher than .5. The End-of-Course Questionnaire is loaded highly for the Total Score (.532) and for questions relating to the tutor and course resources.

Components 4 and 5

Components 4 and 5 are concerned with the level of computer skills and reveals positive loadings of +.5 for Skills and negative scores -.3 for Terminology.

Component 6

Component 6 reveals an relationship between the age and type of the student and their average performance at Level One, with more mature students performing better in the first year of their degree programme. Additional variables in this component include specific computer terms and skills although the loadings are a mix of positive and negative values. None of the values in this component are +/-.5.

Components 7

Finally component 7 reveals relationships between levels of satisfaction on the Mid-Semester and End-of-Course questionnaires and Honey and Mumford's Activist learning style. These values are all +/-.3.

Summary

Skills and computer knowledge are the most significant relationships in this analysis. This reflects findings in the two previous analyses. However, performance and attendance are found to be inter-related with high levels attendance resulting in better performance. Satisfaction levels for e-learning students are consistent with other analyses showing high levels of dissatisfaction throughout the course.

6.3.2.4 Principal component analysis for students in the e-learning group including discussion board data

The final PCA was carried out for students in the e-learning group, adding variables relating to the use of the discussion board. This revealed 31 components with eigenvalues exceeding 1, explaining 89.68% of the variance. Five components have eigenvalues exceeding 3, explaining 17.29%, 10.76%, 6.24%, 5.17% and 3.76% of the variance, respectively (see Table 6.19).

Table 6.19: Principal component analysis for students in the e-learning group with discussion board variables.

Variables	Components				
	1	2	3	4	5
Type of student (standard, young mature or mature)					-.520
Total Overall Performance	.526				.439
Average Attendance	.686				.447
Attendance Week 4	.505				
Attendance Week 8	.500				
Attendance Week 9	.627				
Attendance Week 10	.521				
Attendance Week 11	.546				
Mid-Semester Questionnaire Question 1			.782		
Mid-Semester Questionnaire Question 2			.607		
Mid-Semester Questionnaire Question 3			.611		
Mid-Semester Questionnaire Question 4			.640		
Total for Mid-Semester Questionnaire			.792		
End-of-Course Questionnaire Question 10			.664		
End-of-Course Questionnaire Question 11			.777		
End-of-Course Questionnaire Question 12			.634		
End-of-Course Questionnaire Question 13			.647		
Total for End-of-Course Questionnaire			.577		
RAM		.534			
Bit		.595			
Hard Disc		.587			
Terminal	.504				
Backup		.524			
PC		.584			
DOS		.519			
Icon				-.539	
Input/Output		.534			
Title Bar		.599			
Scroll Bar		.614			
Terminology Score		.785			
Start up a program					
Save Files to Network				-.526	
Retrieve (open) Files					
Create Directories	.529				
Open a Window				.634	
Close a Window				.634	
Enlarge a Window				.745	
Shrink a Window				.623	
Minimise a Window				.500	
Maximise a Window				.500	
Skills Total		.624		.627	
Keyboard Skills		.561			
Mouse Skills		.679			
Computer Knowledge		.532			
Computer Confidence		.684			
General Computer Competencies		.717			

Table 6.19 (continued): Principal component analysis for students in the e-learning group with discussion board variables.

Computer Skills Overall Score	.507	.845			
Discussion board Postings Week 1	.659				
Discussion board Postings Week 3	.731				
Discussion board Postings Week 4	.610				
Discussion board Postings Week 6	.705				
Discussion board Postings Week 8	.592				
Discussion board Postings Week 9	.605				
Discussion board Postings Week 10	.583				
Discussion board Postings Christmas Holidays	.657				
Discussion board Postings Week 11	.705				
Discussion board Postings Week 12	.637				
Average Discussion board Postings	.905				
Total Discussion board Postings	.905				
Positive Discussion board Messages	.652				
Neutral Discussion board Messages	.854				
Short Discussion board Messages (1-2 sentences +/- attachment)	.875				
Medium Discussion board Messages (2-10 sentences +/- attachment)	.679				
Discussion board Message introducing themselves					
Discussion board Message submitting formative work for tutor comments	.769				
Discussion board Message asking for help with formative tasks	.785				
Discussion board Message concerning the assignment	.751				
Discussion board Message addressing other students	.599				
Discussion board Message commenting on course	.701				
Discussion board Message that includes an emoticon	.592				
Response to Discussion board Message between 1 and 7 hours	.806				
Response to Discussion board Message between 7 and 24 hours	.760				
Response to Discussion board Message over 24 hours	.528				

Component 1

Component 1 reveals high loadings on performance, attendance, skills and knowledge and use of the discussion board. A total of 35 variables have values of over +.5 with the highest loadings of +.8 and above (average and total number of discussion board messages .905, neutral messages .854 and short messages .875, response times 1-7 hours .806) found in the discussion board variables.

Component 2

Component 2 has high positive loadings of .785 for the Terminology Score and an Overall Computer Skill score of .845 suggesting that computer skills were not an issue.

Components 3 and 4

Components 3 and 4 reveal an relationship between responses on the Mid-Semester Questionnaire and Computer Skills. Component 3 is further interrelated to a limited number of questions on the End-of-Course Questionnaire. Component 4 has a high loading for the Skills Total (-.526). High levels of dissatisfaction and high level computer skills suggest that more able students may be less tolerant of e-learning courses.

Component 5

Component 5 reveals that the Type of Student, younger students, (-.520) are likely to perform better (Total Overall Performance .439) than more mature students, with positive loading on attendance (Average Attendance .447).

Summary

The components for e-learning students on the course on multimedia are more complex when the variables for the discussion board are included, but the PCA for this group suggests that frequent use of the discussion board is related to performance. However, there is some evidence to suggest that males may not be as comfortable using discussion boards as their female peers. This is unexpected since previous research has shown that males are more likely to be confident using computer technology (Cook et al, 2002; Lee, 2003).

6.3.2.5 Conclusion

Initial analysis revealed that the most significant relationships occurred between the computer knowledge and skills scores. This was supported during the second and third analyses on students in the face-to-face and e-learning groups separately, although

previous research has shown that student skills are not a significant factor in either performance or satisfaction (Bozarth et al, 2004).

The PCA shows that there are high levels of dissatisfaction with the course, this includes students in the face-to-face group as well as students in the e-learning group. This suggests that it was the course and its relevance to the students' programme of study rather than the mode of learning as the main cause of the dissatisfaction as reported by Tricker et al (2001).

High levels of Attendance were found to be a predictor of good performance in all analyses. A positive relationship was expected between attendance and discussion board use as students were required to post a message to the discussion board in order to get an attendance mark for the week. Higher levels of attendance were more likely to be found in younger female students from the face-to-face group. Younger students also attended more regularly in the e-learning group. Saunders and Klemming (2003) found that mature students were less likely to attend because of external factors, such as family commitments or the need to work.

Inclusion of the variables relating to the use of the discussion board resulted in a change to the significant variables for e-learning students. The final PCA analysis suggests that the method of communication between student and tutor had an impact on the performance and that male students are more likely to be affected by this than females. Using the discussion board in a useful and positive way is also an important factor for success. This analysis suggests that students receiving responses within the same working day perform better (Tricker et al, 2001). Carswell et al (2000) point out that not all students find it comfortable to communicate online, whilst Rovai (2001) found that females perceived a higher degree of classroom community than males and Opt and Loffredo (2000) found that personality type affects communication.

6.3.3 Pattern of use

The discussion board was used by all students in the Experimental group (n=66) taking the computer course via e-learning. The use of the discussion board was analysed using both quantitative and qualitative methods (see Chapter 7). The messages posted by students were analysed and the following six criteria were identified: the length and tone of the message, the purpose of the message, the use of emoticons and the number and response time of replies from tutors.

Students posted a total of 1174 messages to the discussion board during the 13-week computer course.

6.3.3.1 Length of discussion board messages

The length of the discussion board messages were divided into three groups: 1-2 lines, 3-10 lines and over 10 lines. Messages may have included an attachment, but this was not taken into account when calculating the length of the message (see Table 6.20).

Table 6.20: Analysis of the length of students' messages.

	Total number of messages (n=1174)	Number of students (n=66)	Number of students posting 1 message
Short (1-2 lines)	1036 (88.25%)	63	3
Medium (3-10 lines)	103 (8.77%)	34	9
Long (over 10 lines)	35 (2.98%)	35	6

Most messages posted to the discussion board were short (88.25%) and included an attachment. These messages were usually concerned with formative tasks that students had completed. Students were required to post a message to the discussion board every week to gain an attendance mark. The maximum number of messages posted by a single student was 52.

Medium and long messages (those over two lines) accounted for 11.75% of the total messages posted by students. These usually concerned detailed issues regarding formative tasks or assignments and did not always include an attachment.

The difference between the numbers of students posting short messages and those posting medium and long messages is considerable, 95% of students posted short messages compared to 51% of students posting longer ones.

6.3.3.2 Type of discussion board message

The type of discussion board messages were divided into three groups: positive messages, negative messages and neutral messages. Positive messages included those which reported positive aspects of the course or student success. These include, for example,

messages of thanks to tutors and students, and messages where students demonstrated positive emotions on successfully completing work and overcoming problems (see Table 6.21).

Negative messages were those which reported negative aspects of the course and where problems arose with formative tasks and assignments. Neutral messages were all messages that were not either clearly positive of negative. For example "Please find attached the task for this week". The neutral category also included requests for help.

Table 6.21: Analysis of the tone of students' messages.

	Total number of messages (n=1174)	Number of students (n=66)	Number of students posting 1 message
Positive messages	103 (8.84%)	38	20
Negative messages	86 (7.32%)	31	11
Neutral messages	985 (84.01%)	65	0

Most messages posted to the discussion board were neutral and were concerned with the course and the work students were doing. Fifty percent of students posted fewer than 12 neutral messages, but a maximum of 53 neutral messages were posted by a single student.

The course questionnaires suggested that students were dissatisfied with the computer course. However, this was not evident from the number of negative messages, 7.3% of the total messages were negative and only 16 were openly critical of the course, most were from students who encountered difficulties carrying out the formative tasks.

6.3.3.3 Purpose of the discussion board messages

The messages were divided into eight sub-categories. All students were expected to post an introductory message to the discussion board during a face-to-face session designed to introduce students to the e-learning environment. Thereafter, students were expected to complete work in their own time and submit outcomes of the formative tasks to the discussion board for feedback from their tutor. Students also used the discussion board to discuss any task-related issues with their tutor. Furthermore, they used the discussion board to request help with assignments, technical issues, other course-related issues and to contact their peers (see Table 6.22).

The majority of the messages were posted as a result of students completing the formative tasks with 63 out of the 66 students posting completed work done. Forty-four students (66%) posted introductory messages during Week One and the same number requested help with formative tasks. These figures suggest that the majority of students were unwilling to use the discussion board as a means of communication. The reasons for this are discussed further in Chapter 8.

There were few messages requesting technical support. This was surprising considering the highly technical nature of the course and the 'complex' range of software and hardware that the students were expected to use.

Table 6.22: Analysis of the purpose of students' messages.

	Number of messages	Number of students (n=66)	Number of students posting 1 message
Introductory message	44 (3.74%)	44	44
Submitting formative tasks	491 (41.82%)	63	5
Requesting help with formative tasks	188 (16.01%)	44	6
Requesting help with assignments	147 (12.52%)	34	10
Requests for technical help	28 (2.38%)	11	6
Messages directed at other students	192 (16.35%)	39	9
Messages about the course generally	68 (5.79%)	37	21
Miscellaneous	31 (2.64%)	24	21

6.3.3.4 Use of emoticons

Emoticons can be used to indicate a range of feelings and some actions. They are extensively used in chat rooms and mobile phone messaging and as such should have been a familiar concept to the students. Of the 1174 messages posted by students to the discussion board only 161 contained emoticons, that is only 13.71% of the total messages. Students reported using them largely to show elation (after successfully solving a problem) or frustration (as a means of indicating to the tutor the need for support). For a minority of students emoticons were part of their style of communicating. The most prolific users of the discussion board did not use emoticons.

6.3.3.5 Tutors' responses to discussion board messages

Tutor response times were subdivided into 4 categories: less than 1 hour, between 1 and 7 hours (a working day), between 8 and 24 hours and over 24 hours. Students were advised that their tutors would check the discussion board twice daily Monday to Friday, and although some tutors might respond to messages during the evening and at weekends this could not be guaranteed (see Table 6.23).

Table 6.23: Analysis of the tutors' response to students' messages.

	Total number of responses (n=473)	Number of students (n=66)	Number of students receiving 1 message
Response less than 1 hour	172 (36.36%)	45	8
Response 1 – 7 hours	99 (20.93%)	39	14
Response 8 – 24 hours	104 (21.98%)	39	14
Response over 24 hours	98 (20.71%)	42	13

Some 79% of responses were posted to the discussion board within 24 hours, with 57.29% replied to within the same working day. The remaining 21% were posted during evenings, weekends and over the Christmas break. Tutors often read several messages from different students and then replied in a single longer message. The limited number of responses from tutors may have discouraged students use of the discussion board although individual tutors developed their own style and some replied to the discussion board more than others. This summary suggested that all tutors responded equally and this was not the case. All students that requested help received a response from their tutor.

6.3.3.6 Summary

In conclusion the greatest numbers of messages were short, neutral and used as a means of submitting formative work. There is some evidence to indicate that students were experiencing difficulty completing the work for the course. Students in the face-to-face groups had similar difficulties during class sessions. However, the limited number of messages asking for help during weeks 8-12 was markedly compared to Weeks 1-7. The reasons for this are discussed in Chapter 8.

6.3.4 Learning styles

Null Hypothesis 17.0: There is no correlation between students' dominant learning style with reference and overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 17.1: There is a correlation between students' dominant learning style with reference and overall performance on the multimedia computer course (CO2250).

Null Hypothesis 18.0: There is no correlation between the Control and the Experimental groups with reference to learning style and overall performance on the multimedia computer course (CO2250).

Alternate Hypothesis 18.1: There is a correlation between the Control and the Experimental groups with reference to learning style and overall performance on the multimedia computer course (CO2250).

Table 6.24 shows that both groups of students show a similar pattern in the LSQ profile. The largest difference between the profiles can be seen for reflective learners in the Experimental group. Thirty percent of the group reported having a strong or very strong preference for the reflective learning style whereas in the control group this figure is 5%. Fewer students reported strong preferences for the theorist or pragmatist learning styles.

Table 6.24: Comparison of the learning styles scores on Honey and Mumford's LSQ between e-learning and face-to-face groups.

	E-learning group (n=60)	Face-to-face group (n=64)
Activists		
Very low preference	6 (9%)	8 (13%)
Low preference	16 (24%)	15 (23%)
Moderate preference	24 (36%)	22 (34%)
Strong preference	12 (18%)	5 (8%)
Very strong preference	6 (9%)	9 (14%)
Reflective		
Very low preference	13 (20%)	14 (22%)
Low preference	16 (24%)	18 (28%)
Moderate preference	15 (23%)	13 (20%)
Strong preference	16 (24%)	11 (17%)
Very strong preference	4 (6%)	3 (5%)
Theorist		
Very low preference	32 (49%)	33 (52%)
Low preference	17 (26%)	14 (22%)
Moderate preference	13 (20%)	9 (14%)
Strong preference	1 (1.5%)	1 (2%)
Very strong preference	1 (1.5%)	2 (3%)
Pragmatist		
Very low preference	43 (65%)	40 (63%)

Low preference	6 (9%)	17 (27%)
Moderate preference	13 (20%)	2 (3%)
Strong preference	2 (3%)	0
Very strong preference	0	0

The overall performance of students in the Control group was not affected by their learning style. The marks for Assignment One show that students who scored highly for the Reflective learning style achieved lower marks (Table 6.25). In comparison, students scoring highly for the Theorist learning style achieved higher marks at better than the <0.05 significance level.

Table 6.25: Correlation between the face-to-face group performance and learning styles scores on Honey and Mumford's LSQ.

		Activist	Reflective	Theorist	Pragmatist
Assignment One performance	Spearman Correlation	.070	-.247*	.206	.145
Assignment Two performance	Spearman Correlation	.003	.041	.022	.069
Total Overall performance	Spearman Correlation	.003	-.087	.098	.129

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 6.26 shows the relation of the performance of students in the Experimental group to their learning style. There is a negative correlation with students who scored highly for the Activist learning style. They did less well in assignments although this was not significant. Students who scored highly for the Reflective learning style performed better in Assignment Two and overall. The most significant correlation is for the Theorist learning style. Where students had a stronger preference for this learning style they performed better. This pattern of significance is different from the Control group and suggests that students with particular learning style profiles may perform better than others.

Students' use of the discussion board is significant for all learning styles except the Activist learning style. Students scoring highly for the Reflective, Theorist and Pragmatist learning styles used the discussion board more, with the most significant of these being Reflective learners (see Table 6.27).

The dominant learning style of the students' did not have an impact on the performance of students in either the face-to-face or the e-learning groups although high scoring reflective

learners and theorists did correlate with better performance within the e-learning group. This agrees in part agree with Carswell et al (2000) who found that learning styles did not have an impact on students' performance. However, they did find that there was a greater number of 'theorists' than other learning styles choosing to take the course. This may suggest that theorists are more likely to self-select onto e-learning courses and this may be because e-learning suits the 'theorists' better than other learning styles although there is no evidence to suggest this in the study cited.

Table 6.26: Correlation between the e-learning group performance and Honey and Mumford's LSQ scores.

		Activist	Reflective	Theorist	Pragmatist
Assignment One performance	Spearman Correlation	-.246	.110	.356**	.209
Assignment Two performance	Spearman Correlation	-.184	.276*	.278*	.093
Total Overall performance	Spearman Correlation	-.230	.280*	.355**	.159

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 6.27: Correlation between the discussion board postings and Honey and Mumford's LSQ scores.

		Activist	Reflective	Theorist	Pragmatist
Total discussion board postings	Spearman Correlation	-.158	.351**	.330**	.288*
Average discussion board postings	Spearman Correlation	-.158	.351**	.330**	.288*

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

In their analysis of sequential and global learning styles Sabry and Baldwin (2003) found that sequential learners showed a higher tendency towards learning online. This could suggest that despite all the work that has been done to produce learning materials by topic rather than in a linear way, students follow the conventional sequential pattern of learning. However, this conclusion may not have generality as Sonnenwald and Li (2003) found the competitive learning style more successful.

Broad et al (2004) highlights a debate in the literature as to what should be taken into account when developing learning resources to support learning styles. Whitefield (1995) argued that there should be a match of learning approach to the learning style of the student. However, Hayes and Allinson (1996) advocate a "deliberate mismatch between educational approaches and learning styles to encourage students to increase their repertoire of learning strategies".

Thus, there seems to be no clear evidence to suggest that any particular learning style is better supported by e-learning although there may be a case that students showing certain learning style preferences, pragmatist and theorist, were more likely to choose to study online. In the study carried out for this thesis there were a greater number of pragmatist males than females although the number of males taking part in the study was limited (females, n=99, males, n=31).

There were significantly more activist learners and this may have had an impact on the study, although initial analysis would suggest that it did not.

6.4 Conclusion

Early analysis of the students in the study revealed that there were no significant differences between students in the Control (face-to-face) group and those in the Experimental (e-learning) group. The majority of students in both groups were female and following degree programmes related to Biology.

The results reported in this chapter reveal a complex picture with no definitive reason being found that can account for the difference in performance of the e-learning and face-to-face groups, with face-to-face students gaining higher marks than e-learning students. The difference would have been greater without intervention in the form of additional face-to-face sessions for the e-learning group before each assessment deadline.

The students' demographic data did not reveal any attributes that could have negatively impacted on the performance of students in the Experimental group. Age, type of student, miles travelled to University and the number of points on entry to University were all discounted. Academic performance at Level One was found to be an indicator of performance for all students.

However, the statistical analysis did reveal that the use of the discussion board had a significant impact on students' performance. This is further emphasised by students in the e-learning performing better for Assignment One (which was group work) than for Assignment Two (an individual component). The nature of Assignment One encouraged the use of the discussion board.

E-learning students scored slightly higher on the Computer Skills questionnaire but the difference was not significant. Many students understood the terminology and could carry out most of the tasks. However, few students considered themselves expert computer users.

Students in both groups reported high levels of dissatisfaction with the course and were particularly dissatisfied with the materials. However, they seemed to be satisfied with the help and support given by tutors. Students in the e-learning group worked longer on the course than students in the face-to-face group.

On reflection the tools used to collect some of the quantitative data could have been improved by updating the standard forms used to reflect the different nature of e-learning.

Chapter 7 reports the qualitative data analysis results and suggests other issues not revealed in the statistical analysis.

Chapter 7: Analysis of qualitative data

7.1 Introduction

The results from the analysis of the quantitative data did not identify any single factor or combination of factors that could explain the significant difference in the marks attained by students in the Control group compared to those in the Experimental group. These statistics included demographic data and data collected during the study. However, statistical analysis did suggest that the greater the number of discussion board messages posted by students in the Experimental group the higher their mark was likely to be. This suggests that further insights might be gained from analysis of the qualitative data that was collected.

The qualitative data that was collected included comments from the Mid-Semester and End-of-Course questionnaires (see Appendix B). These were analysed for issues arising from Case Study 2 from both the face-to-face and e-learning groups. The process of coding followed the mechanism suggested by Coffey and Atkinson (1996) (see Section 3.4.5). Four students from each group were interviewed to gain a more detailed insight into the issues arising from the course. Examples of the comments from the questionnaires and a sample of an interview transcript are presented in Appendix E. Additionally, the discussion board used during the study was analysed qualitatively. These results were then collated into a table, a sample of which is given seen in Appendix F. Several issues common to both groups were found, and are discussed below. These include the relevance of the course to students and their programme of study, their motivation and preferred method of working.

During the early stages of this study data was only collected from the students. However the literature and significant issues that arose during the case studies suggested that tutors' skills, experience and attitudes should be considered in relation to the qualitative data collected from the students. Therefore, tutors' responses to issues arising from the study and how these influenced the delivery of the computer course and the students were considered in the light of the analysis of the above. A sample of the responses from tutors is shown in Appendix E1.

7.2 Research questions

The research questions addressed issues were not entirely satisfied using statistical methods and can broadly be grouped into the three main themes being addressed in this study:

- Tutor-related issues, including the production of course materials, communication and speed of response.
- Technological issues, including ease of use and problems with the technology.
- Student issues, including computer skills, relevance of the course to the student, levels of motivation, student expectations and the ability of students as independent learners.

The initial questions were refined during the analysis of the qualitative data to the final versions below.

Question 1: Did the content of the course and quality of teaching materials influence students' participation?

Question 2: How did students communicate with their tutors and other students?

Question 3: What technical issues limited students' participation?

Question 4: What did students expect to gain from the course?

Question 5: Were students satisfied with the tutors' speed of response to issues that arose during the course?

Question 6: Was the online learning environment easy to use and were any issues highlighted as potential barriers to learning?

Question 7: Were students independent learners and how did this affect their ability to work online?

Question 8: How did the motivation of students affect their participation on the computer course?

Question 9: Was the computer course relevant to students and their programme of study?

Question 10: Was students' performance affected by their lack of computer skills and how did participation on the computer course affect students' level of computer skill?

7.3 Course content

Question 1: Did the content of the course and quality of teaching materials influence students' participation?

E-learning students were expected to view the lecture slides covering the theoretical element of the work, then carry out practical tasks to put this theory into practice and gain formative feedback from the tutor before using these skills for the submission of assignments. E-learning students carried out the work in their own time, posting work to the discussion board as they felt the need. Students in the face-to-face group attended lectures and practical tutorials linking theory to practice receiving feedback from tutors during classroom sessions.

Students in both groups commented on the high quality of materials produced during the course. They agreed that the theory linked to the practical tasks and assessments. The step-by step instructions were seen as useful since computing was not their main area of study. The majority of the students were following programmes in Biological Sciences.

Two issues were found to be important in the participation of students in both groups:

a. Some steps were missing from the practical exercises making them impossible to complete without guidance from a tutor. This was particularly noticeable from comments on the evaluation forms posted by e-learning students. Further evidence of this is found on the discussion board with tutors posting messages with additional instructions and clarification. Face-to-face students reported the same problem during interviews.

b. Step by step practical exercises in early weeks of the course were replaced by instructions given as a series of PowerPoint slides with general instructions on what students were expected to produce. This change of style suited some students better than others.

An example of the above issues occurred in Week 2 when students were required to edit a picture. Step-by-step instructions, in Word/Web page format, were given for this exercise which suited students, but a change in the version of software used meant that students could not find the appropriate colour palette. Tutors posted additional instructions to the discussion board and demonstrated the missing step in face-to-face classes.

Later in the course the students were asked to create and upload a web site. A series of PowerPoint slides showed students how to add pictures, links and tables during the creation of web pages. This change in format and the lack of step-by-step instructions highlights a point made by Salmon (2002) who suggests that there needs to be a balance between too much structure and too little when tasks are created. This is evidenced from a comment by an e-learning student: "Most of the practical tasks were interesting and fun to do, but the ones towards the end were far too complicated and not structured well enough for people who have never used these packages before, e.g. creating web pages".

In contrast one student in the e-learning group completed all the web-page work without help and with no prior knowledge of web-page construction (see below).

Tutor: "Your pages look fine, thanks. Can you tell me how much you have done on web page creation before this course? "
E-learning student: "None I just followed the instructions given in Weeks 6 and 7."

The content was one of the issues that did influence the participation of e-learning students and this can be seen from an analysis of the discussion board. Early exercises were completed (although with difficulty) and posted to the discussion board. Later exercises were often incomplete or missing entirely. It may take students longer to carry out tasks independently via e-learning than in conventional classes as the problem-solving aspect takes longer without support from a tutor.

The issues discussed above were not the only barrier to participation for e-learning students who reported that the number of different media they were expected to produce each week became overwhelming. One student in the e-learning group said: "Too much and too many elements were required; more time should have been spent on fewer elements e.g. web page creation should have been left out".

However, the nature of multimedia means that students were expected to create images, sounds, text and video as well as present them as a coherent product suitable for an audience to view. Many students found this range of tasks particularly intimidating in a thirteen-week course.

The assessments were considered to be a fair reflection of the course content. Assignment One was a group project, each group producing a PowerPoint presentation with multimedia elements. Students in both groups reported that it was the same experience as they had

with other courses. This included students in the e-learning group who used the discussion board as their means of communication during the early stages of the assignment. Evidence from the discussion board and interviews suggests that students from the e-learning group met to finalise details and collate their work before submission.

Tutors allocated students to groups for Assignment One instead of allowing students to choose their own assignment working groups. During interviews students from both groups said that they would have preferred to choose their own groups. Further, e-learning students said they would have chosen other students who were actively using the discussion board.

Assignment Two was an individual assignment. Students created a web site including multimedia elements where appropriate and wrote a very short reflective essay. There is little qualitative evidence to suggest any difference between the groups although the statistical evidence has already shown that face-to-face students performed much better on Assignment Two than their e-learning counter-parts. All except one of the students that were interviewed stated that they would be unable to repeat Assignment Two on their own.

Tutors found the marking of assignments to be laborious. Detailed marking guidelines and criteria were refined using the discussion board and agreed by the team. However, during marking the differing teaching styles caused conflict. Two tutors preferred to mark holistically, giving an overall mark, which could not easily be broken down into the required component marks. This caused additional work for tutors when assignments were second marked and the marks compared for consistency across all tutors and both groups of students.

7.4 Communication

Question 2: How did students communicate with tutors and other students?

Face-to-face students spoke to tutors in class and rarely contacted tutors outside timetabled sessions except for the two days before assignments were due when tutors and support staff were contacted for help with assignments.

E-learning students used the online discussion board. Each student was assigned to a tutor group which had a tutor-group board. This facilitated communication in a similar way to that in a classroom. In addition, the café board allowed for social interaction between students in

all e-learning tutor groups. Finally, there was a public discussion open to all e-learning students and tutors that allowed common issues to be addressed. Interaction between students and tutors and other students varied between tutor groups, but some patterns of use were consistent and many of the issues were common to all tutor groups.

All tutors of e-learning students received emails from students requesting one-to-one help with problems, with two or three students from each set receiving additional face-to-face support. Further investigation of this revealed that these students did not attend the face-to-face tutorial in the first week which may have caused difficulties with adjusting to the e-learning environment.

Students in both the face-to-face and the e-learning groups identified the lack of support from tutors as an issue. Students from the face-to-face group reported that tutors spent too much time with the less-able students. This meant other students had to wait up to 45 minutes in a two-hour class for help, but were assured of some support from the tutor during that period. They were also able to discuss problems with their peers.

E-learning students reported that the response time for tutors answering queries on the discussion board was too slow, particularly when there was a problem preventing students from completing work. This would suggest that when students from either the face-to-face or the e-learning group encountered problems they needed immediate support if they were not to become frustrated and de-motivated. This was particularly important for e-learning students who were not interacting with their peers (see Section 7.6).

The e-learning students suggested that using timetabled chat room sessions for problem solving would have improved their experience. Only two students found the discussion board difficult to use; the remainder reported that they found it easy to use, but not a good means of communication for group work.

Tutors' responses to messages were mixed. Students criticised one tutor for posting poor quality messages on the discussion board, whilst another was criticised for the 'long winded and confusing explanations'. All tutors were praised for the support they offered students on an individual basis by email and the occasional face-to-face tutorial when students had severe problems.

Tutors' responses to messages posted on the discussion board varied from a quick thanks for all the hard work to regular feedback with comments, good and bad, confirming that the

tutor had definitely looked at the submitted work in detail. It could be seen that one tutor would work with a student online, in a type of 'chat' session until the problem was resolved. Students especially appreciated this aspect of support, which again suggests the need for synchronous communication to aid problem solving.

Peer communication in face-to-face groups took place during timetabled sessions and subsequently in University canteens and bars. E-learning students did not communicate with their peers unless actively encouraged to do so, for example during the group assignment. There was one exception, when a student was hospitalised during the course and effectively used the discussion board to contact both tutors and students about the work and her progress. This student later reported to the tutor in an email that she felt studying online had been an advantage to her during this time, minimising feelings of isolation. Students in the face-to-face and e-learning groups found communicating with their peers difficult for the group assignment as students were not allowed to choose the groups. There is an argument that in a work environment teams do not self select and it was anticipated that e-learners would find choosing their own groups difficult. With hindsight it may have benefited the e-learners to choose to work with other students who were prepared to work as enthusiastically online.

Most messages posted to the discussion board on the tutor group threads were short (less than 5 lines) and included the submission of the formative weekly exercises. Approximately 33% of students asked for help during the course and continued to post messages until the course ended.

Students in the e-learning group voiced their dissatisfaction with the course on the discussion board, but not directly to their tutor. Fifteen (out of a possible sixty students) posted one or more messages complaining on the café board, where the emphasis was on student-to-student communication rather than student-to-tutor communication. This board was designed for social interaction and to allow student representatives to contact students about course issues. It was created to be a space where tutors did not post messages and was to be moderated by student representatives. Unfortunately, a tutor posted a response to a criticism made by a student early in the course. This reduced the effectiveness of what should have been a relatively 'private' discussion space for students. Online socialisation as identified by Salmon (2002) did not take place as a result. This could have alleviated some of the frustrations felt by students and made them more 'comfortable' using the e-learning environment.

Nine students posted comments to the public discussion. This, in part, confirms the findings of Hughes et al. (2002) that e-learning students felt more anonymous and uninhibited. Face-to-face students did not voice any dissatisfaction to their tutors although they may have done so in private.

7.5 Technology

Question 3: What technical issues limited students' participation?

E-learning students only reported minor problems with hardware and software. For example web cams needed during Week 2 were only available in the Department of Computer Science and Information Systems. Based on the feedback from the students who were interviewed and messages posted to the discussion board, it is suggested that, at the time of the study, the number of students with easy access to a computer linked to the Internet at home was limited. Irons et al (2002) found that lack of access to suitable technology affected the satisfaction of students. This is exemplified by the following comments from students in the e-learning group: "I have several kids and a computer in the living room where I did most of this work". And "due to not having Internet access at home it means lots of treks down to campus, but as I make enough of them anyway, that shouldn't be a problem".

During the study the university intranet system was shut down for urgent maintenance work. This caused several messages of complaint to be posted to the discussion board. Face-to-face students were unaffected by this. In reality although both groups were affected by the loss of service, only students in the e-learning group complained. This may have been because the e-learning students were more likely to work on the course during the weekend or that the issue was highly visible to e-learners who were being encouraged to visit the discussion board frequently.

The face-to-face students also had minor problems with hardware and software. Tutors identified a problem with the settings for Microsoft Sound Recorder within the Department of Computer Science and Information Systems and ClipArt was unavailable to students working in face-to-face groups.

Both groups had particular problems using software to zip files. There were two reasons for this: understanding the reasons for the technique, to compress files, and to allow more than one file to be sent via the IBIS electronic assignment submission system. Students were

expected to use WinZip to overcome a limitation of the system. IBIS allowed only one file to be submitted at a time. Web sites necessarily contain several files of different types which can include large image files. These had to be compressed and submitted in one file. The technical issues had to be resolved centrally by the IBIS development team. The problem of using zip software by students was largely a file management issue, one which many non-computing students found difficult to master.

7.6 Expectations

Question 4: What did students expect to gain from the course?

Students expected to learn useful and transferable skills. They expected more practical than theoretical learning to take place. However, during the interviews students confirmed that their expectations of the computer course were the same as for other courses, that is, to gain practical skills that have an appropriate theoretical underpinning.

Students expected tutors to give appropriate and timely support and guidance. This is not to say that students always expected tutors to answer messages immediately, but that the timing of response should reflect the urgency or type of response required (see Section 7.4).

Tutors' expectations were for students to participate in classroom and online discussions in both tutor-student and student-student interaction. Peer support was noticeably absent from the discussion board, with only a single posting from one student to help another. This confirms the earlier point that students would only use the discussion board to interact with the tutor to discuss their own work and any problems that they encountered (see Section 7.3).

7.7 Responsiveness

Question 5: Were students satisfied with speed of response to issues that arose during the course?

Students in both the face-to-face and e-learning groups reported that they did not get enough support. Face-to-face students reported that the groups were too large and the abilities of the students too mixed for one tutor to effectively support the group.

The e-learning students were satisfied with a slow response for feedback when they had

posted completed work. However, they were dissatisfied with the speed of response when they had a problem with either the formative exercises or the assignments.

Students were satisfied that tutors produced additional materials as they were needed, in time for the tasks to be carried out. The face-to-face students received additional material about the structure of the Computer-Science network, whilst the e-learning students received additional tutorials on how to create PowerPoint slideshows for students who had not used this software before. The course web site also contained links to other useful sites. *The face-to-face students did not report a lack of resources.*

The e-learning students appreciated working at their own pace, contacting the tutor when a problem occurred. However, the face-to-face students felt that the lack of tutor support in class held them up. "It is now Week 3 yet we haven't been given any feedback on last week's task. It would be nice to know if we are on the right track before we begin this week's work".

If e-learning students were concerned about work posted to the discussion board they either posted a second message asking for a response or more usually did not start the next exercise.

7.8 Ease of use

Question 6: Was the online learning environment easy to use and were any issues highlighted as potential barriers to learning?

Only students in the Experimental group had access to the online learning resources. The resources included a web site with links to practical exercises, lectures and further resources. The virtual learning environment also included software downloads and use of a discussion board as the main means of communicating with tutors and other students taking the course. The web site was accessed via IBIS using unique usernames and passwords for each e-learning student to ensure that students in the Control group did not have access to these resources.

Students in the Control group received printed hand-outs of practical exercises and lecture notes. Any electronic resources needed to complete the practical exercises were accessed via a public storage area on the computer system.

Both groups of students reported finding and using resources easy. Materials were located quickly and labelled on a week-by-week basis, e.g. all the materials for Week 1 could be found either from links on the web page for Week 1 or in a folder named Week 1. Only one student reported difficulty in finding materials on the e-learning web site saying, "with this course I feel a constant pressure to go looking for bits of the course that have been posted somewhere, on some or other thread on the discussion board" (see Appendix E).

Publishing materials on a topic by topic basis had been considered by the tutors during the course design. This would have alleviated the problem reported above, but in order to ensure comparability between the Experimental and Control groups it was decided to mirror the Control group's week-by-week format.

Both groups used the IBIS electronic hand-in system to submit their assignments. This allowed all assignments to be anonymously marked by tutors, thereby ensuring that marking was consistent. E-learning students commented positively on the ease of using the IBIS electronic assignment submission system and the free downloadable software, although a minor concern was raised about the reliability of the electronic system by students and tutors. The IBIS electronic assignment submission system proved to be robust and reliable, the only criticism being that students could only attach one file to each submission thus requiring students to create a zip file of their assignments (see Section 7.2).

Students in the Control group found the resources easy to find despite the lack of consistency in file types and naming conventions caused by tutors' different styles of presentation. Only one student in the face-to-face group reported finding the multiple file types confusing. E-learning students followed links on web pages to these files and this simplified the issues as the inconsistency was largely 'invisible' to students.

7.9 Learning independence

Question 7: Were students independent learners and how did this affect their ability to work online?

Independent learners have the motivation, knowledge and skills needed to make responsible decisions and take actions dealing with their own learning. Dependent learners do best when they can rely on an expert teacher to organise what and when they should learn (Biggs, 1999).

The independent learners, as defined by Biggs (1999), who took part in the study, preferred the flexibility of the e-learning method as this allowed them to work at their own pace. In face-to-face classes independent learners felt restricted and unable to progress.

The dependent learners, as defined by Biggs (1999), who took part in the study, preferred the support of face-to-face classes with tasks broken down into small sections with regular tutor feedback from tutors. Dependent learners did less well working online. Without constant online support from tutors these students quickly became de-motivated. In this case the dependent learners from the e-learning group (where the tutor used the discussion board during timetabled sessions) benefited from this almost synchronous support.

The web-page exercises demonstrated the level of independence well. Independent learners were able to work through the material and find information as they required it. Dependent learners preferred the step-by-step instructions used during the early part of the course.

7.10 Motivation

Question 8: How did the motivation of students affect their participation on the computer course?

Motivation was an issue with many students. Levels of motivation were measured by monitoring: attendance, the frequency and content of discussion board messages and self-reporting by students.

Analysis of the discussion board in particular reveals that students reported that a lack of motivation would be a problem during an exercise in the first week. More males than females reported that lack of motivation was likely to have an impact on their participation and performance on the course. One e-learning student said, "I have major problems with motivation so this e-learning course is going to be a challenge!! I'll be dragging myself out of bed to do some work. It's going to be difficult!" Whilst another said, "I'm lazy" and "find it hard to get out of bed".

Motivation levels changed for both groups of students during the course. At the beginning of the computer course students worked and completed the necessary tasks each week. However, after completing the first assignment, motivation levels fell. This can be seen by a fall in attendance levels of students in the face-to-face group and the already reported fall in

discussion board use by students in the e-learning group. Students in both groups were less likely to complete tasks in their own time. This may have been due to the large number of practical tasks expected during the early weeks whilst students were still learning how to use the e-learning system. Salmon (2002) suggests ensuring that early tasks can be easily achieved.

Motivation in the face-to-face group went up when Assignment Two was due. Students of all abilities worked in the Department of Computer Science and Information Systems on assignments in their own time and contacted tutors and support staff for help. Although there was a rise in the number of discussion board messages during the same period they tended to be from students who had used the discussion board throughout the course.

To work successfully online, students and tutors need to be sufficiently motivated to spend time and effort and to keep returning to take part (Salmon, 2002).

7.11 Course relevance

Question 9: Is the computer course relevant to students and their programme of study?

The generic nature of the course and the diversity of the programmes being taken by the students made it difficult to ensure that this course related closely to their main subject.

Students in both groups did not consider the course relevant to their degree programme. However, the interviews with students did suggest that they understood the importance of computer skills in a wider context. This is a key factor in the initial motivation level of the students who generally were not interested in computers, using them only when they were required to for their studies. They were not interested in learning new skills especially when they view the specific skills as irrelevant.

More specifically, students did not believe that multimedia skills were necessary in either of the above contexts. Although it is true that many of the skills learnt may not have been useful to them during their university careers many of the individual elements might be required once they leave university.

Many students taking the course were studying animal behaviour. These students did not feel that learning about digital video was relevant for their course or their possible future

careers despite the fact that animal behaviour is largely monitored and analysed using digital-video technology.

7.12 Computer skills

Question 10: Was students' performance affected by their lack of computer skills and how did participation on the computer course affect students' level of computer skill?

Students in both groups had a range of computer skills from beginner to expert, with most students reporting themselves as intermediate-level users. The main criticism from students in the face-to-face group was the different ability levels within the group as this caused a problem for tutorial support. Tutors gave more support to the less-able students than the more-able ones. E-learners did not seem to be affected by the differing abilities of students in their tutor group. Tutorial support relied on messages posted to the discussion board. Messages were read by the tutor and responded to as necessary.

Students with advanced skills and those who had taken a computer course at Level One found that some work was repeated; they already had the necessary skills to create PowerPoint slideshows and web pages. It was necessary to ensure that the less-able students had the same opportunity to achieve high marks. This was less of a problem for e-learners who were able to complete simple tasks quickly and saved time by not having to sit in a class waiting for slower students to 'catch up'.

The range of skills students had before taking the course were almost entirely limited to use of the Internet, email, Microsoft Word, PowerPoint and SPSS. No students reported having multimedia skills and only a limited number had built web pages at Level One. This would support the point made by Salmon (2002) that tutors should not be complacent about entry level skills to online learning as many students can still be considered novice computer users. This range of skills suggests that for this course most students could be considered novices. Basic skills such as file management and an understanding of different file types were new to most students, but are critical to successful multimedia work.

Students in the face-to-face and e-learning groups reported that their computer skills had improved as a result of taking the course. Although, most students believe that they would not be able to repeat Assignment Two. As with many practical skills, students reported that they would learn skills on the computer course as they used the computer, but forget them when the same skills are not used regularly.

Computer skills were also an issue among tutors. Some tutors needed to learn new skills before teaching them to students. Courses on multimedia require tutors to be familiar with a large range of practical skills and theoretical knowledge. Every tutor had an area of expertise, for example image manipulation, sound creation or creating and publishing web pages. On this course two tutors found that supporting students uploading web sites to a server necessitated learning these skills for themselves.

7.13 Conclusion

From the analysis of the qualitative data, it has been established that several key issues have affected the performance of e-learning students on the multimedia computer course.

These issues can be grouped into three broad categories:

1. Issues that were controlled and affected by tutors: their teaching style, personal skills and attributes and their levels of commitment to the course.
2. Issues related to the course: its delivery, course content, technical issues and communication mechanisms.
3. Issues controlled and affected by students: their learning style, personal skills and attributes, level of motivation and prior experience.

Tutors and students interact with each other through the electronic system, which therefore suggests that these issues can be further ordered into three layers: issues relating to students, those relating to the technology and those associated with the tutors.

It is important to note the significance of the tutors and system characteristics on the performance of students as these are largely outside of the students' control. In addition, the psychological gap identified by Wheeler et al (1999) places greater responsibility on students to manage their own learning especially in relation to motivation and time management.

Many of the issues were similar for students both in the face-to-face and e-learning groups although they would appear to be more challenging when encountered by e-learning students, for example inadequate materials for practical exercises, level of tutorial support. The key differences would seem to be that support and the level of response given when a problem occurs are crucial. Although not explicit in the qualitative data it would appear from the evident frustrations in messages to the discussion board by e-learning students on the

discussion board that the time spent problem solving was significantly greater than for face-to-face students. This meant that e-learning students either spent longer working on the course materials or did not cover as much material.

Chapter 8: Discussion

8.1 Introduction

The factors that influence students' success when studying online are those related to: the tutor, the e-learning system and the student. Based on an analysis of the data collected during the case studies presented in this thesis (and previous reading) it is evident that the tutor and the e-learning system have their part to play in students' success. Although, the importance of this should not be underestimated, students' should be aware of the different demands e-learning makes on them when compared to face-to-face learning and how they can adapt their own strengths to improve their success.

Success in e-learning is not just about the performance or the marks gained for completed assignments. It is about the whole experience of studying online. This experience could leave a more lasting impression, either positively or negatively, on a student than would a poor mark. The data collected from the study suggests that e-learning left a negative impression on many students.

This chapter identifies the major characteristics of the previously mentioned factors and demonstrates how they affect students' success. The discussion reflects on the literature and the findings from the case studies that were undertaken.

Within an online environment communication and interaction between a tutor and the students is carried out via the e-learning system (see Figure 8.1). The e-learning system includes the facilities and technology the system delivers: the course content, the communication systems and the technology it uses. It also includes the e-learning system's ease of use, responsiveness and the learning outcomes of the course. The results of the data analysis suggest that the responsiveness of the e-learning system can be an important factor for students' success.

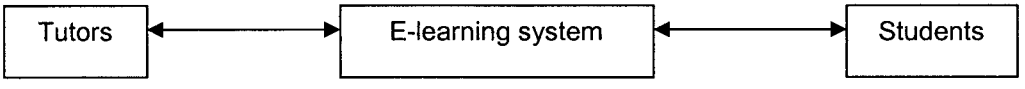


Figure 8.1: A diagram showing the interaction between the factors.

An individual tutors characteristics may affect his/her interaction with an e-learning system. These include demographical characteristics, the attitude towards e-learning and teaching style. Confidence in online teaching methods and an enthusiastic attitude towards e-learning is an important factor for successful online tutoring. Tutors need to remember that students are individuals and adapt their interactions with students accordingly.

In this chapter emphasis is placed on the students' characteristics as these play a major part in students' success and are within their control. Motivation is a key characteristic in a student's interaction with an e-learning system.

8.2 Tutors' characteristics

The diversity and scale of e-learning systems often involve teams of tutors, technicians and support staff in the development and delivery of online courses. This necessitates teams working together cohesively. Each member of a team brings to the process personal attitudes and experiences. These may have a positive or negative impact on the e-learning process and their interaction with the e-learning system (see Figure 8.2).

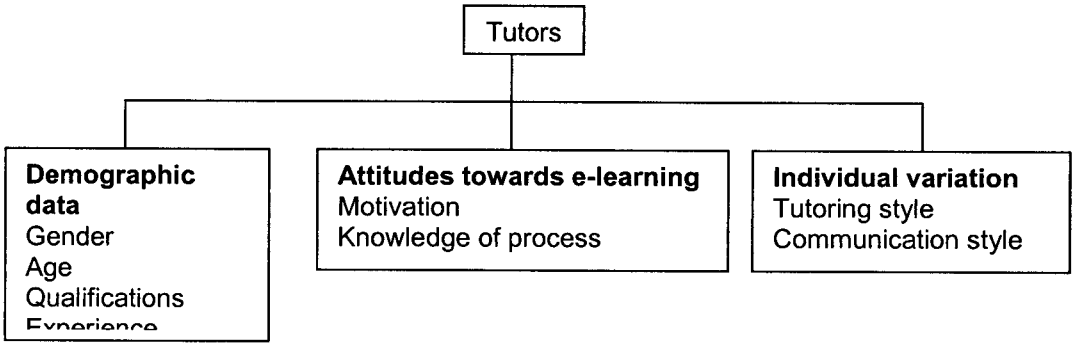


Figure 8.2: Tutors' characteristics.

8.2.1 Demographic profile of staff

Each tutor will have a personal profile that includes his/her gender, age, qualifications and experience. If patterns identified by research relating to students are mirrored by tutors, male tutors may find teaching online more comfortable. They may also have more advanced computer skills.

A tutors age may be another barrier to learning new methods of teaching, e-learning or otherwise. Tutors closer to retiring might be less likely to have high levels of motivation for new methods of teaching and learning, considering them to be unnecessary or a gimmick.

Tutors' qualifications and skills could need updating, especially computing skills for non-computing specialists. New skills would include methods for producing and publishing material. As demonstrated during Case Study 2, this can be a time-consuming and complicated process for many tutors (see Section 7.2). Tutors also need to learn new ways of communicating with students and facilitating learning online. Prior experience of teaching and interacting with students will vary. Each tutor has his/her own style of communicating and adapting this to be effective online might mean learning new skills. For example tutors with a particularly formal style of communicating may need to adapt to a more informal style to encourage rapport with students.

These demographic attributes are likely to affect tutors' attitudes and motivation to participate in e-learning. They could also influence a tutors desire to learn the new skills needed to teach effectively.

8.2.2 Attitudes towards e-learning

Initially, it is likely that most tutors will approach e-learning with a positive attitude. However, many are not prepared for the amount of time it takes to prepare e-learning materials and facilitate learning online. Tutors on Case Study 2 stated that delivering and supporting the course took considerably more time than similar face-to-face courses. Gerrard (2002) found that tutors reported that new e-learning courses took 100% of their time. However, tutors hope that e-learning courses will enable them to widen participation further for non-traditional students who may otherwise be unable to study (Parnham, 2001).

The quality of the courses and the teaching are a concern for many tutors. Most HE institutions follow rigorous quality control procedures, but tutors do not always have good local models to follow when developing new e-learning courses; this can be important if their own experience of e-learning is limited (Gerrard, 2000).

Providing access to examples of best practice should be done locally as well as nationally. At the University of Chester best practice is disseminated in a number of ways. Firstly, IBIS can be used as a repository for documents outlining courses and strategies (face-to-face and e-learning) that have been successfully used within the institution. This facility is known

as the 'shared practice database' and staff are encouraged to add documents to it. These are then made available to all staff at the University. Typically this material includes examples of blended learning used within a course and web sites supporting entire programmes of study. Secondly, staff are encouraged to attend staff development sessions organised bi-annually. These sessions are run by staff within the institution using demonstrations and examples to help raise awareness of best practice and have included many sessions on improving skills for producing and publishing materials, supporting students online and using IBIS to support teaching and learning.

Thirdly, one day staff conferences are held that all academic staff at the University of Chester attend. Speakers with expertise in the field are invited to give presentations. Recent speakers have included experts in e-learning. At a national level, training courses and conferences offer opportunities to access best practice. Particularly useful are the LTSN subject centres which share good practices nationally via their web sites, one day conferences and publications. Fourthly, tutors are concerned with their own lack of skills. Evidence collected during Case Study 2 meant that tutors were unable to support parts of the course as they lacked the skills. For example, two tutors were unable to support the web page work as they could not create and publish web pages; this also caused problems with the creation of course materials and meant that one tutor had to take responsibility for ensuring that e-learning materials were prepared. One tutor found supporting e-learning students particularly difficult, preferring set periods for communicating with students. Many non-computing specialists have real concerns about their own ability to use new technology competently enough to support students (Gerrard, 2000). Even tutors teaching computing in traditional environments can often be intimated when communicating online becomes essential. Tutors do not feel that their job should include technical support and feel at a disadvantage when asked technical questions. Help from technicians and support staff is essential (Sherry, 1995). Gerrard (2002) and Williams (2002) suggest that tutors will need further training to support students online and tutors' methods of interaction and use of their time will need to have greater flexibility than for face-to-face teaching.

Finally, prior experience of e-learning and knowledge of the process will affect a tutor's attitudes and motivation. A negative early experience of teaching online will result in low motivation and a negative attitude towards e-learning (Williams, 2002). For one tutor teaching on the course (Case Study 2) it was her first experience of teaching online. Early problems with the course caused a drop in motivation of the tutor. The more experienced online tutors were less affected.

8.2.3 Individual variation

Tutors' attitudes can change during the delivery of online learning. Initially high levels of motivation and positive attitudes may change when the process is found to be more time consuming than expected. This is particularly relevant for tutors teaching online for the first time.

Tutors can suffer with fatigue if they are required to spend large amounts of time supporting students online. A tutor's early enthusiasm can create unrealistic expectations from the students. Tricker et al (2001) say that students need substantial written feedback throughout. This loss of enthusiasm can result in slower and shorter responses from tutors, which in turn will affect students' motivation.

Frustration and misunderstandings may occur between tutors and students from a loss of the human element of communication, facial expressions and body language, and when students fail to engage in the learning process despite tutor support. In addition, the level of support offered by individual tutors varies; this is an issue when teams of tutors are teaching the same course and levels of support and interaction needs to be consistent across the course.

Teaching using e-learning systems differs significantly from traditional teaching and the loss of face-to-face interaction can cause some tutors greater problems than others. Some tutors find it very difficult to relate to students online. Many educational demonstrations can be difficult and expensive to replicate online. When they are included within e-learning environments they are time consuming to prepare and rarely involve tutors communicating directly with students. Demonstrations are usually delivered in pre-recorded formats such as video, to allow students to view and review the content.

These issues all have an effect on the development and delivery of e-learning courses. The range of skills and experience needed to produce a successful e-learning system cannot readily be found in one individual. Teaching teams are therefore needed and should be chosen carefully to ensure that students are helped and supported throughout the course. Experienced online tutors should be able to support their less-experienced colleagues. The individual styles of tutors working within a team can cause friction. This is more visible to e-learning students than their face-to-face counterparts as it results in changes to the style of learning material and the level of communication on public discussion boards. In order to minimise this, Salmon and Jones (2004) suggest that teams should pay greater attention to planning and project management. Harvey et al (2002) say that tutors prefer working with

like-minded individuals. The differing levels of support caused by individual variation can be minimised by ensuring that levels of online support are agreed by the tutors before the start of a course and that students are made aware of this at the outset. However, individual variation can be an advantage with large groups of students where a tutor's communication style may suit some students better than others.

The tutors' characteristics that were discussed above can be identified from the case studies reported in this thesis. Tutors' skills, technical support, the necessary development and support time all influenced the results of this study and the tutors' motivation. The strengths and skills of the individuals, together with a rationale of their roles and responsibilities should be carefully considered prior to the development and delivery of e-learning courses. When working in teams it is particularly important to present a consistent and cohesive approach to all students.

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8.3 E-learning environment

An e-learning environment consists of the learning system created and updated by the course team and the areas of interaction between the students and the learning environment (see Figure 8.3). Tutors and students communicate with each other using this environment. The attributes of this environment should enable ease-of-use and transparency for all users.

8.3.1 Technology

The technology for an e-learning environment falls into two categories: the technology used by tutors to create e-learning materials, and the technology that allows the materials to be quickly and efficiently used by students. Technology for both needs to be robust, reliable and have features that is familiar and easy to use.

The software used by tutors to create an e-learning environment should be easy to use and upload. The easier the basic creation software/hardware is to use the more likely it is that tutors will update materials regularly. Materials may include web pages, documents, PowerPoint slideshows or sophisticated multimedia systems.

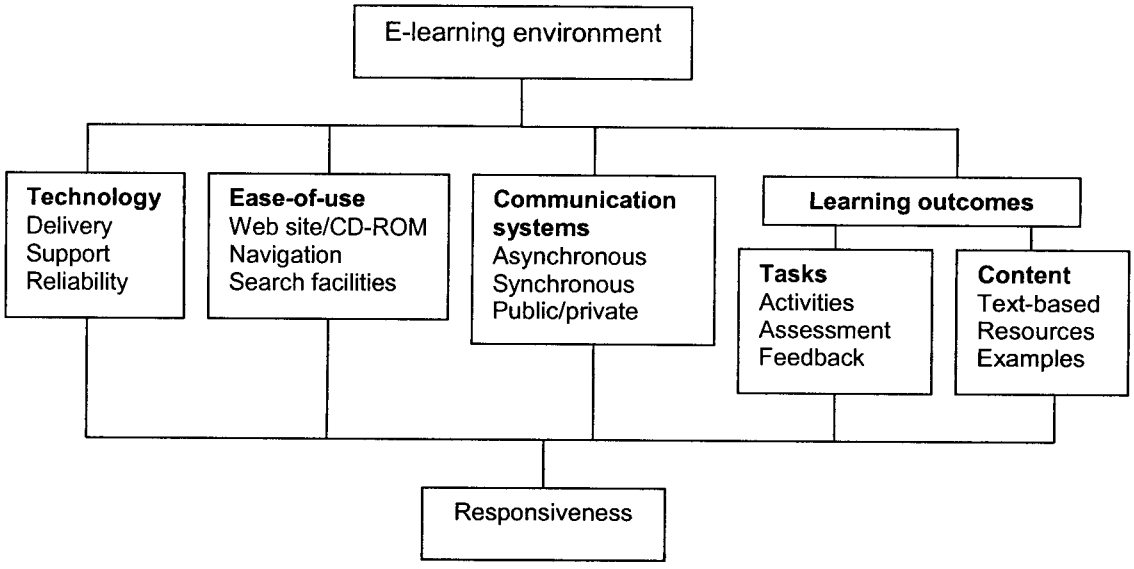

Figure 8.3: Attributes of an e-learning environment.

For most students, computers are tools they use. They therefore need to spend the minimum amount of time becoming familiar with the technology and learning environment. This is especially important for the communication systems which need to be quick and easy to master.

Ideally, the technology being used should be simple and suitable so that tutors can help students with course related problems as they occur. High-end technology should only be included for high-end users or as an essential component of the course. For example many courses should not expect tutors or students to download and install new software in order to follow the course. A list of the hardware and software specifications needed during the course or to complete assessments should be available to students before the course starts.

Technical support for the hardware and software used by the e-learning environment is needed. The minimum technical support is that which ensure the computer network is reliable and efficient. Students using computers at home sometimes need technical support. The cost of Internet access - as a barrier to e-learning as reported by Carswell et al (2000) - is less of an issue as it is more economical and faster due to increased bandwidth. Frequently asked question (FAQ) pages are a good starting point for technical support. Tutors should have full access to technical support throughout the design and delivery of any e-learning course that they design and deliver.

Technical problems will always arise and students are largely tolerant of this provided they are resolved quickly (Carswell et al, 2000). Inaccuracies in course materials are less

tolerated as they are preventable and cause students considerable frustration, often resulting in incomplete work and a fall in student motivation.

The potential range of technology has increased since the completion of this study. The increased bandwidth at the University of Chester allows streaming media to be incorporated into courses as required. Further developments have ensured that much of the information students' access is tailored to their individual needs. For example, each student has easy access to learning materials for the courses they are taking, together with an individual timetable and progress file. The latter can be edited by the students and allows them to keep a record of their progress and goals. IBIS also offers a shared file saving area and group messaging which encourages greater collaboration with peers. Personal learning environments which are systems that help learners take control of and manage their own learning are one of the latest technological developments. They provide support for learners to: set their own goals, manage their own learning and communicate with others in the process of learning.

8.3.2 Content

The content includes all aspects of the course that need to be delivered online, regardless of the media used. The media can be simple web pages, with links to other media and Word documents or a multimedia system with streaming video and sound.

At the course level the materials or course content include: the theory to be learnt, links to further reading and research, activities, tasks, FAQs and assignments to be completed. At the organisational level, the system may also incorporate administrative and support facilities, finance and corporate information.

It is important to build a sense of community between staff and students therefore all content needs to be appropriate, friendly and accurate. The system should also be up-to-date and easy to use (see Section 8.3.3).

The successful delivery of both the case studies used in this research was undertaken using high-quality multimedia content for the courses and extensive support at the organisational level. The University of Chester intranet, IBIS, was found to be a robust and suitable computer system. Academic and technical staff worked together to ensure that the e-learning environment that was developed for the case studies worked as expected.

8.3.2.1 Tasks

These may include practical formative tasks to ensure that students are working on the material. These tasks should allow tutors the opportunity to correct misunderstandings in students' learning, encourage and support students as they work through the course. Formative tasks can take any format suitable for the subject matter, e.g. research work, writing or practical tasks. Assignment tasks and assessments need to be included to ensure that learning outcomes are met. These should be made available to students in time for them to ask questions, receive replies and complete the work. The process of answering students' questions is likely to take longer than in a traditional teaching environment where questions are answered immediately. Completed tasks need to be submitted online. This issue needs to be considered during the design and development of an e-learning system, together with the method of communicating support and feedback.

8.3.2.2 Materials

Materials are usually delivered in the form of an updatable web site that has four purposes:

- To deliver the course material, including theory, practical tasks and assignments and examples of work for students to use as guides for their own research and further work. However, students in a study by Saunders and Klemming (2003) reported only accessing theoretical material when it was needed in order to complete the assessment.
- To provide further resources for students to use. This may include links to external Web sites, additional learning resources or software. Tutors have the opportunity to give students a wider range of materials than the printed materials in face-to-face learning, using links to further resources and information (Williams, 2002).
- To allow access to communication channels between tutors and students.
- To allow access to the wider university community where appropriate.

8.3.2.3 Communication

Web-based communication offers a variety of highly-sophisticated systems. It is the most responsive element which can easily be tailored to individual and class needs. Communication between staff and students and between peers can be divided into asynchronous (email and discussion boards) and synchronous (chat), private and public systems.

Asynchronous discussion can be either public or private and a great deal of research has been done that details the advantages and disadvantages of this type of communication

(Salmon, 2002). Email can be used for private communication between participants. Discussion boards are used for group communication. These are online 'bulletin boards' where tutors and students can leave messages and expect to see replies to messages they have left, or simply read the board. They are being used successfully in e-learning where they encourage students to participate in online discussions by posting responses to tasks and reflective comments. Discussion boards certainly have their place, but they are not the only method of communication and may not be as important or as useful as current research suggests. The advantage is that they are easier for tutors to manage and control than for example chat rooms. They also allow tutors greater flexibility in managing their own time. Email and discussion boards are very responsive to students' needs although the reflective and permanent nature of the communication encourages formality which in turn can discourage relationships or a climate of trust forming.

Synchronous communication, can also take place either privately or publicly. Chat rooms can be used for one-to-one communication and for group discussions. They are certainly more informal in nature although this is not to say that learning does not take place. The informality is largely a result of the temporary nature of the communication. The trace of a 'chat' can be saved, but is usually lost when the conversation ends. With the growth of mobile phone technology and Short Message Service (SMS) messaging 'chat' is becoming a familiar and easy way for students to communicate. From a review of the literature it would seem that less research has been done regarding the use of synchronous discussion, but some of the evidence suggests that it may encourage the development of relationships between tutors and students.

There are disadvantages of using synchronous communication as a learning tool. Students could request a tutor's attention at any time although experience would suggest that even though students can see when a tutor is online they will not initiate a conversation without good reason. Of course, there will be the occasional student who requires constant support. This is similar to conventional teaching - with some students needing more support than others. Strategies need to be developed for managing group online synchronous sessions as these quickly move away from the subject being discussed.

Whether participating in e-learning or conventional learning students like to know when tutors are going to be available as they feel less isolated and more secure. Asynchronous communication necessitates users accessing email or discussion board systems 'just in case' there has been a response. Synchronous communications are advertised in advance, students are guaranteed an online tutor during the session for either private or public 'chat'.

The evidence from Case Study 2 suggests that in order to build a rapport with students tutors need to be less formal (at least initially) than in a conventional classroom to encourage students to 'try things out' and make mistakes. In fact it could be argued that if students see tutors making mistakes online they will feel less intimidated. Salmon (2002) says that writing appropriate feedback messages is a 'dilemma', correcting and usefully criticising without destroying a student's confidence needs to be done tactfully. She goes on to say that tutors themselves should always show a little doubt about their own answers and invite comments.

Web-based communication apprehension is an issue that cannot be ignored. It is a student's level of fear or apprehension associated with actual and anticipated use of information technology to communicate with others (Brown et al, 2004). This in turn will affect a student's use of communication tools. Students who have communication apprehension are often referred to as 'lurkers', the 'silent majority' in an electronic forum; one who posts occasionally or not at all, but is known to read the group's postings regularly. Students do post responses for a variety of reasons, but lack of communication does not mean a lack of learning. In a conventional learning environment these learners would be seen as learning vicariously, which is the process of learning by observing the behaviour of others. Tutors monitor the progress of vicarious learners in the classroom by observation and private communication. It is possible to monitor a 'lurker's' attendance and private communication is possible and should be encouraged. Students with web-based communication apprehension are not necessarily the same students as those with communication apprehension in face-to-face classes. Web-based communication often encourages the shy and quiet students to participate (Williams, 2002).

In a conventional classroom many types of communication are interlinked and are used as required. One-to-one, group, private and public discussions take place in an ongoing dialogue that changes without any conscious thought and often without planning. Students automatically use the method of communication which they feel most comfortable with and tutors respond in a corresponding way. Many e-learning systems use a 'one size fits all' method of communication, usually discussion boards with the occasional email. Whilst the use of SMS messaging, chat rooms and mobile phones is increasing, these are not yet commonplace in e-learning systems. The email and discussion boards tend to encourage more formal communication, at least initially. This could be seen from the email communication during Case Study 1. The chat rooms are more likely to encourage short informal communication thereby supporting a wider range of communication styles.

Building a sense of community online is especially important and tutors can encourage this by including a personal approach when delivering e-learning courses. This may include the use of 'talking head' and student photos, profiles etc. Web pages are easily updated and can be kept relevant, up to the minute and help build the tutor's relationship with the group. Social communication may minimise the feelings of isolation often felt by students studying online (Hughes et al, 2002; Wheeler et al, 1999). These strategies can make an e-learning environment and a tutor approachable and are likely to help build a climate of trust.

8.3.3 Ease-of-use

In order for students to access course materials and communication tools easily the primary navigation menu should be flexible and intuitive. Navigation should support the interaction between users and computers by making computers more user-friendly and receptive to their user's needs. An intuitive Web menu means that it is easy to use by students. Using an intuitive Web menu will aid the usability of the Web site.

Usability is a system attribute is defined in terms of five quality components:

- Learnability: This reflects how easy is it for students to accomplish basic tasks the first time they encounter the system?
- Efficiency: This reflects how quickly students can use the system was they have become familiar with the e-learning environment.
- Memorability: This reflects how easy it is for students to remember how to use the e-learning environment after a period of not using it.
- Errors: This reflects the number of errors made by students and how easy it is to recover from these errors.
- Satisfaction: This reflects the satisfaction students' gain from successfully using the e-learning system.

An e-learning environment should be easy to use so that tutors and students interact with the system and each other without the need for too much instruction on using the environment. Transparent navigation is essential and the quality of the course materials is paramount (Tricker et al, 2001).

If students cannot find the information or communication tools they need, motivation is likely to drop, and frustration levels rise. Students should be able to find everything they need easily and know where to go for friendly, fast and useful support.

The level of language used and links to further reading should be chosen carefully. Systems that are formal in nature may discourage students' interactions. Therefore systems need to be seen as approachable. Tasks need to be carefully designed to build on prior learning. If tasks are too complex or large, the learning may slow, particularly if a problem arises and tutor support is needed before continuing.

Conventional teaching environments with face-to-face classes often necessitate tutors repeating information several times in order to ensure that all students have heard and understood. Although is it possible for e-learning systems to provide links to important information from anywhere in the system, students cannot be relied upon to use this facility. In order to replicate the successful face-to-face strategy of repetition, important information should be repeated in several places. This issue was highlighted during an interview with an e-learning student from Case Study 2 who suggested that repeating important information in more than place would have improved usability.

8.3.4 Learning outcomes

Learning outcomes are a description of what students should be able to do or know by the end of a course. This allows students to prioritise their learning especially during self-managed learning time. Assessments that match learning outcomes allow tutors and students to judge how well the learning outcomes have been met.

Broad learning outcomes are specified during the formal process of developing courses. These learning outcomes are the criteria used for assessments. Students are marked on how well they have met these outcomes. Content is developed to help students meet these criteria.

In order for students to meet these learning outcomes it is necessary to provide detailed, easily-understood learning outcomes for each section of the course and for each task students are expected to complete. This ensures that students understand what is expected of them. This process of including learning outcomes is the same for face-to-face environments. However, their importance increases in e-learning environments as they

enable students to judge for themselves how successful they have been. Face-to-face students rely more heavily on their tutors for this judgement.

Students often find it difficult to judge for them how well they have met the learning outcomes. Learning should take place in a supportive environment that builds confidence. It is an essential skill for e-learning environments where students make judgements and decisions before posting any completed work to a public forum.

The learning outcomes for each activity can be divided into categories to aid students' time management and adapt to varying skill levels within the student population. These categories can be classified as: essential, desirable, and further work.

- Essential learning outcomes are those which the students have to meet in order to complete the course successfully.
- Desirable learning outcomes are those which will allow hard working and more able students to achieve higher marks.
- Further work learning outcomes are those which should increase a student's depth and breadth of understanding. Students undertaking this work are likely to be high achievers and independent learners, interested in deep learning.

A similar technique is used in face-to-face environments although in a less explicit way. Students are given work to carry out during class and in their own time. Depending on their ability and motivation they may or may not complete all the work.

Technologies have been developed that allow automated feedback to be given for some formative tasks and quizzes. Furthermore, intelligent tutoring systems can be used in an attempt to provide greater individualised learning. They often provide helpful guidance and can make a teaching process more adaptable to any given student by exploring and understanding that student's particular needs and then responding to these as a tutor in a face-to-face class might. These systems offer tutorial strategies that interrupt the learner in order to give relevant and helpful guidance at the appropriate time.

8.3.5 Responsiveness

Being responsive means understanding the different communication needs of individuals and adapting peer-to-peer and tutor-to-student communication as necessary. Learning materials can be edited in response to students' needs. For example, lectures may stay the

same as the previous year/semester, but the web pages can be updated for each class.

Responsiveness is the factor that conventional teaching exhibits that e-learning environments are not able to successfully replicate. This responsiveness is due to non-verbal, visual and audible cues each of which are used subconsciously by students. Tutors monitor these and use them to encourage and reinforce student's progress. Tutors then respond to the cues in a variety of ways, e.g. allowing more thinking time, smiling at the students, asking questions, explaining a difficult point in a different way, using graphics instead of words etc. (Russo and Benson, 2005) found in their study that immediacy of response affected the learning outcomes achieved, students' satisfaction and their attitudes.

E-learning cannot easily allow tutors to watch for the non-verbal cues mentioned above, although there are some strategies that tutors can use to assess students' progress, e.g. the use of emoticons and analysing the content of written messages more closely. However, for this to be successful students would need to be encouraged to use emoticons more frequently. Written communication can be monitored for tone and frequency, as well as the formal content. Synchronous group discussion allows less-confident students to give one-word answers. This type of communication also allows tutors to ask direct questions to students who may be following the conversation silently.

E-learning students may appear to be more demanding of a tutor's time than face-to-face students (see Section 8.3.2). They expect an immediate response to problems. A delay in response from a tutor may cause frustration and a loss of motivation. The solution could be a timetabled synchronous session where tutors guarantee to be online for a period of time, although with large groups of students 'chat' could be hard to control and difficult for students to follow. Video conferencing could be used, but its use requires a high level of computer skill from both tutors and students; it has the advantage of tutors and students being able to use visual and verbal cues. Tutors need to use all their skills to ensure that online groups can be built and sustained (Salmon, 2002).

It is important to note that students are not intentionally being more demanding. When they are studying and problems arise without an immediate response from a tutor they are often

unable to continue studying. This is particularly frustrating to students when the problem is considered to be simple.

Feedback to students in a conventional classroom is often done on a one-to-one basis. It may be overheard by the student's nearest neighbours but can be considered relatively private. It is often limited to a single question and answer. Feedback given using discussion boards is generally public with little opportunity for privacy. To alleviate this problem tutors should give more detailed feedback, both positive and negative to the whole group and use private communication methods e.g. email as necessary.

E-learning systems present information and tasks on a web page or discussion board message. E-learning does make extensive use of links and signposting to refer students back to relevant issues, but this assumes that students will be sufficiently motivated to follow the links. In many cases repetition may be more effective. This repetition would help students to understand the frame of reference of the work they are doing. Whereas in a conventional class the same information may be given several times using different methods to ensure that as many students as possible will remember and use the material.

Current e-learning systems are usually designed to encourage interaction and reflective thought. Rapport is often developed by including face-to-face elements either at the beginning or at specific times during the course. Apart from this, e-learning environments can be fairly rigid and 'force' students to learn and interact with the system in a specific way, although much depends on how an e-learning course has been designed. Students are put under similar pressure in face-to-face environments, the non-visual cues being important as tutors can monitor students' progress by watching them and offering support as it is needed. E-learning tutors can offer support by contacting students who have not posted replies to work set, which could help to motivate them. Another solution is to have a public and shared file-space where students keep their work then, if students are working, but not communicating, it would be visible to tutors. Also tutors could acknowledge that less work will be done during the middle part of an e-learning course when there is a natural drop in motivation (see Section 8.4.7) and ensure that extra support is offered at this time.

Many e-learning systems do not encourage social or highly informal interaction. Conventional classes, whilst they try to ensure that a set amount of learning takes place, acknowledge that conversations, writing and practical work undertaken is often only useful as part of the trial-and-error process of learning. During much of this process students are using peers for support. E-learning does encourage peer communication using discussion

boards and some courses use this very successfully by including a 'café' discussion board (see Section 5.6.2). Students are encouraged to use this board to discuss any issues of interest to them. These may be problems with the work they are doing or a discussion about the previous night's football match.

The points above suggest that e-learning systems need to become less formal and more approachable. The current position is difficult for many tutors new to e-learning who find teaching online unfamiliar and inhibiting.

Although during the case studies some technical problems were encountered they were quickly overcome by both tutors and students. The e-learning materials were easy to use and navigate. As the discussion above suggests, consistency when presenting materials and the reliability of communication systems are important, but the overriding need is for tutors and the technology to be responsive to students' needs.

8.4 Students' characteristics

Hardy and Boaz (1997) and Bozarth et al (2004) found that distance learners needed significantly different characteristics, from learners in a face-to-face class, in order to be successful studying online. These characteristics included independence, assertiveness and self-discipline. The case studies reported in this thesis suggest that motivation may affect the success of students taking e-learning courses. Successful learning online necessitates high motivation (see Figure 8.4). This can be affected by a number of attributes as is discussed below.

8.4.1 Demographic profile of students

Each student will have a personal profile that includes gender, age, qualifications and experience. Vermunt (2005) found gender, age and prior qualifications may affect performance.

- The gender of the students may affect their approach to learning. It may also affect the level of their computer skills (Cook et al, 2002; Lee, 2003). In both these studies males were found to have higher levels of computer literacy.
- The age of the students may affect their level of computer skills. Mature students may not be as confident as younger students using computers for learning, although mature students are likely to be more independent learners and more willing to participate in discussions (MacDonald and Stratta, 2001).

- Prior qualifications and knowledge may influence a student's ability to study online. Not only subject-specific qualifications, but a wide range of transferable skills, particularly time management, may be needed.
- Experience of learning in non-traditional environments might be of benefit to students. Mature students are likely to have a broader experience of this although this may not be recent or include e-learning.

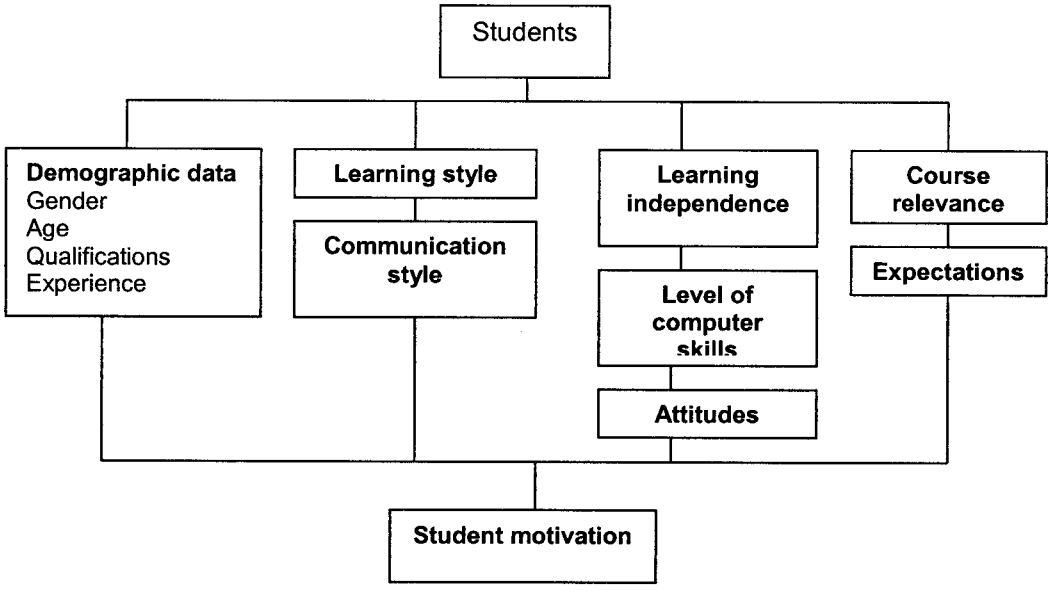

Figure 8.4: Students' characteristics.

Whilst the evidence collected from Case Study 2 would suggest that students on the e-learning course were not affected by their demographic profile, it is interesting to note that, in Case Study 1, the mature students, studying for a postgraduate qualification and with advanced computer skills were more successful studying online.

8.4.2 Attitudes

Widening participation at the University of Chester has seen an increase in diversity of students taking degrees. These students are more reward oriented rather than learning for the pleasure of it. This is likely to have an impact on the effort students make in completing a course. This is especially true of students who are self-funding.

The attitude of most students at the University of Chester remains positive and well balanced. They are open to new experiences and methods of learning, but increased awareness in their rights has resulted in an expectation that they have the choice to reject those they consider unsuitable and demand a more familiar option.

8.4.3 Expectations

Students studying at the University of Chester have high expectations of e-learning courses. They expect:

- Guidance from tutors that supports and encourages their learning, but that is not too formal or patronising.
- Course materials to be helpful and the tasks to be manageable.
- To be able to progress at their own pace. This adds an additional expectation that tutors will be available to support students as required. Obviously, one tutor cannot be available 24 hours a day 7 days a week; therefore a compromise needs to be sought. Twenty-four hour support has been offered by large multinational companies by using teams of support staff working in shifts. In HE this is unlikely to happen although it is possible where teams of tutors are teaching the same course for them to develop a timetable where they share the support for all groups on the course rather than being completely responsible for one or two groups all the time.
- The technology and e-learning system to be reliable. They expect to be able to access the learning environment from anywhere, on any computer and for it to work without breaking or causing loss of work.

Tutors at the University of Chester expect a level of motivation and commitment from the students towards the course. E-learning depends on the students accessing the materials on a regular basis and interacting with the system so that learning takes place and a climate of trust can develop. Support or guidance cannot be given if students do not communicate with their tutors. In conventional teaching environments students have to demonstrate their lack of ability before tutors can offer help.

8.4.4 Level of computer skills

Learners should only need basic computer skills to study online. More advanced skills may be needed for specific courses, e.g. computer courses. If advanced skills are needed or if specialised hardware and/or software are required then this should be made clear during the course promotion and at the very latest on application to the course.

Basic skills include the use of: the Internet for browsing and searching, communication software including discussion boards and synchronous discussion systems, word processing, spreadsheet packages and presentation software. Although the lack of computer skills is becoming less of a problem, there are still areas that many students are unfamiliar with, particularly discussion boards, which many current e-learning courses rely

on. There is often a gap between what the students believe their proficiency levels to be and what instructors actually experienced in online learning situations (Bozarth et al, 2004).

Courses which require higher levels of skill than those mentioned above need to emphasise the need for specific skills and offer additional support or learning prior to the commencement of the course. Students should not be expected to acquire these new skills in addition to learning the course materials.

8.4.5 Course relevance

A course that is being studied online should be either relevant and useful to students in their professional life or interesting to their personal life. In both cases, for students to become engaged with the learning, they should have some prior knowledge of the subject at least to the prerequisite level for the course.

Students without this knowledge and interest in the subject are more likely to drop out as they face the additional challenges of learning in a new environment involving new skills and knowledge. These students are likely to drop out early in the course in the same way that conventional students drop out if they find the course is not suitable.

A major problem with the Experimental group used in the study described in this thesis was the lack of relevance of the course to the students' programme of study. Students began the course without either an interest in or the prerequisite knowledge of the subject being taught.

8.4.6 Learning style characteristics

Learning style characteristics are a broad range of learning strategies adopted by students that best suit their personality and ability to learn. These together with other attributes discussed below will have an impact on students' motivation when using e-learning as a method of study.

8.4.6.1 Learning independence

A student's level of learning independence is not the same as the level of motivation (see Section 8.4.7). Whether or not students are able to learn independently depends on whether they have learnt a particular set of skills in order for them to work individually. It is a process where students develop the values, attitudes, knowledge and skills needed to make

responsible decisions and take actions dealing with their own learning (Department of Learning, 1987).

A student's level of independence depends on factors such as age, skill level and ability in a particular subject. Learning independence can be encouraged by allowing students greater autonomy within a structured environment. Strategies might include encouraging students to work on projects that interest them, finding their own resources and working in groups provided the project fulfils the learning outcomes of the course. Saunders and Klemming (2003) found that highly independent learners used course materials in a structured and disciplined manner throughout the course and not only when assessments were due.

Students also need to be able to assess for themselves if they have met the learning outcomes and how well they have met them and also how they can improve their work (see Section 8.3.4).

Many students coming into HE from schools and colleges are highly dependent learners and this may be one reason for the lack of success of students in the Experimental group. It can be argued that HE is the place to learn independent learning skills and is one of the key transferable skills that employers expect from graduates. Chan (2001) found that undergraduate students appreciate the need to learn independent learning skills, but goes on to argue that simply demanding students work independently will not result in the development of these skills. Rather, tutors need to encourage tutor-to-student dialogue, for guidance and support.

8.4.6.2 Learning style

Each student will have developed a range of preferred strategies and behaviours that enable learning to take place. These are usually defined as a student's learning style and may be:

- Activist, reflector, theorist, pragmatist
- Sequential, holistic
- Deep or surface

However they are defined, Ross and Schulz (1999) identified learning style as one potentially influential variable to the success of students. A tutors' awareness of this may help tutors to identify which e-learning strategies students prefer in order to support all styles more effectively.

Although learning style theory is widely accepted amongst educational theorists in the context of traditional classroom environments, there is still little research on the adaptation to individual styles in an e-learning environment. In particular, the possibility of fluctuations in a learning style with changing tasks or content has not yet been addressed.

E-learning is an active process conducted in a self-directed fashion. E-learning provides many opportunities for constructivist learning by supporting resource-rich, student-centred and interactive learning. However, it is important during the design and development of an e-learning course to include components that support all learning styles. One of the great advantages of e-learning is that it should be able to cater for each learner's preferred learning style. Despite this claim not every student will find e-learning suitable for his or her preferred learning style. Some students will feel bored or intimidated by the experience.

8.4.6.3 Communication style

Students choose their preferred communication style depending on their self-confidence, subject knowledge and communication skills.

In conventional classroom sessions a minority of students will usually take part in discussions, whilst many others are likely to listen and learn vicariously. Some of these students will participate if encouraged and supported. The remainder will either not participate or speak to the tutor privately away from the class. E-learning systems need to offer this flexibility in order to increase motivation.

Some students do not use online communication. This does not imply that no learning is taking place, although it is more difficult for tutors to know when a lack of communication is attributable to a student's style or because of difficulties experienced. These students work through the material alone and produce high-quality work. They are rare, but have their counterparts a in face-to-face environment. These are the students who never attend or contact tutors, but still produce high-quality work.

E-learning students will demonstrate the same range of communication styles (see Section 8.3.2) and communication apprehension as face-to-face students although different students may be affected. Shy students report they prefer communicating online whilst students who speak confidently in face-to-face environments find the permanent nature of online communication intimidating.

Other characteristics of students already discussed are likely to have an impact on a student's communication style e.g. gender. Cook et al (2002) found women posted fewer messages to the discussion board.

8.4.7 Motivation

For most students motivation is high at the start of a course and drops until assignments are due. This is similar to conventional learning, where classroom sessions ensure at least a minimal level of motivation is maintained. The problem is how to successfully encourage a minimal level of motivation with online students.

Motivation is linked to theories of deep and surface learning originally developed from empirical evidence by Marton and Saljo (1976) and then elaborated on by Ramsden (1992), Biggs (1993) and Entwistle (1981). The deep learners' motivation is the love of learning. These learners relate new knowledge to previous knowledge, everyday experience and organise everything into a coherent whole. Surface learners tend to be goal oriented with each learning experience treated in isolation (Atherton, 2004).

An important motivating factor in independent learning is the encouragement of students' own interests and their desire to learn. Students will be motivated to learn if the learning activity is relevant to their interests and if the knowledge is useful and provides a means of achieving a desired goal.

Motivation will fall quickly if students are not engaged with the course and if a rapport with the tutor has not been built. A formal tutor could discourage students who feel intimidated online. In the same way that tutors are concerned with the public nature of e-learning in emails and discussion boards so students are concerned with appearing foolish if they are wrong. Students in the study carried out by Chan (2001) reported relying heavily on tutors for motivation. It should be acknowledged that both tutors and students are human and may make mistakes during the course. In face-to-face courses these errors are often overcome with a laugh and a joke. Methods of overcoming this intimidation and embarrassment online need to be found.

It is interesting to note in Herzberg (1966) 'motivational hygiene' theory that isolation is considered to be de-motivational whilst controlling own work is motivational. E-learning can certainly be an isolating experience without student and tutor communication, but does give students greater autonomy over their learning.

The students on the pilot study were a highly-motivated and computer-literate group for which the course on multimedia was relevant. In contrast the students taking part in the main study were non-computing students taking part in the course on multimedia as a key skills course and their motivation and level of computer skills were very different to those in Case Study 1. This affected the way they used the e-learning materials and their performance. It was easier for e-learning students not to participate than for their face-to-face counterparts.

8.5 Conclusion

This chapter has considered the complexity of designing and delivering e-learning and the reasons it may be less successful than face-to-face learning. Lessons can be learned from careful analysis of the reasons for the success of face-to-face teaching and the differences between the two types of system.

Tutors and students need to adapt and learn new skills and find new ways to manage their time. Many e-learning courses rely on those involved regularly checking discussion boards and emails for new messages. This is not an efficient use of time and if managed badly affects the rate and flow of work. A strategy for supporting students immediately a problem occurs needs to be found, especially when the problem occurs during normal working hours when students expect tutors to be available. Students have often spent a considerable length of time trying to solve the problem themselves before posting a request for help. Students are not unreasonable and do not expect immediate support at unsociable hours. It is unreasonable to expect tutors to stop work to answer problems immediately if they are called upon to do this constantly during normal working hours.

If teams of tutors and support staff are involved in the development and delivery of e-learning courses this will allow work to be shared and higher levels of support given to students. Care should be taken to ensure that materials are consistent and accurate, and all tutors offer the same level of support. The public nature of e-learning makes individual differences between tutors more noticeable than in face-to-face teaching.

Time management affects all aspects of the design and delivery of e-learning courses for tutors. Many tutors develop their learning materials on a weekly basis, often just before they have to give the lecture. E-learning resources should be ready for the beginning of the

course. This allows students to work through materials at their own pace. During the course tutors' time can then be used to support students.

Time management is also an issue for students. Many students started the course (CO2250) enthusiastically and worked well at the beginning. There was a drop in work rate until assessments were due. For e-learning to be successful students need to work consistently throughout the course to ensure that any problems they have can be resolved in time to complete assessments. A change in the nature and timing of assessments could encourage students to work more consistently throughout although this may cause fatigue if students consider they are being over assessed. One strategy is to ensure that all activities or tasks in the essential category of learning outcomes relate directly to assessments, e.g. planning work, drafts and prototypes.

This chapter has considered why face-to-face teaching is so supportive and suggests strategies for offering this flexibility in e-learning environments. Tutors need to accept that students have different ways of working and communicating and support all learning styles. Keeping motivation high can be difficult with students who find it hard to communicate. Tutors should be able to adapt tasks and methods of communication to suit students' needs. Identifying the best way to support individuals can be a time-consuming and difficult task.

E-learning puts more responsibility on students to work. Many extrinsically motivated students will find this difficult. Due to widening participation there has been a change in the culture of HE with students relying more heavily on tutors for guidance. There needs to be a reverse shift in culture for students to accept this responsibility.

Although many factors affect a students' ability to learn online, which creates a complex and individual profile, their style of communication, their ability to work independently and their previous experience will determine how successful they are.

The any time, any place ethos of e-learning courses suggests they are flexible and suitable for all students. However, most courses are far from flexible in considering how to support the wide range of individual styles used by students to learn.

Chapter 9: Conclusions and proposals for further work

9.1 Introduction

The aim of this thesis was to investigate how e-learning at the University of Chester might more effectively support students' needs, thereby improving their experience of e-learning. This included areas within the control of tutors (the interface, teaching materials and assessments) as well as those controlled by the student (motivation, time management and learning styles). Two case studies were carried out. It was anticipated that these would clearly differentiate these factors. The first of these was a technical case study designed to explore the use of multimedia technologies both for teaching and learning. The second case study was a pedagogical one designed to explore the impact of e-learning on undergraduate students taking a course on multimedia. The data and information that was collected was carefully analysed in order to reach the conclusions that have already been discussed in detail elsewhere in this thesis.

9.2 Summary

Earlier research reported that computer technology and students' experience of it was limited and that this technology was unreliable (Sherry, 1995). By the time of the current study, systems were more reliable and user friendly. Increased bandwidth allowed the use of multimedia for teaching and learning.

Students at the University of Chester had become more familiar with using computer technology, but they still had some limitations in their profile of skills, e.g. file management. Most already used the University of Chester intranet IBIS to review course materials and send emails. This allowed the research to concentrate on the nature of course delivery and the students' experience.

Despite following good practice such as that identified by Salmon (2001; 2002) during the design and delivery of the course on multimedia the results from Case Study 2 showed that the performance of students in the e-learning group was worse than that of students in the face-to-face group. Face-to-face students performed better in both the group and individual assignments, with a greater difference in the second individual task. The results from Case Study 1 and previous research, conducted by Carswell et al (2000) and Saunders and Klemming (2003), suggested that the opposite was likely to occur and e-learning students should perform better than students in the face-to-face group.

Factors that may have contributed to this are varied and complex. These include those identified in previous research, e.g. computer skills (McMahon et al, 1999), motivation (Marton and Saljo, 1976), ease of use (Tricker et al, 2001) and relevance of the course to the students (Bozarth et al, 2004).

Use of the discussion board and facilitation by tutors was found to be important. A student's willingness and ability to use the discussion board was the single largest factor determining performance of the e-learning students. The public nature of the discussion board would appear to inhibit some students. In addition there was little evidence to suggest that the discussion board had been used for peer-to-peer communication and support during the course.

In traditional classrooms students support each other, especially during practical work, but it is a private and informal arrangement between them. Attempting to use a discussion board for this purpose makes it both a public and more formal process. British students often feel uncomfortable evaluating their peers' work, whereas other cultures do not experience this problem (Whatley and Bell, 2003).

It could be argued that too much emphasis was placed on group discussions that were not assessed. Discussions are an effective learning strategy used in many traditional learning environments, they may be less so in e-learning. At the University of Chester it is the minority of students who actively engaged with the discussion board on a regular basis and would seem to resent doing all the work, whilst the invisible majority learn vicariously.

Group work and peer communications would seem to be more effective when used for assessment. Students' performance was better in the group assignment than in the individual one, although the qualitative analysis revealed that it was highly stressful for the students with most of the work being done by one or two students in each group who regularly contributed to the discussion board.

This study has identified the need for students to be able to interact with the e-learning system in the way they feel most comfortable. Some students are less confident using discussion boards than others and this would seem to limit their progress. The e-learning course should respond to individual student's needs, particularly in the way students communicate with the tutors and their peers. This applies equally to introductory web pages as it does to the communication systems, which should build a sense of community.

This study differed in three ways from much of the earlier research described in the literature.

Firstly, students were not given the opportunity to choose the mode of learning and both modes of delivery were carried out simultaneously. Many previous studies that have compared e-learning with traditional delivery used students that had self-selected for one mode or the other (Carswell et al, 2000). The lack of choice mirrored the real experience of many students at the University of Chester and the results reflect an accurate representation of students' attitudes towards e-learning - particularly when e-learning is included in a more traditional programme of study.

Secondly, this research involved a complex course on multimedia. It required that a range of non-standard software was available and supported. It successfully allowed students to produce multimedia systems. The University of Chester's network successfully supported all elements of the course, with only one minor break in service due to essential maintenance. This demonstrated that complex material can be supported within e-learning environments provided that staff are committed to the course and remain enthusiastic.

Thirdly, the course was practical in nature and students were required to produce media every week and submit them using the discussion board for feedback and evaluation. Much of the research reported in the literature has placed the emphasis on text-based activities (Oravec, 2003; 2005). Whilst some e-learning students did have problems producing one or two of the artefacts, most succeeded in passing the course despite a lack of interest in the subject which affected students' motivation from the outset. The only e-learning students who failed the course were those who did not submit assignments.

In order to improve e-learning at the University of Chester some of the facilitation methods currently used need to be revisited and developed further. The e-learning systems available via IBIS need to become more flexible, personal and responsive to the needs of the students.

In addition it is important to consider the way in which tutors support students through various communication tools. In this study students were assigned to tutor groups with each group supported by a single tutor. It was not possible for the tutors to be online twenty-four hours or even office hours only as they had other responsibilities. Students were found to expect rapid support from tutors during office hours. Even so, the use of an

asynchronous discussion board sometimes meant that students had to wait several hours for help, advice and feedback on work. Tutors working as teams might be able to guarantee a faster response thereby increasing the effectiveness of feedback and students' feelings of security. If tutors were always timetabled to be online at the same time each day/week, students, if they wished, would be able to build up a rapport with a particular tutor knowing that the tutor will be online. However, students rate appropriate support above the need of developing a relationship with the tutor.

A range of affordable communication tools, synchronous and asynchronous, public and private, should be available to students for them to choose the method of communication that they find most suitable. This could include audio communication using tools which offer telephone quality, audio conversations as part of a synchronous communications system via the Internet.

Better course design would have allowed all the course materials to be available at the start of the course rather than week-by-week as they were during this study. This would have allowed students to complete the material or exercises they considered easier first, leaving the more difficult work for later when their confidence and familiarity with the e-learning environment had increased. An additional level of flexibility would have been to allow students to organise the material according to their preferred method of working. For example, students could have placed all materials of the same type together, for example, practical, theory and research activities or link material on the same topic together. The latter was the preferred method of structure for tutors in the Department of Computer Science and Information Systems at the University of Chester. This would suggest the need for the development of intelligent learning environments which was beyond the scope of the research reported here.

The Disability Discrimination Act (UK Parliament, 1995) which came into effect after this study requires higher education to support all students equally. Materials produced need to be in a format suitable for all students taking the course. At the present time, developers often have to build several different versions of web pages and learning materials to include audio, text only or specialised printed materials. The need for personalised learning environments is already an expectation; it should be extended to include the personalisation of e-learning environments for students using e-learning as a learning environment.

The strategies outlined in this section are suggested as a way of improving the e-learning experience for students. Tutors sharing the task of supporting students online would require

teams of tutors with the same skill-set working together to offer guaranteed support to students when they need it. The development of intelligent learning environments is a specialised skill that requires computer programmers to work with academics to produce learning material and the overarching environment. This would require a shift in the academic and management culture within HE and may not sit easily next to the more traditional activities that are used at the University of Chester.

9.3 Limitations of the study

As an investigation of the impact of e-learning on undergraduate students at the University of Chester this study has shown that whilst the technology is available to support a sophisticated e-learning environment, students' attitudes and tutors' skills are not conducive to successful e-learning.

Various methodologies were considered before the design of this research, but a critical shortcoming of the study was that students could not choose their mode of learning thereby negating any pre-disposition students might have had for a particular mode. One of the weaknesses of the research was the lack of control that could be exercised over groups of participants. For example, the fact that the face-to-face and e-learning groups interacted with each other on other courses and discussed their experience of the course on multimedia as it was progressing. This likely to have led to dissatisfaction among students in the e-learning group who felt that they were being disadvantaged.

Another problem area was the timing of the course. It is likely that much of the dissatisfaction that was experienced would not have occurred if the study had run over a period of two years, on different campuses or in different semesters. Had this been the case great care would need to have been taken to ensure that the teaching and learning aims and objectives were the same.

The complex nature of material covered in the course on multimedia made it difficult for non-computing students to learn even in a face-to-face delivery. The e-learning environment was an additional layer of technology with which students needed to be familiar so as to be able to study effectively. It was also the first time the course on multimedia had been delivered in either mode so there had not been the opportunity to revisit the learning materials and assessments before the study.

A more suitable course for Case Study 2 would have been an introductory computer course that was delivered at Level One. This would have had several advantages over the course in multimedia in that it was a well-established course that had been running for several years. Students would then have probably been less concerned about the effects the study would have on their overall marks as Level One marks do not count towards their final degree classification. As the course was timetabled in both semesters, e-learning and face-to-face methods could have been run at different times, alleviating some of the problems encountered by students talking to their peers in the other group. Another alternative would have been to design a biology course that would have been more relevant to students in the study.

The course on multimedia expected a high level of skills from tutors and students; this caused a strong reaction in some cases and highlighted the difference in performance between e-learning and face-to-face groups. Carrying out the study over two years or using the Level One course would also have increased the size of the population.

Practical courses may not be well suited to e-learning especially if they require demonstrations, although these could be delivered by video demonstrations included within the materials. The courses on multimedia used advanced technology to support students using a wide range of hardware and software. The technology was robust and reliable and IBIS was found to be a good managed learning environment for the delivery of the Experimental course.

At the time of the study, ethical issues were very carefully considered and interventions were included to ensure that any negative impact of the study was minimised as far as possible without affecting the results. Future studies of this nature will continue to have to go through an ethics committee and it is right that they should. No students were disadvantaged by taking part in the study. Marks were moderated to bring those of the e-learning students in line with those of the face-to-face students. Future studies should ensure that all students taking part are given the choice of studying via e-learning or face-to-face. Alternatively, all students should study via e-learning and students from a different cohort used as a control.

Based on the interviews and later comments from students involved in the study, it became clear that a more thorough debriefing of all students and tutors involved in the study was required. Many students were still concerned that their marks had suffered as a result of the study - despite being told several times during and after the course that if the study was

found to have affected marks, as was the case, marks would be adjusted to a normal distribution accordingly. In reality the proportionate weight of any difference had no material effect on the final degree classification.

The pilot study ensured that appropriate technology was available to support Case Study 2 before the CO2250 course was designed and developed. However, some of the issues that caused problems during Case Study 2 could have been anticipated had the population used for the Case Study 1 been similar to that used for the Case Study 2, Level Two undergraduate students rather than MSc computing students who had a higher level of skills.

With more time, a second study could have been carried out to triangulate the results. This would have necessitated running the CO2250 course again via e-learning. Time constraints, together with negative feedback from participants, indicated that it was such a negative experience for the students it would have been unreasonable to repeat the process.

The nature of educational research is that a large number of extraneous factors can affect the results and this research was no exception. However, the groups were found to be equivalent at the outset, the only different factor being the mode of learning. Despite this, during the analysis it became clear that quantitative data should have been collected on factors that included motivation and the level of independent learning. A more useful diagnostic test for computer skills could have been developed and administered before and after the study. Students found completing the four questionnaires that were used onerous.

The author's lack of experience with some of the statistics (such as factor analysis) initially caused problems. These were successfully overcome through instruction and an extensive programme of guided reading.

The model developed is far more complex than was anticipated, but it draws together empirical research undertaken by others as well as that carried out here. The main conclusion emphasises the need for greater matching of the e-learning environment to students' needs.

9.4 Further work

In order for e-learning environments to become more responsive to students' needs, the methods of communication and the learning strategies employed should be varied and flexible enough to meet each individual student's learning characteristics. Following on from this research three areas can be identified as needing further investigation:

- Web-based communication styles
- E-learning strategies
- E-learning styles

9.4.1 Web-based communication styles

Evidence from this research suggests that many students feel uncomfortable with the public and formal nature of discussion boards. Work needs to be undertaken to establish which communication tools students would prefer to use if they had a choice together with reasons for their choice. For example the growth in mobile technology (with its wide-spread use of SMS text messaging) and the increasing use of online chat rooms, would suggest that these informal methods of communication might appeal to people of all ages. Limited use is made of these at the University of Chester. It is suggested that allowing e-learning students greater freedom in their choice of communication tools would lead to a number of web-based communication styles being identified.

9.4.2 E-learning strategies

Further research needs to be undertaken to examine which activities and strategies currently used in e-learning environments at the University of Chester students find most helpful and successful and those which actually promote effective independent learning. This could lead to a range of successful strategies being established at the University of Chester, promoting more effective learning.

9.4.3 E-learning styles

From further investigation of learning styles specifically for e-learners a pattern may emerge that establishes links between students' preferred communication style and the adoption of specific e-learning strategies. This could lead to the identification of a series of e-learning styles. These might have a different structure and taxonomy compared to existing typologies.

9.5 Conclusion

At the University of Chester, during the time it has taken for this research to be carried out, many more undergraduate courses were being designed and delivered via e-learning or at least incorporate some web-delivery as part of blended learning. This move to blended learning, where traditionally taught courses are additionally supported with e-learning strategies, is increasingly becoming the norm. This can involve large amounts of a tutor's time for preparation and delivery.

At the time of writing this thesis many e-learning courses are still attempting to mimic traditionally taught classes; a more effective use of e-learning would be to encourage independent learning and problem solving. Students should be given the opportunity to communicate and personalise their interaction with the e-learning systems.

E-learning should be a process where students are in control of their learning, but often they are given little control or choice about the method of interaction with the learning environment. When this is possible, e-learning at the University of Chester will have become sufficiently flexible to truly enhance the quality of students' learning experiences.

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