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**The Role of Information Design on Pedagogical Effectiveness and User Interface Usability of Web-based E-learning**

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# The Role of Information Design on Pedagogical Effectiveness and User Interface Usability of Web-based E-learning

First Year Probation Report

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# Section 1 Introduction

This report documents my research topic, The Role of Information Design on Pedagogical Effectiveness and User Interface Usability of Web-based E-learning. The report covers how this was derived within the context of existing literature, and how, in a work plan, it will form the basis for my thesis submission.

## Background

The research looks at a problem highlighted in Squires and Preece (1999). E-learning is at the junction of two disciplines, pedagogy and user interface design. Existing heuristics to assist in the design and evaluation of e-learning materials do not combine these two perspectives on e-learning successfully. They tend to emphasise one discipline to the detriment of the other. There is a gap at the overlap between the two disciplines.

In education, the focus is on pedagogy and often the aim is simply to prevent the technology getting in the way. User interface design, in contrast, tends to focus on the technology to the exclusion of the learning materials' purpose. Much of the earlier work in user interface design was in e-commerce, where the user is motivated to complete the task and, for example, buy a book online. Hence, it was sufficient for the technology to not to hinder the user for the interface to be considered successful. This may not be true for e-learning, as a student may not have the same intrinsic motivation to complete an online task as does a customer. This can be rectified by providing an external stimulus, such as making the task part of a summative assessment (Flood *et al*, 2004). This, though, returns us to the underlying pedagogy and the nature of the learning activities incorporated into the materials.

The research looks at the overlap between learning activity design and use interface design. The overlap is termed *Information Design* in this report. Information design 'comes down to making decisions about *how to present information* so that people can use it or understand it more easily' (Garrett, 2003). This is relevant to e-learning, for it is through e-learning materials that students develop the understanding and learning outcomes as intended by their tutors.

The research project will implement e-learning materials to support students on an OU course and provide empirical data for analysis to:

- highlight mismatches between the tutors' intentions and students' perceptions;
- reconcile in the information design the two sets of requirements that arise from the dual role of a student as both a learner and a user; and

- examine the role of information design in causing students satisfaction, or dissatisfaction, with their learning.

From an interpretation of the analysis, heuristics to specifically address *Information Design* will be derived. These heuristics will supplement those from pedagogy and user interface design.

### **First Year Probation Assessment**

This report is divided into four main sections covering:

- a review of the existing research and theory that sets my research in context;
- my proposed research question;
- a description and justification of the research techniques to be used; and
- a work plan to realise the research.

They are followed by a conclusions section, documenting the benefits of the research and its dissemination.

This report also includes two appendices that supplement the work plan. These include description of the project's stakeholders, and the ethical considerations in this project.

This report is one of the four constituents of the first year probation assessment. The other three constituents are described in the following sub-sections.

#### **A mini-viva**

This is arranged for 14:00 Monday 26 June 2006 in Berrill Meeting Room 2, level 2. Attendees are Dr Judith Segal and Dr Patrick McAndrew (independent assessors), Dr Shailey Minocha, Dr Pete Thomas and Professor Josie Taylor (supervisors) and David King (assessee).

The viva will begin with a short, five to ten minute presentation, followed by formal discussion of the probation report and proposed work.

#### **An oral presentation**

The assessee has given several presentations. The most recent was to the U500 Mini-Conference. This was attended by Dr Shailey Minocha who commented that the presentation 'was lucid, had a clear story-line and was well-received.' and that it had '...engaging examples, clear flow, and [was an] easy to understand presentation.'

## **A summary of PhD skills development**

This is documented in the project share, [\\penelope\MCSUsers\MCS-Groups\Computing\E-Learning\\_Envrmt\\_Eval\\_Project](\\penelope\MCSUsers\MCS-Groups\Computing\E-Learning_Envrmt_Eval_Project), in the Skills\_Audit folder. The files in this folder are continually updated as evidence is accrued, and the master document recording progress will need updated as part of the probation assessment.

## **Conclusion**

The next section in this report is the first of the four main sections. That section is the literature review. It sets the context for this project and identifies gaps in the literature which this research project aims to address.

## Section 2 Literature Review

This is the first of the four main sections of the probation report, the literature review. It presents the context for the research and identifies three gaps in our current knowledge that this research will address.

### E-Learning

At its broadest, e-learning is the-delivery of learning through electronic means. E-learning can involve a variety of media — including CD-ROMs, video and audio tapes, and websites — and encompasses both online courses and multimedia applications.

At its simplest e-learning is ‘e-delivery’: the educational materials are made available to students in electronic format. This use of e-learning is now almost universal across all disciplines in UK higher education (Hammond and Bennett, 2002). Thus, much e-learning is delivered as blended learning, whereby the electronic materials supplement traditional teaching. Students though, do not always perceive that this is the intended use of the e-learning materials..

Sometimes students consider the e-learning material as sufficient for their studies. They ignore the requirements for additional reading, thinking around, and practical experience of, the subject matter (Rainbow and Sadler-Smith, 2003). This problem often occurs when course authors are not trained in the new media and simply transfer their existing materials to an electronic format (Fayter, 1998). Without training, the course designers rely on their previous teaching experience and tend to focus on their role as a ‘deliverer of content’ (Conrad, 2004). The resulting elementary ‘electronic page turner’ encourages passive-learning. The existing materials had been presented in lectures and seminars, which usually included additional discussion and explanation of the content. This interaction is not transferred to the electronic format. If the student considers the e-learning materials as sufficient for their learning, rather than as a supplement, then they will not attend the teaching sessions and so miss out on the additional material. (Fayter, 1998).

The opposite problem was investigated by Karuppan (2001). She looked at the Principles of Operational Management course for the reasons why some students exploited class-based material only and ignored the web-based material provided for them. The web-based material was primarily the lecture notes in HTML format, with the addition of expanded notes and definitions. Students found that the class-based material was sufficient for their needs. They thought there was no need to use the web-based material as it only repeated the class-based material. Feedback from the students indicated that they would have explored the web-based

material if it clearly offered something new and different. The students specifically mentioned interactive elements in their replies. The additional information did not motivate the students to use the web-based materials, they wanted actively engaging materials

From the perspective of human computer interaction (HCI), this literature review looks at the possibilities for e-learning to go beyond e-delivery, and for the e-learning materials actively to engage students. It considers what e-learning material can deliver to students, what attributes will encourage its use, and its impact on students' learning experiences.

### **Added Benefit through E-Learning Material**

E-learning materials can remove manual tasks for students. Through eliminating the need for students to set up experiments, simulations offer scope for students to focus on higher order thinking skills such as problem solving, designing experiments, and interpreting results. These are skills that go beyond the knowledge and understanding of a subject, but involve the application of this knowledge in novel situations too. For example, a CBT undergraduate chemistry course was devised to achieve the goal of developing a student's intellectual skills (Crowther *et al*, 2004). It initially gave disappointing results. After a usability evaluation, several minor usability issues such as the inability to rewind video clips were eliminated. The re-designed course met the authors' goals for their students to learn these higher order skills while conducting virtual chemistry experiments.

Aczel *et al* (2004) demonstrated what can be achieved with well designed e-learning software, specifically developed to achieve the intended learning goals. They developed a software tool incorporating visual proofs to teach symbolic logic to undergraduates: the visualisation helped students develop their formal reasoning. Experimenting with proofs using the software was easier than using paper so the students were encouraged to experiment. However, the researchers found that not all visual cues were equally effective. They found some visual cues were even detrimental, though only expanded on this with one example: novice students did not realise empty placeholders meant missing information, not a missing rule in the proof. They have redesigned the software and are now assessing whether these changes will enhance the students' experience.

This highlights what it is for e-learning materials to be 'well designed': they must both deliver the intended learning goals of the course author, and be usable.

## **The Two Elements in Evaluating E-Learning Materials**

The evaluation of e-learning materials requires at least two evaluations: the ability of the material to support the desired learning outcomes from a pedagogical perspective, and the ability of a student to use the material's interface (Feldstein, 2002). This is true of all aspects of e-learning technology. There is, however, no commonly agreed set of terms for these evaluations. For example, Díaz (2003) defines the two evaluation goals in assessing the usability of educational e-books as their 'educational usefulness' and their 'user interface usability'.

The literature-review in this report has adopted the ISO 9241:11 definition of usability: *usability* is the extent to which a product can be used by specified users to achieve a specified goal with *effectiveness, efficiency* and *satisfaction* in a specified context of use. Díaz (2003) gives priority to the *context* for the use of e-books, and hence evaluates 'educational effectiveness'. This research, however, gives priority to the *goal* of use, as this will provide a tangible measure in the research questions. Hence, this review will use the term '*pedagogical effectiveness*'. The term 'user interface (UI) usability' will be used for evaluating interface presented by the e-learning materials.

### **The First Element: Pedagogical Effectiveness**

Theories on effective teaching can be traced back to the writings of Aristotle and Plato in Ancient Greece. Traditionally education was seen as a means of instruction, and the central role in the process was that of the teacher. The teacher's goal was to pass on knowledge of behaviours and skills to their students. In the twentieth century, new ideas emerged about the nature of knowledge and how students acquire knowledge.

Cognitive scientists, such as Piaget (1977), developed the concept of knowledge as the creation of a child rather than knowledge as an independent entity given to the child. This work related to the development of thought and language in a child. Extending this idea, Vygotsky (1962), emphasised the role of dialogue in the process of a child's cognitive development. He also contributed the idea of a zone of proximal development (ZPD). This marked the natural limit to a child's own development of knowledge, and to progress a child would need help. Bruner (1975), based his work on Vygotsky, and developed the concept of scaffolding from ZPD. He proposed that a child could accomplish with an adult's assistance that which they could not accomplish independently. The adult would create temporary scaffolding to support the child as they moved beyond their immediate knowledge. These new ideas in child development soon

began to inform pedagogical theory. As the students are active constructors of knowledge, as opposed to passive recipients, these ideas are collectively known as *constructivism*.

E-learning materials can act as a repository of knowledge materials and deliver instruction. E-learning material, as an artefact to help a learner learn, can incorporate many tools to support a variety of pedagogical theories. They can support the constructivist approach, through enabling dialogues with teachers and peers, tools that offer educational experiences and tools to support reflection upon those experiences. The common goal of all these pedagogical approaches is that the student achieves a positive learning outcome. Therefore, the ability of a student to achieve the desired learning outcome could be regarded as an appropriate measure of the artefact's pedagogical effectiveness.

### **The Second Element: User Interface Usability**

That an artefact should be usable is a self-evident requirement. There are many guidelines and principles to assist in designing usable artefacts, as well as also more formal statements such as the ISO 9241:11 Guidance on Usability summarised earlier in this report. This means a student should be *satisfied* after completing their *efficient* and *effective* study of the e-learning material. To paraphrase Norman, (1988) the student as a user of the interface should clearly see how to use the e-learning materials, that they can see what they need to do to use them, and can then understand the results of their actions. This is the conventional application of usability principles to the design of user interfaces.

### **Combining the Elements**

Succinct guidelines have been developed to assist in evaluating the usability of artefacts. E-learning materials can be evaluated using such as Shneiderman's Eight Golden Rules (Shneiderman, 1992) and Nielsen's Ten Heuristics (Nielsen, 1994). Successful as these are in determining general usability, neither was developed with the specific intention of supporting learning materials.

There have been several attempts in recent years to develop similar expert-based evaluation instruments specifically for e-learning materials. Among the earliest of these was the DELTA checklist (DELTA, 1995). However, this did not attempt to assess pedagogical effectiveness, but only looked at UI usability and pedagogical content.

In 1999 there were several attempts to synthesise interface design and pedagogical design heuristics. One approach, (Albion, 1999), was to create checklists by merging previous works, in this case Nielsen for the interface and Quinn for the pedagogical design, and then add an

extra checklist for the educational content. This produced three sets of heuristics for use in an evaluation.

Other authors went a step further, and merged their checklists into one: Squires and Preece (1999) took this approach and extended Nielsen's heuristics to accommodate constructivist pedagogy, so limiting the general applicability of their new heuristics. In contrast, Jones *et al* (1999), sought a wider approach in focusing on contextual significance, especially why e-learning materials were adopted in the first place. Taking this idea to the next logical step, Mayes and Fowler (1999) sought to move the evaluation's emphasis from the user interface design of the e-learning tools to the design of the learning task the tool was intended to support.

Since then other approaches for expert-based evaluation of e-learning materials have been proposed. The approaches permit experts from both education and multimedia design to successfully identify usability problems with the e-learning materials; however, the experts still have difficulties identifying problems with the materials' pedagogical effectiveness (Dimitrova *et al*, 2001) One explanation offered by Dimitrova *et al* (2001) was the different focus the usability experts brought to the material to that of the students. The experts looked at the materials from their perspective of their speciality rather than as a learner using the materials. The experts did not consider the implications for learning from the usability problems they found. Support is given to this idea arises from the experts locating issues that did cause the student problems, such as the complexity of the topic and its presentation, but did not predict correctly the impact of the problem on students' learning.

### **Effective Evaluations**

Squires and Preece (1999) argue that separating usability, and learning in evaluations leads to superficial results, especially by specialist in education who ignore usability elements. This is generally less of a problem with contemporary checklists as their developers are more aware of usability issues. For example, Kukulska-Hulme *et al* (2003) explicitly require that an e-learning web-site be navigable. However, Zaharias (2004) reports that there still remains a need for further elaboration and empirical validation of Squires and Preece's work as none of the current evaluation tools truly combine both elements of an evaluation in the way envisioned by Squires and Preece. Zaharias (2004) conclusion, like that of Dimitrova *et al* (2001) is that there remains a need to evaluate e-learning materials with actual learners alongside any expert-based evaluation.

## **Towards Effective Evaluations**

There is a large body of proven experience regarding effective practice in teaching that can inform e-learning evaluations. Yet this experience is not always applied to e-learning. As Achtemeier *et al* (2003) found in assessing undergraduate e-learning course evaluations, while the course authors may be aware of the theoretical and pedagogical underpinnings of their profession, their e-learning evaluation tools were not based on this knowledge. Thus, each question in all of the course questionnaires was valid, but the questionnaires were not comprehensive. Achtemeier *et al* (2003) highlighted the omission of questions about the students use of online communication tools with their tutors or classmates during the course – despite the acknowledged importance of this towards developing an online-learning community. The conclusion was that the course evaluations were not based on documented best practice. The resulting evaluation tools lacked rigour, raising doubts about the validity and reliability of the answers.

A similar hindrance to the development of e-learning heuristics can be seen in the first two examples of e-learning materials cited in this review (Crowther *et al*,2003; Aczel *et al*, 2004) as both report successful e-learning applications, yet do not define which components led to the students' success in achieving the intended learning outcomes. The absence of such detailed information makes it difficult to develop evaluation heuristics that embrace both the pedagogical effectiveness of, and the UI usability of, e-learning materials in the manner proposed by Squires and Preece in 1999.

In addition, both examples describe a redesign of their e-learning materials' interface, suggesting that effective evaluation tools to aid the design do not exist. The issues were identified after students used the materials rather than by the developers during the design stage. One may conclude, there remains a gap in the evaluations. To understand more fully where these gaps may lie, needs first a better understanding of the goals of the evaluation. The next two sections look at what is meant by effective-learning, and at the nature of the users.

## **Distinctions in E-Learning**

Our measure of effective learning is the achievement by the student of the stated learning outcomes. There are many possible-learning outcomes, and their principle classification in contemporary UK higher education is provided by the QAA (Quality Assurance Agency).

There are four categories of learning outcomes: knowledge and understanding, intellectual skills, practical skills and key/transferable skills. Of these categories, intellectual skills are nearest to the constructivist concept of learning. The other categories require that the student

acquire and use the skills in set situations. In contrast, while the principles underlying intellectual skills can be taught, they are distinguished as being 'intellectual' because the skills are applied in novel situations. The starting point for all four categories is the same, it is to train the student in the basic principles required to achieve the learning outcome.

### **E-Learning as E-Training**

E-learning is well established in delivering 'training' outcomes. It can achieve better results than the equivalent face-to-face methods for teaching basic comprehension as shown in a case study based on using Excel to teach remedial mathematics to undergraduates (Frith *et al*, 2004). This relatively simple reproductive knowledge can be delivered effectively (Joint, 2003). Arguably, this use of e-learning should be distinguished as 'e-training', for the learning is constrained to accomplishing a narrowly defined set of tasks rather than equipping the student with skills to be applied in non-routine situations.

Most e-training though is not conducted by formal students in the education system, but by employees aiming to become more competent and efficient at certain tasks within their existing role. These learners other commitments are cited as the prime reason for failing to complete a course. The majority (92.5%) said they had learnt what they had set out to learn regardless of whether they had finished the training (Baldwin-Evans, 2004.) This statement was validated the students giving examples of the use of their new knowledge.

A distinction in the use of e-learning materials can be drawn based on the type of learning. In e-training as described above, the student is developing skills within their existing experience. In developing intellectual skills, the learner is deliberately moving beyond their experience (Quintana *et al*, 2000). This means that the 'learner' is not a typical 'user' as generally understood in user-centred design (UCD) (Norman, 1986). In UCD, users are considered as knowledgeable in the domain in which they are working, and while this may be true for students using e-training materials to enhance their work related skills, it is inherently not so with students using e-learning materials to learn a new knowledge domain.

An example of a user not being knowledgeable in their domain is seen with learning and the development of a student's intellectual skills. This is considered as a process of constructing knowledge where the student is an active processor of information (Laurillard, 2002). Despite the characterisation of academic learning as a constructivist process, the pragmatic constraints of learning and teaching in higher education (HE) institutions pose restrictions on the use of pure constructivism. Nunes and McPherson (2003) argue that e-learning environments in HE should adopt pedagogical models that are not fundamentalist in nature. However, their paper

does not describe the learning experiences and interaction of a student as a user with e-learning material.

### **The dual role of the student**

Students are both learners and users and they may have different requirements of e-learning materials in these two roles (Smulders, 2003). Not least because as learners they are not yet competent at the goal of their learning, however competent they may be at using the e-learning materials that is intended to help them reach that goal (Quintana *et al*, 2000).

The software must hide with a simple interface whatever complexity there is in its potentially advanced and complicated features that support the intended learning, (Ardito *et al*, 2004). In learning higher order skills such as reflection the student must be stretched: it is not enough to make a student comfortable, the e-learning material must ensure it makes the learner think (Mayes and Fowler, 1999).

This literature review will not consider e-training further, but instead will focus on ‘e-learning’ and what this means for the student as both learner and user.

Having drawn this distinction between students in training and learning one needs to ask if there are any other distinctions relevant to students using e-learning.

### **E-learning students**

Initially, e-learning was often an adjunct to distance learning, or a supplement on traditional courses for those who could not make use of, or easily gain access to non-electronic materials and methods. Hence, students on e-learning courses were often from a different background to those on face-to-face full time courses. Typically, students were drawn to online learning by its inherent flexibility, allowing them to fit in their studies around their existing commitments. E-learning students are often part-time, employed and over 40 (Packham *et al*, 2004). As Dutton *et al* (2002) report the students other commitments to family and work lowered their study performance, though their greater general experience and concomitant skills, particularly with using computers, balanced this out. They also found higher attrition rates with e-learning courses compared to traditionally delivered courses, as one might expect given the differing nature of the students and their external commitments.

Increasingly though, e-learning materials are part of mainstream education (Hammond and Bennett, 2002). Indeed, more of a student’s experience at university is online from enrolment to assignment submission (Thomas *et al*, 1998). Therefore, e-learning students are no longer a special group of students as potentially all are expected to use e-learning materials. As students

have no option but to use e-learning materials, their individual preferences have become a more significant factor: analysis of undergraduate enrolment to two types of course, one based on synchronous video-conferencing the other on asynchronous internet hosted distance learning materials, showed that the students' learning preferences matched the course study style. In this case, independent self-confident learners preferred the internet course (Katz, 2002).

Students must be comfortable with the e-learning materials. If the technology is too innovative and therefore unfamiliar, students tend to switch their learning strategy to one that enables them simply to pass the course rather than to explore the course concepts, whatever the intentions of the course authors (Sadler-Smith and Smith, 2004). Similarly, it is not always possible to assess who will benefit from a particular technology, for users may interact with it in differing ways. A quantitative analysis of students' perception of how much they gained from the online interactive components of their course was a strong indicator of their final performance regardless of the actual use they made of these components as measured by the number of contributions they made (Piccicano, 2002).

All these analyses show a positive correlation between the learner feeling they are in control of the e-learning course material, managing their progress at their own pace, and their stated satisfaction. Chou and Liu's case study (2005) of high school students in Taiwan shows that engendering this feeling among the students leads to a more positive learning climate as recorded by the students' in a self-assessment questionnaire. This matches the general findings in interface design for any applications (Shneiderman, 1992); the user makes more effective use of an application if they consider themselves in control of it, rather than the other way round.

Thus, if there are benefits from putting the student at the centre of the user interface design process, is the same true for putting students at the centre of the learning process?

### **Student Led E-Learning**

The development of new learning theories in the last century generally saw a change in the way knowledge was viewed. Knowledge should not be seen as a body of facts to be transferred from teacher to student, but as something for the student to develop for themselves. This epistemological difference requires the learning environment to offer an experience of knowledge, as opposed to the transmission of knowledge, and can be seen in the differing use made of new technology by different disciplines.

While all disciplines used ICT to distribute information, it was the humanities, with their more subjective view of knowledge, which made most use of ICT to support discussion to enable a student to develop their own understanding (Hammond and Bennett, 2002). The use of

groupware to support project work within a course has also been found to be beneficial in terms of successful learning outcomes in which the student develops their own knowledge (Becker and Dwyer, 1998).

Online—now synonymous with web-based—e-learning has a unique advantage over other forms of e-learning material to assist a student in developing their own knowledge. Web-based e-learning materials can support asynchronous communication.

### **Towards Students' Independence**

If the e-learning materials are packaged as a self-contained entity then the student can progress at their own pace, and at their choice of time and place of study (Salmon, 2002). In Spiceland and Hawkins' study (2002), e-mail and bulletin boards were used to support the teaching of accountancy. The students appreciated the use of active learning as it engaged them in the learning. The study also found that students liked the flexibility in scheduling their own time provided by the e-learning tools. This flexibility can allow a student progress at their own pace without having to wait for the guidance of a tutor. The e-learning materials provide the support while the student creates knowledge. Through placing a student in control of these materials, that student can become an independent learner. They can learn on their own, or with limited direct support.

A survey of undergraduate students showed they support the idea that computer assisted learning can be better than traditional methods for direct instruction and would permit their learning without the intervention of tutors (Rainbow and Sadler-Smith, 2003). The same survey, though, showed they did not value e-learning materials when used for other forms of learning.

Course authors too, can draw a similar conclusion. One study of post-graduate engineers at Cambridge describes success by using different teaching materials to achieve different learning outcomes (Platts, 2004). The e-learning materials were used for the direct instruction of practical skills only. The teaching of intellectual skills was through small group tutorials with the students working on a semi realistic project.

The use of blended learning, mixing e-learning and traditional face-to-face methods, suggests a there may be a limit to the possibilities of e-learning to deliver all types of learning outcomes.

### **Existing Limits to Students' Independence**

There is an expectation in UK Higher Education 'that teaching without tutor contact leads to an unacceptable lowering of the quality of teaching and learning' (Joint, 2003). Implementing e-learning need not lead to reduced tutor contact. As shown by Platts (2004), by using

e-learning materials to teach the basic knowledge and understanding of a subject, tutor time can be freed up to support the student in developing higher order thinking skills.

E-learning can also provide direct contact between tutor and student through tools such as e-mail and indirectly through tools such as discussion forums. These tools can also support communication between the students, supporting their social learning. However, there is a danger that un-moderated online discussions can become 'poorly related monologues' (Thomas, 2002), and hence of little benefit to students in assisting their learning. On the other hand, Hron and Friedrich, (2003) have shown that too much intervention can diminish motivation amongst learners as the learners assume a passive role and wait for the tutor to provide the answer.

The support available within the e-learning materials marks a natural limit to a student's independence: this is the boundary beyond which a student needs assistance from a tutor. However, that assistance need not be directly related to the learning. Salmon (2002) extends the role of a tutor in online discussions and forums to support the socialisation of the students using these tools. The tutor helps promote the development of a social group and the conversation among its members. This allows the students to achieve the full benefit of these e-learning tools, through generating their own dialogue of knowledge construction. Through promoting peer groups, the students can progress independently of a formal tutor.

### **Supporting Students' Independence through E-Learning**

Theroux *et al* (2004) looked at an online case study in an MBA course. The case study was delivered to the students in 'real time'. The tutors released the learning materials during the course so that the requirements emerged throughout the course rather than as a single document at the beginning. The students appreciated the learning was very close to its real world equivalent. They also enjoyed this approach as it forced more collaboration and consensus building amongst themselves. The students communicated using the e-learning tools provided: e-mail and online forums. Their work progressed independent of their tutors.

Guidance can be more direct too. Hirsch *et al* (2004) implemented a structured dialogue tool for argumentative learning. The structure restricted students to selecting and completing partial sentences. This restriction encouraged better construction of claims and arguments and was considered an appropriate level of constraint. Similarly, in Aczel *et al* (2004) cited earlier, the authors suggest that a part of the success with their visual proofs tool lies in the constraints placed on the students' experiments.

E-learning materials can give the students a rich learning experience. The virtual world presented in these materials can remove many practical obstacles such as the time taken to draw

proofs on paper as compared to letting the e-learning materials draw them according to the students' instructions (Aczel *et al*, 2004). However, unconstrained learning can lead to problems of its own. This can be an issue with hypertext navigation, as students create their own route through the material. However, most commercial offerings avoid this problem by not exploiting the full potential of e-learning.

The limited exploitation of e-learning materials was found to be true of most commercial interactive CDs by Laurillard *et al* (2000). They looked at the use of multimedia CD-ROMs in schools. Beginning with commercial CD-ROMs, they found these only supported a student's construction of knowledge by a simple action-feedback cycle. This did not take forward the student's learning, as the student was not supported in creating a meaningful narrative through the material. Instead, the students were browsing and completing individual actions. Laurillard *et al* then created a new CD to address the lack of support. Their work highlights the overall importance of *activity design*. The activities must not just support the immediate acquisition of information by a student, but take them forward in their learning too. This relates back to educational concept of scaffolding – of taking the student to the next *appropriate* step in their construction of knowledge. However, making such resources and guidance available does not mean that students will make use of them.

Kashy *et al* (2003) give an example of the latter problem in their study of the teaching of calculus to physics undergraduates. Some students used a legitimate, commercial website for answers to their questions and achieved the correct answers; but did not have to work through the calculations. In contrast, their peers, who used the course website were forced to do the calculations. Hence, in the final examination only the latter students could answer the more involved questions that required them to show the development of their answers. Issroff and Scanlon (2002) when investigating the use of online discussions as tutorials, give an example of the opposite problem. Each posting to the online discussion was meant to be limited to 50–200 words, but the more enthusiastic students posted over length contributions. This meant that there was an increase in student communication which was one of the goals of the study. However, the scheme was seen a failure owing to the overall increased tutor workload. Their conclusion was that introducing on-line technology is not enough, supporting procedural changes are required too because the e-learning materials could not provide the necessary guidance.

### **Conclusion: three identified gaps in the literature**

E-learning materials can support a variety of teaching strategies and intended learning outcomes. They are effective at providing direct instruction and particularly useful at supporting learning experiences through simulations – for example, by avoiding the manual tasks

associated with setting up experiments. Online e-learning materials offer the further advantage of communication tools, thereby facilitating social learning through collaboration among students. *One key gap*, however, is the absence of an evaluation methodology to assist in the design and development of this range of e-learning materials.

As shown in the examples where e-learning materials were redesigned (Aczel *et al*, 2004; Crowther *et al*, 2004), the existing evaluation tools often cover the educational aspects successfully, but not the user interaction with the materials. This is important in the first instance as the material must be usable in order for learning to be achieved. It further gains in importance once e-learning materials are used to encourage a student's independent learning, a concept at the heart of constructivist pedagogy. As Chou and Liu (2005) showed a well designed interface can even engender a positive learning climate. This is important to support tutors and designers avoid the problem identified in Laurillard *et al* (2000) of e-learning materials becoming disjointed activities without support to take the student through the material. Thus, the HCI aspects of e-learning materials can do more in pedagogical terms than just avoid obstacles in providing access to learning materials. A *second gap* in the literature, is the absence of extension of usability when applied to e-learning materials.

Except for training, e-learning materials are rarely used alone. There is no clear boundary between the use of e-learning tools and tutor intervention to support a student's learning. Course designers tend to fall back on their traditional role as a teacher to inform their design choices. This can mean failure to realise the full potential of their e-learning materials to enable student independence.

The problems in evaluation tools and setting the boundaries for using e-learning materials are compounded by the dual nature of the student as both a learner and a user. Each role has different requirements, for example, while both a user and a learner need clear navigation through the material, a learner may need pauses for reflection – something that is anathema in interface design. Therefore, some compromise will be required between the two design objectives. The literature only alludes to the existence of the problem. This *third gap*, is the absence of an understanding the impact of this problem, and how best to resolve it.

Based on the three gaps in current literature suggests we have three research issues:

- the absence of an evaluation methodology to assist in the design and development of e-learning materials;
- the lack of an extension of usability to include pedagogical effectiveness when applied to e-learning materials; and

- that the student has a dual role as both learner and user and so has two sets of requirements that must be integrated in the design of the e-learning materials.

These issues mean we cannot reliably use e-learning materials as a mentor when a student is creating their own understanding. The next section of this report develops a research question which aims to address the three research issues.

## Section 3 Research Question

The literature review has suggested there are three open issues, which mean may limit the use of e-learning materials. This section describes the development of a research question to address this gap.

### The E-learning Environment

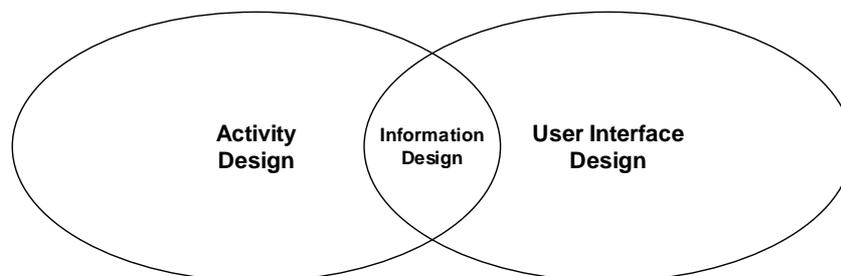
The research will use look at *web-based* e-learning materials only. This is because online materials have the advantage of supporting asynchronous communication. This communication is necessary to facilitate the social aspects of constructivist pedagogy within e-learning materials.

### Taking the Student through E-Learning Materials

The primary goal of e-learning materials is to provide educational support for students (Kukulska-Hulme *et al*, 2003). This means the key design factor to achieve a student's learning is the pedagogy not the technology (Nunes and Macpherson, 2003). The choice of pedagogy determines the learning activities that will be implemented in the e-learning materials to achieve the desired learning outcomes. The role of the technology is to enable the students to access the learning activities.

E-learning materials can, hence, be considered the overlap between these two disciplines: pedagogy that drives the design of the activities, and technology drives the user interface design. The *Activity Design* is constrained by the tutor's intended learning outcomes. The *User Interface Design* is constrained by the UI widgets and interface behaviours in the e-learning materials. The overlap is shown in figure 1.

**Figure 1: The Influence of Information Design**



These concepts overlap in Information Design, which ‘comes down to making decisions about *how to present information* so that people can use it or understand it more easily’ (Garrett, 2003). This is the idea that the design of an interface can do more than facilitate the user’s movement among the content, it can convey information in its own right (Tufte, 1983; Tufte, 1990). This draws the distinction that the user may be satisfied with the information presented, but misconstrue the author’s intent.

This is particularly important with the teaching of intellectual skills as they are more open to individual interpretation, unlike the didactic transfer of information required to achieve knowledge and understanding of the learning outcome. A similar concern arises with constructivist-based e-learning materials, as the student is expected to construct their own knowledge. These concerns relates to the boundaries of independent learning the student can achieve. Referring to figure 1, at what point in the student’s construction of knowledge do they move left out of information design into activity design. They will no longer have the support of e-learning materials, with implications for the tutor’s support role.

The overlap shown as information design is the area:

- where a positive user experience can be transformed into a positive learner experience;
- marks the boundary of the learning that can be delivered using e-learning materials alone; and
- where any compromises will be made in the interface design to reconcile the demands of the student as learner and as user.

Understanding information design as shown in figure 1 will assist in resolving the issues identified in the literature review by:

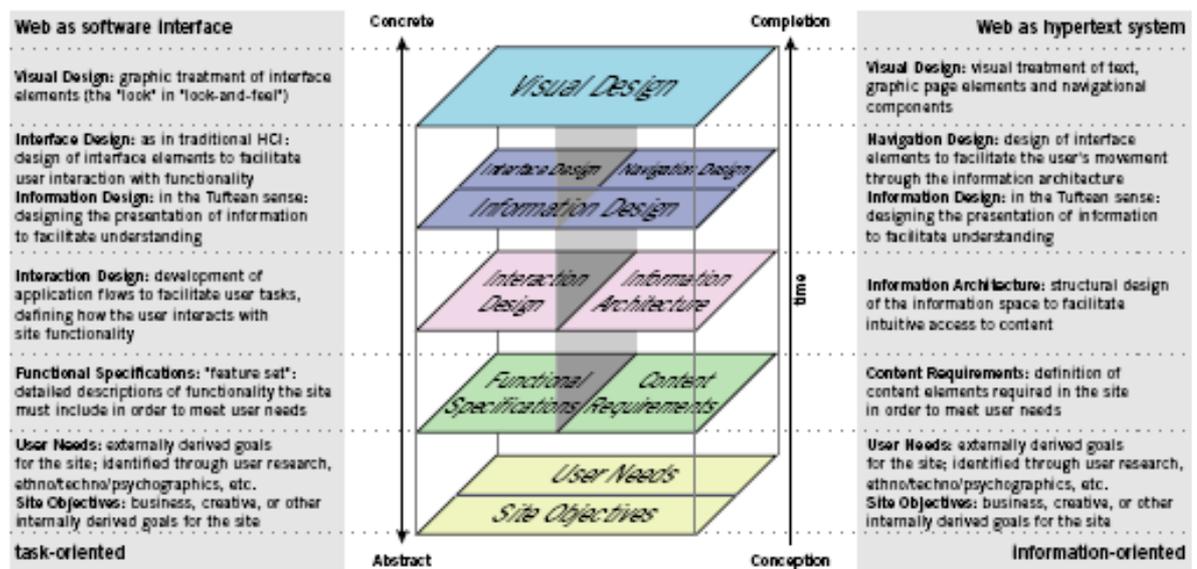
- identifying the demands of the student as learner and as a user so that an informed decision can be made as to the interface design should there be a conflict;
- eliciting those elements of user interface design that are relevant to activity design and so extending usability principles to e-learning materials; and
- thereby, deriving heuristics to supplement existing evaluation heuristics in education and interface design.

### **A Framework to Explore Information Design**

The overlap highlights the benefits of considering the whole ‘user experience’ – both as learner from the activity design perspective and as a user from the user interface design perspective. ‘User experience’ is a term from human-computer interaction and refers explicitly to website

design. Garrett (2003) defines a framework for user experience to bridge the gap between the use of a website defined by its designers and the details of the interface defined by the site's developers. This work grew out of his experience as a web-site developer, in which the views of the site's designers were not given equal significance by the developers as they built the site. This parallels e-learning evaluation heuristics, where they emphasise pedagogical effectiveness or the user interface usability, but do not provide a balance between the two disciplines (Squires and Preece, 1999).

**Figure 2: The Elements of User Experience (Garrett, 2003)**



Adapting this framework (Figure 2) to web-based e-learning can help bridge the between the learning strategy defined by the course's authors and the details of the interface defined by the course's developers.

The student's experience of the site is based on the quality of all five layers. The underlying strategy is defined by the course's authors and determines the sites objectives and content. The visual design and interaction design is set by the website developers. *Information Design* binds the information architecture to the visual design to allow the student as a learner to use the functions and the student as a user to navigate the material.

### Evaluating the Role of Information Design

The research will study the overlap of pedagogical effectiveness and user interface usability and its influence on a student's learning when using e-learning materials. The role of *Information Design* is to accurately convey the course authors' pedagogical intent to the student so that the student can achieve the course author's intended learning outcomes.

## **Research Objectives**

To assess the role of Information Design:

1. Perform an empirical study on a web-based e-learning environment to:
  - elicit author intentions in designing the learning activities ; and
  - elicit student perceptions of using the learning activities.
2. Identify element that facilitated and hindered user interface interaction from the students' perspective.
3. Identify causes of satisfaction and dissatisfaction felt by a student towards their learning.

## **Research Outcomes**

1. The three research objectives will result in an empirically-grounded understanding:
  - of authors' intentions and students' perceptions in the use of e-learning materials by identifying the matches and mismatches;
  - of the information design from a student's perspective, both as a learner and as a user, and if any difficulties arise from the overlap of these two roles; and
  - of the overall student experience when learning with e-learning materials to set the limits and relative importance of information design in context.
2. Develop supplementary heuristics to assist in the design and evaluation of web-based e-learning materials.
3. Disseminate the heuristics and empirical study through papers and conferences.

## **Conclusion**

This section described the development of a research topic to address the issues identified in the literature review, and concluded with defining the research objectives and outcomes. The next section describes the research techniques to deliver them.

## Section 4 Techniques

This section outlines the proposed research techniques to meet the objectives and outcomes defined in the previous section.

### Background

The research aims to explore the role of information design in assisting a student achieve the tutor's planned learning goal(s) when studying using e-learning materials. To enable this to be studied a suitable environment for an empirical study will be required. It is proposed to make use of the Open University's new Virtual Learning Environment (VLE), Moodle, for this purpose. Moodle is a web-based e-learning resource.

Data for an empirical evaluation will be provided through two interventions in M883 Software Requirements for Business Systems using Moodle.

The first intervention investigates the use of e-learning materials for 'e-training'. This does not require intellectual skills from a student. This intervention is based on Chapter 3 of the course set book<sup>1</sup>. The aim of this chapter is to define a 'product purpose' for the project. Moodle QUIZ resources such as multiple choice questions or cloze delete sentences would replace some of the existing study exercises in the printed material. This provides a formative assessment of the student's knowledge at an early stage in the course before TMA01, and serves to introduce online assessment to the student.

This serves as a contrast to the second intervention, which explores the use of e-learning to assist students acquire a new technique. This requires the student to use their intellectual skills. The literature suggests a mixed record in using e-learning materials to develop intellectual skills. This second intervention is based on Chapter 5. The students act as teams of requirement analysts and, using the 'product purpose' as a guide, elicit detailed requirements from stakeholders. They document the answers using a Requirements Recording Tool supplied with the course. This work contributes towards the summative assessment in TMA02. The proposed intervention is to enhance the groupwork element primarily by using Moodle's WIKI resource to support communication and information sharing, though other tools will be used as required.

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<sup>1</sup> Robertson, S. and Robertson, J., (1999), *Mastering the requirements process*, Addison-Wesley, London.

Moodle’s BLOG will be useful in this intervention for students to record their reflections. This will provide data on how well the intervention and accompanying tools, worked.

### Sample Size

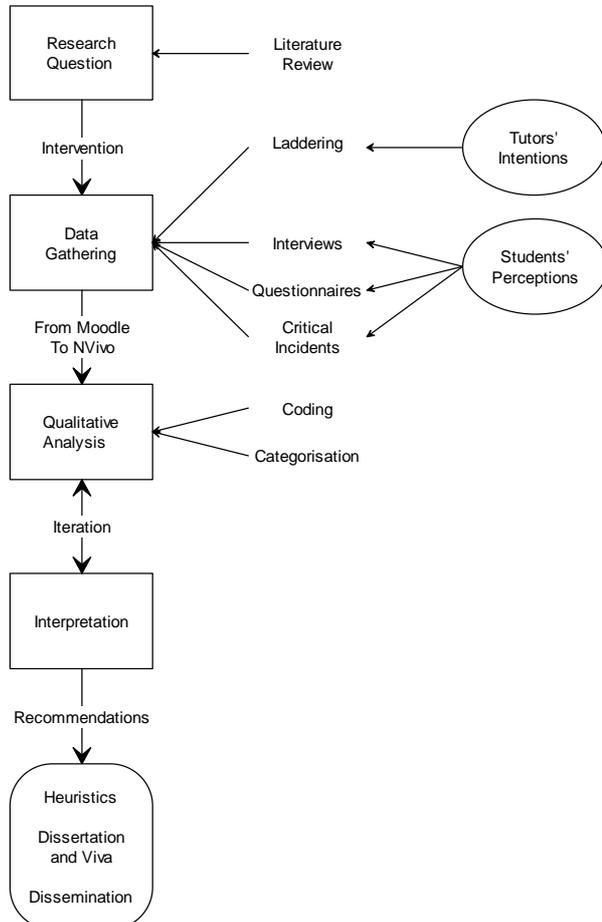
The course team expect there will be 150 students in each presentation of M883. Of these, approximately 70% will complete the course. Of those, some 50%, with encouragement, may complete the questionnaire. Therefore, the sample size is likely to be about 51-52 respondents per presentation.

This will be supplemented by opportunistic interviews. It is also planned to conduct interviews with students who abandon their studies. In both cases, there will probably be less than ten people in each survey.

### Overview

These tasks will be used to achieve the research outcomes. Their relationship to each other and the PhD dissertation is shown in Figure 3: Research Design.

**Figure 3: Research Design – relating research techniques to research tasks**



The next sub-section documents the data handling techniques in more detail.

## **Methods**

### **Questionnaire**

The questionnaire allows a larger number of students to be included in the survey than if interviews alone had been conducted. The larger sample size will improve the reliability of the results owing to the greater opportunity for repetition of codes and the possibility of more categories emerging from the data.

There are two options for delivering the questionnaire: making use of the existing student survey questionnaire process, and Moodle.

The former has the advantages of being a known process, both in the sense of the students being familiar with it, as well as it being proven with the data gathering being already systems in place.

A Moodle questionnaire:

- has no delivery costs;
- is delivered to the correct survey population;
- is accessible to the students;
- has readily exportable data; and
- has tools to track the return rate.

For eliciting views at the start of – and during – the course, Moodle has the advantages described above. For a retrospective questionnaire, however, it is less suitable as the student will have to return to the online course materials and this may affect the response rate.

For a questionnaire at the start of the course to examine a students' expectations Moodle is the preferred delivery mechanism for the reasons given above. For a *post hoc* study of a student's experiences, the service provided by the OU Student Survey Office may well be more appropriate.

The questionnaire, of either delivery method, will investigate the influence of information design on the students. This will be through two types of question. Firstly, there are those that can be answered using a pseudo-Likert scale, aimed primarily at confirming the core concepts that underlie information design such as navigability of the online material. Then there will also

be open questions, answered in free-form text. These will explore the students' expectation of and reaction to the interventions. Open questions are needed to ensure that any categories emerge from the students' answers not the researcher's questions.

The second method of data gathering is through interviews.

### **Interviews**

Student interviews may be used to supplement the questionnaire data by permitting a greater exploration of the emergent categories. This will be reviewed as part of the data analysis work.

Interviews will also be used on an opportunistic basis:

- to follow up a critical incident;
- to explore with students' who do not complete the course, the possible influence of information design on their decision.

The interviews will be semi-structured to ensure that the core concepts of information design are covered, yet are flexible enough to capture other issues that place the core concept in context.

Interviews will be face to face where possible, though as the students are geographically dispersed telephone interviews may be substituted as required.

Questionnaires and interviews are scheduled according to the needs of the students' course – they must not interfere with their studies and learning outcomes. This means they may not fully capture a students' reaction to the interventions. This problem can be addressed through another data gathering technique: critical incident reports.

### **Critical Incident Reports**

The students' views will be supplemented by enabling the students to record critical incidents at the time they happen. This can be achieved using standard Moodle activities such as BLOG and DIALOGUE.

This will permit the recording of particular events that influence a student, positively or negatively, at the time they occur. The reports may be followed up with an interview, or further online communication once the student has had time for reflection on the incident.

This data will help in understanding any conflicts that may arise from the students' dual role as learner and user. It will also enhance both the validity and the reliability of the questionnaire data regarding student perceptions of the e-learning materials.

The three data gathering techniques will be used to elicit the students' views.

### **Laddering**

To understand the intentions of the course team in designing the course material a more rigorous form of elicitation than an interview is proposed.

Laddering is similar to a structured interview. It is a hierarchically-structured technique using pure language for eliciting categorisations, hierarchies and levels of explanation.

This information will be matched against the categories that emerge from the student data, to help understand how well the information design has conveyed the course team's intentions.

These four techniques, questionnaires, interviews, critical incident reports and laddering, will provide the raw data for analysis. The next sub-section considers the use of these techniques in data gathering and analysis.

### **Data Gathering**

To investigate the potential mismatch in the use of e-learning materials the views of both authors and students will be sought. The authors' intentions for the material will be elicited using laddering interviews. The students' perceptions will be sought before and after the course through questionnaires.

Issues in the UI interface arising from the students' dual role as learner and student will be captured by through Critical Incident Reports. Opportunistic semi-structured interviews may be used to follow up these reports if more detailed information is required. These will be valuable in assessing any differences between the two interventions and the different nature of the activities involved.

The students' level of satisfaction with their learning will in part be covered in the end of course questionnaires. The results will be compared to the results obtained in the students' assessments. The existing IET Student Statistics Office questionnaires will be supplemented by additional questions relating specifically to the role of information design in the interventions. This will be supplemented by semi-structured interviews, the structure of which will be derived from an initial analysis of the questionnaires.

Opportunistic semi-structured exit interviews will be conducted with students who drop out of the course too, to elicit their views on the course and especially if information design had any bearing on their choice to leave.

The use of multiple sources of data gathered through different techniques will permit triangulation of the data to enhance its validity and reliability.

### **Qualitative Analysis and Interpretation**

The collected data will be coded to assist in categorising and pattern searching. The data is primarily qualitative as this is exploratory research, eliciting opinions.

The tutors' intentions will provide the initial codes to analyse students' perceptions. It is expected that additional codes will emerge from the latter data. These codes will help refine the opportunistic semi-structured student interviews. The interviews will help explore the relative significance of the codes and emerging categories.

*Ad hoc* data relating to the user interface aspects of the e-learning material will be incorporated from the Critical Incident Reports. This data will be particularly useful in relating information design to navigation between individual tasks as part of a larger learning activity.

Data from the questionnaires and interviews to elicit the students' satisfaction will be coded to determine if there are themes that match those already identified in the students' perceptions.

The codes can then be categorised to identify significant principles that can inform the development of heuristics.

### **Analytical Techniques**

The primary analysis will be typological – categorising events and behaviour to identify patterns and themes in the data. Ideally, this will produce mutually exclusive patterns but in all probability, the results will overlap so producing a taxonomy rather than a typology.

Given the expected amount of data, software will be used to assist in its coding and categorisation.

The analysis will be software assisted using the recently released NVivo7 to ensure a systematic categorisation of the data.

### **Conclusion**

This section has documented the four proposed data gathering techniques (laddering, questionnaires, interviews and critical incident reports), the proposed sample population, to be drawn from M883, and the use of a software tool, Nvivo7, to assist with the data analysis.

The next section expands this description of the techniques into a work plan to deliver the research outcomes.

## **Section 5 Work Plan**

This section outlines the overall work plan proposed for the delivery of the PhD to meet the research objectives and outcomes stated in section 3 using the techniques described in section 4. The scope of this work plan includes the research itself, and writing it up in a thesis and defending it in a viva.

The section has three sub-sections. Firstly, the overall schedule is presented as a pseudo-Gantt chart. The plan is accompanied by notes explaining the tasks and highlighting the decisions made regarding their scheduling. Secondly, risks to the plan are identified along with mitigating and contingency actions. Thirdly, other considerations such as costs and equipment are noted.

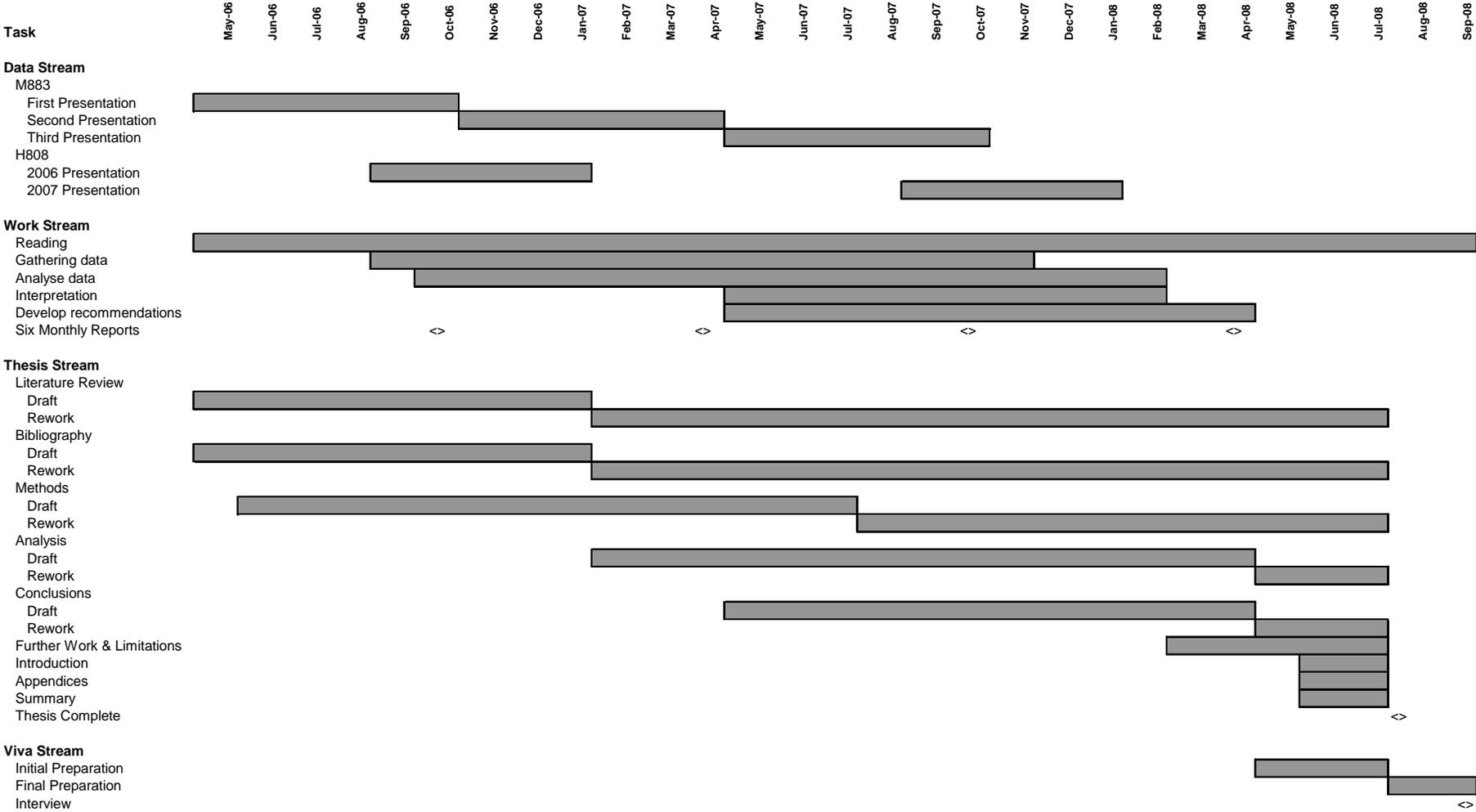
### **Overall Schedule**

The schedule is divided into four major work streams:

- Data – the availability of suitable data or the research;
- Work – the primary, high-level tasks of the research;
- Thesis – the writing of the PhD thesis itself; and
- Viva – tasks necessary to complete the final element of the PhD.

The following chart, figure 4, shows the proposed work schedule.

**Figure 4: Work Schedule**



## **Notes on the individual tasks in the Work Schedule**

*M883* – the primary data source

*H808* – the contingency data source

*Reading* – continues throughout the PhD process up to the viva itself.

*Gathering data* – potentially begins with questionnaires to students on the *first* presentation of M883. This presentation is without the proposed interventions and so can serve as a baseline to compare against later results. The main data collection is through the second and third presentations of M883. Collection should end one month after the end of the third presentation of M883.

*Analyse data* – begins approximately one month after data collection begins, and ends some three months after the last data is collected. Analysis will continue throughout the project.

*Interpretation* – begins one month after analysis. This overlap is to ensure the project is on track by validating collection techniques and analysis techniques. The analysis will continue in parallel with data gathering and both should conclude at the same time as no new interpretations should be emerging by the end of the analysis.

*Develop recommendations* – to proceed alongside the interpreting the data. This is to develop the interpretations into the research outcomes (heuristics). It will continue for two months after the interpretation work ends.

*Six Monthly Reports* – required by the Open University, included in this plan as a reminder.

*Literature Review* – aim to complete by end of calendar year, allowing for holidays this means January 2007. Thereafter, will need to be continually revised in the light of new publications and anything arising from the continued reading.

*Bibliography* – to progress in step with the Literature Review

*Methods* – writing to begin in conjunction with development of the questionnaires and interviews. Aim to complete primary draft half way through second M883 presentation, to allow time for data gathering and analysis. Thereafter subject to revision until the thesis is complete, target July 2008.

*Analysis* – writing to begin once primary version of Literature Review is complete, January 2007, which is some four months after the analysis itself began. Primary version to be

completed two months after analysis itself completed, and in conjunction with the Conclusions section.

*Conclusions* – writing to begin in conjunction with developing the conclusions, and will finish when the recommendations task finishes. It is expected that the write up of the analysis, conclusions and recommendations tasks will influence each other. The recommendations themselves will be included within the ‘conclusions’ section.

*Further Work and Limitations, Introduction, Appendices and Summary* –the last four sections of the thesis are not shown as having separate draft and rework stages for they are produced late in the project and are of much smaller scope than the previous sections. A separate formal primary draft will not be produced for them.

*Thesis Complete* – target date is beginning August 2008. This will allow two months for the external examiners to read it before the viva. This timescale may have to be reviewed as it includes the August holiday period.

*Initial Preparation* – begin with completion of the primary drafts for all the main sections of the thesis.

*Final Preparation* – to begin once the thesis is complete and submitted to the external examiners.

*Interview* – target date is September 2008

### **Key Risks to Plan**

*Sample sizes – insufficient data returned:* This will mean there is inadequate data for analysis. It can be mitigated by designing the intervention so that students will be encouraged to provide the data. The contingency is use a different intervention.

*Data quality:* This can be a concern with qualitative methods, reliability and validity will be addressed by using two data gathering methods (questionnaires and interviews), and gathering data from two presentations of M883.

*Initial Design Workload:* There is a high risk period in Summer '06 as both questionnaires and interventions must be designed, piloted and implemented in this period with no float in project plan. There is no mitigating factor available. The work schedule would have to be rethought.

*Availability of Intervention Environment:* If any element of the environment is not available, or if M883 cannot be taken into Moodle, then the project cannot proceed as planned. Close liaison with Phil Butcher and Niall Sclater is being maintained. Contingency actions are:

- 1) Use own Moodle, though this has hardware and support implications,
- 2) Use H808 for research, though this has timescale implications,
- 3) Use other OU courses, though this has timescale and organisational implications.

A full project risk register is maintained in [\\penelope\MCSUsers\MCS-Groups\Computing\E-Learning\\_Envrmt\\_Eval\\_Project\Project\\_Plans\RiskPlan2006-05-25.doc](\\penelope\MCSUsers\MCS-Groups\Computing\E-Learning_Envrmt_Eval_Project\Project_Plans\RiskPlan2006-05-25.doc).

### **Other Considerations**

The plan does not show any communication tasks, such as attending conferences or writing papers. Sufficient float has been left in the schedule to allow the completion of the tasks, though their exact timing cannot be shown as it is not known currently.

The project does not require the development of new software.

The project does not require additional dedicated equipment.

Therefore, there are no costs arising to the project from the above two considerations.

There are no issues regarding accommodation, nor access to supporting functions, such as printers.

The project does require the consent and support of staff across the OU. More detail is given on these in Appendix A: Stakeholders.

The ethical considerations arising from working with the project's participants are presented in Appendix B: Ethics.

### **Conclusion**

This section has shown how it is planned to deliver the proposed research. The overall schedule and risks to the schedule have been presented, supported by annotations.

The next section of this report covers what will be done with the outcomes of the research, and the expected benefits.

## Section 6 Contributions

This section presents the use to be made of the research outcomes, and how they will benefit the HCI community.

### Intended Benefits

The research will produce information providing greater understanding:

- of tutors intentions and student perceptions in the use of e-learning materials with guidance to help identify matches and mismatches;
- of interface design from a student's perspective – both as learner and user, and any contradictions that may arise; and
- of the overall student experience when learning with e-learning materials to set the limits and relative importance of information design in context.

This understanding will be used to develop supplementary heuristics for the design and evaluation of web-based e-learning materials, with the aim of addressing the gap identified by Squires and Preece in 1999. The heuristics will enable web-based e-learning course authors and developers to assess their materials while writing them. This will reduce development cost and time as less rework will be necessary than if the issues are identified later in the development process, for example, during user evaluation.

### Dissemination

An important element of any research that it is communicated to the relevant academic community and makes a contribution to that community.

This work will be disseminated through a variety of conferences, meetings and presentations. These may include:

- meetings purely within the Department of Computing, such as to the HCI Research Group;
- across the Open University at annual events such as the Teaching and Learning Conference or IET's Computers and Learning Research Group Conference;
- outside the Open University at conferences. Major conferences to be considered include CHI in the spring of each year, NORDICHI in the autumn of every second year, and the

various BCS HCI Special Interest Group conferences. Other conferences will be considered as appropriate. The current 'Call for Papers' are being kept so as to provide a calendar of opportunities through the next two years' work.

Where appropriate, and with guidance from the supervisory team, the work will be communicated in articles too. This may be in a formal, peer reviewed journal, such as *British Journal of Education Technology*, or in a less academic, practitioner-based setting such as *UX matters*, a web site for the 'user experience community'. Interim results and deliverables may also be written up as Technical Reports produced within the Department.

Initial communication will be within the HCI community as the work is based in the Department of Computing and uses HCI as its primary focus. As the research progresses, and based on feedback from the first presentations, the communications can be modified to suit the other audiences of this cross-disciplinary topic.

Interim presentations to doctoral colloquiums and conferences, and journal articles, are highly valuable as a means of recording and validating the progress of the research.

## **Conclusion**

This report has set out in four main sections:

- the literature review to highlight three gaps in our current knowledge of designing and evaluating e-learning materials;
- a research question to investigate the ability of information design to address these gaps;
- the techniques to be used in the research; and
- the overall work plan for the research.

This concluding section documents the proposed benefits to the HCI community from the research and the dissemination of these benefits.

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# Appendix A Stakeholders

## Immediate Stakeholders

There are two groups of immediate stakeholders:

- my research supervisors: Dr Shailey Minocha, Dr Pete Thomas and Professor Josie Taylor; and
- the M883 Course Design team: Dr Pete Thomas, Dr Steve Armstrong and Dr Shailey Minocha.

These two groups are intimately involved with the success of this research being the key enablers of, and primary reviewers for, all activities and deliverables. They share a stake in the successful outcome of the work.

## Inner Circle Stakeholders

These are key individuals within the Open University who are gate keepers to resources required by this research.

Alison Ashby, IET, Head of Student Statistics Team

( ☎ 53919, ✉ a.n.ashby )

Is in charge of the current student surveys, and can co-ordinate and assist with the distribution of supplementary surveys such as this work may require. Also co-ordinates all such requests so that students do not receive too many such survey requests.

Barbara Poniatowska, Maths and Computing, Course Manager,

( ☎ 54887, ✉ b.m.poniatowska )

All changes to course materials produced within the Faculty of Mathematics and Computing are to be cleared with her.

Christina Lloyd, Student Services, Head of Teaching and Learner Support

( ☎ 59357, ✉ c.k.lloyd )

Similar role to Alison Ashby, can assist with conducting surveys. In particular, can give approval to such work.

Gill Kirkup, IET, Senior Lecturer

( ☎ 52412, ✉ g.e.kirkup )

As course team leader for H808, can give permission for the use of her staff and students as participants in this work.

Joan Stewart, AACS, Project Manager

( ☎ 52928, ✉ j.m.stewart )

Is interested in the development of e-assessment tools and can provide practical help and experience to the development of the interventions.

Mat Schencks, Policy Development Group, On-line Communication and Collaboration Project Manager

( ☎ -, ✉ m.schencks )

Is interested in online collaboration tools for social learning.

Niall Sclater, Policy Development Group, VLE Programme Director

( ☎ 54527, ✉ n.l.sclater )

As director of the OU's VLE strategy can give permission for this work to use M883 in Moodle. This work requires that M883 be used in Moodle ahead of the original conversion schedule.

Philip Butcher, LTS, COLMSCT Fellow/VLE e-Assessment Project Leader

( ☎ 53730, ✉ p.g.butcher )

Is interested in e-assessment at a strategic level, and can ensure the necessary Moodle activities are available for this work.

Contact details taken from The Open University Intranet Staff Directory; information last checked Tuesday 23 May 2006.

### **Outer Circle Stakeholders**

These are individuals and groups who do not benefit directly from the work nor act as gate keepers to resources, still have a role in supporting its successful conclusion. These include three professional groups:

- Probation assessors;
- External examiners; and
- Academic community.

These groups represent the stakeholders who can provide validity to this research as well as providing the larger discourse to which this research will contribute.

There are also two personal groups:

- Peers; and
- Family.

These groups provide the support, encouragement and informal feedback to ensure successful completion of the research.

## Appendix B Ethics

All work will be conducted in accordance with the Open University's guidelines on Ethics as set out in the U500 course materials and seminar 'Ethics in Research' delivered as part of the U500 course, 5 December 2005. Approval for work will be sought from the Open University's Student Research Project Panel and the Human Participants and Materials Ethics Committee prior to conducting the individual work elements.

The primary ethical concern is the respect of the individuals who participate in the research.

The purpose and use of the research will be explained to all potential participants.

Explicit consent will be requested in accordance with Open University guidelines to participate in the interviews and questionnaires. There will be no compulsion on an individual to participate. To eliminate any potential bias arising from a self-selecting sample, the reasons for non-participation will be requested, though there is no obligation on the person to reply.

All participation will be voluntary and involve no payment to the participants.

The development of interventions for this research will not affect the ownership of the Intellectual Property Rights of the teaching materials within which the interventions occur.

Students' participation, or non-participation, in the research interviews and/or questionnaires does not affect their assessment on the course.

Note, that students' participation in the interventions will benefit their assessment in the course as they will be designed that way so as to encourage their use.

If they so choose, a participant's responses may be removed from the documentation at any time. All responses, and summaries of responses, published in any form arising from the work, and in the thesis itself, will be anonymous.

The collection and analysis of the data will be retained to permit retrospective analysis for bias and so ensure the veracity of the results.