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What Value has Design in Computer-Based Learning (CBL)?: An Analysis from the Student Perspective

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Abstract

In recent years the use of Computer-Based Learning (CBL) has become the focus of much attention, for a range of stakeholders, in Higher Education and beyond. The research in the area of CBL has largely focussed on comparisons with more traditional forms of teaching and has used measurements of learning achieved to draw conclusions regarding CBL. Although the case for considering students as consumers and the need for learner centred approaches has been strongly made, there has been little in depth research on the student perspective regarding the instructional and interface design of CBL materials.

This thesis seeks to address this by eliciting the views of students using CBL material within Higher Education and Business, regarding the design of a range of CBL material currently in use. The results reveal the importance of providing a range of options within the design of the CBL material in order to cater for the range of learners concerned. The results reveal the complexity involved in meeting user needs and wants when both cognitive and affective domains are considered. Importantly the use of graphics, multimedia and interactivity is revealed to have both direct and indirect value for learners. The use of on-screen text has been shown to have clear value in terms of information transfer, but to become problematic for users where it is perceived as over-used.

This thesis concludes that there are benefits to be gained from the inclusion of multimedia and interactive elements within a wide range of CBL material, currently in use in Higher Education and beyond. There are also benefits for learners in the provision of both information transfer and problem solving modalities. In order to cater for a range of users the design of the CBL material should offer quality and flexibility within both instructional and interface design elements and that flexibility should be under the control of the users concerned.

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Glossary of Terms and Abbreviations

AI	Artificial Intelligence
ASSIST	Approaches and Study Skills for Students
CAL	Computer Aided Learning
CBL	Computer Based Learning
CTI	Computers in Teaching Initiative
DMLE	Design & Manufacturing Learning Environment
EI	Educational Intervention
ELTHE	Evaluation of Learning Technology in Higher Education
EPS	Electronic Performance Support
GUI	Graphical User Interface
HBS	Harvard Business School
HCI	Human-Computer Interaction
KSTBB	Knowledge, Science or Technology Based Business
LTDI	Learning Technology Dissemination Initiative
MENTOR	Multimedia Educational Technology for Operational Research
MNE	Microsoft Networking Essentials
OR	Operational Research
SEI	Strathclyde Entrepreneurship Initiative
SHS	Scottish Hotel School
TALiSMAN	Teaching and Learning in Scottish Metropolitan Area Networks
TILT	Teaching with Independent Learning Technologies
TLTP	Teaching and Learning Technology Programme
TLTSN	Teaching and Learning Technology Support Network

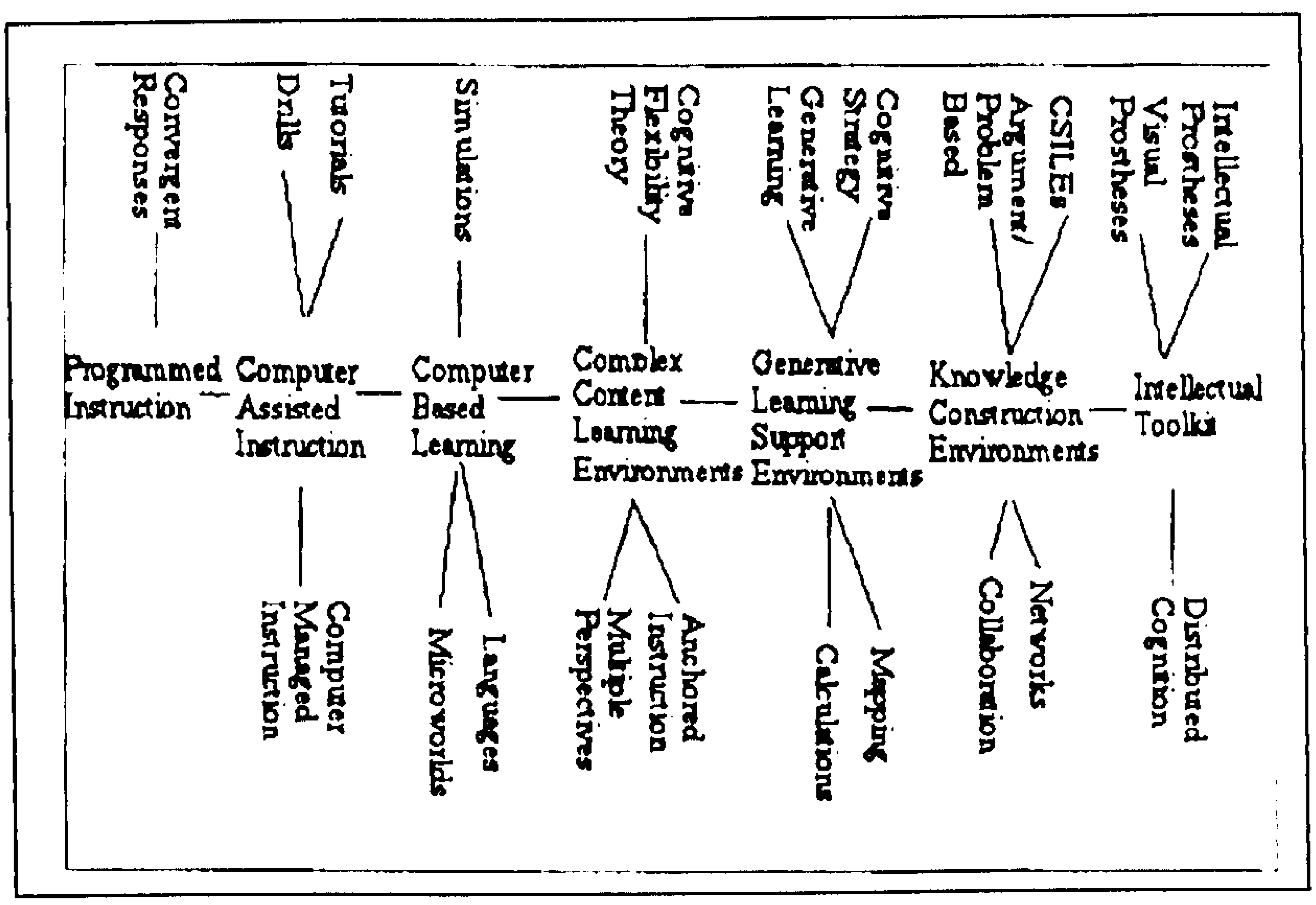
Chapter 1: Introduction

1.1 Overview of Introduction Chapter

This chapter provides an overview of the issues which define the importance of this research and indicates the perceived gap in the literature which it strives to fill. The subject is one which is of interest to a range of stakeholders and will be examined briefly from each of these perspectives, setting the scene for the literature review which follows in chapter two. The chapter also provides a brief overview of the research which has been conducted.

While mention is made of higher order uses of computer learning technologies (see Figure 1.1) the focus of this research is on learning which is primarily achieved using computer-based material. Within this thesis such material will be referred to as CBL material.

Figure 1.1: A Brief History of Computer Learning Technologies



(Source: Jonassen 1993, p332)

The research was undertaken with the aim of investigating the currently held views of learners in Higher Education and beyond, regarding the computer-based material in use. The research has investigated five different CBL packages, of differing levels of sophistication and in use in different contexts. The feedback from the learners concerned has been considered in relation to the current thinking as demonstrated in the literature.

1.2 Importance of, and Motivation for, This Research

The subject of this research is important because the requirements within Higher Education have changed and if the wants and needs of learners undertaking Higher Education have to be met by computer-based materials, it is important that we can form as clear an understanding of the issues involved as possible.

This investigation was inspired by a combination of personal experience, anecdotal evidence, and material from the literature. Personal experience, as both a teacher and a learner, had suggested that human learning was multi-faceted on many levels and that lack of attention to this would be likely to result in lower levels of learner engagement in the learning process. The anecdotal evidence had been gained over many years within a range of educational environments and had suggested that perceptions of the educational process and views held regarding the value of elements within the process varied widely both in educators and learners. The material from the literature included views of educators, psychologists, technologists and learners. These views tended to suggest that the perspective from which the learning experience was viewed was likely to affect the relative value attributed to the type of learning experience and therefore the component parts highlighted as important. Given the espoused importance (Laurillard 1993) of a learner-centred approach to teaching and learning, it was considered that research addressing the learner-centred views on the effectiveness of the use of computer-based material for learning would be of value.

Educational technology is developing at an ever increasing rate and we are faced therefore with a difficult task when attempting to draw conclusions on the value of such for learning. However the human race evolves slowly and the learning processes continue to have many of the same characteristics and needs as they had prior to the changing technology. It may therefore be argued that the learners themselves are best placed to offer real feedback on the value for them of any given learning experience.

The aim of this investigation was thus to offer current insight regarding the learning experiences offered by computer-based packages being currently used, within real learning situations, involving real demands being placed on the learners concerned.

1.3 Stakeholders Involved in the Development and Use of Computer-based Learning Material

The importance of the stakeholders involved in the development of computer based materials is highlighted by Robinson et al (1998):

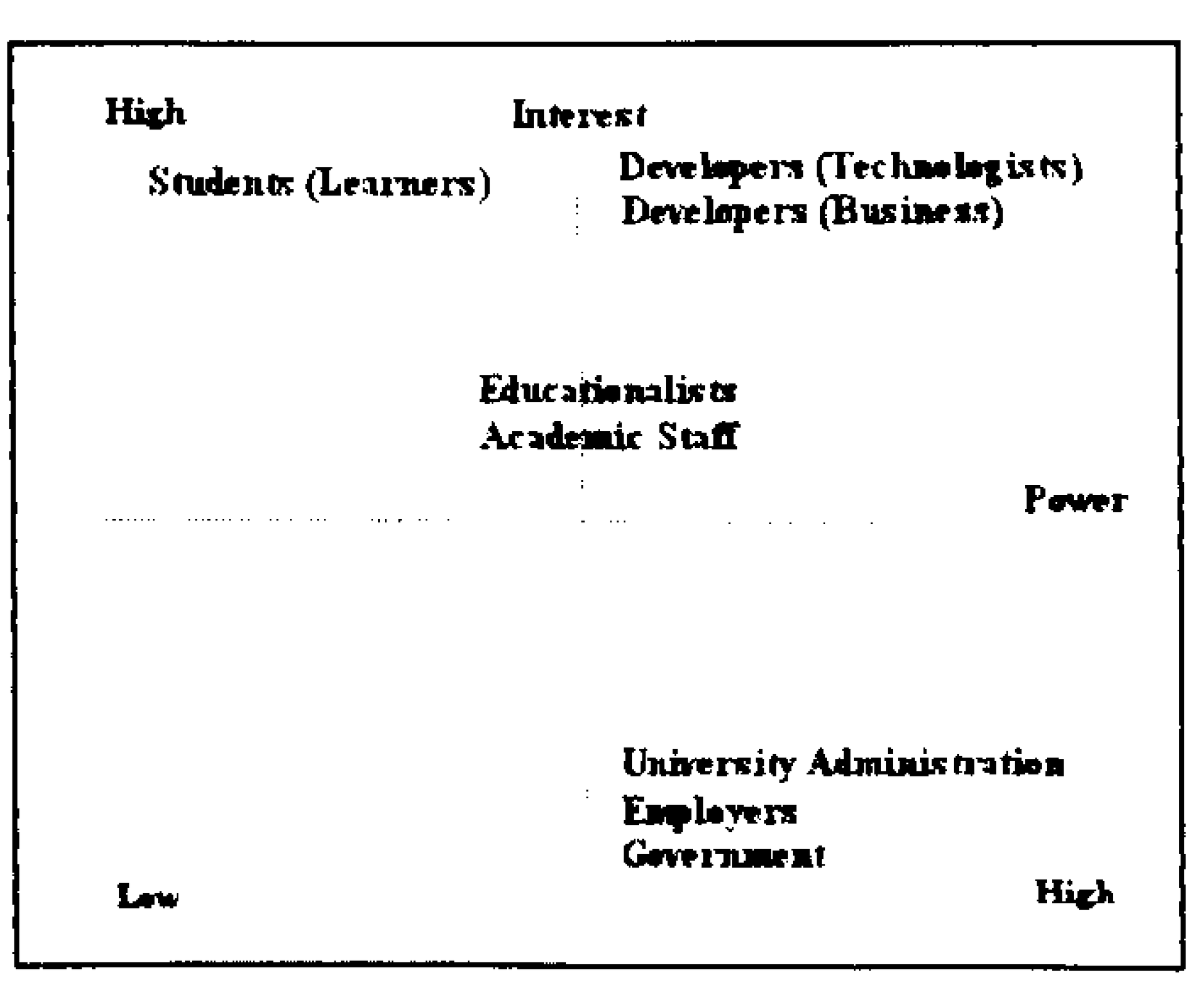
"In developing technology-based environments we encounter not only the barriers presented by the learner, ... but also those presented explicitly or implicitly by all the stakeholders involved in the learning process." (Robinson et al 1998, P52)

A range of stakeholders are involved in learning and teaching per se and the range increases when we move on to consider CBL. The stakeholders involved may be taken to include: Government / university administration, educationalists, developers (technologists / business), employers, academic staff and students. Stakeholders are likely to hold a particular perspective on the design, production and use of computer-based material, with each primarily focussed on their particular priorities, in descending order of perceived importance.

Power in this context is regarded as the decision making capability which permits the stakeholders concerned to make changes should they so wish. Interest is regarded as a combination of the stakeholders' level of awareness of the issues and potential level of impact of decisions made on the stakeholders concerned.

The power / interest diagram below (see Fig 1.1) indicates the likely locations on these dimensions where the learners are not regarded as central to the CBL provision offered.

Figure 1.2: Power / Interest Diagram



The level of interest in the provision of CBL may be high while the level of power is low, or vice versa, with variations between. Those with the maximum level of power within the relationship are likely to steer the development in the direction they prefer. The power level may be influenced by commercial or business issues, concerning such resources as time and money, by technical expertise and specialist knowledge such as programming skills, or by political influence such as hierarchical power within an educational institution. The party with the highest "interest", yet lowest "power", is likely to be the learners. However, if we take the view that the learner should be the central focus of the provision and that the meeting of learner needs and expectations as "customers" should be our desired goal, this is likely to change the power / interest position of learners. Where the interest of learners is accepted by all other stakeholders as the highest priority, understanding of the needs and expectations of learners should drive the instructional design of computer-based material. The instructional design should then drive the selection and use of appropriate media. The selection and use of appropriate media should then drive the level of graphic design and programming required, in order to produce a computer-based package which meets the needs and expectations of the learners concerned. The importance of this paradigm shift is highlighted by Reigeluth (1999), who stresses that there are clear implications for instructional design theory and nature of design decisions made.

1.4 Previous Research

Those who have worked in this arena include educators, psychologists and technologists. There has been a tendency in such research to construct experiments which set out to test "learning" where computer-based material is involved. There has also been a tendency to compare the computer-based results, of the test concerned, to the results of those taught by "traditional" methods. Much of this research has given rise to the "no significant difference" findings which have in their own right given rise to debates regarding how such findings might, or indeed should, be interpreted (Russell 1999). The literature shows that issues such as learning styles and approaches to learning are considered by many to impact on the process and outcomes of learning. The nature of human memory and ways in which our senses are used in gathering, storing and retrieving material has been researched heavily within the realm of psychology. Alongside the "learning" element there is the area of "motivation", which the psychological literature has shown to impact significantly on human behaviour, including learning behaviour. The centrally important message is that the human learning process is incredibly complex and we are still a long way from gaining a complete understanding of how we learn. It might be argued that we are also quite a way from fully appreciating what we learn, why we learn it, and in which ways we then make use of such learning.

1.5 The Research Gap

What has not been done previously is to investigate the direct (i.e. effect on cognitive domain relating to learning outcomes) and indirect (i.e. effect on affective domain relating to motivation) impacts on a range of learners, in Higher Education and beyond, as they perceive them to be, of the design and use of CBL material. This takes us beyond the realm of test, re-test, involving actual recall or answering of content based questions. Here we must attempt to take into account the complexity of human behaviour and the components within such which contribute to learning. This takes us into the complexity of human perception, cognition and motivation. We must take account of the cognitive and affective domains and acknowledge their interdependence and their combined impact on the learner when using computer-based material. This is addressed in this research by investigating the learners' views on their experience when using the material and their perceptions of the learning achieved.

This research project was designed to focus on the gap between the research on learning as measured by testing recall of, or capability with, content presented using CBL material, and the perceived impact on the learner of the design and use of such materials, within real environments, while exposed to real pressures which may be conflicting with each other from the learner's perspective. The focus of this study was the views formed by real learners, within a real environment, seeking to achieve an educational outcome which was important for them, using computer-based materials. The perspective taken was that of the espoused approach within society today which suggests that learners should be regarded as centrally important and that the provision of "education" should focus on meeting the learners' needs in order to facilitate their learning.

This research does not address funding issues nor does it compare "teaching methods" on the basis of "cost-effectiveness". The focus is that of the impact of the use of computer-based material on learners and which aspects of such might be of value for the learners concerned. This allows options to be considered on their educational merits, without confounding the potential value for learning by introducing the constraints of commercial operations from a business perspective. While some may argue such an approach to be rather idealistic, it remains one way of presenting the possibilities offered by computer-based materials in their own right. Any issues relating to cost-effectiveness may be addressed in further research once the learners' positions, regarding the perceived value for them of the computer-based material, have been clarified.

This thesis approaches the evaluation of CBL from a different perspective, thereby offering an original contribution to the established body of research. The learner's perception of the impact of the design and use of the CBL material on their learning is investigated within and across five case studies, each of which involves different CBL material and contexts of use, utilising a range of methods of data collection and analysis, some of it longitudinal, from which overall conclusions are drawn.

1.6 Aims of This Research

This research was intended to reveal the expressed views of real learners and to offer a tangible "reality check", for those who seek to argue a case for, or against, the use of computer-based material, and the ways in which such material might best be presented for learners. The central aim of the research was to investigate the perceived value of computer-based material to learners. It was considered that this research would help to identify the direct, and indirect, impact of such materials on learners, taking the cognitive and affective domains into account.

The focus of the empirical investigation was to discover the way in which computer-based material was perceived, by users attempting to learn from such. The immediately pragmatic value in this study was that it might help inform those engaged in developing computer-based material for use within the context of the University of Strathclyde, with the wider value of the study being that it would offer a level of holistic insight into the perceptions of current users of computer-based material within a learning context. The expectation was that the study would help clarify the perceived value of so called "bells and whistles" when computer-based material for learning is involved.

The task of investigating learner perception of computer-based material for learning is complex and important as such perceptions may influence learning outcomes (Sambrook 2001). Within this research several modes of data gathering and a range of case studies were employed, with the intention that the level of triangulation achieved would permit the weaknesses of one approach to be compensated for by the strengths of another.

There was a desire to explore the arena concerned in a way which permitted issues to emerge from the data gathered rather than setting out to investigate narrowly defined hypotheses. The expectation however was that there would be added value for learners where higher levels of interactivity and increased ranges of multi-media presentation were employed within the materials concerned. It was considered that the value added might take different forms for different learners, and the intention was that the research should allow a level of clarification to be gained, as to the nature of the value added from the learners' perspectives. Notwithstanding, all efforts were made to overcome any researcher bias, as will be discussed in detail later.

The relationship considered in this research was that computer-based materials, directly and indirectly, impact on human affective and cognitive domains, thereby affecting levels of motivation and depth of learning. The higher the level of multimedia and interactivity offered, the greater the impact on these areas and the better the learning outcome was expected to be from the learner perspective (see Fig. 1.2).

Figure 1.3: Detailed Relationship Investigated: Computer Based Material and Learners

Higher levels of Interactive Multimedia offered in Computer based materials for learning	→ →	Greater Positive Impact On Affective Domain ↕ Greater Positive Impact On Cognitive Domain	→ →	Increased Motivation ↕ Increased Learning	→ →	Outcome Perceived as Valuable by Learners
Note: → denotes 'leads to...one way', ↕ denotes 'leads to...two way'						

1.7 The Aspects of Learning and Educational Technology Addressed in This Research

The area of particular interest for this study was the view of the more mature and relatively sophisticated learner, by which is meant those in Higher Education, or the workplace equivalent. This sector of education was chosen in order to access groups of people for whom: the learning path had been followed by choice; the learning involved was likely to be reasonably demanding;

and from whom a level of self-reflection might be requested in terms of responses to questions posed.

The technology of interest was computer based learning material which made use of currently available technology and employed aspects of hypermedia and multimedia. These aspects were of particular interest, as they were considered to offer possibilities for the development of learning in ways which permitted the complexities of the learning arena, in terms of presentational capability and available options enabling learner needs, wants and expectations, to be addressed more fully than might have been expected prior to their availability. The research literature in this area indicates a number of aspects of computer-based material which are likely to be important in terms of their impact on learners.

The areas with which we were concerned included: the level of challenge offered, application of learning to problem solving and decision making; interest level of tasks set; level of thought inspired; self monitoring of learning; demonstration of competency; curiosity arousal; feeling of "being there"; freedom of choice offered; reference to expert input; level of control offered; use of humour; level of engagement; level of realism; ease of use; level of motivation inspired; suitability of screen displays used; interface effectiveness; error recognition and handling; use of prior knowledge; use of improvisation; selection of material in realistically complex scenarios; use of multiple perspectives; reflection on learning; assessment used; change made in understanding; approach taken to learning; impact of interactive elements; influence of previous experience with computer-based material; impact of sound and video material and impact of high quality images.

Feedback was sought relating to what impressed the subjects, affected their level of engagement, irritated them, affected their depth of thought, ways in which their learning might be made easier, how it might be ensured they learn what they should, effect of simulation on their learning, effect of visual display on their learning, effect of video clips on their learning, comparison with other learning experiences, and their preferences for face to face learning experiences. The subjects' approach to learning was addressed, using specific questionnaires.

1.8 The Approach Adopted

This research was undertaken in order to ascertain the value, or lack of value, in making use of high end, rather than more basic levels of computer-based materials for learners. This was considered to involve all aspects of the process of learners interfacing with the learning environment, a large element of which would concern the computer-based dimension, but including the wider array of complexity which may be considered to make up the learning experience. In order to take the wide range of variables concerned into account a holistic approach was regarded as a necessity for this research.

The learner's perspective was regarded as crucial, as their experience of using the computer-based material for learning was considered to constitute reality for them, and therefore a valid evaluation of the learning concerned and the value of the materials in use. Clearly learners may vary in their awareness of their own learning. However their views of learning using computer-based materials may be argued to be valid for them, and as valid as their views concerning other modes of learning. Where the espoused aim for such computer-based materials relates to meeting the needs of the user, then views regarding the use of such are of equal importance from any user within the range for whom the material has been produced.

The cases were selected on the basis of suitability of materials in relation to the focus of the research and the degree to which access could be achieved to the students concerned in order to gather the feedback required.

The first case study involved the MENTOR "Introduction to Entrepreneurship" material for an undergraduate class. This was presented to students from a computer platform and was supported by tutor contact via email and a small number of direct contact sessions over a twelve week period. The research was conducted using questionnaires at the direct tutor contact points and interviews at agreed times with student volunteers. The students were working towards 1 credit for the class concerned, which required completion of this material and associated pieces of assessed work. The MENTOR material was largely text based, with some interactive exercises and it included graphics and hyperlinks but did not make use of sound or video material and did not involve the use of virtual worlds or simulations. Navigation was mainly provided in the form of hypertext, buttons and navigable maps.

The second case study involved the Mediabase material for undergraduate and post-graduate students in the Hotel and Hospitality Management Course (Food and Beverage Management). This was presented to students from a computer platform and was supported by direct tutor contact at both lectures and lab sessions and email contact over a twenty-four week period. The research was conducted using questionnaires at agreed contact points. The students were working towards 1 credit for the class concerned, which required use of the Mediabase material and associated pieces of assessed work. The Mediabase material used text, sound and video with some screens being entirely text, some with text and video, and others consisting of video scenarios, or navigable maps or exercises. Navigation was mainly provided in the form of menus and sub-menus.

The third case study involved the DMLE (Design & Manufacturing Learning Environment) material for the KSTBB (Knowledge, Science or Technology Based Business) undergraduate class within Strathclyde Entrepreneurship Initiative. This was presented to students from a computer platform and was supported by direct tutor contact within the single lab session concerned and both direct lecture and email contact over the twelve week period of the class. The research was conducted using questionnaires at the single lab session. The students were working towards 1.5 credits for the class concerned, which required use of the DMLE material and associated pieces of assessed work. The DMLE material used text, sound and video with some screens being entirely text, some with text and video, and others consisting of video scenarios, animations or exercises. Navigation was mainly provided in the form of menus and buttons. The DMLE material made use of a simulation within which the students could adjust given aspects of design, manufacture and marketing in relation to the product concerned and could adjust their decisions at any stage in the simulation.

The fourth case study involved the HBS (Harvard Business School) material "Launching A High Risk Business" for a post-graduate class within Strathclyde Entrepreneurship Initiative. This was presented to students from a computer platform and was supported by direct tutor contact within the single lab session concerned and both direct lecture and email contact over the twelve week period of the class. The research was conducted using questionnaires at the single lab session. The students were working towards 1.5 credits for the class concerned, which required use of the

HBS material and associated pieces of assessed work. The HBS material used text, sound and video with some screens being entirely text, some with text and video, and others consisting of video scenarios, animations, or exercises. Navigation was mainly provided in the form of menus and buttons. The HBS material made use of a simulation within which the students could adjust given strategic aspects of the business, but then had to run with the emergent effects of such decisions.

The fifth case study involved the MNE (Microsoft Networking Essentials) material "Networking Essentials" for a workplace based class within the Woolwich Building Society. This was presented to students from a computer platform and was not supported by tutor contact. The research was conducted using questionnaires distributed at three points over the flexible study period. The students were working towards an industry recognised certificate for the class concerned, which required use of the MNE material and associated pieces of assessed work. The MNE material used text, sound and video with some screens being entirely text, some with text and video, and others consisting of video scenarios, animations, or exercises. Navigation was mainly provided in the form of menus and buttons. The MNE material made use of a simulation within which the students could choose a course of action and obtain feedback on their decisions.

1.9 Review of "Introduction" Chapter

This chapter has provided an overview of the issues relating to this research and has indicated the nature of the relationships concerned. The value of this research for a range of people involved in the provision of Higher Education and the way in which this research offers a contribution to the identified gap in the body of knowledge in the area has been outlined. The nature of the original contribution offered by this thesis to the established body of research has been clarified in relation to the focus on learners, the range of cases involved and the range of methods employed in data collection and analysis.

Chapter two addresses the literature under the global headings of instructional design and interface design. The literature review which follows in chapter two is necessarily wide in that it covers the range of issues and developments involved from a range of stakeholder perspectives. The issues addressed include changes in the arena of learning and teaching, the opportunities offered by and the issues involved in evaluating, computer-based learning material in Higher Education. These are considered in the first part of the literature review, which then focuses on the instructional and interface design aspects as they apply to the development of computer-based learning material. Brief summaries are provided at central points in order to orientate the reader and highlight the linkages between sections within the literature review.

Chapter 2: Literature Review

2.1 Overview of Literature Review Chapter

This chapter provides a review of the areas in the literature considered important for the design, development and use of computer-based learning (CBL). This review addresses relevant learning and teaching issues in relation to the provision of CBL in Higher Education and beyond. For the purposes of this thesis, the research areas of central importance will be addressed. These are considered within the banners of instructional design and interface design.

Under the banner of instructional design the literature addressing perspectives on education and the nature of the student within Higher Education is discussed. This leads on to discussion of the literature highlighting the importance of learner motivation and engagement and the implications for CBL. From there the literature highlighting the importance of designer perspective is addressed. This leads up to the literature highlighting the importance of the make-up of the computer-based material from an instructional design perspective.

Under the banner of interface design the literature addressing interface design and usability is discussed. This leads on to discussion of developer perspectives and their implications for interface design.

Literature on evaluation of CBL is then discussed and the need for further research in this area is highlighted.

2.2 Design Aims of CBL

When we are attempting to evaluate the design and use of computer based material it is important that we take a range of elements into consideration. The potential range involved is reflected within the banner of human computer interaction, which is fairly clearly summarised by Preece et al (1996) as including: organisational, environmental, health and safety, comfort, task, and interface factors in addition to the cognitive processes and capabilities of the user, system functionality and logistical constraints.

There are many variations of CBL material in use within the Higher Education arena. The range of CBL material in use in Higher Education is as diverse as the nature of Higher Education topics and learning processes. This gives rise to the use of commercially produced CBL materials and also to the production of in-house products. The complexities of the needs involved in Higher Education are reflected in the development of both specific CBL materials and also authoring platforms under such banners as TLTP (Teaching and Learning Technology Programme).

At one end of the continuum in Higher Education we have computer based lecture notes which may be found in most institutions and which may be regarded as the most basic form of CBL material, using text and in some cases graphics but generally offering no further media or functionality. Computer-based tutorials may be found which offer students guidance through materials by utilizing hypertext as highlighted by Colgan et al (1994). Computer-based simulations may be found which seek to offer a substitute for laboratory experience as highlighted by Edward (1996). CBL material may also be found which offers the possibility of combinations of media at author discretion, such as the MENTOR material developed for the teaching of OR and used in a range of UK Universities, as highlighted by Thornbury et al (1996). The range of material has grown as the technology has developed and we now have possibilities for multimedia use and levels of interactivity which far exceed those on offer in years past.

The design aims of CBL are likely to vary according to specific requirements. However it is likely that in educational terms allowing all users to feel they have been stretched, and discovered new things is likely to be fundamental. The optimum aim of those involved in the design of CBL materials may be to enable users to feel they have had an adventure while undertaking their learning process. The design elements of the CBL materials are centrally important in achieving such an aim.

The central areas of design for CBL include: instructional design, and interface design. Within each of these overarching design areas the related elements of graphic design and multimedia design are also important. The views expressed within each of these areas vary according to the perspective of the stakeholders concerned. For the purposes of this research the design issues will be sub-divided into the two main areas of instructional and interface design and related design issues will be addressed in relation to the main areas being discussed.

2.3 Instructional Design and CBL

The following sections address issues of particular importance for the instructional design of CBL materials. In order to guide the reader through the wide range of issues the discussion of instructional design has been sub-divided into the following categories:

- strategic issues
- learner issues
- provider perspectives
- interactivity and the use of multimedia

2.3.1 Strategic Issues Relating to Instructional Design of CBL

The following sections provide a holistic overview of fundamental issues which influence instructional design within CBL material. Perspectives on learning as a concept, process and outcome are discussed in relation to their potential impact on the instructional design of CBL material. Issues relating to the evaluation of CBL and the impact of evaluation on instructional design are discussed as is the academic perspective on the design and development of CBL material.

2.3.1.1 Instructional Design and Understanding Learning

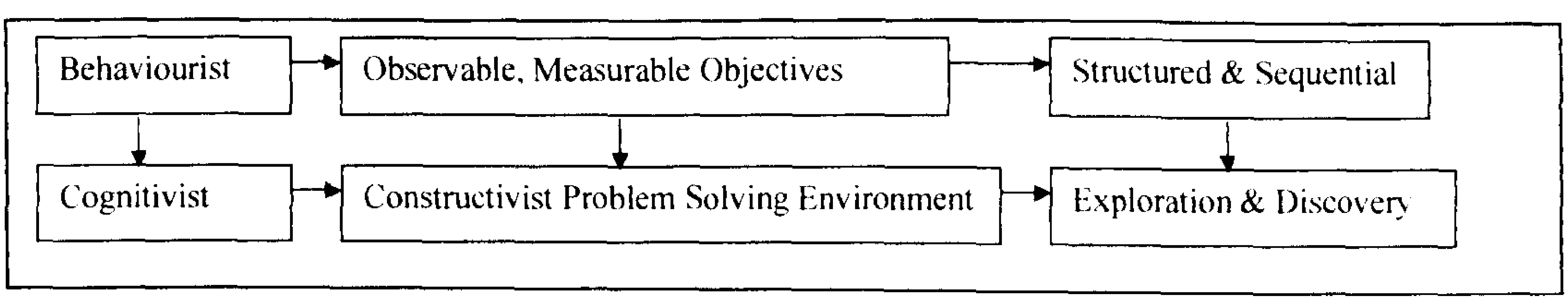
Instructional design is essentially a design for learning and therefore requires an understanding of the processes involved in learning and the desired outcomes of such processes. From an educational perspective, instructional design based on sound pedagogical principles, supported by established educational and psychological theory, should be the driving force behind CBL material. The prime purpose of instructional design should be the developing of an educational artefact which then permits those for whom it has been designed to learn. From this should emerge the reasoned argument in favour of other component parts of the CBL material.

Human learning is complex and influenced by many factors which have changed in nature and relative importance over time, utilising the available learning technology and communication options available within the environment of the time. We have formalised the process of learning over the centuries and we have created institutions and practices fashioned according to the beliefs of the time and influenced by the perspectives of those responsible for deciding on the theories to be supported at that point as highlighted by Walberg and Haertel (1992). A significant enabler of successful learning is the provision of appropriate teaching. Therefore in order to enable learners to become "self-teaching", or "independent learners", we should be clear on all requirements of learning and teaching, but the arena is of such complexity that it might be argued to be almost impossible to know all there is to know as pointed out by Draper (1997). We must temper our confidence in currently held views regarding learning and teaching by reminding ourselves that apparently established theories in the so-called "hard sciences" were revealed over time to have been misguided. The current theories regarding teaching and learning are equally vulnerable, therefore we must retain an element of an open mind when considering such.

The changes of perspective and theoretical standpoints on learning may be evidenced in the progression from associationism to behaviourism and cognitive theory, which have influenced our understanding of, approach to and provision of learning experiences as highlighted by Walberg and Haertel (1992). This is reflected in the CBL materials we design and use in education, where the instructional design of material is likely to stem from a particular conceptualization of learning and the role of the learner and the teacher, or instructor. Approaches may vary from those based on behaviourist leanings which favour a highly structured environment to the radical constructivists favouring the use of very open environments offering only minimal imposed structure.

The progression from theory to pedagogical practice and from the behaviourist approach to that of the constructivists has evolved over time, as reflected in figure 2.1 below.

Figure 2.1: Progression of Theory / Approach Over Time



The focus from the behaviourist perspective is on "outcomes", while the focus from the cognitivist and developmental perspective is on "processes". This shift in perspective has implications for the design of CBL material at both instructional and interface design levels. The influence of epistemological perspectives on design, from positivism which promotes an objectivist perspective on instructional design, to relativism which promotes a constructivist approach to constructional design, is highlighted by Reiser and Dempsey (2002).

The focus of learning has shifted from the historically valued regurgitation of information to the "retooling" of knowledge. The capabilities of critical thinking and analysis of information to be used in problem solving within complex contexts, is now considered highly important. In order to equip learners appropriately it is considered by such as Grabinger et al (1997) that they should be engaged in instructional activities which reflect the problem-solving processes likely to be encountered within such working environments. Roles of instructors and learners are changing, which may be influenced by the development of new forms of discourse as highlighted by Bayne (2000) and design recommendations are inspired by the increased drive towards learner self-regulation based on constructivist approaches as highlighted by McLoughlin and McCartney (2000). The need for continuing professional development, given the changes in the business world is highlighted by such as Brown (2000) and Luca et al (2000).

Somekh (1996) reminds us that while computer technology may have reduced the need to memorize facts the need to train the mind clearly remains, as evidenced in on-going debates regarding transferable skills. The nature of "learning" we wish to enable using CBL has implications for the type of CBL required. Romiszowski (1992) reminds us that the design of CBL material may exhibit the influence of views ranging from Skinner and his emphasis on "conditioning", through to Bruner (1966) and Vygotsky (1986) and their perspective on knowledge as a constructive process and may therefore offer learners a range of experiences, from drill and practice opportunities reflecting a behaviourist perspective, to problem solving opportunities involving complex decision making reflecting a constructivist perspective. While such views may differ significantly, employing a range of approaches may have something useful to offer, while a confrontational standpoint is likely to be less productive as pointed out by Desforges (1989).

The importance of instructional design-theory is highlighted by Reigeluth (1999) who points out that instructional design-theory is design oriented, identifies ways to facilitate learning and the situations in which particular methods of instruction might best be used. The methods concerned are considered as probabilistic in that they are likely to increase the chances of attaining goals. Reigeluth (1999) points out that values underpin the goals pursued by instructional design theory and trade-offs may be required at the instructional design level between effectiveness, efficiency and motivational appeal. He considers there is a need for a change of paradigm from one focussed on "sorting" to one focussed on "learning", with customisation rather than standardisation as an approach. Instructional design can help in the development of resources geared to meeting learner needs and wants with the goal of facilitating the development of initiative and problem solving capabilities on the part of the learners. This has underpinned the move towards the constructivist approach in instructional design.

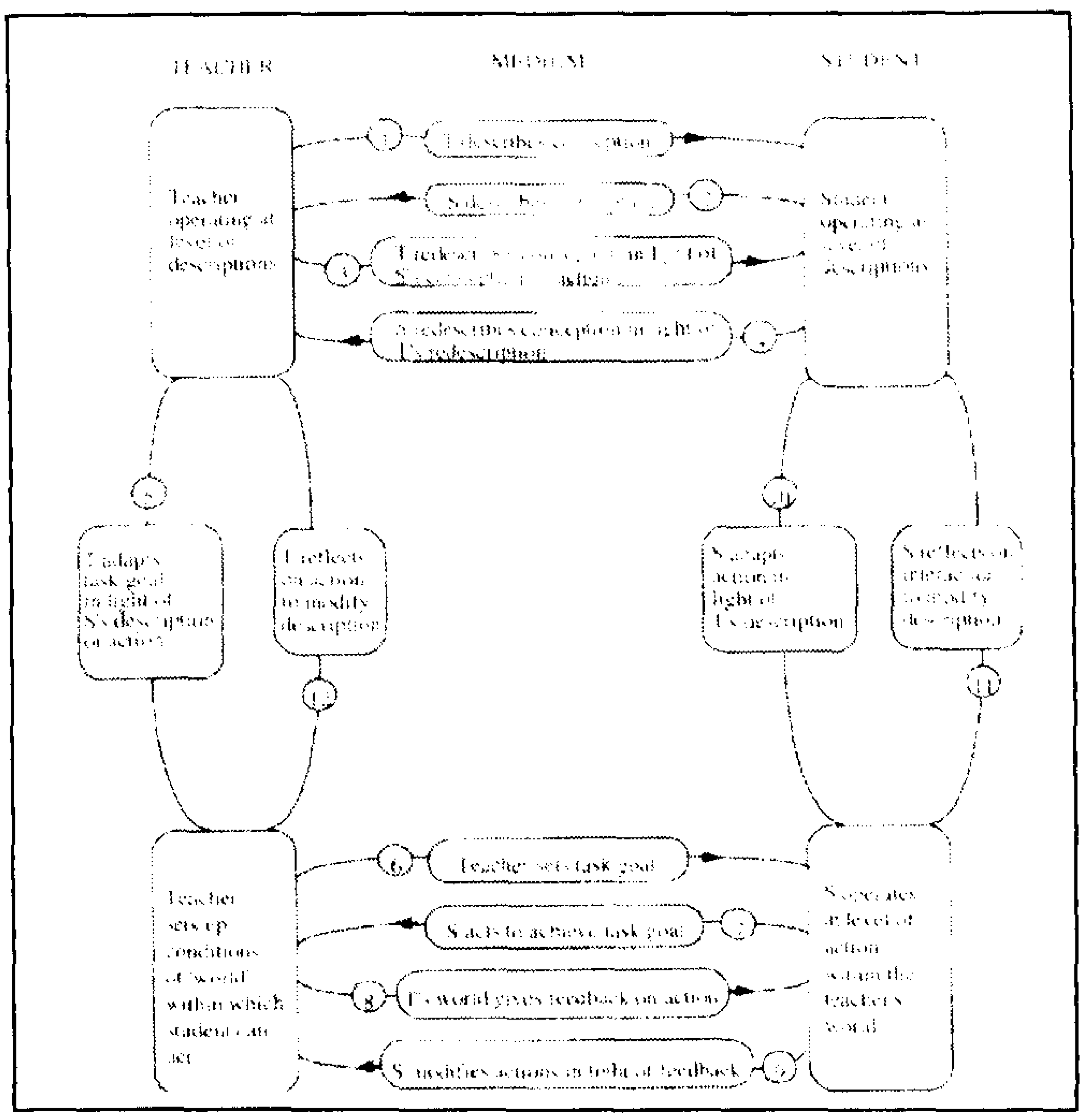
2.3.1.2 Constructivist Approaches and Learning

It is currently considered that the use of examples which are simplified and decontextualised is likely to result in what Whitehead (1929) refers to as "inert knowledge", which fails to equip learners to address problems when faced with real situations. The constructivist perspective is considered to address such issues and is currently highly favoured in education, involving the use of authentic contexts, encouragement of learner responsibility for learning, provision of activities which promote higher-order thinking, and the assessment of content and learning processes using realistic tasks within authentic contexts as highlighted by Grabinger and Dunlap (1995). Authentic contexts are considered to offer greater ease of retrieval of that which is learned. The use of such an approach involving realistic problem solving experiences for learners is considered likely to lead to learners gaining deeper and richer knowledge structures which offer a higher likelihood of transfer to novel situations as highlighted by Grabinger et al (1997). From a constructivist perspective the importance of learners constructing "schemata", which they then use to inform further learning, has implications for CBL material, as it should enable learners to build on existing schema and provide support for them in constructing new schema as highlighted by Somekh (1996). This requires that learners be given personal control over the pace and direction of their learning, which would reflect their developing understanding.

The changing nature of Higher Education, moving from the traditional face to face model to one relying heavily on resource based learning, is considered by such as Twining et al (1998) to create a need for CBL material to support student learning. However the degree of learner control enabled and the extent to which "resource based learning" may be considered by such as Laurillard (1993) to be tantamount to a "dereliction of duty" on the part of the provider is an aspect of considerable debate in Higher Education.

Laurillard's Conversational Framework highlights the importance of the two-way communication process involved in learning and the iterative nature of the learning process (see Figure 2.2).

Figure 2.2: Laurillard's Conversational Framework



(Source: Laurillard 1996, p103)

This perspective is argued by such as Montgomery Masters (2000) and Goss and Kerr (2000) to be an appropriate model to underpin instructional design.

There are many implications for the design of the CBL Material when we attempt to support such a pedagogical model. These must be taken on board from the outset or there is a danger that the model concerned may be compromised. The importance of integrating the pedagogy concerned in the instructional design of CBL material has been highlighted by Hinostroza and Mellar (2000), as has the requirement for appropriate levels of learning and instructional demand within the instructional design by Lee (2000). Authentic scenarios, reflection, articulation, student mediation roles and a technology supported environment for creating contexts have been highlighted as central to the instructional design of a problem based multimedia resource by McLoughlin et al (2000). It is considered by such as Naidu (2000) that cognitive support tools should be incorporated into inquiry based learning environments. While the value of problem based learning environments may be accepted, caution is advised by Riedel et al (2000) regarding the time consuming nature of the design and implementation aspects of such. These issues are all relevant for the development of CBL material and the fact that such issues are still the subject of academic debate suggests that we have not yet addressed them to a level where we may accept the resulting CBL material fully supports the pedagogical model we would desire.

That there is a need for CBL material to enable learners to be able to re-visit, or re-address material at various stages is clear. This is necessary even within a constructivist model in that the construction may require use of previously accessed material. The limitations of human memory capability create a need for re-addressing material and may be related to the "spiral curriculum" concept proposed by Bruner (1960), which suggests that learners should be introduced to concepts, in a variety of different ways, over a period of time. The strengths of CBL might be argued to be particularly appropriate for offering such an approach. However where the approach taken by the designers involved relies on repetitive use of software without variation there is a risk of monotony and such material fails to offer all that the technology capability might enable. The use of CBL material which is interactive may be argued to offer a level of support, or "scaffolding" for learners. While fairly basic feedback and the setting of further tasks may create an incentive for the student to continue working, it is important to note the point made by Somekh (1996) that simply setting and answering questions may fail to achieve this where it is perceived by users as dull.

The importance of "situated" learning has been highlighted by Brown, Collins and Duguid (1989) and is considered to clarify the meaning of that which is to be learned and provide support in terms of context, rather than expecting learners to deal with abstract representations. CBL approaches may "situate" the learning by simulating real circumstances, or by offering an environment such as a "microworld" within which learner expectations are managed and the resulting learning experience may be considered as authentic within such. This is particularly relevant where a constructivist approach is concerned in that the knowledge constructed will benefit from the situated perspective.

The design of the CBL material may be guided by the metaphor in use, in that the material may be based on an acquisition metaphor, or an activity metaphor. These are likely to reflect the underlying philosophy employed by the designers of the material. The emphasis has shifted from that of acquisition to that of activity, which reflects the shift in philosophy from that of behaviourist to that of constructivist.

2.3.1.3 Changing Expectations and CBL in Higher Education

Previous expectations of those promoting the benefits of CBL, regarding the use of CBL material, appear to have been over-optimistic in hindsight as highlighted by such as Jacobs (1992, 1998), Oppenheimer (1997), Meek and Meek (1998) and O'Hagan (1999). However technology and expectations have moved on regarding standards of presentation provided to users. The issue of expectations is a complex one and it highlights the difficulty of satisfying users in education. That said, a number of the benefits offered by CBL today, were also claimed in relation to the early teaching machines. These include self pacing of learning, patience with learners and the provision of consistent responses to learners. Novelty value of using such early technology was also considered potentially motivating, as may be argued for the current technology. The impact of educational philosophy and subsequent pedagogy was reflected in the move to "discovery learning", which resulted in the early teaching machines becoming displaced as they could not facilitate the new approach to learning. As Jacobs (1994) points out, the technology progressed and the possibility of offering a discovery learning approach using a teaching machine became possible. Clearly pedagogy and technology are dynamic in nature and their influence on each other should not be underestimated.

As pointed out by Brain, Dewhurst and Williams (1999), the use of computers in Higher Education is widespread and the impact of CBL has been significant. This may be considered to offer a means of addressing many of the challenges facing Higher Education, however underlying drivers are likely to influence which potential benefits are exploited and there are issues for the learning we expect to be achieved and that which we engender by the approach taken. It is considered by such as Marton and Saljo (1976) that in Higher Education there is an expectation, that "deep" would be preferable to "shallow" learning. It has been highlighted by Laurillard (1993) that one of the dangers of the many changes in Higher Education is that contact between students and academic staff will be reduced and training rather than academic discussion will become the order of the day, which such as Littlejohn and Stefani (1999) consider may lead to students adopting a "surface approach" to learning, where tutor and student responsibilities are unclear. Porrit (1997) points out that many students have been found to prefer face to face lectures and tutorials to computers and that there is a potential danger of students feeling isolated, therefore becoming demotivated, when working within a technology mediated environment. The teacher's role has been identified by Fox (1997) as important in addressing these issues. Grantham and Hunt (1999) take the view that CBL can result in a surface approach being taken by learners, but that this is likely to be influenced by the design employed within the material and the context within which the material is used.

Changes at a global level, in relation to the needs of society and economic circumstances and the knock on effect on Higher Education, are highlighted by Grabinger and Dunlap (1995) as having an impact in the form of widening access for learners, including mature students, with changes in the courses offered in terms of content and modularization of structure being significant factors to be considered. These issues are all essentially related to resources as pointed out by McCartan and Hare (1996). The drive toward "lifelong learning" is clearly backed from the highest levels in government and aims to increase the level of access to education with a view to producing enterprising scholars as pointed out by Seale (1999). Lifelong learning may be taken to include workplace based learning, continuing professional education and further formal study, the use of which may be regarded as categories of post-graduate learning. Such learning is considered likely by such as Candy (2000) to require self-directed and peer-assisted learning, experiential and real-world learning, resource-based and problem-based learning and reflective practice and critical self-awareness, with which students should be offered help. The need to address educational outcomes, increased access, a more diverse range of learners, increased costs and funding issues has been highlighted as fundamentally important in Higher Education by such as Ehrmann (1995), Jacobs (1997), D'Andrea and Gosling (2001) and Richards (1994), which such as Porrit (1997) argue may underpin the enthusiasm expressed regarding independent learning. The increase in the range of students raises issues regarding the level of provision required for their learning as highlighted by Candy (2000) and the involvement of the lecturer as facilitator is argued by such as Davies and Crowther (1995) to be particularly important. Allowing students to learn at a pace which is comfortable for them is highlighted as important by such as Johnson, Dewhurst and Williams (1997) and the importance of catering for the learning preferences of students in courseware development is highlighted by such as Jones, Jacobs and Brown (1997). All of these issues impact on the motivation for, and the nature of, CBL provision.

2.3.1.4 Students as "Consumers" and the Design of CBL

The growth in the market driven approach to Higher Education has, according to such as Hart (1999), increased the likelihood that learners will expect their needs and wants to be met to a greater extent than in the days of central funding as a public investment in society. There has been a shift in the perception of the "student" within "Higher Education" and in the context of "Lifelong Learning", which brings us to consider the student as a "consumer". Such a perspective may be argued to be almost inevitable by some, yet inappropriate by others, who argue that this approach will potentially result in the demise of "education" in favour of "training" and the negative impact this would inevitably have on Higher Education. Given that we are now dealing with learners Bourdeau and Heller (2000) refer to as "choosers", where once we dealt with "users" of CBL material, it becomes increasingly important that our provision is considered motivating by learners, which highlights the requirement to understand the learner perspective. Where the student is regarded as the customer in Higher Education, an understanding of the "customer" and catering for their preferences is highlighted by such as Hobbs and Boucher (1997) and McAleese (1998) to be essential. The viewpoint of the "learner – customer" in Higher Education is of even greater significance in the current climate, given the likely expectations involved and the levels of choice available in the Higher Education marketplace. It may therefore be argued that the extent to which current learners, using current CBL material, consider it to be effective for them and their views on whether their expectations are met by the material concerned, are fundamentally important. For the current research the implications of the "consumer" perspective for the design, development and delivery of CBL material is considered important and it is argued that regarding the student as a consumer may lead to better design of CBL materials.

The nature of the audience for CBL material is of particular importance in relation to the design, use and success of the material concerned. The audience for CBL material in Higher Education is frequently "captive" rather than "discretionary" and may be compelled to use CBL material which causes them to suffer "unconsciously". While the "cascade", or "waterfall" approach to developing software, which does not centrally involve end users, may be argued to suffice for the "captive" users, it is unlikely as Hughes (2000) points out, to result in software which would be highly valued by "discretionary" users. If the CBL is directly related to assessed work, then perhaps we in education are also exploiting a "captive audience" by subjecting them to CBL materials / environments which they would not use if they had a choice, and had the option of switching off, without incurring a cost. In the current environment, students, at the Higher Education level are likely to undertake tasks which have a related element of assessment, but are less likely to complete tasks which are not assessed, which suggests a "captive" v "discretional" reaction to the material offered. Poor design in CBL materials may therefore be tolerated by learners in Higher Education due to lack of choice coupled with a need to achieve a specified goal, or to accomplish a set task. Use of such materials does not necessarily reflect learners' personal preferences had they complete freedom of choice. There is a danger of users adapting to poor design, which is highlighted by Mandel (1997) as the "WYKIWYL: what you know is what you like phenomenon".

Designers might be expected to seek to exceed user expectations which, as Mandel (1997) points out, requires dynamic wants and needs regarding interface design to be considered and the interface to be transparent in use as highlighted by Cooper (1995). Any attempt at moving design of CBL material / environments in this direction would clearly require considerable knowledge of the audience for whom the material / environment is intended, and what the material should allow them to achieve. It is important that education providers seeking to use CBL material should be aware of the users' expectations of the material, and of the developers' expectations of the user, regarding ease of use, and the progression of expectations over time. The need to achieve high grades should not be incompatible with the desire for students to be offered experiences which are close to the "real thing", rather than improving their ability to regurgitate "the correct answers". One of the fundamental issues may be considered to be the form of assessment employed. Where this is such, that students seek to tailor answers to suit those marking the work and as Jacobs (1998) suggests, it may be argued that we are not assessing "real" learning.

2.3.1.5 Decision Makers, Perspectives on Learning and the Design of CBL

The perspective from which those decision makers, who decide on the learning provision to be offered to students, view the concept of "learning" is clearly important in terms of the provision offered. This applies as much to CBL material as it does to other forms of provision. Ted Nelson, the inventor of such terms as "hypertext" and "hypermedia", defined "thinkertoys" and described a "docuverse" which we currently refer to as "cyberspace". His "intertwingled" approach to organising material conflicted with the hierarchical approach taken by the education system, which involved arbitrary barriers. Mavericks, such as Nelson, may be considered, as suggested by Hughes (2000), to help prevent us becoming locked into a rule-bound system which might then dictate which developments might be permitted. Where CBL is adopted as an approach, this reflects decisions made by individuals or groups, within a set of remits, agendas, beliefs and values regarding the focus and style of the learning experience to be offered. CBL material may range in complexity and subsequently in cost and we must consider the drivers involved in the material produced, given that drill and practice software is easier to generate than software designed to support constructive approaches to learning. Somekh (1996) points out that such considerations are relevant for decision makers, who may require a balance to be struck.

Stakeholder perspective is clearly important within the arena of instructional design as demonstrated by the range of theories on such. The importance of stakeholder perspective is illustrated by the following section which offers an overview of views from central figures within the instructional design arena.

Reigeluth and Frick (1999) point out that while in research on descriptive theory, validity is a major methodological issue, the major issue for design theory is "preferability". This they define as the extent to which the particular method is considered better than other options for attaining the outcome sought. As the authors point out this is dependent on stakeholder values and tends to involve effectiveness, efficiency and appeal. These as the authors point out may be situation dependent, reflecting stakeholders' wants and needs.

It is argued by such as Snelbecker, (1999a) that there are differences between knowledge producers and knowledge users and cultural differences exist to the extent that different authors may use terms such as theory and model to refer to the same thing. Snelbecker (1999a) considers that there are barriers to cooperation between knowledge producers and users and that the cultural gap between the two groups impacts on the judgements made regarding the value of theories and research findings, with the practitioners, such as teachers and instructional designers, looking to modify practice on the basis of the theory, while the producer is more likely to regard theory as ongoing. As Snelbecker (1999a) points out, knowledge producers may be encouraged to focus on a specific theoretical position or research approach then proceed essentially ignoring others, as illustrated by advice offered to students by Hall and Lindzey (1957). The danger being that such an approach may lead to a failure to appreciate the value in an alternative approach. Snelbecker takes the view that a wider perspective reflecting on a range of theories and approaches to research, offers more "lenses" through which both practical and theoretical issues may be viewed.

Snelbecker (1999b) considers the range of views expressed in instructional design theories to reflect more general trends in education. He highlights observable trends such as the emphasis on cognitive processes, the growing recognition of the role of affect, the perceived need to address learners' individual characteristics and the generally agreed need to improve effectiveness of instruction. He also points out that there are differing views of how this might be achieved. Such issues have clear importance in relation to stakeholder perspective and the design and use of CBL materials. Snelbecker (1999b) goes on to point out that while behavioural theory is less influential in instructional design now than it once was, there is a danger that we may be losing valuable ideas should we discard such entirely. Snelbecker (1999b) postulates that there may be options of having multiple goals for instructional theories, or multiple instructional theories for given curricular goals. He considers that instructional theories might be classified in terms of the learning outcomes they target, using a taxonomy such as Bloom's Taxonomy of Educational Objectives. Snelbecker (1999b) cites Clark (1983, 1992 and 1994) as arguing that technology, being merely a delivery system, should not be expected to have any meaningful impact on instruction, but rather what we do with it in terms of instructional methods and design influences learning. Snelbecker considers that our design and development strategies should allow us to accommodate differing theories, such as behavioural and constructivist, within the same context thereby benefiting from the range of features offered.

Stakeholder perspective is likely to influence, or be influenced by, the paradigm in use. The paradigm in use affects the instructional goals set in terms of what to teach and how it should be presented, with clear implications for design and use of CBL material. Reigeluth and Moore (1999) point out that the industrial-age paradigm was focussed primarily on memorization and procedural skill development and that while these levels of learning still have an importance there is a need for a higher level of learning, or higher order thinking skills, for the information-age. This has given rise to a need for a new paradigm of instructional theories offering a customizable learning experience. While the taxonomy of educational objectives offered by Bloom (1956) has been widely used in education, there are several others as Reigeluth and Moore remind us. They go on to suggest that these may be synthesised in terms of memorizing information, understanding relationships, applying skills and applying generic skills.

Mayer (1999) points out that we have progressed from a view of learning as response strengthening, through learning as knowledge acquisition, to learning as knowledge construction and he highlights the importance of designing instruction for constructivist learning. We have as Mayer highlights, progressed from a drill and practice approach, through a transfer of information approach to a meaningful interaction approach. The level of activity within the interaction is however an issue in its own right and concerns the concept of active learning. Mayer distinguishes between behaviourally active and cognitively active. In order to be cognitively active the learner must be attempting to make sense of the material being studied and Mayer takes the view that constructivist learning depends on the learner being cognitively active rather than behaviourally active (Robins and Mayer 1993). This has important implications for the design of "interactivity" within CBL materials, where the interactivity should therefore be designed to engage learners cognitively for constructivist learning to occur. Mayer considers that the learner need not be behaviourally active for constructivist learning to occur and that such learning may result from the apparently passive reading of text. He points out however that the text must be designed to elicit the appropriate levels of cognitive processing. Mayer refers to this as the selecting, organising and integrating (SOI) model, where the learner engages in selecting, organizing and integrating the information concerned. Here we have an interesting apparent contradiction whereby material which requires physical activity, such as point and click, may not inspire active learning, while text material which required no physical activity could inspire such. This is a potential dilemma for instructional design and the definition of "interactive" employed in the description of CBL material.

Perkins and Unger (1999) point out that while the acquisition and retention of knowledge is important the goal of education should be that such knowledge be used at the level of understanding. The authors stress that knowledge is not the same as understanding and that there is often a great deal of effort required to achieve understanding. The authors accept that there are levels of learning which are not aimed at understanding, but rather at laying the foundations for later learning which is aimed at such. They caution however that such an approach runs the risk of making education "boring and meaningless" for learners. Perkins and Unger consider that understanding a topic involves being able to think and act creatively and competently with the knowledge of the topic. The authors refer to such activities as "understanding performances" and consider such to expand learner understanding via problem solving, decision making and adapting old ideas to new situations. The authors consider their four-part framework utilising generative topics, understanding goals, understanding performances and ongoing assessment to provide a constructivist approach which is orienting and supportive. They argue that their framework allows for a range of pedagogical styles to be employed given that attention is paid to performances of understanding, but concede that time and effort must be realistically allocated in order for their approach to be worthwhile.

Schank, Berman and MacPherson (1999) highlight the importance of learning skills by doing and gaining information within its context of use. They consider one of the main problems with traditional approaches is that skills are not being learned. The goal-based scenario approach stresses the importance of content and process goals, the importance of motivation, realism, context, easily accessed information and situated relevant feedback. The authors argue that we learn using case based reasoning in real life and this approach should be used in education to enable novices to become experts. This relates to the importance of the provision of realistic scenarios within which learners may make interactive use of CBL material.

Jonassen (1999) takes the approach that learning is best approached using ill-defined problems, thereby offering the opportunity for knowledge construction within an authentic environment which encourages active learning. He considers that the problem used should be authentic (i.e. what practitioners do), interesting, relevant and engaging for learners. Case based reasoning should be encouraged with case examples available with learners enabled to easily access relevant information on a just in time basis. Scaffolding should be provided for the required skills and the level of task difficulty and coaching should be employed to help motivate learners and provoke reflection. This again raises issues for the design and use of CBL material, especially when the needs and wants of a wide range of learners are involved.

Reigeluth (1999) proposes Elaboration Theory as a means of sequencing instruction to suit the learner-centred approach. Reigeluth considers elaboration theory to offer a holistic approach by using simpler versions of the task or content, rather than breaking the content into smaller pieces and teaching them separately. Elaboration theory involves a conceptual elaboration, theoretical elaboration and simplifying conditions sequence. Reigeluth considers the elaboration approach to enable the learner to understand holistically, thereby acquiring the skills of an expert from the first learning episode. He considers that the holistic approach enhances both learner motivation and quality of instruction.

The importance of clarifying what is to be taught and why, prior to considering how best it might be taught, is highlighted by Gardner (1999). He considers that the end goal of education should be on understanding and that the facts and skills within specific disciplines should be regarded as the means by which such understanding might be achieved rather than educational ends in themselves. Gardner (1999) highlights traditional apprenticeship and such institutions as the science museums as successfully developing understanding in the learner. He points out that learners are allowed time to learn within such environments and that there is scope for multiple inputs from which understanding may be constructed by the learner. Gardner (1999) also highlights direct confrontation of misconceptions as a potentially successful approach, commenting that teachers may encourage learning by highlighting inadequate conceptualizations on the part of learners. Gardner (1999) takes the view that theories are best understood by being applied and promotes "teaching for understanding" as an approach which emphasises performance, stressing the use of topics which are both central to the discipline and attractive to students. Gardner (1999) points out that people differ in terms of cognitive strengths and weaknesses and that our minds work in different ways. He points out that while traditional psychological theories assumed the existence of single relatively fixed "intelligence", this view is now challenged. Gardner (1999) highlights his theory of "multiple intelligences" as offering possibilities for the teaching and assessment approaches employed. Gardner (1999) cites eight processing mechanisms or intelligences: linguistic, logical-mathematical, musical, spatial, bodily-kinaesthetic, naturalist, interpersonal, intrapersonal and comments that there may also be "existential intelligence". He points out that his theory should be considered as facilitating good education when applied to independently established educational goals. Gardner (1999) suggests "entry points" which are Narrational, Quantitative, Foundational, Aesthetic, Hands-on and Social as approaches for achieving learner engagement and suggests the use of metaphors and qualified analogies to promote understanding in learners. Gardner's (1999) central point is that individuals should be given the opportunity to use their intelligence directly. Gardner (1999) considers that for concepts to be understood well there is a need to represent the "core notions" of the topic in more than one way. He therefore considers that significant time should be spent on a given topic, it should be represented in more than one way and that the multiple approaches used should explicitly involve a range of intelligences, skills and interests. Gardner (1999) considers that the current technologies enable us to individualise the services we provide for learners and teachers and to be "tailor-made" to address multiple intelligences. He considers the central question should be what we use computers for. This perspective clearly indicates the need for multi-modal provision being made available within CBL materials. Gardner (1999) reminds us of the danger of becoming too emphatic in our standpoint:

"New discoveries, as well as new disciplinary trends, gradually undermine today's orthodoxy; tomorrow's scholar might remake our understandings."

(Gardner 1999, p85)

Hannafin, Land and Oliver (1999) also highlight the importance of multiple perspectives and divergent thinking. The authors highlight the distinctions between directed and open-ended learning environments and the relationships involved in learning. They highlight the importance of scaffolding when engaging in problem solving activities within open learning environments.

With the educational focus as the main driver for the development of CBL material, instructional design should be paramount, rather than "technical convenience". The use of "multimedia" within CBL materials requires decisions to be made as to "appropriate" materials for inclusion within the package. Such decisions are likely to be influenced by the underlying beliefs, values and educational approaches of the decision makers, whose "vision" may range as Boyle (1998) points out, from making incremental improvements to radical transformations, such as the move from teacher-centred to learner-centred approaches. As highlighted by Twining (1999), it is important for those involved in designing, developing and delivering CBL materials, to have an understanding of the strengths and weaknesses of the available media, which should be coupled with an understanding of the educational requirements involved, in order that decisions made focus on the strengths of the media concerned and that a complementary mix of media be achieved. The use of multimedia is argued to be motivating for learners by such as Whitelegg, Scanlon and Hatzipanagos (1997) and by such as Laurillard (1993) to be useful in catering for constructivist approaches to learning. However the use of such media may require significant levels of support where inexperienced learners are involved, which might be considered in relation to first year students in Higher Education, given the changing nature of the student catchment concerned.

Where non-linear and interactive capabilities are offered and "multimedia" used, this provides advantages including active experimentation, abstract conceptualisation and the use of real-life settings to contextualise knowledge which offers the potential to enhance learning. Some, such as Davies and Crowther (1995), consider however that with the exception of "computer-skills" the use of computer-aided learning (CAL) and multimedia courseware is unlikely to contribute to the development of transferable skills, which therefore makes additional input necessary using other teaching methods. The importance of keeping an open mind regarding the potential of multimedia and CBL material is highlighted by Newble and Cannon (1991), who comment:

"We must not be seduced by the novelty nor must we let the opportunities they present pass us by"

(Newble and Cannon 1991, p149)

A central issue highlighted by such as Boyle (1998), regarding the use of "multimedia" in CBL material, is that the "educational vision" should inform the use of the "multimedia". The pedagogy and instructional design behind the development of CBL materials / environments involving multimedia materials may lead to the use of animations as highlighted by Guttormsen Zuberbuhler and Krueger (2000), or a game environment as highlighted by Amory and Govender (2000) and Mak and Mallard (2000), being considered appropriate. The design issues in such learning environments are as important as in any other mode of delivery. Some, such as Miller, Brandenburg and Schweingruber (2000), go so far as to suggest that those in education must endeavour to capture the imagination and compete with game environments. However strategies adopted by developers may, as Carswell (1998) points out, run counter to the best interests of the pedagogical design, with the potential danger of settling for the "safe-but-possible", thereby condemning the material to being more "mundane" than might have been possible. This clearly highlights the importance of stakeholder perspectives and the need for clarity of understanding and iterative approaches to design in order to balance the needs of the stakeholders involved. When those involved in the provision of CBL focus on what "may" be done, without giving the required level of thought to what "should" be done, or where the pedagogical standpoint is not fully informing the instructional approach adopted, there is a danger of simply replicating that which would have been done in other modes. One by-product of such approaches has become known as "shovelware" and is essentially the "shovelling" of material as it would have been used in another medium (e.g. print) onto a computer-based platform for delivery. The other end of the continuum, as Carswell (1998) points out, is where use is made of multi-media, and functionality options, simply because it can be done, rather than for sound pedagogical reasons. In order to best utilize the advantages offered by computer technology, we should first consider what we would wish to have, based on our underlying goals, for the learners for whom we are generating the material.

2.3.1.6 Opportunities, Threats and the Design of CBL

Examples of opportunities offered by developments in technology include Engelbart's "information space", which we would currently term "cyberspace" and the development of graphical display capability. Such developments have influenced the approaches taken to provision of computer based materials. However, whilst opportunities are offered by technological developments, they may simultaneously be restricted by political and commercial interests. The possibility that commercial interests may conflict with the developmental possibilities favoured by visionaries gives some cause for concern in the computer related arena. Examples may be found at various levels of the importance of the political perspective for developments in the computer based arena. One notable example being that funding was stopped for Engelbart's "Augment" when the hard Artificial Intelligence route became popular. Such issues as device independence may also be regarded as reflecting the importance of the political perspective. The important point, as highlighted by such as Hughes (2000), being that the "political will" may choose to support a route or development which fails to make the best use of the available technology.

As Cresswell (1998) points out, there are clearly sound pedagogical reasons for the introduction of computer-based approaches in Higher Education, including the desire to facilitate greater levels of student-responsibility for independent learning and the provision of some levels of enjoyment for learners as highlighted by Dale Sullivan and Irvine (1999). However there remains a potential for conflict between ideals and economy. This is a perennial issue for education, given that the whole concept of a single teacher, or lecturer, addressing many learners was designed to offer a level of economy, rather than to meet the needs of learners as highlighted by such as Porrit (1997) and Stanley and Eastcott (1999). This approach has shown remarkable resilience, even in the light of developments in underlying theories and philosophies in education, and Pilipenko and Komissarova (1995) point out that such resilience has proven to transfer into the computer-based domain. The likely requirement for CBL to contribute to increased staff efficiency, in order to be accepted by those providing courses for learners, is highlighted by such as Hawkridge (1998) to carry the potential danger that the drivers underlying the educational experience offered are more concerned with issues of economy, than issues of a pedagogical nature. Where such underlying motives are driving the generation and use of CBL material, there is a danger that the approach taken will fail to make best use of the technology. Some reassurance might be taken, as Haywood et al (2000) point out, from the acknowledgement by senior staff that the value of such approaches should be considered in relation to the improvement or maintenance of "quality", rather than in creating efficiency gains. However the underlying issues relating to staff time, relative valuing of "teaching" and "research" and the requirement to meet student volume targets, may give cause to reflect on the definition of "quality" to be employed.

2.3.1.7 Evaluation Perspectives and the Design of CBL

In order to evaluate CBL material we must clarify the underlying purpose for which it is intended, therefore we must also define what we consider to constitute learning. Our intention may be to maximize learning, but it would be important to clarify whether our target was that of maximizing volume of learning, which might be regarded as breadth of learning, or "quality" of learning, which might be regarded as depth of learning, as we might choose to define such. The motivation underlying the evaluation of CBL material is of central importance, and summative evaluations of such material may be misleading, as Draper (1997) points out, in that they may be driven by demands relating to cost-effectiveness and durability rather than pedagogical concerns. We may choose to judge the worth of CBL on the basis of cost of purchase and volume of use, which might offer some easily calculated cost-efficiency figures. However it is worth noting the point made by Somekh (1996), that well designed software, even if used infrequently, is likely to do more for learning than badly designed software used frequently.

We may judge by direct comparison with other options and argue that student opinion is not sufficient in itself to support the case for using a more costly approach and that, as Jacobs (1995) proposes, clear evidence of learning "in some better way" than would have been possible by less expensive means is required. We may focus on the problem we are requiring the interactive media to solve and the potential for scaling up, from which perspective such as Clark (1996) consider there is little numerical evidence that computer mediated teaching results in educationally worthwhile improvements. This approach however runs the risk of overlooking the value which might be added by dimensions offered by the computer-based environment, which other modes of provision do not offer to the same level. This risk may be argued to be greatest where a narrow focus is taken on learning outcomes, selected for ease of measurement, rather than considering the holistic perspective of the learning experience. The issue when attempting to evaluate computer based material becomes further complicated in that poorly designed material may be well used, while well designed material may be poorly used. The well used material may therefore, on the basis of usage statistics, appear more effective, or appealing, to students. Evaluative conclusions drawn from narrowly focussed research, while arguably appropriate within a restricted field, may lead us to inappropriate conclusions regarding potential value of particular design elements, or media options in the wider arena of learning. The danger being that we may in the light of such conclusions decide such elements offer no added value, therefore should not be included in the CBL design. This may lead to the loss of benefits such elements might offer simply because they were not highlighted within the particular piece of research conducted. The importance of avoiding the "baby and bathwater syndrome" in the arena of education is highlighted by Romisowski (1986), who points out that the syndrome was identified as a significant problem in education by John Dewey in the 1920s. This remains an important point to keep in mind with regard to the design of CBL material.

2.3.1.8 Academic Motivation and the Design of CBL

From the academic staff perspective there are issues ranging from pedagogical standpoint to fear in relation to job security, their importance reflected in the many seminars and papers produced offering suggested ways of overcoming such barriers to the use of computer based materials in education. Those involved in the provision of education may be loosely divided into those who are interested in finding out how students think and adapting their teaching appropriately, or those for whom economies of scale are paramount. Ehrmann (1995) regards these as being good and bad options respectively, in terms of underlying motivation. Such approaches may however also reflect the trade off between "interest" and "practicality" given the range of drivers involved for teaching staff. Where the development and use of CBL material in Higher Education is driven by the desire to increase teaching efficiency, based on a traditional model of learning, the CBL material may, as highlighted by Davies and Crowther (1995), be relegated to a subordinate role resulting in a failure to exploit the full potential of CAL and multimedia technology. The creation of content material may suffer from a lack of encouragement for academic staff to use their time in this way and experienced paper-based writers may produce material which is inappropriate for on-screen use. The low status of "teaching" within the academic profession has been highlighted, by such as Allen et al (1996), as constituting one of the biggest barriers to successful use of learning technology. That courseware should be high quality, work well and fit the needs of lecturers' individual requirements, is clearly identified by Jacobs (1996) as an area of importance which the material produced has not always successfully addressed. Highly motivated and well rewarded staff might be prepared to address such issues but the prospect of such efforts going unrewarded minimises the likelihood that staff will choose to undertake such work.

2.3.1.9 Review of Strategic Issues Addressed in Relation to Instructional Design of CBL

The preceding sections have explored a range of issues relating to the instructional design of CBL material. Some of these while perhaps appearing to be peripheral at first glance, have been identified as fundamentally important in influencing the approach taken to instructional design. At the root of instructional design lies the perception of learning as a concept, process and outcome. Such perceptions have been shown to change over time and to be influenced by changes in expectations of learners and educators and by the available educational technology. The use to which educational technology is put has also been shown to be influenced by the perceptions of learning held by the decision makers involved at the particular point in time. The facilitation of deep rather than surface learning has been highlighted as an aim within Higher Education and the implications for instructional design have been discussed. The changing perception of the student role within elective Higher Education has been highlighted as an important influence on instructional design and the importance of addressing the affective domain in relation to discretional users has been highlighted. The appropriateness of established approaches to developing CBL materials has been discussed in relation to the changing perceptions of learner role from captive to discretionary and the impact of such on instructional design of CBL material in Higher Education. The importance of decision maker perspectives on the issues discussed has been highlighted as has the potential impact of such perspectives on the instructional design of CBL material. Opportunities and threats to Higher Education presented by CBL have been identified and discussed in relation to instructional design. Central issues relating to the evaluation of CBL material have been highlighted and discussed in relation to instructional design. The importance of academic motivation has been highlighted and factors affecting such have been discussed in relation to instructional design.

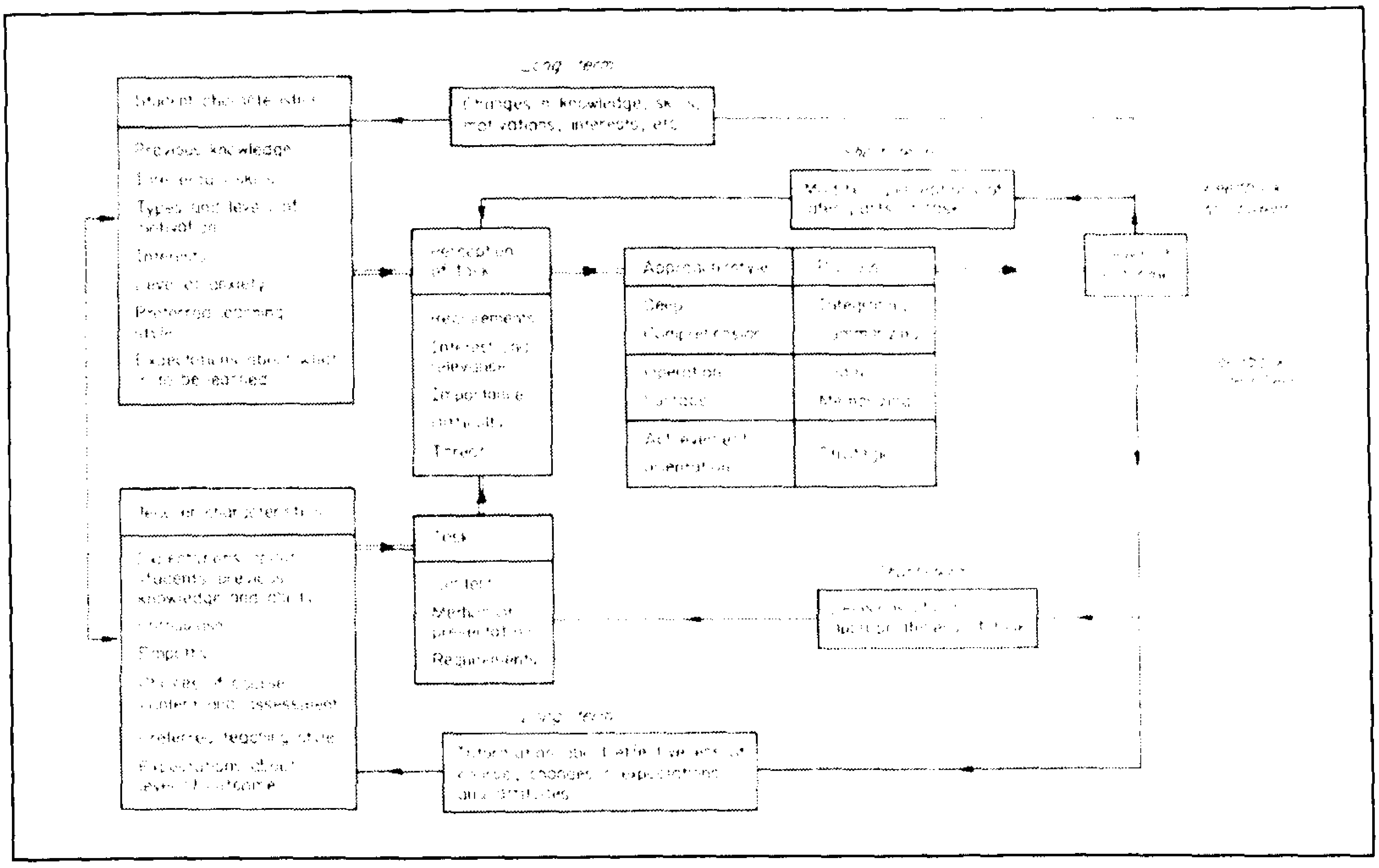
This takes us to the point where we can recognise that a wide range of factors must be considered when addressing instructional design issues. The material covered regarding instructional design demonstrates that there are many ways of perceiving and evaluating the instructional design aspect of CBL material. This leads us to the next area of importance when considering instructional design in CBL, which is that of the learners for whom such material is developed.

2.3.2 Learner Issues and Instructional Design

The following sections discuss learner issues which are important in relation to instructional design. These include individual characteristics within the cognitive and affective domains and their interaction with and importance in relation to the instructional design of CBL.

The range of factors potentially impacting on the learning process is highlighted by Entwistle (1981) and provides an overview which helps locate the issues addressed in the following sections (see Fig 2.3).

Figure 2.3: Factors Influencing The Learning Process



(Source: Entwistle 1981, p247)

2.3.2.1 Learner Motivation and the Design of CBL

Motivation to learn is an important aspect of effective teaching and is likely to be based on the interaction between the individual's expectation of being able to complete a task and the perceived value of the task for the individual concerned. Design elements may also act as "hygiene" factors, the absence of which might demotivate as suggested by Davies and Crowther (1995). The source of individual motivation is also important. Introverts are considered to be self-motivated, while extroverts are motivated by responses from others and academics have demonstrated a tendency to be self-motivated. The finding that two thirds of the population is classified as extrovert by the MBTI, may suggest an area of difficulty for academics in relating to, or understanding, the needs of their students as pointed out by Davison, Bryan and Griffiths (1999). Given the changes noted in the nature of the student body and that academics are frequently involved in the generation of CBL materials, it is important that they should be able to relate to the needs of the learners for whom the material is intended.

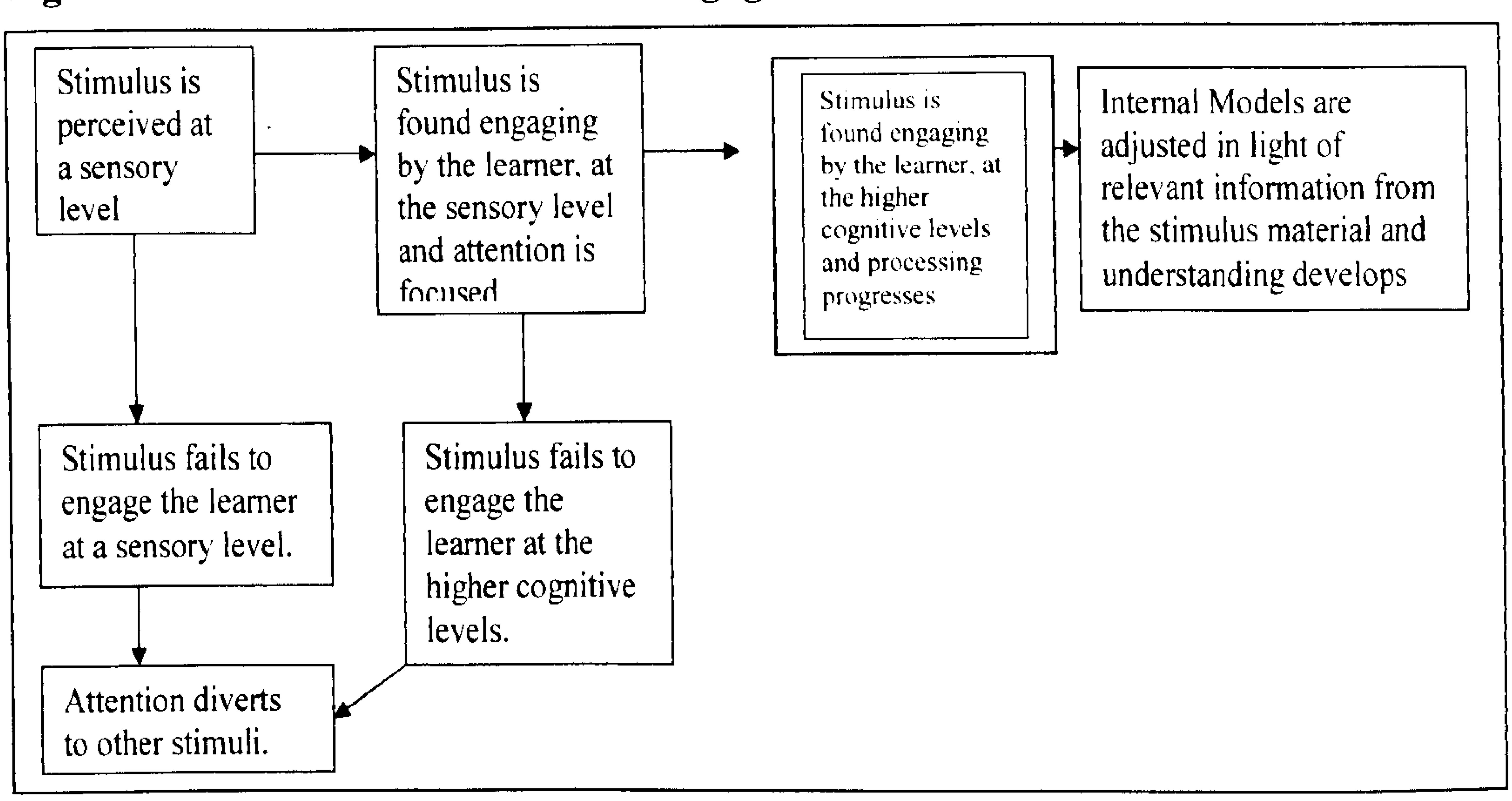
The perceived effectiveness of CBL material is likely to be influenced by learners' assumptions regarding their personal motivation, with those who consider the material should motivate them being likely to expect best use to be made of the available technology in order to do so. Those who consider that they should be self motivated and the task of the CBL material is simply to provide a source of information, are likely to be less demanding in their expectations of the extent to which available options should be used. This may apply to the range of approaches to learning, from surface to deep. The success of the delivery approach adopted is therefore likely to be affected by the learner's approach to learning as highlighted by Biehler and Snowman (1990). Motivation and support for a range of learning styles should be addressed within CBL material as Porrit (1997) suggests, with recognition that some students want "guidelines and boundaries" and some are motivated to pass exams rather than seeking deeper learning. While the traditional, highly selective, system may have assumed its university students as "motivated to be there", already schooled in the required behaviour for serious study, and prepared to persevere with any material presented by academics, it is less likely that this may be assumed in today's environment. If we accept the element of "motivation" to be partly the responsibility of the provider then we must reflect on the possibilities and implications for motivating learners using CBL materials. In addition to the delayed gratification of achieving a pass grade in a final degree, we must also consider the design elements which may offer potential for motivating learners. However we must also accept that individual differences exist within the affective domain, as they do in the cognitive domain, which leads us into a range of issues relating to the design of CBL material. Motivation is considered to be significantly affected by the prior experience and the attitudes formed on the part of the individual learner. The development of intrinsic motivation, as Somekh (1996) points out might be referred to using terms such as "mindfulness" or as "the will to learn", is considered to be required in order to achieve sustained engagement over long periods.

Reiser and Dempsey (2002) highlight Keller's (1984) Attention, Relevance, Confidence and Satisfaction (ARCS) Model as providing guidance regarding options for inspiring learner motivation. The importance of gaining attention by arousing the learner at the perceptual and inquiry level, connecting with learners by identifying and meeting their needs and offering flexibility of choice to match their motives and connecting with their previous experience is highlighted. The model also highlights the importance of intrinsic and extrinsic reinforcement or reward in achieving learner satisfaction. Reiser and Dempsey (2002) remind us that personal judgement is required on the part of the instructional designer regarding the selection of activities which make up the tactics employed, which again highlights the importance of stakeholder perspective.

2.3.2.2 Learner Engagement and the Design of CBL

The term engagement, as highlighted by Stoney and Oliver (1997), may be found in the literature relating to CBL material / environments, as an important aspect of the learning process. Engagement with the learning process is necessary for learning to take place and engagement may be affected at various levels and in various ways. It is important to be aware of the process of learner engagement (see Figure 2.4) when considering the design of CBL material. The debate concerning gaining learner engagement on one hand and the notion of employing alleged "bells and whistles" on the other, highlights the importance of the choice of medium and the way in which the selected medium, or media, might be used within CBL materials / environments. Intrinsic motivation, with the user valuing the task for its own sake and attaching importance to the process, rather than the product, of the task or activity has been highlighted as important for meaningful learning. User beliefs about self are considered to affect levels of intrinsic motivation. To design for intrinsic motivation the task environment and the task itself should be presented as meaningful, at an appropriate level of difficulty, allow for multiple levels of coding, and require the user to be active in the task.

Figure 2.4: The Process of Learner Engagement



There are trade offs involved here, regarding design decisions, at various levels. There may be "habituation" effects as sensory mechanisms tire, which reinforces the importance of designing the interface for the user's purpose. The limitations of short term memory must be taken into account when designing screen displays that do not impose additional cognitive load on users' short term memories. The characteristics of long term memory should be taken into account when designing for recognition and recall. The perspective offered by such as Mandel (1997) suggests that user interfaces should be designed to reduce reliance on human memory, by using the computer's strengths to support human weakness. Engagement in computer-assisted mass lectures can be affected by the interactive multimedia used, the lecturer facilitating, and idiosyncratic factors of the students concerned as highlighted by Pausawasdi and Henderson (2000). The engagement factor is highlighted by Kennedy Eizenberg and Kennedy (2000) as supporting students in the use of CD ROM material in their learning tasks and fostering deep understanding. The importance of meaning, experience and motivation is highlighted by Gjedde (2000), with the lack of canonical narrative elements in multimedia edutainment programmes considered to limit their usefulness in learning environments, due to possible cognitive costs for the user. A possible affective dimension to the use of hypertexts is highlighted by Harvey, Clariana and Jonassen (2000), in relation to differences in task and the effect on navigation choices, transfer of knowledge and attitude towards the topic. The case for educational CD ROMs being made as interesting and attractive for children as computer games and the gap between multimedia for education and entertainment being reduced is highlighted by Morozov and Markov (2000) and the engaging nature of the game approach is highlighted by Prensky (2001) (see Fig 2.5)

Figure 2.5: Games and Engagement

WHY GAMES ENGAGE US

Games are a form of **fun**. That gives us ***enjoyment and pleasure***.
Games are a form of **play**. That gives us ***intense and passionate involvement***.
Games have **rules**. That gives us ***structure***.
Games have **goals**. That gives us ***motivation***.
Games are **interactive**. That gives us ***doing***.
Games have **outcomes and feedback**. That gives us ***learning***.
Games are **adaptive**. That gives us ***flow***.
Games have **win states**. That gives us ***ego gratification***.
Games have **conflict/competition/challenge/opposition**. That gives us ***adrenaline***.
Games have **problem solving**. That sparks our ***creativity***.
Games have **interaction**. That gives us ***social groups***.
Games have **representation and story**. That gives us ***emotion***.

(Source: Prensky 2001, p106)

Functionality is highlighted as important and the provision for user control over the system, process and content within the interface design is considered to increase intrinsic motivation to learn, with cognitive optimisation argued by such as Stoney & Wild (1998) to maximise intrinsic motivation.

2.3.2.3 Expectations, Engagement and the Design of CBL

Expectations are highly significant when considering the pedagogical value of the "fun" element, and when considering the short term and long term impact of "fun" interface designs. One of the central issues in relation to the use of CBL material is that it should allow users to perceive that they are making progress. This is important in many respects and it may be that where progress is temporarily delayed, there is a case for offering a level of "entertainment" and feedback regarding the situation for the user. It is considered by such as Mandel (1997) that at least an "illusion of progress" must be maintained, as must user control. There are clearly benefits to be gained in matching, as closely as possible, the expectations of the authors and their subsequent provision, to the expectations of the learners concerned. The expectations that authors of CBL material hold of their potential users are likely to influence the goals they set, and the routes they offer users for achieving such goals. The expectations that users hold of the CBL material are, as Hughes (2000) points out, likely to influence their approach to the material concerned. As Hughes suggests, expectations of "intelligence" can be constrained by constraining the context, an example of which might be Joseph Weizenbaum's "Eliza", which constrains the user's expectation within the "analyst" context. The level of responses expected by the user are therefore perceived as "intelligent", while outwith the constrained context the responses would be perceived as less than "intelligent". Again we are dealing with both the management of expectations and the avoidance of violation of expectancy. It may be argued that we might learn from the Disney approach of providing users with an "enjoyable experience". The underlying issue here however, is how we might encourage and satisfy growing expectations. It may be argued that an acceptable focus of "entertainment software" includes offering "fun" and being "seductive", which would be of lower value for users focussed on personal productivity, or work. In the case of productivity focussed users it may be argued that ease of learning and ease of use are likely to be user priorities. The importance of recognising how much frustration users are likely to tolerate, before they give up, is clear for those providing the "entertainment" and expecting "productivity". Users are likely to have three basic goals: to find information, use information, and remember information. Design goals should ensure that the most appropriate medium is used at the most appropriate time, offering the most appropriate information. The importance of avoiding too much emphasis on visual and functional sophistication, which may distract users from their specific tasks, is highlighted by such as Mandel (1997).

The concept of "chunking" as identified by Miller (1956) is generally considered in relation to short term memory. The concept of "chunks" relates to engagement also and are similar to "stories" in that they each provide the user with an "emotional payoff", which may relate to the brain's need to organize sensory data becoming an end in its own right. From this perspective we may be regarded as "addicted" and stories may be considered as feeding the addiction, as do "successful artefacts", as highlighted by such as Hughes (2000) who suggests that Websites, VR worlds and other computer applications should seek to engage users to the levels achieved by jokes and fairytales. Learner engagement may be considered as central to learning and to involve attracting the learner, gaining their attention and holding their concentration.

We may consider engagement at the sensory perception stage, at the processing and storage stages, and at the stages of constructing knowledge, developing understanding and building adaptive expertise (see Fig 2.4). It is important that designers have an understanding of human cognitive processes and factors affecting perceptual and motor performance given that, as highlighted by Shneiderman (1998), such issues are likely to have a profound effect on the quality and design of most interactive systems. The first level at which learning is likely to be influenced, by the level of user engagement, may be considered as that of perception (see Fig 2.4), potentially involving attending to information at a level below that of conscious thought, as demonstrated by the work of Cherry (1953) and the so-called "cocktail party phenomenon". Such issues of perception and processing have potential implications for the design of CBL material in terms of learner attention.

From there we might consider engagement at higher levels of cognitive processing, involving memory, retrieval and levels of understanding. These may be regarded as prerequisites to the level of cognitive change we would regard as learning, in the context of Higher Education. In order to engage learners at both the sensory and cognitive levels we must cater for their expectations, wants and needs. It is considered possible to offer an environment within the computer-based domain which may achieve this goal, to a significant extent. In seeking to offer such a level of learner centred provision we must give serious thought to our underlying reasons for the decisions we might make regarding design. While pedagogical design remains crucial, it is possible to increase learner motivation and enjoyment by making the learning experience more "relevant" and "visually stimulating". This may be accomplished with the use of illustrations, videos, simulations and other resources, such as linked material and self-assessment questions, and moderate use of humour. The potential for positive impact on motivation for CBL by the use of microworlds is highlighted by such as Somekh (1996). By treating the learners as "discretional" rather than "captive" users, issues relating to design become centrally important at the motivational as well as the informational level. As Mandel (1997) suggests, it may be considered that users should be allowed to decide their preferred style of interaction with the computer based material and that designers should design for different user types, and the different tasks that the users may be engaged in at different times. Having responsibility for motivating users suggests that designers of CBL material should, according to Hughes (2000), take perception, cognition and interaction to a level of "conscious understanding" by analysing the ways in which engaging performers such as stand-up comics, or good writers, engage their "discretionary" audience. There is therefore a distinct possibility that elements considered as "bells and whistles" for "captive" learners may be significantly important when dealing with "discretionary" learners. To some extent this might be reflected in the attention to detail given to software for younger learners.

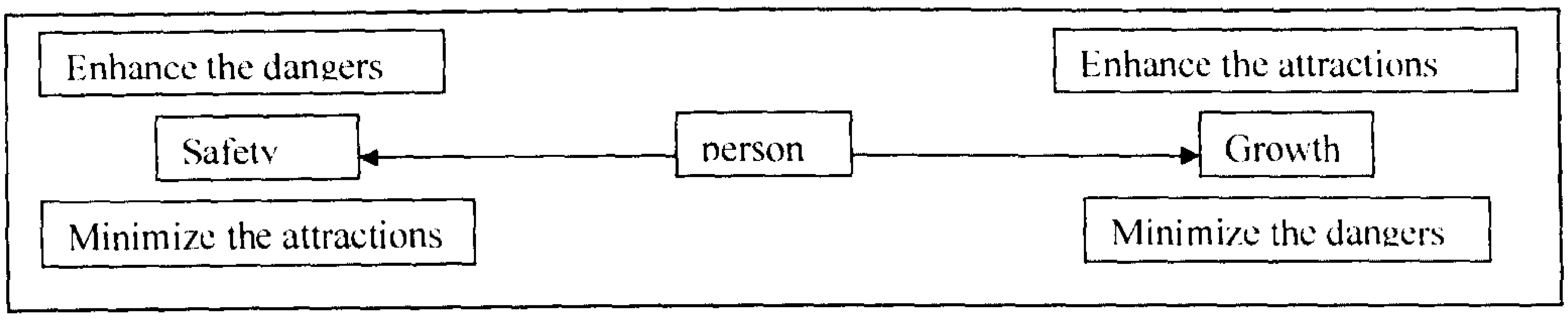
The approach taken to learner motivation is likely to depend on the views held by those offering the learning experience. From a behaviourist standpoint they are likely to consider motivation using reward, negative reinforcement and punishment, which in CBL material would be reflected in a highly structured environment, which offered reinforcement of responses given. The motivation from this perspective is extrinsic in nature.

From a cognitivist standpoint the individual perception and desire for "equilibriation" or balance in the conception held of the world is important as highlighted by Piaget. Equilibriation may be achieved by "assimilating" in relation to existing concepts, or "accommodating" by modifying existing concepts. The direction the behaviour takes is considered to be the individual's approach to overcoming the disequilibrium involved. The discovery learning perspective involves questions, which lead to learners recognizing gaps in their knowledge and seeking to address such. In CBL material this would be reflected in an exploratory environment, which enabled users to gain information leading to their assimilation and accommodation of the concepts concerned. The motivation from this perspective is intrinsic in nature. Intrinsic motivation is considered by such as Bruner (1996) to result in learning being valued for its own sake. As highlighted by such as Brophy (1983), learners with an intrinsically motivated approach to learning have been found to be relaxed, persistent and task involved, seeking to increase their level of understanding or cognitive skill. This mode of learning is considered to enable the self-discovery approach to be applied to other problems the learner may encounter. One of the central problems relating to the cognitive approach is that it may be difficult to induce a state of disequilibrium in learners to the level required to motivate them to seek the learning they require. This is likely to be so where material is perceived by the learners to be less than appealing.

From the humanist perspective the concept of "needs" becomes centrally important, with the lower needs requiring to be gratified in order for higher needs to emerge, which the individual would then be motivated to satisfy. The lower needs are considered by Maslow (1968) as deficiency needs and are regarded as requiring to be satisfied by others. Growth needs are regarded as being satisfied largely by the individual themselves. This view suggests that deficiency motivation will give rise to significant levels of dependency on others, while growth motivation is more likely to lead to self reliance in dealing with any difficulties faced. Individuals are considered to make choices from a perspective of avoiding that which they fear, or achieving that which they desire (See Figure 2.6).

Maslow's theory offers a level of clarification of choices made by learners when the opportunity is given for self-directed learning, and why some may have a stronger desire to know and understand than others. The limitations of this theory include the difficulty in establishing which needs are unsatisfied and the level to which it is possible to do anything about the gratification of such needs. It is likely that the best an education provider may offer is to attempt to help learners learn more effectively. In CBL material this would be reflected in an environment which enabled users to choose the form in which the information and concepts concerned were presented to them. The motivation from this perspective is variable.

Figure 2.6: Growth v Safety Motivation



(Maslow 1968, p47)

Fear of failure may be regarded as an important issue for learning environments, with the enhancement of the attractions offered being important to encourage motivation towards growth rather than safety. If learning is made appealing and the possibilities for embarrassment and failure are reduced, learners are more likely to be willing, or even eager to do the assigned task. A "need for achievement" may be regarded as underlying human motivation as highlighted by McClelland (1961) and this "aspiration" to "achieve" may also be related to a need to avoid failure as pointed out by Atkinson (1964). From this perspective some individuals are success oriented, while others have a high anxiety regarding failure. The goals success oriented individuals set are considered likely to be in the intermediate difficulty range, while those in the anxiety category are considered likely to set very low, or very high goals. The anxiety driven individuals therefore either succeed at very easy tasks, or avoid criticism for failure on the difficult tasks.

Explanations given by learners for their success, or failure, have given rise to "Attribution Theory". As highlighted by such as Biehler and Snowman (1990), from this perspective attribution of success or failure to internal or external factors on the part of the individual, is likely to influence the effectiveness of the learning materials and environment. Where the individuals are high achievers they are likely to be success oriented and will be unlikely to be negatively affected by instances of failure during their learning process. Rather they will be likely to resolve to work harder thereafter. Where the learners are low achievers they are likely to anticipate failure rather than success, to such an extent that the achievement they might manage may have little effect on their failure-avoiding strategies. It is therefore clear that while the "behaviourist approach", of carefully structuring learning material and rewarding each stage in the learner's journey through the material, highlights the importance of rewarding feedback being given to learners, there is value to be gained in moving beyond such external motivation. The design of CBL material must take the need for gratification and the level of intrinsic motivation into account, for the range of learners targeted, if we wish to achieve the best possible affective impact. Internal motivation for learning might ideally be expected to develop in learners before they enter into Higher Education, however they are also likely to be inspired by external motivation. Designers of CBL material need to take such external motivation into account, by stimulating curiosity and offering some form of challenge which learners become inspired to accept, or by directly assessing their learning.

Assessment may be considered as external motivation which may have very frequent elements of "gratification" where opportunities for positive reinforcement are taken, or the assessment may be distant with the subsequent need for delay of gratification to be accepted. Where assessment is the motivator which influences the approach taken to learning this is likely to be reflected in the preferences expressed regarding presentation of material, with the highest value being placed on the resources the learners consider will provide them with the best return, regarding the related assessment. The clear danger, as pointed out by Issroff Osmond and O'Higgins (1997), being that material not considered as directly related to passing the assessment may be regarded by learners as merely an extra. One option for designers would be to make the use of the CBL material directly assessed, which may achieve the outcome that learners make use of the required material. There is some risk however that such requirements may result in negative feelings towards the material on the part of learners.

The importance of matching the instructional approach taken, to the student's learning objectives and catering for their motivation for learning, may be considered a central issue to be addressed in the design of CBL material as highlighted by Aedo and Catenazzi (1997). The use of imposed conditions, expectations and values, within microworlds are unlikely to match the expectations and values of all learners (Somekh 1996), which suggests that alternative approaches should be offered. We are likely to increase the chances of intrinsic motivation by paying greater attention to discriminative reward on the basis of quality of response. Such as Biehler and Snowman (1990) consider that by adopting the "cognitivist approach" and emphasizing intrinsic motivation to learn, we are likely to increase our chances of success in motivating the learner, by making the information and skills they have to deal with as interesting as possible. It is also likely that by making the tasks and sub tasks and their related elements of content more interesting for the learner, we will avoid reducing, or even increase their level of motivation to undertake the work involved in order to learn. The importance of enabling the learner to realistically monitor their achievement, therefore avoid misattributing the reasons for their progress, or lack of such, has implications for the design of reflective learning opportunities and facilitation of metacognition. As Hughes (2000) points out, motivating the user to start and continue using computer-based material within the initial minutes, or run the risk that their attention will be lost, is one of the difficulties facing designers. While people may consider a computer acceptable as a tool with which they might undertake work, they may not consider it acceptable that a computer should take a controlling role in their learning dialogue and this may therefore, as highlighted by Kommisarova (1994), adversely affect their motivation and emotional state. Where the facility is offered to explore CBL material, the learner may as Barker (1990) suggests, become distracted and diverted which may have a negative impact on knowledge transfer and attitude of learners as highlighted by Pilipenko and Komissarova (1995).

The level of authenticity in a problem based learning environment has been found to influence both motivation and achievement as highlighted by Kang and Kim (2000). Teaching at an adequate demand level has been shown by Kritzenberger , de Wall and Herczeg (2000) to cause positive mental states. Motivational strategy and task relevance has importance for the likely intensity and persistence of student learning effort as pointed out by Borrás and Coronel (2000). Factors linked to value and expectancy for success have been highlighted by Ferreira (2000) as important in a Web based course environment. User satisfaction when using computerized instruction materials has been linked with learning, teacher role, tedium, real-world applications, software and gender differences, as highlighted by Passmore et al (2000). These findings suggest that CBL material should be perceived as authentic and relevant by users, offer appropriate levels of demand and reinforce the likelihood of successful progression through the material in order to maintain motivation levels for users.

2.3.2.4 Engagement, Narrative and the Design of CBL

High levels of concentration, referred to by Csikszentmihalyi (1982) as "flow" or Kozma (1991) as "cognitive engagement", might best be achieved by uninterrupted forms of presentation, such as that employed by books, films, or even lectures, to the level where the motivation increases to the level of excitement. While we might consider this to be rather rare in the case of a lecture, it might be reasonable to accept, as suggested by Bordwell & Thompson (1997), that this may happen with books and films on a more regular basis. The use of computer-based material may, as such as Somekh (1996) suggest, enable such levels of engagement to be achieved. Emotional engagement with computer based material may be influenced by the presence, or absence, of a "story shape" in the material concerned, which constitutes a game played with user expectations. Stories have a sequence and the sequence is important, with early stages of the story likely to present the user with an aspect to intrigue, in the middle they are likely to try to predict what will happen next, and in the end they may be presented with an outcome they didn't quite expect. In the real world confusion may result when we cannot establish or invent a suitable story, to the extent that events which are too abrupt are impossible for us to assimilate, resulting in extreme cases in trauma, or in mundane cases "cognitive noise". A coherent narrative path through a story is centrally important in the film industry, and according to Hughes (2000) should be regarded as equally so in the domain of interactive media, yet this is not done. Such approaches to the production of "multimedia" gave rise to the terms "shovelware" and "multimediocrity". The multimedia CD ROMs which proved failures both commercially and aesthetically, may as Hughes (2000) suggests have fallen victim to this lack of attention to "narrative flow". While narrative may be considered important, it is equally important to consider the "three-dimensional spaces, or landscapes" concept, in that we should as such as Hughes (2000) suggest, endeavour to lead learners through the "terrain" which is best suited to them as individuals. The important point being that we may all find different routes into various subjects, but will eventually cover much of the same ground. Just as we may argue, as Hughes (2000) does, that a "bad" teacher, would be one who knows only one route while a good teacher, would have the ability to find and lead through "multiple paths", we might argue that good CBL material / environments should offer the same capability. It may be argued, as Hughes (2000) points out, that "good stories" have "digressions", and that "digressions" are the "whole point of hypermedia". From this perspective letting people find their own route is central, and the notion of the computer domain as "landscape" may be considered to offer some useful messages for design of the software interface concerned.

2.3.2.5 Review of Learner Issues and Instructional Design

The preceding sections have highlighted the importance of learner motivation and engagement in relation to learning and the implications for instructional design. The importance of expectations on the part of both learner and education provider and issues of assessment have been highlighted and discussed in relation to instructional design and learner engagement in the learning process. The importance of narrative within CBL material has been discussed in relation to instructional design. The impact of stakeholder perception of the requirement for motivating instructional design has been discussed and related to the need to cater for individual needs within a discretional audience where CBL is offered.

This leads us to consider the approaches to instructional design which influence such factors and their use within CBL material. Centrally important in determining the approach taken to the instructional design employed is the provider's perspective and that of the designer(s) and author(s) of the CBL material. The following sections address these aspects in relation to instructional design.

2.3.3 Provider Perspectives and Instructional Design

The following sections address instructional design issues from provider perspectives as reflected in approaches to design and authoring of CBL material.

2.3.3.1 Designer Perspectives and the Design of CBL

The currently favoured approach to software design, as highlighted by such as Metros and Hedberg (1998), emphasises the importance of the range of skills to be found in design teams rather than individuals. There is clearly a need for teamwork, with the shared philosophy of the importance of two-way communication to meet any challenges and attend to the range of issues, as perceived from the range of perspectives which reflect specific expertise within the team. In situations where the design, development and delivery of CBL materials is contracted out to each sub-group, there is a danger that the level of mutual communication required will not be achieved and that the material produced will reflect this. Soloway and Pryor 1996 point out that software design has gone from technology driven, to learner centred approaches and Bannon 1991 considers that users should be regarded as "active agents" within the design process rather than objects to be studied. Mandel (1997) however cautions that we should not rely entirely on user input to drive the user centred design, as we might get so caught up in the present approach that we don't design for the future. The opportunities offered by the computer-based environment range from simply another way of presenting the same traditional text-based material as pointed out by Sparrow, Herrington and Herrington (2000), to the possibility of offering an experience for the user, which is unique to the medium and exploits its best characteristics in the most appropriate ways as highlighted by such as Hughes (2000), Nielsen (1995) and Vince (1995).

The design of CBL material requires an awareness, on the part of designers, which differs from traditional design guidelines for print based materials. The computer-based domain of "cyberia", or "possibility landscape" (Hughes 2000), or "opportunity space" (Boyle 1997), requires considerations to be made at levels, and in ways, which previous domains have not required. One of the most fundamental aspects of the computer-based domain is that it is dynamic. When interactivity is considered as a design element there is potential for many levels of interaction and many layers of communication with the learner. Perception may be considered to operate at the conscious level, but also at a level below that of consciousness. The importance of this in terms of design relates to the use of media in ways which engage the range of sensory perception. When CBL material is to be generated it is therefore likely to involve a design team which at the high specification end of the spectrum is likely to include: academic content experts, instructional designers, programmers, graphic designers, video / film specialists, sound specialists, photographers and potentially actors, as highlighted by such as Hedberg and Metros (1998), Mandel (1997) and Hall (1997). At the other extreme we may be faced with a lone academic attempting to re-work existing resources. For anything beyond the most basic level of production we are likely to have at least three perspectives involved, from which the same CBL material may be perceived quite differently. The perspectives may be considered to include academics, technical experts and learners, and the weighting given to the perspectives is likely to vary according to the stakeholder perspectives of those who have the power to make decisions. Computer based material may therefore, as Mandel (1997) suggests, be considered to have a set of "beliefs built in" which are of particular importance when we are dealing with software for learning and may be observed in the early software design, which took little regard for the user, who was expected to adapt to suit the computer-based material concerned.

We have now moved to a perspective where we expect the material to be designed to suit the range of learners for whom provision is made. This raises issues regarding levels of experience, motivation and expectations of users, which are likely to influence their use of the material / environment developed. The expectations, of the instructional designers of CBL material, are likely to be reflected in the pedagogy they adopt within the instructional design. The potential for variation in perspective, exists both within and between learners, academics, and technical experts. Where CBL material is being designed, the designer should have both technical and educational expertise and should be capable of assimilating the subject content and maintaining an awareness of the student's perspective. Authoring computer-based material is, as such as Porrit (1997) highlight, a two-way process and good authoring should enable the translation from expert resource into a working activity, leading to learning outcomes. Professional collaboration as Lisewski and Settle (1995) point out is likely to produce better design and results.

2.3.3.2 Author Involvement, Quality and the Design of CBL

The central involvement of the author of the material is important throughout the development of the computer-based material, thus enabling "nuances of interaction" to be developed in the material, which are likely to be lost in the scenario where concept and content material are handed over to "technical experts" for production. This iterative approach may be argued to preserve what Hughes (2000) refers to as the "invisible handwriting" of the author. Those responsible for authoring or designing computer-based material may be considered to impose their "world view" on the material they develop, in that assumptions are made on the part of such developers which translate into the software produced. The underlying assumptions of such developers may as Hughes (2000) argues, give rise to software which may either "empower" or "stupefy" users. Such assumptions impact on instructional design and interface design, where CBL material is concerned. The maker's (i.e. author's) perspective may be reflected in the interface design and the way in which the interface aligns with the users preferences, or requires to align with the interface requirements as reflected in what such as Mandel (1997) refer to as an "application orientation". A similarity exists in "maker's work" at the fractal level, which allows us to recognise the author by studying any section of the work, as the fractal similarity will prevail. Examples of this may also be observed in such areas as music and film, where the composer or director's style may be observed in any section from the piece.

We generally recognise our preferences without thinking deeply about the underlying reasons, whereas connoisseurs "apply conscious thought" to their "unconscious preferences" and discover the reasons for them. Where the connoisseur focuses their attention on the features that reveal the "secret history" of the object concerned, this enables the "lay-person" to realise that they had been influenced by these aspects. It is important to note, that to reveal the reasons for our likes or dislikes, still does not explain how we experience this. The mental processing concerned may be considered to be "unconscious". The important issue for the design and use of CBL material is that users may "unconsciously" perceive underlying issues within the design of the material and this may influence their perception of the value of the material and their level of motivation in using such. We may react to what Hughes (2000) terms as the "maker's handwriting", at a level below conscious thought, and therefore react to the computer-based material on the basis of such. As Hughes (2000) suggests, where the "maker's handwriting" reflects "competing agendas" and "fudge" we are likely to react to such by choosing not to use the material concerned.

The meaning of the term "quality", which in general use may be regarded as signifying "of the highest standard" may, from a narrower definition in the business arena, also be considered to signify the meeting of a "set specification". Depending on the stakeholder perspective from which expectations and design issues are viewed, it may be considered that a "culture of workmanship", achieving a "good enough" design would be appropriate, or from an alternative perspective that the software concerned should be of the highest standard in all areas of design and making best use of the latest technologies. It may be argued that "quality" in design should include the design of motivating CBL material. As Davies and Crowther (1995) point out, it may also be argued that the "motivational" aspect of multimedia tends to be overplayed and that "page-turning" CAL and that which is little more than a "text-book plus flashing lights" is likely to be tedious and dull. While the initial novelty element of multimedia may add incentive for engagement in the short term, "enjoyment" does not constitute learning and therefore multimedia features might be considered more as hygiene factors rather than direct motivators. The approach taken to the design and delivery of CBL material is likely to be based on designers' and providers' assumptions regarding motivation. If they consider it is their responsibility to motivate the learner to use the material in a positive way, they are likely to make best use of the available technology in order to do so. If they consider that the learner should be self motivated and their task is simply to provide a source of information, this is likely to be reflected in their use of available options. Clearly the definition of "quality" employed would be greatly influenced by the perspective adopted regarding the importance of designing CBL for motivation of learners.

2.3.3.3 Effective Learning and the Design of CBL

Elements identified as important for effective learning include the use of prior knowledge, hypothesis generation and motivation, all of which have implications for the instructional and interface design of CBL material. The relevance of such elements is also important regarding the selection and use of appropriate multimedia resources within CBL material as highlighted by Valley (1997). The importance of considering the constraints and opportunities offered by the environment when dealing with instructional design, before deciding on the delivery approach used is highlighted by McMahon (2000). The "temptation" for some to place large tracts of text into online materials raises design issues regarding the "activity" as "supplementing" the unit, rather than "being" the unit as highlighted by Herrington, Sparrow and Herrington (2000). When considering issues of instructional design, we should reflect on what we wish learners to achieve (our educational aims), what experience we wish them to undertake in order to achieve such aims (our objectives which learners must meet in getting to the aim), and the way in which we will determine whether the learners have successfully achieved the stated aims (assessment). In addition to these fairly fundamental considerations we should consider the reflective aspect of judging whether we have offered the learners the most appropriate learning experience in order to meet their needs (evaluation) and make adjustments to the material concerned, where considered appropriate. This approach is not new, but applying such an approach to the CBL arena is by comparison relatively recent. Just as the approach was complex in so-called "traditional" approaches to teaching, it remains complex, and may even be considered more complex when applied to CBL. The complexity may be considered increased by the many debates within the arena of teaching and learning, being added to debates within the arena of learning technology. It is important to address the central issues within the educational debates as these affect the perspective from which the instructional design employed in CBL material might be viewed. Where once the main aim of CBL material might have been the highly structured progression of the learner through a selected range of information, with the focus on retention and recall of such, the main aim now of CBL material based on constructivist approaches might be considered to be the engagement of the learner in the constructive learning process. This has had a major impact on the design principles underlying the generation of CBL material. The use of "authentic" learning tasks, to ensure that learning is considered meaningful by the student, discovery learning methods, in order that the student may construct their own understanding, and an emphasis on learning how to learn and solve problems, rather than learning factual information, coupled with recognition of the importance of supporting problem solving and where possible collaborative learning, is now the major focus from the constructivist perspective as highlighted by Boyle (1998). There are implications here for related areas of design, including the use of hypermedia, multimedia and the more immersive design options including levels of "virtual reality". Instructional design has the task of enabling learning to take place at an appropriate level for the user, from the pedagogical perspective of the author, using media selected by the designer. Instructional design may, as pointed out by such as Elen (2000), be regarded as having its focus on the identification of optimal relationships between learner-related and instruction-related variables, in order that instructional, or learning, goals be attained. While most would agree that high level principles are important regarding the approaches in instructional design, such as Boyle (2000) argue that such principles are not enough. Instructional design might be considered, by such as Ahmad (2000), to offer tools to mediate between course objectives and desired learning outcomes. Tools and templates have been developed to assist with instructional design, whereby instructors can fill in the learning activities and study material, as highlighted by Remmers and Collis (2000). Similarities have been identified between instructional design and engineering, suggesting as argued by Doré and Basque (2000), that the term "instructional engineering" is justified. Christman and Kazlauskas (2000) suggest that electronic performance-support systems may be employed to assist designers in applying contemporary learning science in their designs.

2.3.3.4 Structure, Hypermedia and the Design of CBL

The provision of CBL in the form of an "electronic book" may be considered to support independent learning by making use of a range of media including images, animation, sound, and hypermedia links as highlighted by Pilipenko and Komissarova (1995). One of the central design issues for instructional design where hypermedia is concerned relates to the level of structure considered appropriate. The imposition of structure within hypermedia material may be considered to be contrary to the underlying philosophy of many who favour the use of hypermedia, but restricting the freedom of navigation has been highlighted, by Aedo, Diaz and Catenazzi (1997), as beneficial for less experienced learners. One of the fundamentally valuable contributions, made by the use of computer-based material, in terms of meeting differing needs of learners, is that it enables learners to allocate time to the material in the way they find appropriate. This as Johnson, Dewhurst and Williams (1997) point out, permits additional time to be given to areas identified by the individual learners as important for their needs. The focus according to such as Harrison (1994) should be on the learning experience offered rather than the delivery medium used, allowing the design to suggest the appropriate media and such as Laurillard (1993) consider backup provision should be made to maximise the benefit students gain from studying the material presented to them. While the use of computer-based material may offer students greater access to content, increased flexibility of time and pace of study and the opportunity to develop autonomy in learning within a structured learning experience, it is likely, as such as Laurillard (1993) suggest, that student expectations will be that the lecturer will guide them through the range of information available, thereby allowing them to achieve their goals "without undue extra effort". It may be argued that most students do not have the time, or background required, to make "liberating navigational choices".

2.3.3.5 Review of Provider Perspectives and Instructional Design

The preceding sections have highlighted the importance of the approach taken by those responsible for designing CBL material in relation to the instructional design aspects and perceptions held of the learners for whom material is generated. The importance of continuity of the author involvement and the potential impact of such on the instructional design achieved has been highlighted. The potential for conflict of interests between stakeholder groups in design teams has been discussed in relation to instructional design. Elements highlighted in the literature as important for effective learning to take place have been discussed in relation to instructional design and the use of multimedia and hypermedia resources within CBL material. This leads us to consider the importance of active learning and the level of interactivity designed into the CBL material.

2.3.4 Interactivity, Multimedia and Instructional Design

The following sections highlight the importance of interactivity and media selection in relation to instructional design. These aspects are then related to learning styles and approaches to learning and the implications for instructional design are discussed.

2.3.4.1 Active Learning, Interactivity and the Design of CBL

The complexity of interaction in relation to design of computer-based materials is highlighted by Preece Rogers and Sharpe (2002) and offers a level of overall orientation within which to consider the issues addressed in the following sections (see Fig 2.7).

Figure 2.7: Relationships Among Interdisciplinary Concerned With Interaction Design

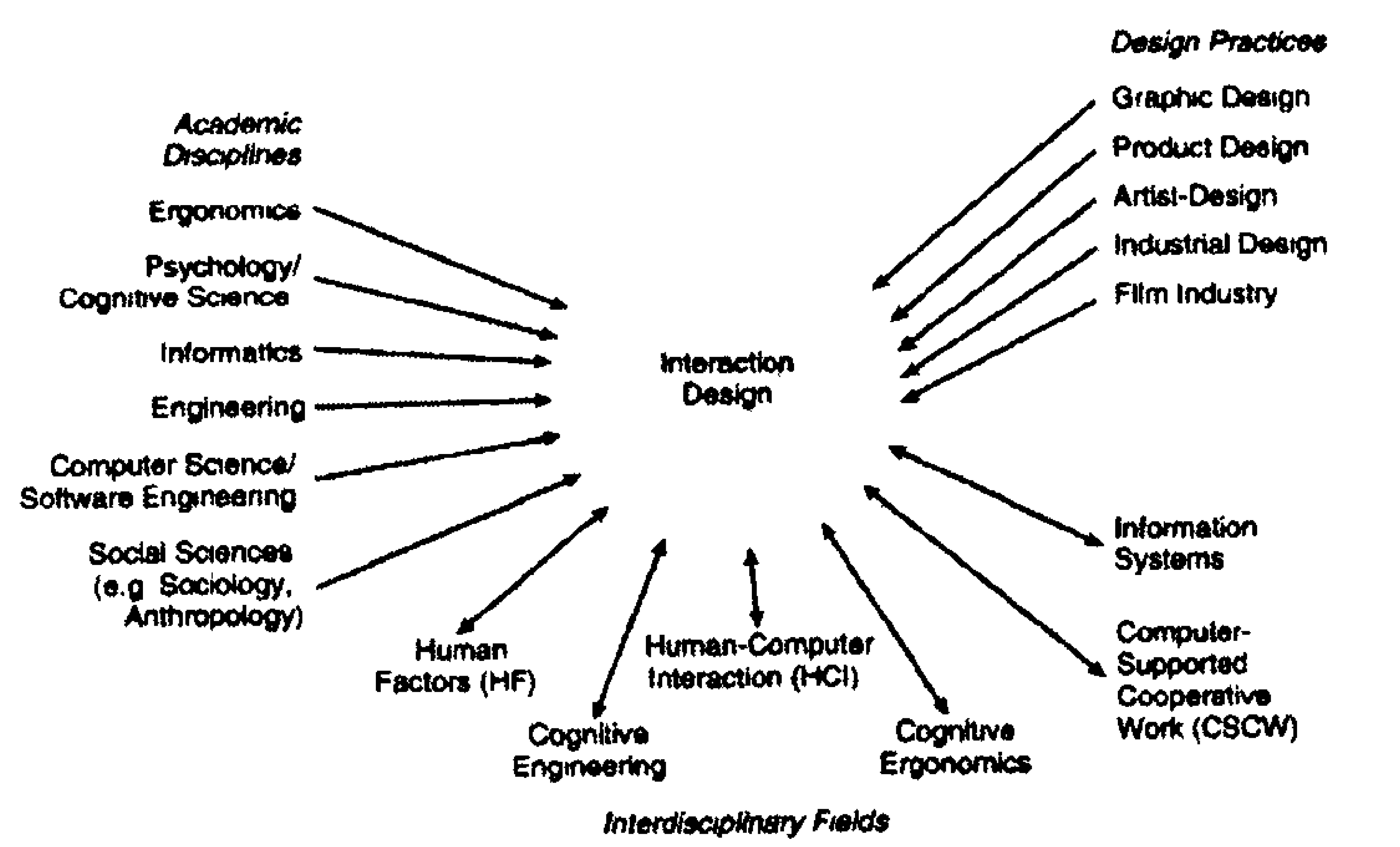


Figure 1.3 Relationship among contributing academic disciplines, design practices, and interdisciplinary fields concerned with interaction design.

(Source Preece, Rogers and Sharpe 2002, p8)

As previously mentioned, it may be argued that knowledge which is learned, but not used in problem solving activity, is "inert knowledge" and is likely to remain so until used to solve problems. It may also be argued that one of the ways in which it is possible to engage learners "actively" is to have them undertake some level of problem solving exercise. This takes us to another area of complexity in that such issues may be addressed within the CBL material per se, or may be addressed in some way within the overall educational environment concerned but remote from the computer-based material, as with the submission of assessed work based on, but separate from, the computer-based provision. Making learners "active", rather than "passive" when engaging in learning is possible with computer technology, which such as Richards (1994) consider may help overcome the problem of large scale lecture theatres and the issue of "passive learning". However the human-computer learning experience may also be considered "passive" when dealing with knowledge transfer as pointed out by Pilipenko and Komissarova (1995).

The issue of whether a learner is "active" or "passive" is one which must be considered carefully on a number of levels. There is a danger that physical movement might be construed as "active" learning, which it may be argued not to be in situations where learners are simply copying notes from a blackboard without any further thought regarding the content, or in the case of CBL material simply clicking a button to advance through a range of material on-screen without any further thought regarding the content. This relates to the points raised by Mayer (1993) as outlined previously, regarding the requirement for cognitive engagement. Clearly there are issues here which relate to the instructional design of CBL material, in order to ensure that the "active" learner is encouraged to be "active" from the perspective of the focus of the learning desired, as opposed to simply active physically in moving through without further thought. The problem of course is similar for CBL to the problem faced traditionally, in that we must rely on external evidence of such "active" learning as we cannot monitor the student's thought processes, only the product of such, which might be labelled "learning outcomes". Approaches such as questioning, exercise completion or discussion may be employed to get students to actively engage in the subject matter. CBL materials may enable progress to be made dependent on the completion of required tasks, and on-line feedback to be provided which enables students to assess their own progress and level of understanding, which may be considered to reduce the likelihood of "freeloading" and cater for individual interests and abilities. However, as Davies and Crowther (1995) point out, simply getting students to provide an answer to questions does not ensure the desired level of thought and too many "problems" being set may make the package tedious to use.

Interactivity may be considered of central importance in computer-supported learning environments and may be directly related to interface design. It may be considered that interaction paradigms relate to the metaphors and characteristics presented to users, and that when new learning scenarios are used this frequently implies adoption of new interaction paradigms as highlighted by such as Adriano, Adriano and Ricarte (2000). An actor added "drama" element is considered by such as Amory and Govender (2000) as likely to create a more meaningful interaction with the player in a game style model of an interactive book, while interactive and animated analogies are argued by such as Hansen and Narayanan (2000) to prime learning from subsequent visualizations. Interactivity may be regarded as involving more than guided clicking through branched instruction, and would be expected by such as Sniderman, Boyd and Joos (2000) to offer opportunities for testing, falsifying, validating and elaboration of understanding at the higher levels of interactive capability. Interaction with the instructor is argued by such as Richardson, Tunwall and Carnevale (2000) as continuing to be regarded as centrally important in the level of learning achieved by students.

As pointed out by Hughes (2000), the label of "interactivity" may be applied to a wide range of experiences and contexts including the use of machinery, toys, and tools, with the important aspect being the part played by the user. The term "interactive" may be used to describe most if not all multimedia packages although the definition in use may be less than clear, with some highlighting two way communication being involved and others simply highlighting an immediate response to input as pointed out by Heath (1995). It may be considered, as suggested by Hughes (2000), that some level of dialogue is required which takes the user beyond the "point-and-click" level of "interactive". The concept of "interactivity" is complex and there are clearly many design issues to be addressed, with the connection between "interactivity" and "engagement" clearly significant, as highlighted by Laurel:

> "There is another, more rudimentary measure of interactivity: you either feel yourself to be participating in the ongoing action of the representation or you don't."
>
> (Laurel 1991, P20)

Well designed interaction may be argued to possess many of the characteristics of a good play as argued by such as Laurel (1991). This essentially involves a rise, climax, and fall in the level of action, with the crucial point being that interest is constantly rewarded throughout these stages. Hughes (2000) refers to the notion of an "emotional payoff" following the "what happens next" approach arguing that this acts as a positive motivator for interaction and engagement. From the perspective of those such as Mandel (1997), the "interaction techniques" used should reflect the developments in technology, rather than being based on "obsolete technology". Clearly from an educational perspective the nature of the interaction in relation to the content and to user expectations is clear, as expectations may be violated where interaction techniques offered within the instructional design are based on "old" technology, while user expectations are based on developing technology. Where early "interactive" systems featured "talking heads", these often prevented the user interacting with the system in that they took control of the screen away from the user. Users regarded the talking heads to be "condescending", "arrogant" and "stupid", resulting in their reluctance to interact lest they trip another talking head episode. The provision of a "shut up" button failed to resolve the problem, from which we might conclude, as does Hughes (2000), that users were reluctant to treat even a "digitised person" in this way. Again we are faced with an area of complexity, in that "interactivity" may be seen differently from differing perspectives, and aspects which from the developer's perspective seem to add value, may not be regarded as valuable by users. Computer-based material may be categorised, and even evaluated, on the basis of the level of "interactivity" offered, as reflected in the range from recognition (A) to recall (B), comprehension (C) and reconstructive understanding (D) to constructive understanding (E) as highlighted by Somekh (1996). Developers of computer-based material might be expected to ensure level C, as this might be considered to represent the lowest level of constructive understanding, and work towards levels D and E, which might be considered to offer more complex learning to be demonstrated. This might be achieved by linking interactivity on and off screen, or the use of simulations. CBL material may be considered to require interactivity as it is attempting to perform the task of a teacher and it may be argued, as Somekh (1996) points out, that the greater the extent to which the CBL material attempts to fulfil the role of the teacher, the greater the need for interaction to be offered. It is considered by some, such as Brailsford et al (1997), that CBL materials should address the elements of dialogue between teachers and students, but that most tend to focus on the "declarative" aspects of the learning process. Given that simple navigation through the information presented has been regarded as "interactivity", it is therefore argued by such as Carswell (1998), that interactivity of a more sophisticated level is of less importance. Such views highlight the importance of user requirements and expectations and the level of priority which might be attached to elements within CBL material by various stakeholders.

Simulations in computer-based material, might be considered to offer interactivity at the level D standard by enabling the student to learn regarding the cause and effect implications of responses given. This might be considered to create a level of "disequilibrium" leading to "active learning". It is also argued however, by such as Edward (1996), that even where the use of simulations within CBL material are considered to offer the best alternative available to the "real" experience, they lack the capability to offer the user a high level of "feel" for the environment and operational tasks involved and they are not good for developing team-working skills. Simulations have been found by Couture and Francis (2000), to be as efficient as real experiments within the domain of physics, given that they are realistic and have credibility. Multimedia simulation has been found by Keppell, Kan and Brearley Messer (2000) to meet the needs of dental students, in accessing suitable patients with medical conditions. Simulation programs for Higher Education, when carefully designed, are considered by such as Sniderman, Boyd and Geza (2000) to promote higher level instructional goals.

The use of a "game" approach is considered likely, by such as Mandel (1997), to facilitate "active learning" given that it enables learners to develop skills. Where we employ a games approach, we therefore accept the element of "play" and the potential value of such for learning, as highlighted by such as Prensky (2001). Play, as Hughes (2000) points out, may be considered as an exploration of "possibility spaces" and the level of control the user has within the domain and the "safety" aspect of the "virtual environment" may be considered as significant benefits for the user. Games are valuable learning tools as they have recognizable goals which users are challenged to achieve. It is argued, by such as Hughes (2000), that when users are engaged in a "serious" use of Excel, they are "playing "what-if" games". The importance of expectancy may be seen within the games arena in that users accept the "constraint of context" within the game scenario. Such acceptance prevents violation of expectancy by managing the expectations of users. The message for CBL material would therefore be that game environments have potential for learners but that "expectancy" requires to be managed or met. This suggests that we should seek to establish the existing levels of expectancy, in order to decide on appropriate approaches to the management of such within the computer environment.

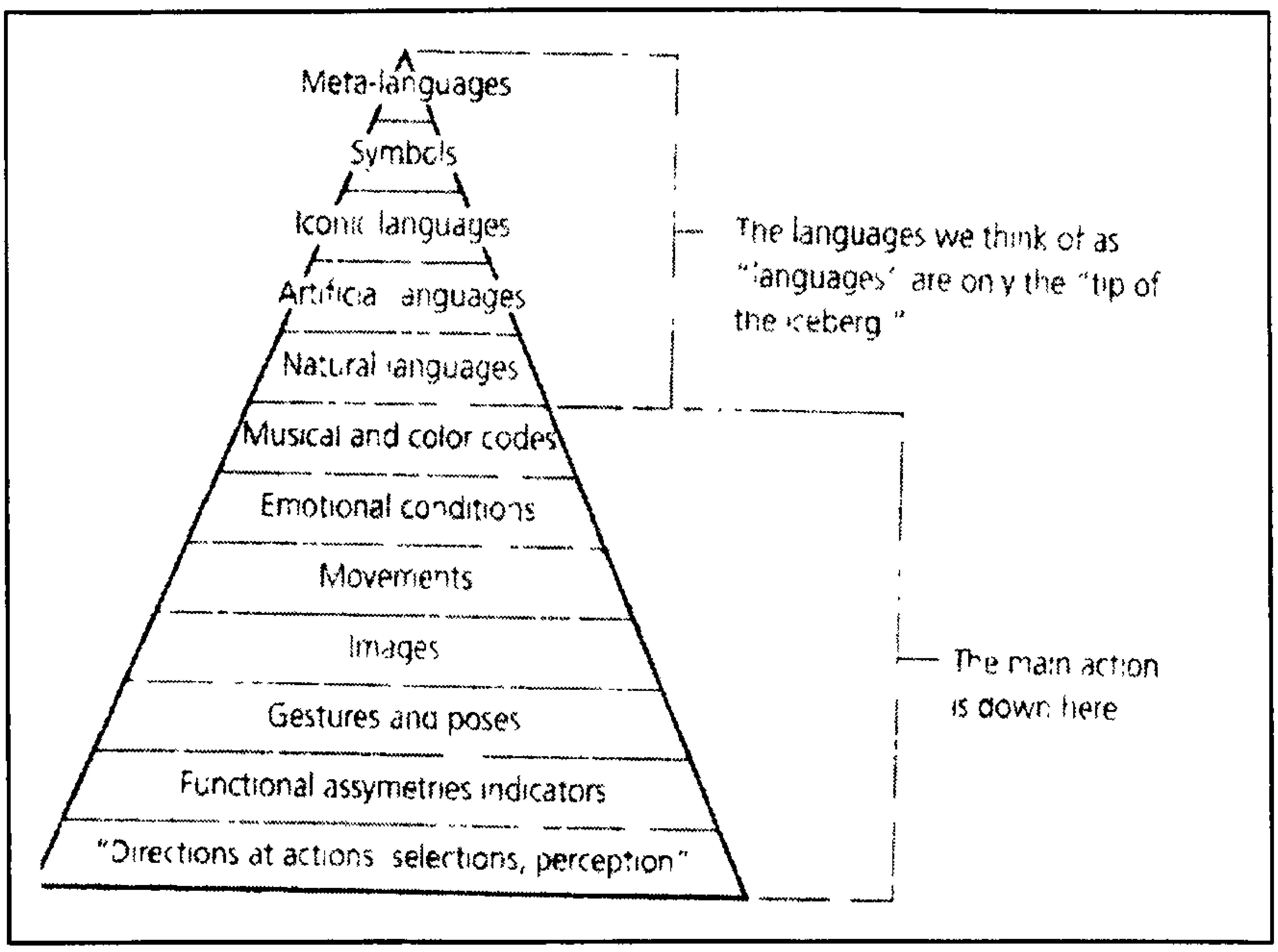
The notion of "responsive environments", as Hughes (2000) points out, may be traced back to the work of such as Krueger (1983), which may be argued to have contributed greatly to the arena we now refer to as "Virtual Reality". The central notion of "happenings" may be considered as a crucial element in this arena of "artificial reality". The particular value of Virtual Reality where "Force feedback" is enabled, relates to the whole-body nature of the experience and the level of interaction facilitated as highlighted by Hughes (2000). Virtual reality is regarded, by such as Vince (1995), to have the potential to offer the computer user an "immersive" and "interactive" experience. The extent to which this is currently achieved often relates directly to cost. There are, as with most technical products, levels of sophistication ranging from simple and basic to complex and elaborate. Haptic (i.e. force-feedback) virtual reality has proved useful as an aid to teaching, and it has potential for replacing invasive examination techniques in veterinary education as highlighted by Brewster, Montgomery-Masters and Glendye (2000). Virtual reality, as Chee and Khoo (2000) point out, may enable participation in activities which would be impractical in real life, with "QuickTime" Virtual Reality being used in the development of virtual anatomical models as highlighted by Dispensa, Duncan and Moon (2000). Virtual reality may also be used to offer previews of locations as highlighted by Germann and Broida (2000). A virtual world may be used for instruction in subjects from computer science as highlighted by Hill and Slator (2000), to building and running simulated robots as highlighted by Smith (2000), and in clinical medicine, scientific and educational visualization such as the work on Reovirus as highlighted by Gadbois, Rittenhouse and Goulden (2000). Virtual reality can facilitate viewing from various perspectives, allowing the visualizing of concepts and relationships and the use of 3D worlds may even be of value in empowering student introspection as pointed out by Juell (2000). Some, such as Hartman and Vila (2000), consider the gap between existing application programs and virtual reality interfaces may be bridged using "middleware".

2.3.4.2 Media Selection, Multimedia and the Design of CBL

Providers' perceptions of learner role are likely to be influenced by the theoretical approach to which they subscribe and the pedagogy associated with such an approach, which in turn will be likely to influence the selection of media for use in a CBL environment as highlighted by such as Romiszowski (1986) and Boyle (1997). It is often highlighted that we are more likely to remember that which we are enabled to take in using our range of senses actively. This may be reduced to the rule of thumb guideline offered by Mandel (1997), that we are likely to remember 20% of what we hear, 40% of what we see and hear, and 75% of what we see, hear, and do, which indicates the potential impact of the use of multimedia. Multimedia offers potential for enhancing our understanding of material presented, as Mandel (1997) points out, in that the mode of presentation may be made more similar to the ways in which we are likely to think, employing pictures, sounds, words, and multidimensional links. Some, such as Mandel (1997), consider the audio element is underutilized in computer based materials and that, where audio is used, it is centrally important to offer the user the level of control required to customise its use by adjusting the volume as they prefer. The potential offered by high quality graphics for the sense of "being there" is considered by Hughes (2000), to be illustrated in the "virtual tour" of the Royal Navy's frigate HMS Manchester. The opportunity to observe and recall violent situations, offered training opportunities for London's Metropolitan Police. The use of interactive video allowed the abruptness and stress of real-life crime to be retained. Similarly, for training at Dartmouth College Medical School in the early 90s, "Regimental Surgeon" and Traumabase", as Hughes (2000) points out, provide examples of the power to be gained by employing sound and its potential to create the "illusion of reality", supporting the aim of getting subjects to make good decisions under pressure. The central ingredient here may be argued to be the element of reality, with the multimedia element permitting this to be achieved. The use of video within the computer based environment is receiving greater attention as issues of a technical nature are becoming less problematic. As Peters and Collis (2000) point out, techniques involving compression and streaming have been particularly relevant for this element of computer based multimedia. Video offers users the opportunity to observe, which is of value in an educational context and the use of QuickTime streaming videos offers advantages for users as highlighted by Javenkoski, Reutter and Painter (2000). Such as Giouvanakis, Samaras and Tarabanis (2000) and Nickerson (2000) point out that streaming technology and the use of Synchronized Multimedia Integration Language (SMIL) offers further opportunities for development, while such as Mann et al (2000) argue that the presence of speech may be considered to improve multimedia learning. Such as Blatter (2000) consider that video may be considered as "narrative dynamic multimedia", which raises implications for instructional design and highlights the importance of adopting a pedagogical perspective on the use of that which is technically possible within the video arena as highlighted by Doerksen, Mattson and Morin (2000) and the importance of interactivity with the video material concerned, rather than simple viewing, as highlighted by Bergman et al (2000). The use of video embedded in hypertext is considered by Bidarra, Chambel and Guimarães (2000) to offer increased levels of attention and motivation, due to elements such as movement, novelty and appeal. Videoclips are considered by such as Chambel (2000) to enhance the authenticity of a CBL environment, and the use of hypervideo to offer the level of structure and organisation required for effective reflection on the part of the user.

It is evident that the development of computer-based interactive multimedia requires designers to work with forms of communication or "languages" in addition to those with which "traditional" media designers have routinely used. It may be argued that the "lower seven languages" as presented by Hughes (2000) take on significant importance for computer-based interactive multimedia (see Figure 2.8).

Figure 2.8: Languages in Multimedia



(Source Hughes 2000, P179)

The computer medium may be regarded as an emotional medium which can give people enormously rich emotional experiences and such experiences tap into the power of "unconscious processing". The importance of "unconscious processing" is argued by such as LeDoux (1998) to rival, or exceed that of spoken language in the natural world. As Hughes (2000) points out, strong emotions may be aroused both in the use of computer games and of "serious" software", which may be considered to help explain why people play with their favourite applications in a way they wouldn't with such items as typewriters. It may be argued that our awareness of learning via other modes should be brought to bear when designing for learning via CBL material and that as we use a range of senses to learn in the real world, we should attempt to accommodate such when learning from computer-based material. This leads us to the potential importance of a perception of "being there", which may be argued to link with the perception of "interacting" with the material. Each of our senses helps the other and we have the opportunity, in the computer domain, to use several channels at once. The importance of the way in which things are designed to respond to the user and the speed with which screen transitions are made and feedback is provided to the user therefore becomes centrally important. In such an environment we must as Hughes (2000) points out, pay close attention to the "sub-three-second domain" in order to engage our audience.

It may be argued that the "effectiveness" of multimedia courseware must be considered in the light of the educational objectives in use. Educational objectives may be categorised using any of the main taxonomies ranging from Bloom to Reigeluth (see Table 2.1) and generally range from recall and recognition of information to synthesising material and critically evaluating knowledge, understanding and competence.

Table 2.1: Instructional Taxonomies

Bloom	Gagne	Ausubel	Anderson	Merrill	Reigeluth
Knowledge	Verbal	Rote Learning	Declarative Knowledge	Remember Verbatim	Memorize Information
Comprehension	Information	Meaningful Learning		Remember Paraphrased	Understand Relationships
Application	Intellectual Skill		Procedural Knowledge	Use a Generality	Apply Skills
Analysis Synthesis Evaluation	Cognitive Strategy			Find a Generality	Apply Generic Skills

(Reigeluth and Moore 1999, p54)

It may be argued that multimedia courseware has generally focussed on the objectives, of "recall and recognise specified information", "comprehend and digest information" and "apply what they have learned", with some barely progressing beyond the first. Such approaches are considered unlikely to engender deep learning and are more suited to "training" rather than "Higher Education". From a "testing" perspective it may be argued that multimedia packages can only test objectively, which restricts them to right / wrong answer formats which do not lend themselves to analysis, synthesis and evaluation objectives. While there are ways in which greater flexibility may be built into such approaches, the central benefits of multimedia for human learning may be, as such as Davis and Crowther (1995) and Mandel (1997) point out, that it brings the experience closer to the way people might be expected to learn best in the "real world". The value of multimedia for learning is summed up by Mandel:

"A human being learns and retains best when looking at a map, hearing a sound, watching a moving picture, or choosing a path. Multimedia offers exactly this capability."

(Mandel 1997, p352)

Expectations held by learners using CBL material may influence their perception of the material and the way in which the material is presented may lead to expectations on the part of the learner. Where expectations of "multimedia" are violated there is likely to be a negative impact on the experience for the learner in both affective and cognitive domains. When CBL material / environments make use of images which correspond to reality, this is likely to set expectations and aspects may prove important in use, which were considered to be less important at the design stage. An example of this might be the potential problems with "shallow personalities" in "talking heads". As Hughes (2000) suggests, our expectations of people, "even digitised versions", appear to include that they should recognise us on future occasions, having met us initially. The use of talking heads which simply repeat the same clip to users who are re-visiting a location in the computer based environment, is therefore likely to be counter-productive, given that this is likely to conflict with user expectations.

2.3.4.3 Learning Styles and Approaches and the Design of CBL

It is known that a range of factors impact on learning and that these often relate to "individual differences" in areas such as "personality", "motivation", "cognitive style", "ability", and "learning style". These are considered to be reflected in the approach the individual takes to learning. In the CBL arena it may be argued that insufficient attention has been paid to such issues as cognitive and personality styles, and differences in learning styles. Student centred learning, promoted in the Dearing Report (1997) as essential, implies that learning styles should be taken into account when developing courseware, as learning effectiveness can be increased by accommodating individual learning styles. The underlying purpose in classifying the learners is the provision of learning opportunities to match their preferred way of learning. This is likely to involve the assessment of attributes ranging from emotional state and motivation, to prior knowledge, intelligence, and self-concept. While some would consider different definitions of "cognitive style" and "learning style", Valley (1997) points out the terms are used interchangeably. There are clearly variations in the definition of learning styles, as Groat and Musson (1995) point out, the definition in use is generally defined by the authors of the work concerned. Three classifications which have been of particular importance in influencing the development of CBL materials are those of: "holists and serialists" (Pask 1976), "divergers, assimilators, convergers and accommodators" (Kolb 1984) and "theorists, pragmatists, reflectors and activists" (Honey and Mumford 1982). From the Pask perspective, holists are considered to attempt to grasp the "big picture" prior to examining detail, and serialists are considered to prefer to learn a step at a time, grasping the detail of the basic concepts before moving on to the more complicated aspects.

Those such as Pask (1976), Schmeck (1983) and Entwistle (1988) take the view that individual students tend to be consistent in their approach to learning. Pask considers that performance is likely to be negatively affected if learners are forced to adopt their non-preferred style of learning. However such as Aedo and Catenazzi (1997) and Valley (1997) consider that there is some uncertainty regarding the stability of such preferences and whether the expressed preferences might be academic subject-specific or apply both within and between academic subjects. The importance of the interaction between learning styles and the impact of situation-specific concerns on approach is highlighted by such as Laurillard (1984) and Ramsden (1979). It is clearly evident that differing views exist regarding the stability and usefulness of learning styles. As Valley (1997) points out, it may be argued that such variables as intelligence, prior knowledge, motivation, anxiety levels, self-concept, and learner control are unlikely to be independent of each other, and that the effect of such variables on the learning experience are likely to affect the learning style preference on the part of the learner. It may also be considered that assisting learners to employ different learning strategies may be more appropriate than trying to accommodate the individual preference of the learner, especially where the nature of that which is to be learned might influence the style considered appropriate.

Hypermedia based courseware which can accommodate both serialist and holist learning needs may be considered capable of inspiring students to accept software, rather than human teachers, which the "infinite patience" claimed for computers even with the addition of immediate feedback and reinforcement, failed to achieve. It is possible to identify learning style by the use of a "standard test", such as Kolb's (1984) Learning Style Inventory, which is designed to measure the abstract / concrete dimension and the active / reflective dimension. Kolb takes the view that learners have aspects of each classification within their preferred learning style. The learners are categorised, based on their responses to the questionnaire, as "divergers", "assimilators", "convergers" and "accommodators". Divergers are considered to prefer concrete experiences and reflective observation, convergers to prefer abstract conceptualization and active experimentation, assimilators to prefer abstract conceptualization and reflective observation, and accommodators to prefer concrete experience and active experimentation.

Learners may from the perspective of Honey and Mumford (1982), be categorised as "theorists", "pragmatists", "reflectors" and "activists". While the theorists are considered to think problems through step by step and generate theory from their observations, pragmatists are considered to be focused on experimenting with new approaches to establish whether they work in practice, reflectors are considered to observe and think about issues from a range of perspectives, and activists are considered to become enthusiastically involved in any new experiences.

The relationships between "learning styles", "teaching strategies" and "learning activities" are, as Valley (1997) points out, less than entirely clear, therefore the nature of the interaction between the individual learner characteristics, the particular features of computer-based material and how such interaction affects learning effectiveness is also less than clear. Jones, Jacobs and Brown (1997) argue that there remains a need for research investigating ways in which information technology may be used to accommodate the learning preferences of students. Where learning styles and learning activities offered can be made complementary, there is likely to be benefit for the range of learners involved, which has implications for the instructional design and for the interface used and the level of control and flexibility offered to learners using the material.

The implications for the design of CBL material are that learning style should be accommodated at the instructional and interface design levels. The possibilities, as Valley (1997) points out, include that the learners are classified by learning style and the software developed to suit, or that some form of software based screening is used to allocate according to assessed learning style, or that the responsibility for style selection is given to the learners in the form of choice.

Approaches to learning are likely to be affected by a combination of the learner's motives and strategies to learn and their perceptions of the tasks concerned. The approach taken to learning may be considered as being open to change and development. It is considered that deep and deep-achieving approaches to learning are likely to result in better learning outcomes than surface, or achieving approaches. An internal locus of control is considered to be influential in the development of a deep approach to the tasks presented. It is likely that some learners will not be ready to handle an internal locus of control, therefore providing learner control over system, process and content functions may not lead to more effective learning for all learners. Leading learners to consider the structure, rather than the detail, of related knowledge is argued, by such as Wild & Quinn (1998), to be centrally important for learning.

Approaches taken in learning situations are influenced by motivation for learning. It may be agued, by such as Robinson et al (1998), that there is a motivational continuum from "instrumental" to self-developmental", with the extrinsically motivated learner likely to seek to expend minimum effort for maximum reward, while the intrinsically motivated learner is likely to welcome challenge and seek high levels of personal development. The use of CBL material may be considered to be influenced by and to offer opportunities for dealing with such issues in learning.

The multi-modal capability of hypermedia systems may is considered by such as Kim (2000) to be capable of accommodating differences in cognitive style of learners, while such as Shiratuddin and Landoni (2000) highlight the importance of taking learning styles, intelligences and preferences into account in the instructional design of electronic books. It is considered by such as Law et al (2000), that while a team based approach to learning has been found to foster a positive and co-operative team dynamic, self paced learning has a more significant effect on learning itself. It may be argued that there is no "one", "correct", way of learning, or achieving understanding, given the nature of individual differences and "multiple intelligences" as highlighted by such as Gardner (1983) and Hughes (2000). This has many implications for the design and use of CBL materials / environments, in relation to both instructional design and interface design. Given the levels of uncertainty regarding such issues in learning and teaching it may be argued that the provision of a range of options within the CBL material might best benefit the learners concerned.

Additional cognitive load may be incurred by learners due to "extraneous activities" such as learners being required to reorganise information in order to make it readily accessible for their purpose. This might be considered to be required primarily due to the material concerned reflecting the instructional design approach taken being based on the mental models of "experts", rather than being organised in ways which permit learners to process the information concerned in a manner with which they are familiar. The matching of the instructional design, to the learner's preferred style is argued by such as Pillay, Boles and Raj (1998), to release "cognitive resources", thereby allowing such resources to focus on linking the material being studied to prior knowledge. Teachers and students are at different stages in their development, which as Davison, Bryan and Griffiths, (1999) point out, has an effect on their approach to problem solving and relates to the "novice to expert" model of learning. The "paradox of expertise" being that experts are likely to have forgotten the "rules of the early stages" and therefore find it difficult to explain how they arrived at a given conclusion. By recognising that teachers and students are likely to differ regarding learning styles and motivational needs, with differences in experience adding yet another likely difference and the tendency for teachers to adopt approaches which best suit their personal style, we are better placed to cater for such differences. Davison, Bryan and Griffiths (1999) consider that educational technology offers such possibilities and the design of activities to promote deep learning should reflect the limited capacity of novices to undertake the activities of which the experts are capable. CBL material cannot properly address the needs of learners from the constructivist perspective, unless there is a capability for modelling the user and thereby offering an appropriate level of content and structure for the individual learner. At one level this takes us into the arena of artificial intelligence and adaptive software, which has not as yet become the norm for CBL material in Higher Education. However, such as Somekh (1996) point out that other ways of attempting to tailor the level of CBL material to the needs of the individual learner may include the use of pre-tests to set the level of material offered.

2.3.4.4 Review of Interactive Multimedia and Instructional Design

The preceding sections have highlighted the importance of the active involvement of learners in the learning process and discussed the implications of such for instructional design. The importance of media selection and the use of multimedia have been discussed in relation to instructional design and learner expectations of CBL material. The concept of learning styles has been highlighted and the importance of approaches taken to learning has been discussed in relation to instructional design.

2.3.5 Review of Instructional Design and CBL

This section of the literature review has discussed the underlying aims of instructional design and has considered the issues involved in attempting to achieve such aims where CBL is concerned.

The complexity of the human learning process has been highlighted as centrally important and theories regarding such learning processes have been identified. Changes in Higher Education over time and the nature of expectations involved have been highlighted and the centrally important issue of the role of students within Higher Education has been addressed. Implications of these issues for the instructional design of CBL material and the importance of the element of learner choice have been highlighted. The importance of stakeholder perspectives and the potential influence of such on the design of CBL material, including the use of multimedia and hypermedia has been highlighted. Potential conflicts and trade-offs involved in relation to opportunities and threats presented by technological developments have been identified. The issues involved in the evaluation of CBL material and the importance of the perspective adopted regarding such evaluations have been highlighted. Academic perspectives on the design of CBL material has been addressed and central issues highlighted. The importance of motivation within the learning process has been highlighted and the relevance of designer perspectives on the provision of motivating CBL material has been identified. The importance of engagement and the influences on the level of engagement achieved have been highlighted. The potential impact of learner and designer expectations has been highlighted. The concept of motivation has been considered from a range of perspectives and the implications for the design of CBL materials have been discussed. Assessment has been considered under the banner of motivation and the implications for the design of CBL material have been discussed. The potential importance of authenticity and narrative flow in achieving learner engagement has been highlighted. The importance of designer perspective and the value of design teams in generating CBL material and the central importance of author involvement have been highlighted. Factors influencing effective learning, including issues of learner self-management and the implications of such for the level of structure built into CBL material, has been highlighted. The potential benefits of active learning and the value of interactivity and game-based approaches within CBL material has been highlighted. The importance of media selection and use within CBL material has been highlighted. The importance of differences in learning style and approaches to learning and implications of such differences for the design of CBL material has been highlighted.

Having discussed the range of issues involved in relation to the instructional design of CBL materials this leads us to the importance of the means by which learners are allowed to access the instructional elements, which may be referred to as the user interface. The next section highlights a range of important issues in relation to the design of the user interface, which must take many of the same issues into account as previously highlighted in relation to instructional design of the CBL material, to which the interface allows access.

2.4 User Interface Design and the Design of CBL

The user interface may be regarded as the means by which the learner is enabled to interact with the instructional design. The following sections highlight the importance of motivation, functionality, learner control, cognitive optimisation, interactivity, cognitive load, screen design and orientation in relation to interface design for CBL material.

2.4.1 Interface Design, Learner Motivation and Engagement

Learning is considered, by such as Mandel (1997), to be more effective where learners are motivated to seek the knowledge and skills they require in order to solve the problem faced. Therefore in order to maximise learning opportunities in instructional multimedia, it is particularly important to design interfaces that motivate learners. Stoney & Oliver 1997 consider eight central attributes of motivation and engagement have been identified as being involved in making interactive multimedia appealing to adult learners: immersion, reflection, flow, collaboration, learner control, curiosity, fantasy, and challenge. The quality of the interface is highlighted by such as Jih (2000) as important for learning effectiveness, while such as Mills (2000) point out that issues of accessibility should be taken into account and such as Morozov and Markov (2000) highlight that the interface should be attractive to the user.

Interface design is considered by some, such as Mandel (1997), to be the most important element in information technology as it allows the user to access the information and interactivity offered by the pedagogically driven instructional design of the CBL environment.

The graphical user interface (GUI) is now largely accepted as standard on computers and may be defined in relation to a range of features, but interface designs may employ various combinations of such, giving rise to a range of GUI designs. The essential ingredients include windows, icons, menus and pointers. The advantages of GUI design, for users, relates to the objects concerned showing on screen as they would in print and the capability to manipulate objects and information directly on screen. The GUI environment tends to employ an "object-action" style, rather than the "action-object" style employed by command line interface design. As Hughes

(2000) points out, while the arrival of the personal computer had opened the "landscape" up to thousands, the command-line interfaces of the 80s kept it in the words of Hughes (2000) "hidden from the eyes of non-initiates". The coming of the graphical interface was a watershed in terms of computer literacy and the visual impact of interface design gained importance from the point where command line interfaces gave way to Graphical User Interfaces. There are many sub-layers to this area of design for CBL environments. The main issue relates to the awareness of visual design principles, on the part of those involved in the process of generating CBL materials / environments. It is questioned, by such as Brown (2000), whether we are currently providing CBL developers with the required knowledge and understanding of the visual, graphic and design skills that are really needed. The importance of design at the visual and graphic level is highlighted by Mandel (1997), who comments that:

"Every line, every control, box, piece of text, color, and graphic on the screen impacts users not only singly, but also in combination with everything else on the screen."

(Mandel 1997, p296)

The design concerned may be application oriented, whereby users are required to work in the way set by the application, or may be object-oriented whereby the user may do what they wish to do to the object concerned and the application does what must be done to achieve the outcome required. GUIs may be considered capable of offering education, entertainment, and help for users. It may be argued that they make the machine fit the user requirements, rather than the user fit the machine's requirements. The graphic capability of GUI design offers the possibility of provision of memory aids and feedback areas informing users of the current status of the material / environment. The visual feedback capability may be used to provide reminders to users of context and progress, illustrating for the user that all is operating as it should and progress is being made. The terms used should be meaningful for the users concerned and the elements from controls to icons and animations should have meaning for the users and serve a purpose.

The central benefit of GUIs for users may be considered to be the capability offered to interact with multiple types of data in a consistent way. This as Mandel (1997) points out, has been developed to the level of object linking and embedding, whereby the option exists to link to original material stored elsewhere, or to embed the entire set of material within the document container concerned.

2.4.2 Usability and the Design of CBL

The move from text based material to interactive multimedia is considered by such as Al-Hunaiyyan et al (2000) to have significantly increased the importance of human factors and usability, which is argued by such as Beaufils and Blondel (2000) to be centrally important in hypermedia systems.

The nature of usability goals are highlighted by Preece, Rogers and Sharpe (2002) with reference to user experience goals and design (see Fig 2.9).

Figure 2.9: Usability and User Experience Goals

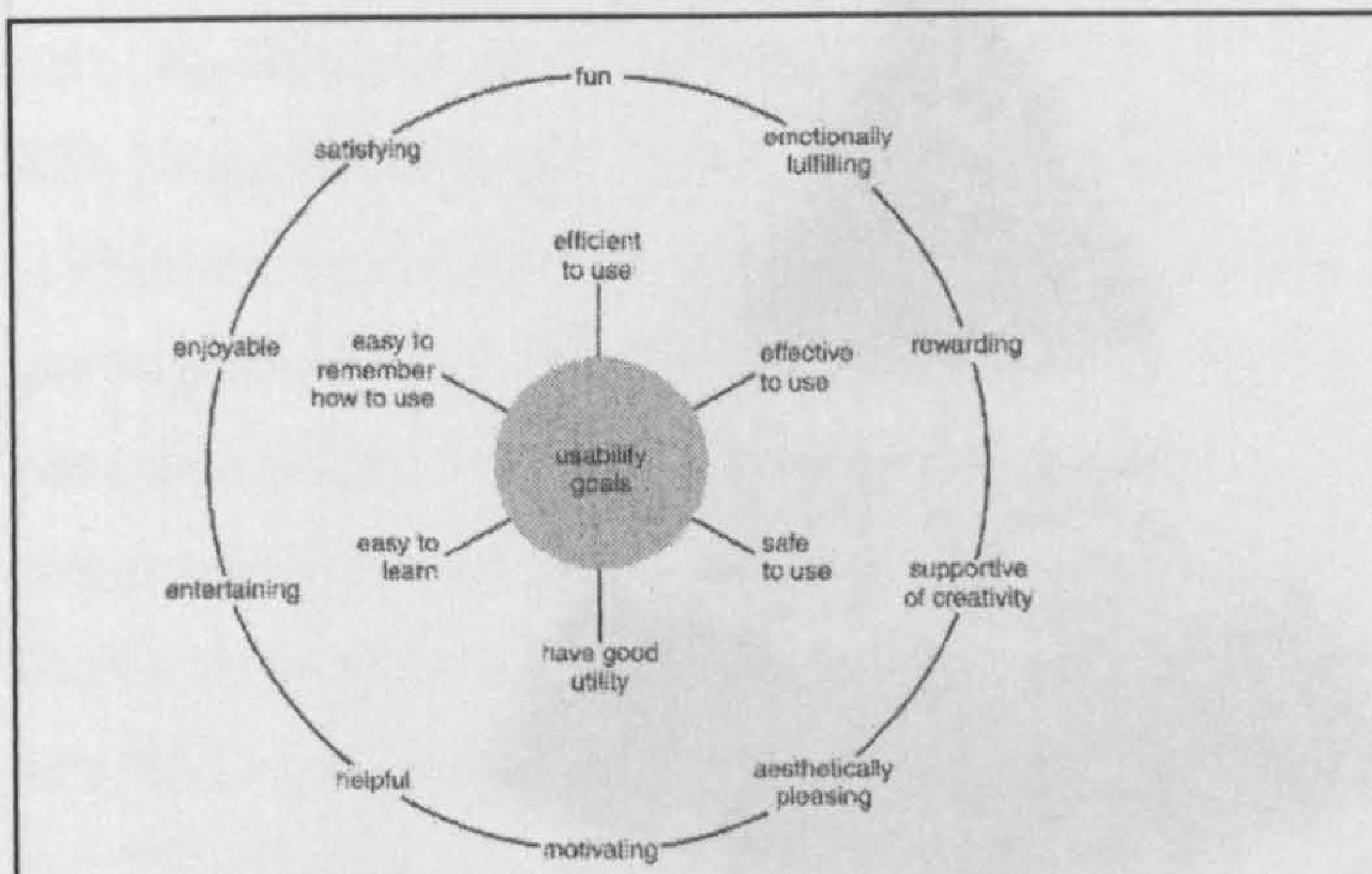


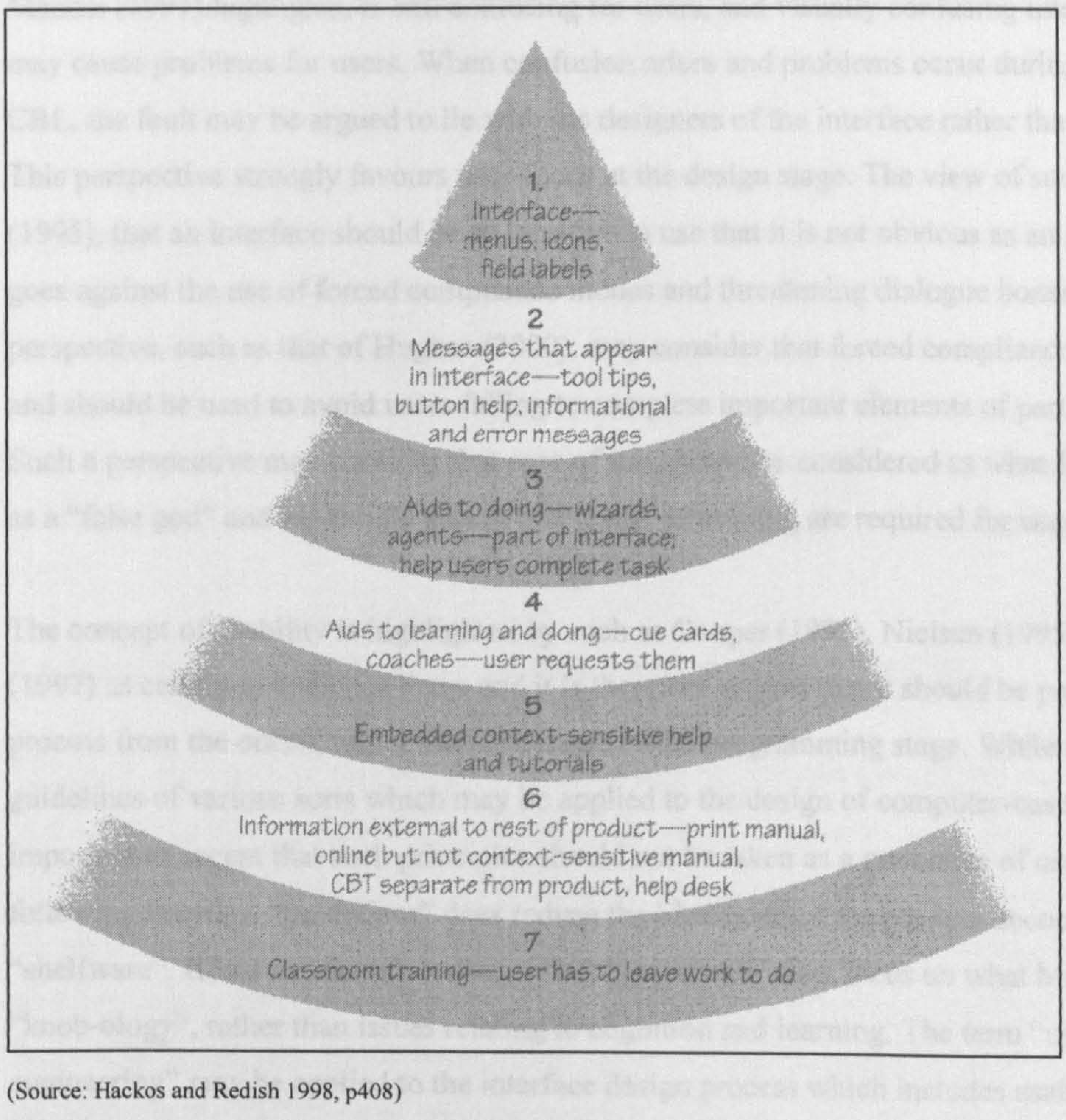
Figure 1.7 Usability and user experience goals. Usability goals are central to interaction design and are operationalized through specific criteria. User experience goals are shown in the outer circle and are less clearly defined.

Mandel (1997) considers usability to be one of the centrally important aspects to be addressed in the iterative approach to interface design. The central issue here is that we may have a CBL environment which is based on an accepted pedagogy, derived from a current theory, utilising an appropriate instructional design which fits the pedagogical model, with an interface design which benefits from the input of those trained in graphic design, yet users may still encounter difficulties which we could have avoided. This is the domain of "usability" and those such as Cooper (1995) and Nielsen (2000) consider that it impacts on all computer-based materials, which indicates that it should be considered in the evaluation of all CBL material.

Common usability problems range from the use of ambiguous menus and icons, to inadequate error messages. The increased capability to make images, image maps and text operate in the same way as buttons, may lead to confusion for users and this may be taken as indicative of the need to set user expectations at the outset, in terms of their use of the interface design concerned.

The layers of information and instruction likely to be contained within software are highlighted by Hackos and Redish (1998) (see Fig 2.10). Given that this is equally likely within CBL material it is clear that we must consider usability at many levels.

Figure 2.10: Levels of Information and Instruction in Software Products.



(Source: Hackos and Redish 1998, p408)

There is however an issue regarding the user's expectations in relation to "ease of use", as highlighted by Mandel (1997), in that a design which is easy to learn in the short run may prove to be laborious to use in the long term. This highlights the importance of offering the appropriate provision to meet the needs of the users concerned, and draws attention to the need to consider the dynamic nature of the user relationship over time. When dealing with learners using CBL materials it is likely that early setting of expectations will be a significant factor affecting their level of engagement and satisfaction when using the material. An example of setting user expectations regarding interface functionality may be seen, as Hughes (2000) points out, in the CD ROM "Critical Mass" by Lisa Anderson, where "rules of use" are made clear to users in the first moments of use and that the different graphical styles coexist by differentiating and flagging up different kinds of information. Much of the experience of interacting with computers, as Mandel (1997) highlights, is still confusing for users, and visually confusing interface design may cause problems for users. When confusion arises and problems occur during the use of CBL, the fault may be argued to lie with the designers of the interface rather than with the user. This perspective strongly favours user-focus at the design stage. The view of such as Cooper (1995), that an interface should be so intuitive in use that it is not obvious as an interface at all, goes against the use of forced compliance modes and threatening dialogue boxes. A contrasting perspective, such as that of Hughes (2000), may consider that forced compliance is appropriate, and should be used to avoid users failing to complete important elements of particular tasks. Such a perspective may consider that ease of use should be considered as what Hughes refers to as a "false god" and we should accept that levels of training are required for users.

The concept of usability is highlighted by such as Cooper (1995), Nielsen (1995) and Mandel (1997) as central to audience focus and it is therefore argued that it should be part of the design process from the outset, rather than at the end of the programming stage. While there are guidelines of various sorts which may be applied to the design of computer-based materials, it is important to accept that such principles should not be taken as a guarantee of usability, although following interface "guidelines" does reduce the likelihood of the product becoming "shelfware". However, there is a danger that "guidelines" may focus on what Mandel refer to as "knob-ology", rather than issues relating to cognition and learning. The term "usability engineering" may be applied to the interface design process which includes usability testing. Clearly, as Anderson and Shapiro (1989) point out, defining the meaning of terms such as "user friendly" is as important.

It is considered by such as Mandel (1997), that we have gone from a function focus, which gave little regard to the user, to a task focus, which centres on the user. Users' wants and needs should therefore be of prime concern, within an iterative approach to interface design. As Mandel (1997) points out, user acceptance and product usability should therefore be considered to be as important, as program functionality and we should be aiming at "user-seductive, and fun to use" rather than simply "user friendly" designs. This may be considered particularly important due to the increased range of computer users concerned. Placing control with users, reduction of user memory load and maintaining of interface consistency are considered by such as Mandel (1997) to be centrally important aspects of interface design. Important principles for placing users in control may be considered to include the judicious use of modes and the direct manipulation of objects. The provision of visual feedback to users may be considered useful in reducing the user's need to remember. It is argued by such as Cooper (1995) and Mandel (1997), that the interface should be made as transparent as possible for users, including the use of terms that users understand and the masking of system details that users do not need to know. One of the key areas in this regard is that of feedback and error messages, which should avoid jargon where possible and should avoid assigning blame. There are issues also for the style of language used, in that it should not imply aggression (e.g. terminate etc.). Given the likely impact of previous experience, it is also important that interface designers avoid forcing learners to "unlearn" behaviours they have become accustomed to using. The issue of style becoming dated must be considered however and a dynamic approach to design may be useful as highlighted by Mandel (1997).

2.4.3 Interface Based Support for Users and the Design of CBL

Electronic performance support (EPS) may be used to facilitate learning by providing appropriate levels of guidance on demand, with ease of navigation being crucial in accessing such support. There are a number of techniques and elements, ranging from help text to "wizards" or "advisors" which may be employed to help users and different learning styles may be supported by different types of EPS. The rationale underpinning this EPS approach is that learners will achieve a higher level of learning when they can perform "real" tasks while learning. On screen "advisors" may be regarded as the new type of "tutorials", offering "expert advice" on task completion. These generally operate within a linear format, which allows users to view the support material while they use the interface. On screen "wizards" differ from "advisors", in that they take over control, requiring the user to perform the task concerned using the wizard environment. Mandel (1997) categorizes wizards as help and EPS, rather than "intelligent software".

The computer interface design may be classified as user driven, transaction oriented, or workflow. Wizards are geared to creating workflow interfaces. As Mandel (1997) points out, we might be well advised to be cautious with our expectations of "wizards", given that just because they are new and software producers are using them does not mean they will fulfil their promise. The IBM definition of agents cites the dimensions of agency, intelligence and mobility and the use of agents may be considered as a form of "delegated manipulation", rather than the direct manipulation of the interface by the user, as highlighted by Mandel (1997). Agents, as Wohl (1995) points out, may be considered as programs which act in a similar way to that in which a human agent might, acting on behalf of the user to achieve the result desired by the user. Agents may be visible on screen, or operate invisibly in the background. Styles for visible agents include talking heads or actors / avatars, which may be 2D, or 3D. The concept of "intelligent agents" involves the agent having access to knowledge sources. It is considered that agents should provide benefits to users, as highlighted by such as Ball et al (1996). User interface agents may be categorised as intelligent software, including coaches, angels, guides, advisory agents, avatars and actors, personal assistant agents, or softbots and autonomous agents . Four levels of agent ability have been highlighted, ranging from task usefulness, to role performed, nature of intelligence possessed and ability to learn as highlighted by Maes (1994). Agent technology is one of the spin offs from research into artificial intelligence and has attracted significant attention from software developers, who currently make use of such technology in their products.

Pedagogical agents, which may be customised by content experts and teachers, are considered by such as Baer and Tanimoto (2000) to improve the learning experience. The suggested use of pedagogical agents ranges from generation of musical ideas as highlighted by Cook (2000), to their use as collaborative co-learners as highlighted by Kurhila (2000). The design issues for the agents are highlighted by McKenna and Waraich (2000) to include social aspects of believability, which is considered to impact on the exaggeration of agent features to aid recognition. Animated pedagogical agents may be used to promote constructivist learning in a discovery based learning environment as highlighted by Moreno, Mayer and Lester (2000). Nkambou and Laporte (2000) consider that agents may operate in the virtual environment to help students achieve their goals and Rogers et al (2000) consider instructional design agents, which combine techniques in human-computer interaction (HCI), artificial intelligence (AI) and educational theory, may be used to help educators in their course preparation. Projects using an on-line assistant, allowing repetitive tasks to be removed from the teacher interaction, thereby permitting the teacher to assist with those tasks requiring higher order cognition, have been found by Garcia (2000) to be rated more highly, than those using software alone. Gama (2000) considers there is potential for a "Reflection Assistant", to be used in helping students use their metacognitive skills in problem solving or case based learning systems.

2.4.4 Developer Perspectives on Interface Design and the Design of CBL

In terms of interface design we may consider the existence of three centrally important perspectives of the user, the programmer and the designer. The central message relates to the influence of such perspectives on decisions and outcomes, regarding the computer based material developed. The various stakeholders within the arena of computer-based materials may be considered to have hierarchies or "caste systems", whereby members of one group may not be prepared to accept those from another. This is considered, by such as Hughes (2000), to be an "empire building" approach and to be at the root of many problems faced in the design and use of computer based materials. The centrally important issue relates to the level of control or influence which particular groups may exert and the impact of such on the material offered to the end-user. It may be argued that much is tolerated simply in order to "get along", despite it being possible to create better designs.

Gould (1988) argues that, from the perspective of the programmer, the approach adopted is likely to be aimed at enabling things to be done in the way the programmer prefers, and for users to be offered some additional element, to compensate for any difficulties they may encounter due to the design approach adopted. As Mandel (1997) points out, such an approach is inappropriate given the emphasis on "user-friendly" programs for today's users and this has increased demand on programmers and on the processing power required to make the material easier to use at the interface.

The designer's perspective may be regarded as bridging the gap between the user's model and that of the programmer, and to address the components of presentation, interaction and object relationships. It may be argued that perceptions should account for 10%, interaction for 30% and object relationships for 60% from the designer's perspective. One of the central points raised here relates to the relative importance given to the "look" and "feel" of the design used. The object relationships are highlighted as particularly important, including the properties, behaviours and metaphors concerned. We may therefore conclude that the "look" and "feel" of the interface is not the whole story in terms of user engagement. Levels of satisfaction, involving aspects of "usability", are likely to be important, and should be judged in the light of the "user's" perspective. Mandel (1997) argues that the designer's model should be formed from the object relationships to the presentation, or "bottom up" approach to the "iceberg model".

In interface design, as with "instructional design", we are likely to be faced with trade-off decisions regarding which elements to prioritise and from which perspective this should be done. People make judgements based on their particular perspective on the issue and it is particularly difficult to establish which set of guidelines should be followed when there are apparently contradictory viewpoints expressed. The issue then becomes one of priority and perhaps hierarchy as to which view is more heavily weighted for decision making purposes. There are many potentially beneficial ways in which CBL material might be designed, and options currently exist which have been previously discounted or ignored, but might have been better than those chosen. Priority tends to be given to the views of those considered as "experts" in the particular field. This is slightly problematic when we are dealing with emerging technologies and an education system in a state of flux, as those considered as "expert", are likely to have gained their expertise within an environment which employed different parameters and involved different expectations. Such differences in perspective may give rise to the "baby and the bathwater syndrome", or may result in failure to exploit new opportunities. Putting unquestioning faith in "experts, or "leaders" in the field, to the exclusion of other views, as pointed out by Hughes (2000), is likely to result in a skewed perspective. Those involved in the development of CBL material, might be well advised to maintain an open-minded approach and revisit alternatives from different perspectives. While we might argue that the philosophy of education and pedagogy should set the learning agenda, it should be recognised that the "possibility landscape" is not fixed. As Romiszowski (1992) points out, whether in relation to pedagogical approach, instructional design, or interface design, we should avoid Dewey's "baby and bathwater syndrome" and the inappropriate use of the so-called "bells and whistles" approach wherever possible. We should however be wary of misattributing the "bells and whistles" concept, given the importance of engaging the learners concerned.

2.4.5 Interface Design, Engagement and the Design of CBL

The importance of interface design for engagement is illustrated by Mandel's (1997) comment that interfaces are about fostering "appropriate illusions". It is clearly important to gain and maintain the attention of the learners when we are attempting to engage them in the learning process. This is particularly important when dealing with CBL material and a wide range of users. The potential nature of the audience concerned may be reflected in the findings of those investigating Web use, such as Somerson (1996), which highlight the apparently short attention span of some users. If we accept that we should offer CBL material which would hold a discretional audience, then there are clear messages here that gaining, and holding, learner attention must be considered as a priority. If we further accept that the main purpose of CBL material is to engage learners as fully as possible in the learning process, we must, as Somekh (1996) points out, take the concept of "flow" into account within our interface design, in that the interface design must not interrupt the "flow" for the learner, in ways such as tasks being imposed by the computer. The decisions made regarding interface design are, as highlighted by such as Cooper (1995) and Nielsen (1999), likely to affect the perception of the "user", or learner and from a sensory perspective such issues as the use of multi-media and peripheral devices comes into the debate as highlighted by such as Gregory (1966, 1980), Shneiderman (1998), Vince (1995) and Mandel (1997).

Navigation in graphical user interfaces requires, as pointed out by such as Mandel (1997), that we deal with "perception" which means visual cues and organisation are centrally important, therefore the skills of graphic artists and book designers should be represented on the interface design team, in order to ensure the application of appropriate design principles and to address issues of consistency in design.

Creativity is considered to be an important element of interface design and being experienced with the "medium" involved may be regarded as a prerequisite for such creativity. The cautionary note sounded by Hughes (2000) however, is that experience might restrict if it is too narrow in nature, which takes us back to the central importance of perspective. The extent to which the authors and designers choose to make use of the range of multimedia options within the CBL material / environment is likely to reflect a range of variables including timescales, funding and personal perspective on instructional design. Beauty and functionality are regarded by such as Hughes (2000) to be highly related, the implication being that the media selected should be honed to the level of "beauty". However, as Hughes (2000) points out, it is possible to over-refine the material to the level where the "natural constraints" of the media are ignored. This again highlights the importance of having a range of perspectives represented within the design team and the importance of such for the end product. The style adopted should be appropriate for the context, but the judgement however remains largely subjective. The value of the "bricolage" (mental model of handcraft) type approach to development of CBL materials has also been highlighted as valuable by such as Baumgartner, Salzgeber and Wydra (2000).

Design planning is argued by such as De la Teja, Longpré and Paquette (2000) to be more important than technical features, in developing learning environments that are adaptable to user needs and preferences. The importance of avoiding the pitfalls of "shovelware" when redesigning a paper based course is stressed by such as Lavoie and Stanton (2000), while others such as Sparrow, Herrington, and Herrington (2000) present a defence of "shovelware", pointing out that it can offer immediate outcomes that are positive, when used as a strategy for introducing large numbers of academic staff to online teaching.

Results of using courseware may be considered as disappointing, perhaps due to the high cost of development, time and expertise requirements, which may from the perspective of such as Boot and Barnard (2000) be addressed by adopting a "building block" approach, based on the use of templates, designed to allow those with limited multimedia experience to rapidly develop courseware for simple learning objectives. Authoring tools, designed to apply recognised instructional design techniques, are considered by such as Friedrich et al (2000) to put interactive courseware authoring in the hands of the classroom educator. The approach taken is likely to reflect the perspectives of the interested parties and where courseware is involved this is likely to be influenced by the pedagogical approach favoured by the academics concerned. The value of such approaches as "shovelware" is clearly open to debate, but generally considered an inappropriate use of the computer-based environment. The traditional "waterfall" approach to design is less favoured, by such as Mandel (1997), than the iterative approach which covers a range of alternative designs and offers prototypes, which it is considered acceptable to discard.

Again it may be argued that we should focus on the user and "usability" as reflected in user feedback. From such a perspective, we should give priority to the user feedback with the user's definition of "customer satisfaction" as the focus, even where "guidelines" might suggest an approach which conflicts with such. One of the central problems in this regard is highlighted by Rushby (1997), who points out that that while user involvement is clearly acknowledged as important throughout the design and development of CBL materials, this is likely to add significantly to the time and cost involved.

As Mandel (1997) suggests, the designers role may be considered to be the building of an interface which is both appropriate for the task and fits the user's model of the computer based material / environment. People have an orientation towards predicting "what happens next", which places expectation in an important role, whereby the inappropriate handling of the user's expectations may result in considerable levels of confusion and emotional responses. The notion of "cognitive train wrecks" that occur when users cannot predict the behaviour of the interface, highlights the importance of taking user expectation into account.

2.4.6 Interface Based Learner Control and the Design of CBL

The "chunking" of material in short-term memory as highlighted by Miller (1956), may lead to errors of omission in which the sense of "closure" may cause users to overlook elements which should have been addressed. The importance of ensuring that users are not left in situations where tasks, which are necessary, remain incomplete is used, by such as Hughes (2000), as an argument in favour of using "forcing functions" and "modal" dialogue boxes that prevent other user actions prior to completion of the task concerned. An alternative perspective is adopted by such as Cooper (1995), who argues that a dialogue box should be regarded as another "room" and we should ensure that there is a "good reason" to go there, given that the intrusion of the dialogue box, goes against the "butlerian spirit". It may therefore be valuable to prevent the learner missing out a vital part of the task, due to closure effects, but it may be equally important that the computer based environment maintains user engagement by taking the "butlerian" etiquette into account within the interface design. The interface should permit a range of navigational options to suit the range of users concerned. There should be a challenge in using the software to complete the tasks involved and users should "feel they are getting somewhere" when using the software. Such as Hughes (2000) argue that users should get a feel for the software by using any of its features and that feel should be consistent throughout the design, also that there should be navigation "landmarks" but not "road signs" which are intrusive. From this perspective it is considered that tangible reminders of their journey, such as printouts should be available options for users to take and any surprises should be in character with the context and feel of the material and interface. It is argued from the perspective of Hughes (2000) that people attempting to generate such creative works need to be allowed time and resources to explore and find the "landscape".

There are several factors which add to the complexity for those attempting to design suitable interfaces to offer users experiences which may be considered as "successful and satisfying experience". One of the central issues relates to "navigation" of the material and the use of hyperlinks. There are issues of design at various levels in relation to hyperlinks and the design of navigation options. The navigation elements may be considered to be graphic elements in their own right, multimedia elements in their own right, interactive in their own right, and a functional interface element in their own right. Allowing users to explore hyperlinked texts and graphics is considered by such as Hughes (2000) as central to the use of CBL material / environments.

Most CBL materials will include elements of hypertext, or "hypermedia". The terms hypertext and hypermedia are considered to be synonymous by Nielsen (1995), although other writers may regard the former as applying to text only while the latter refers to the multimedia capability. The perceived advantages of hypertext, as highlighted by Conklin (1987), include tracing references easily, modularity of information and author collaboration, while centrally important disadvantages include disorientation and cognitive overhead. A central issue when dealing with hypertext, or hypermedia, as highlighted by Hughes (2000) is that of navigating in "hyperspace", with the notion that we should be able to "fly" effortlessly through "information space". However, given the complex issues of navigation, degrees of structure and usability issues, we must accept that we have a way still to go. Some, such as Hughes (2000), take the view that computer games may be the closest we get.

Hypermedia continues to be beset with problems of complex navigation and meeting the needs of the individual user, as highlighted by Mullier, Hobbs and Moore (2000). Such hyperlinked environments as the Web lack many of the features required for truly interactive hypertext, typically limiting interaction to simple point and click browsing, and running the risk of users becoming lost in hyperspace. Glynn et al (2000) consider such problems might be addressed by using a "trail" based system, offering increased interactivity while grounding navigation and Gall (2000) highlights positive effects of a conceptual orienting task on both learning and attitude in the use of a hypertext system.

As Hughes (2000) points out, given that people make "internal models" to find their way around "information space" and refer to and adjust these models on a largely unconscious level, it is important to enable users to form such internal models of the information space by providing them with a clear sense of the space they're in. A range of techniques including "wipes, fades and dissolves" have been used for this purpose within the arena of cinema and were also used by Atkinson within the Macintosh Operating System and the Hypercard application. Speed of operation is argued, by such as Hughes (2000), to be one of the centrally important attributes of such transition techniques, as negative effects may be found where transitions fail to operate quickly.

One of the issues raised in relation to navigation is that of achieving a balance between freedom for the user to navigate the material and retaining the structure the author intended for the material. When enabling learners to have personal control over the pace and direction of their learning, the use of "icon buttons" is likely to make it easier for this to appear exploratory and attractive to users, rather than the use of menus which might be considered more cumbersome. From a constructivist perspective, enabling navigation for learners supports the construction of new schema, based on "where they go" in the software and "what they do". This as Somekh (1996) suggests, raises issues in relation to the level of structure imposed in terms of information sequencing, or freedom given to navigate at will. The range of media and approaches to provision of CBL materials is such that it may be required that the message concerned is made clear within every element, or sub layer. This is likely given the nature and ubiquity of hyper-linking within and between elements and changes the level to which control over learning is in the hands of the learner. The circumstances of the users may also affect their motivation to explore the material, route taken, and the level to which this is done. The journey, or process, may therefore be considered as more important than the particular route taken. The interface design is influenced by the decisions made, regarding the nature of the user group, the use to which the material will be put, the degree and type of interactivity involved, and the range of design options considered appropriate in the particular case.

The command line interface was the original style and is the least likely to support the user's mental model of how the computer based material / environment works, as it essentially supported the programmers model rather than the users, reflecting a lack of consideration for users. However the command line approach although difficult to learn, is much faster for end use by experienced users, therefore has advantages and disadvantages which are likely to be related to the user's needs and expectations. This highlights the importance of user purpose, expectations and circumstances. Today's users are likely to be task driven, seeking to complete their tasks quickly and easily, therefore making the situation more suited to the user is a likely requirement, involving additional work for the programmer.

Menu approaches to interface design are likely to be particularly helpful for novice or casual users, as they allow navigation and selection within a metaphor which is relatively familiar in the real world environment. The menu approach offers a range of styles from the hierarchical, full screen, to dropdown and cascading menus, a central feature being that they allow users to be presented with only the valid choices within the current context. While it is often the case that menu items are text based, they may equally be graphical in nature as reflected in toolbars, or palettes. Pop-up, or context menus may also be used offering choices appropriate to the current task. Menus offer a means of presenting the developer's view of the system to the user in a way which users can see, understand and use. Menus are generally used alongside other interface styles and the advantages and disadvantages must be considered relative to the context and interface style combinations involved. Multimedia designers may consider that the interface "has to be fun", which may conflict with the user expectation where such is not one of using a "fun" application, which is likely to relate to the user's goals. If users are simply seeking information, they may become frustrated if they have to negotiate a "fun" puzzle type environment in order to access such. One way of addressing this issue is that the computer based material might set the users expectations by making the "rules of engagement" clear at the outset and ensuring that these are kept appropriate throughout the learning material concerned.

While changing the rules frequently may be acceptable within "puzzle-world" environments, it is likely to be "profoundly disturbing" where users do not expect it. This may be addressed by pre-conditioning expectations of users by "arranging things so that people don't expect what they can't have", which is likely to involve enabling users to learn the limitations and basic rules at the outset of using the computer based material. As Hughes (2000) points out, the use of rollovers which users find immediately on browsing the menu screen may be considered to do this in "Critical Mass", which was considered to have achieved success, by having a large number of "rollovers" on the initial screen. Subsequent screens were not considered to require this, as the users' expectations had been set, thereby avoiding the frustration caused by clicking on "dead" graphics.

2.4.7 Interface Design, Computer Literacy and the Design of CBL

The concept of tailoring the material to the individual user may be applied to all areas of design involved in generating CBL material. This takes us to the arena of computer-literacy levels and the impact of such considerations on the design of CBL material. The user's perspective on and evaluation of the interface is likely to be influenced by their prior experience of and familiarity with the use of computers, which may be referred to as their level of "computer literacy".

As recently as the mid 1990s there was still evidence of a lack of computer literacy on the part of students entering Higher Education and this was one of the key problems for the interface design used in CBL material as highlighted by Richards (1994). As Anderson et al (1993) point out that surveys undertaken in 1990, 1991 and 1992, relating to undergraduates entering the University of Edinburgh, found that students were entering with widely varying skills, experience, and confidence in the use of IT, with many having little or no experience in the use of computers. Thompson (1996) concluded that levels of computer literacy, regarding wordprocessing capability were found to be weak, despite tuition being provided within the university. While Thornbury et al (1996) concluded that computing skills had increased in students to a level where this was no longer considered a real issue for the use of CBL.

A lack of capability with the technology increases the "overhead" involved for learners and therefore impacts on the learning experience. There is evidence to support the value of stories and metaphors in interface design, as a means of reducing the overhead incurred by users. Aedo and Catenazzi (1997) point out that the use of stories in addressing navigation issues has been shown to be particularly helpful for younger learners and the use of a book metaphor has been found to offer a level of familiarity for learners. As pointed out by Carswell (1998), the "book interface" is low on overhead as it has become very familiar to us over generations. When considering the use of the book metaphor, it is valuable to reflect some on what books offer in their more traditional format, and then consider in what way this is affected when the book metaphor is used within CBL material.

2.4.8 Interface Design, Media Choice and the Design of CBL

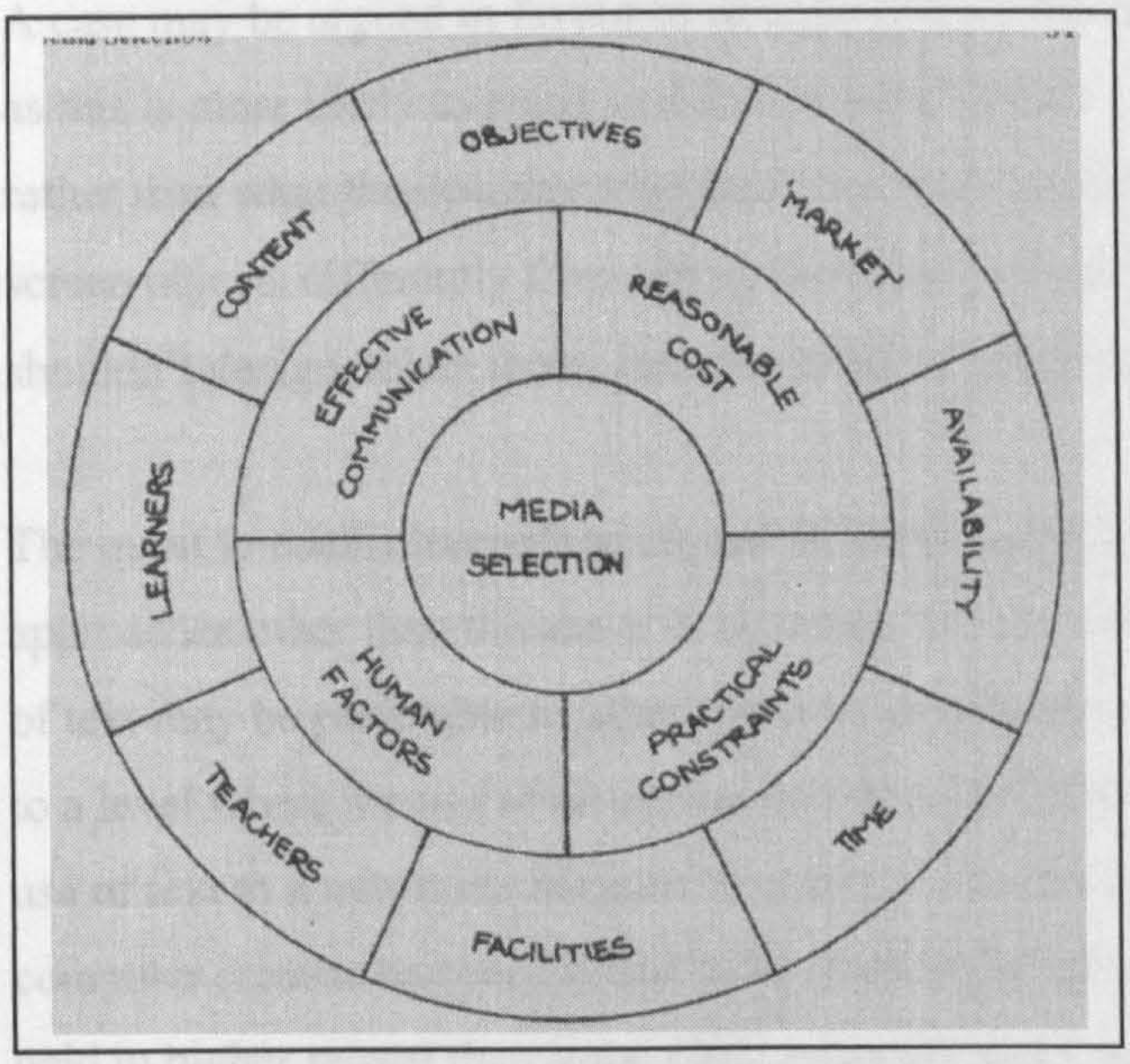
In interface design, the range of media and the design layout of such are centrally important and the design of the screen display, display of text and use of hypermedia must be carefully considered. Such issues become particularly complex when we consider the possibilities of the use of sound, animation, or video as made possible by the use of "multimedia" , and become even more complex when the possibility of virtual reality environments is considered.

When we start to consider the component parts of the computer-based environment we find a range of opinion as to presentational mode and style. As pointed out by such as Cooper (1995), Nielsen (1995 / 2000) and Hughes (2000), there are debates about the value of text, graphics, animation, simulation and interactivity, at a range of levels.

Visual presentation of information is highlighted by such as Tufte (1983) to involve areas of graphic excellence which communicate their message clearly. It is considered by Tufte (1992) however that colour is frequently misused as an element in interface design, and that the use of colour as "decorative" is likely to limit its ability to portray meaningful information. While the initial impact of bright colours may be considered to catch the attention of users, making the interface appear friendly and easy to use, such as Mandel (1997) refer to this as the "Las Vegas Effect " and consider it likely to distract users from their tasks. Guidelines for the use of colour are highlighted by such as Murch (1984) and Marcus (1990) to be centrally important, even where the publication dates of such guidelines may appear dated, as the human characteristics to which the guidelines relate may be argued to make them equally valid today as at their time of publication.

Factors potentially influencing media choice are highlighted by Romiszowski (1981) (see Fig 2.11) and these may also be related to the aspects discussed regarding stakeholder perspectives.

Figure 2.11: Media Selection



(Source: Romiszowski 1981, p341)

The visual design issue may be seen as particularly relevant, when considered alongside the increasing promotion of courseware, being authored by those who have not been trained in design. It may be argued that the possibilities available within the "computer landscape" may, as suggested by Lichtman (2000), have an impact on visual design to a level where the technological shaping of visual culture may produce an art of technology and a technology of art. Visual cues may be regarded as providing powerful representations of reality, facilitating the identification and recognition of patterns, in areas such as clinical pathology as highlighted by DeBourgh (2000). Knowing which design principles are most important may be argued to be of central importance of when making "design tradeoffs", with design principles to be regarded as high level concepts and beliefs offering guidance or principles which should be sensibly applied rather than followed blindly. This perspective is taken by Metros and Hedberg (1998) who argue that highly successful interfaces may be designed by breaking design principles, given that there is a clear purpose in so doing. The design of multimedia material, from the perspective of such as Trower (1993), should not be influenced by such aspects as "coolness", or the use of "flashy graphics" to compensate for a poor interface. The use of interface design and window layout guidelines is considered by such as Wilchins (1995) and Canon (1995) to be an appropriate way to address such issues.

A case may be argued in favour of designing from the user in, rather than from the system out, as this is more likely to result in a design which offers users what they actually need or want, rather than what the designer may think the users need or want. Developers are likely to view screen objects differently from users, therefore such as Mandel (1997) suggest that developers shouldn't design object icons, but should allow graphic designers to work with users on these.

The quest to enable learners to engage in constructivist learning might be best facilitated using approaches other than the use of text, but as Somekh (1996) points out, for some learners the use of text may be preferable to other forms of presentation. Computer display units have developed to a level where the use of on-screen text is better facilitated, thereby no longer restricting the use of text to a minimum because of quality of screen display. Being required to read text from computer screens has been found to be disliked by learners, with well structured books being held in higher regard than some CBL materials and books considered to offer the advantages of familiarity and portability. This suggests that, should the quantity of text required be extensive, printed materials might be considered as more appropriate for that element of the material which requires the text to be used. Such as Harding et al (1997) argue that advances in software and hardware, though likely to resolve issues relating to the use of video and audio in CBL material, should not be considered likely to resolve the issue regarding reading text from computer displays.

Expectations of learners have been found to be such that computer-based material should offer clear benefits over books, such as improved access to information, a flexible structure, and interactivity as highlighted by Carswell (1998). Where the electronic form of the material is tantamount to a direct transfer of that which was previously offered in the printed form, there is little or no benefit in having the material presented via computer. There is also likely to be an overhead involved for learners in reading significant amounts of text on-screen. The case against the use of electronic approaches to enabling learning might be argued on the basis that electronic approaches have been found to be less efficient than the paper-based systems they are designed to improve upon. The simple addition of a media element can radically transform the perception of, and meaning attached to the material concerned. The use of such techniques is clearly demonstrated in the art of film making, where the same scene may be changed by the addition of a particular element of music or sound. The combination of media elements is also reflected in the use of such to provide "contexts" which cue the viewer's perception, such as the use of elaborate frames for the work of artists and the use of informative captions. In attempting to make "appropriate" use of the media characteristics we must reflect on the purpose behind such use, or our goals in using the media concerned.

As highlighted by such as Hughes (2000), the emotional engagement element should be achieved in addition to the rational level in computer based materials and it must also be taken into account that communicating in a "medium" is significantly different than in a face to face mode, given that you are trying to influence others remotely.

It may be argued that we are dealing with a situation which parallels the human communication system. It is possible for an individual to utter words which appear to have one meaning, while their non-verbal communication sends quite a different message with a contradictory meaning. Interestingly we tend to believe the non-verbal statement in such transactions, which may offer food for thought regarding the use of visual materials in interface design, particularly where anthropomorphic elements are involved. The central consideration here relates to the nature of the available media options within the CBL material / environment and the possibilities offered by such. As Hughes (2000) points out, the nature of the media selected is likely to significantly influence the nature of the "landscape" we create in "Cyberia", which in turn is likely to affect learners using CBL materials or environments.

The use of more than one form of media in the CBL material allows it to be defined literally as "multimedia", but this may be argued to be an extremely narrow definition of the term. However, expectations of "multimedia" are likely to go beyond the literal definition of the term, to the level where use of video is expected, as highlighted by Richards (1994). Where the use of such media as video is concerned there are issues to be considered ranging from the resolution and frame rate of the material and the quality of the accompanying audio element. Expectations are also likely to be affected by experience of "media" as pointed out by Harding et al (1997). Some, such as Collin (1995), consider multimedia to be the combination of sound, text, video and graphics. As pointed out by McCartan and Hare (1996), the use of "multimedia" in CBL material within the Higher Education arena has increased over recent years, with an increasing number of "multimedia" products becoming available. It is important to remember however, as

Hughes (2000) reminds us, that while the computer enhances our capability with multimedia, examples of the use of multimedia may be found which significantly pre-date the desktop computer, such as Laslo Maholy-Nagy's "The Light-Space Modulator" and Kurt Schwitter's "Mertzbau" rooms. As Hughes (2000) points out, such examples may be considered as immersive multi-media, though neither involved the use of a computer. The most significant enhancement might be considered to be that the computer makes multimedia easy to replicate. The relative ease with which "multimedia" may be created in computer-based material may be considered partly to blame for situations where the use of multimedia is perceived as gratuitous and at the level of embellishment which adds little of value to learning, resulting in scepticism regarding the value of multimedia in Higher Education.

The goal for computer based multimedia may be the enhancement of the communication between the user and the computer. The use of multimedia technology may be considered to offer advantages for the provision of help to users, in text, graphics, audio and animated formats including video. Some, such as Mandel (1997), consider that task analysis should be used to determine the best media for the type of information, user tasks, and user preference at the time concerned and that multimedia instruction should be customisable by the users to match their preferences. Multimedia may be used to enhance both presentation and interaction, which should be done in ways which also enhance usability, rather than a gratuitous addition of "noise". Appropriate use of multimedia may be considered to support and strengthen the interface design principles of placing users in control, reducing their cognitive load, and offering consistency.

The design element is centrally important in order to benefit from multimedia, by simultaneously stimulating the sensory systems, thereby allowing the brain to process information more thoroughly. This is likely to be achieved when the different information is interrelated and therefore communicates meaning to learners, while poorly designed and inappropriate information may lead to the loss of the intended meaning as highlighted by Mandel (1997).

The use of the term "quality" by those involved in the arena of multimedia may be argued to have become devalued and concerns exist regarding the criteria used to judge "quality" of multimedia. However it may be argued that multimedia material need not always be of the "highest quality" and that trade off decisions require to be made in order to balance a range of demands including time and cost involved.

2.4.9 Interface Design, Affordances and the Design of CBL

In the real world we tend to notice "differences" most of all, which allows us to operate in many ways without "conscious thought" and reduces the level of "cognitive overhead" required. Artefacts which appear, and behave, in predictable ways allow their users to concentrate on the task in which they are engaged, which is important for interface design. The software interface encompasses the whole experience between the user and the computer, and ambiguous or conflicting cues can cause confusion. Objects may have "affordances" which reflect their use and purpose, in a way which indicates what it allows the user to do, or "affords". Some objects may however have "natural affordances" that "lie". The power of such "affordances" is such that instructions may be disregarded in favour of responding to the "affordance" perceived. This may be considered to be indicative of the "superior speed and power of "unconscious" brain processes, compared to the much slower ones that handle consciousness and language". As pointed out by such as Hughes (2000), confusion is often due to "designers" creating "stupid objects", rather than a fault on the part of the user, and the computer permits stupid objects to be made "very easily" and unwittingly. Real objects with well-known affordances have become regarded by some designers as "requirements" in computer interfaces, based on Norman's work on "natural affordances". This approach ignores the fact that the "Desktop" is not a literal metaphor, and that even "real-world originals" were novel originally, gaining acceptance though they were not metaphors for anything else. The metaphor used may become a "dead weight", requiring every related function to become part of the metaphor. Metaphors can be difficult to find and such as Cooper (1985) consider they restrict us to "mechanical age artefacts". The potential value of "real world metaphors" may be considered to be that they allow users to transfer their knowledge of how things look and work, thereby involving user expectations. Consistency may be considered as centrally important and it may be argued that, where a metaphor ceases to work at any point in the interface, a new metaphor should be found, on the basis that metaphors might be extended but should not be "broken". The importance of semantic and syntactic feedback in interface design, in particular the avoidance of mismatches between expected and actual behaviour, including use of source and target emphasis in drag and drop actions, and the differences involved in variations of operation such as copy, move, and print may be considered within the arena of affordances as highlighted by Mandel (1997).

Social interfaces aim to follow the social and natural rules of the "real world", taking advantage of the user's social skills and capability with natural language. The aim is to get closer to the level of conversation that people might have with other people. The move towards social user interfaces and agents takes us towards issues involving social and cultural rules of conduct. People use social rules to guide their behaviour and bring social expectations to bear in their evaluations. They tend to assume that a stimulus is a social entity, are biased toward natural rather than symbolic orientation, and exhibit social responses induced by primitive cues, as highlighted by Nass, Steuer and Tauber (1994). The provision of "personal guides" within a social interface design is likely, according to Shneiderman (1998), to result in the characters initially being considered "cute", then as silly and thereafter as a source of annoyance. Such comments from interface experts indicates that we still have much to learn about the social aspect of interaction between people and computers and that we should not create more personal interaction simply because we can as highlighted by Mandel (1997).

2.4.10 Interface Design, Animation and the Design of CBL

Unconscious processing of cues from perceived movement assists us in making sense of our environment, and may account for the preference for "being there" rather than simply looking at a picture. This would suggest that animation might be offered to users of computer based material / environments in order to provide additional input to the senses and increase the feeling of "being there", which might be considered as a form of "psychological distance". There are implications for interface design, given that static pictures are currently more prevalent. As pointed out by Gregory (1966), the eye is actually excellent at detecting motion, via peripheral vision, therefore it is logical that the "computer community" have favoured "languages of movement". However the interfaces they produce, as Hughes (2000) suggests, often look "stone dead", which would appear to be contradictory. The use of animation is argued by such as Baecker et al (1995), to permit a level of immediate understanding that a still image fails to achieve, or assist understanding to a greater extent than static images. Such as Hughes (2000) consider that the addition of an animation sequence can affect perception and emotional engagement to such a level that it turns an "irritant into an asset". Animations are considered by such as Lisewski and Settle (1995) to be likely to increase the engagement and enhance the learning experience. It is argued, by such as Hughes (2000), that a computer program should be designed to indicate its "eagerness to serve", as illustrated in the analogy of a real dog which uses subtle cues to indicate its alertness and availability to serve, which could never be confused with a "stuffed dog". A level of movement might be provided which would be informative at the unconscious level, and thereby reduce the "cognitive overhead" of "interpreting the systems affordances". This however, as pointed out by Hughes (2000), would require both subtlety and speed in order to avoid becoming an irritation. Particular design challenges are raised by educational publishing on the Web, as highlighted by such as Reilly and George (2000) and the development of material for the Web has re-kindled interest in the use of animated images, which may prove useful for the further development of CBL material / environments. As with other media elements however, we must take the particular attribute of the media into account in light of the instructional design and user expectations involved, lest we merely create "visual noise". It may be argued that animation is effective for portraying complex processes which evolve over time, and may be employed to help the interface answer user questions.

2.4.11 Review of User Interface Design and CBL

The preceding sections of the literature review have highlighted issues involved in interface design and discussed the importance of central aspects of interface design for CBL material.

Motivation as a concept has been identified as an important element to be addressed in the design of interfaces for learners and central attributes involved in making interactive multimedia appealing for learners have been discussed in relation to interface design.

The significance of the graphical user interface has been highlighted and usability issues have been identified. Potential for provision of interface-based user support and perspectives on interface design have been highlighted. Perspectives on achieving user engagement and the importance of the degree of control offered regarding the interface have been identified. Potential effects of computer literacy levels of learners, issues relating to media selection and affordances and the potential use of animation have been highlighted in relation to interface design.

This discussion of interface design issues and implications of such for CBL when combined with the earlier discussion of the issues involved from the perspective of instructional design, sets the scene for the remaining aspect of importance for this research, which is the evaluation of CBL material.

2.5 Evaluation of CBL Materials

The following section addresses issues identified in the literature as relevant in the evaluation of CBL materials.

Laurillard (1998) offers an overview of findings from evaluation studies of CBL and asserts that many evaluation studies offer the "predictable conclusions" that:

- learners show enthusiasm for the medium
- there is no significant difference in measured learning outcome when compared with an alternative method of teaching
- other issues meant that the medium did not reach its full potential
- senior management support led to greater success of the medium
- accreditation resulted in the medium being more highly valued
- the project studied demonstrated the potential for the medium to be educationally effective

Laurillard's (1998) conclusion is that such findings have become so common that they should be regarded simply as replications. She goes on to point out that the overall situation must be taken into account when drawing conclusions regarding the evaluation of educational methods.

The evaluation of educational material of any type is complex. When we are faced with CBL material the complexity is increased. A range of possible approaches to the evaluation of CBL materials may be clearly seen in the work produced under the banners of various organisations and initiatives (see Table 2.2).

Table 2.2: Sources of Information and Support in the Use of Learning Technology

Organisation / Initiative Title	Acronym	Website
Learning Technology Dissemination Initiative	(LTDI)	http://www.icbl.hw.ac.uk/ltdi
Teaching and Learning in Scottish Metropolitan Area Networks	(TALiSMAN)	http://www.talisman.hw.ac.uk
Teaching and Learning Technology Programme	(TLTP)	http://www.icbl.hw.ac.uk/tltp
Teaching and Learning Technology Support Network	(TLTSN)	http://www.icbl.hw.ac.uk/tltsn
Computers in Teaching Initiative	(CTI)	http://www.cti.ac.uk/
Evaluation of Learning Technology in Higher Education	(ELTHE)	http://annick.stir.ac.uk/elthe/

(source. Harvey 1997)

When evaluating CBL material we may choose from a range of evaluation methods and applications of such. The main possibilities have been highlighted by the LTDI (see Table 2.3).

Table 2.3: Resource Implications of Evaluation Methods

Evaluation Method	Preparation Time Required of Evaluator	Student Time Required (as subject)	Actual Time Required to Conduct the Evaluation	Time required to Analyse Data Gathered	Additional Resources Required due to Evaluation
Checklists	low-moderate	low	low	low	low
Concept Maps	low	low	low	low	low
Confidence Logs	low-moderate	low	low	moderate	none
Cost Effectiveness	moderate-high	none	none	moderate-high	none
Designing Experiments	high	low-moderate	low-moderate	low	low
Ethnography	low	low	high	high	moderate
Focus Groups	low	moderate	moderate	low-moderate	moderate
Interviews	moderate-high	moderate	high	moderate-high	moderate
Nominal Group Techniques	low	low	low	low	low
Pre and Post Testing	high	moderate	moderate-high	moderate	low
Questionnaires	moderate	low	low	moderate	none
Resource Questionnaires	low	low	low	moderate	none
Split Screen Video	moderate	low	moderate	moderate	high
Supplemental Observation	low-moderate	moderate	moderate	moderate	moderate
System Log Data	moderate-high	low	low	moderate	moderate
Trials	moderate	high	moderate	moderate	low -high

(Source: Harvey 1998)

It is generally considered that all of these approaches have something to offer. There are however underlying issues which must be considered. The findings of the Teaching with Independent Learning Technologies (TILT) based research into observing and measuring the performance of educational technology highlights the problematic assumptions often underpinning evaluation:

"The problem begins with deciding how to define performance and whether a given view of the problem is in fact tenable in the light of the facts. For instance one attitude is that the objective is evaluation and that this simply amounts to forming a supposedly expert judgement without gathering any data about what students actually learn. At the other extreme is the attitude that the issue is just one of careful experimental measurement. This however assumes that what needs to be measured is known i.e. all the factors with an impact on learning have already been identified."

(Draper et al, 1994 p3)

As Draper et al (1994) point out, there are guidelines available to enable quick evaluations of software for the purposes of deciding whether such material should be used or not (e.g. Machell and Saunders, 1991), which generally consist of features checklists. However this, as the authors point out, is largely dependent on the perspective of the person completing the checklist.

Draper et al (1994) conclude that people are not good at guessing how effective teaching material is for others, therefore the authors favour the approach of observing, testing and asking the learners themselves. The authors outline the potential of both formative and summative evaluation, commenting that while their work was largely motivated to support summative evaluation, implications for formative evaluation emerged from their work. One of the fundamental conclusions the authors present is that:

"What performs more or less well is not some material or medium (a lecture, a book, a computer program) but the whole teaching and learning episode managed by the teacher who employs the EI (Educational Intervention) as one element."

(Draper et al TLTP 1994 p7)

As pointed out by Oliver (2000) the process of evaluation by which people make judgements of value and worth, is complex and often controversial where learning technology is concerned. There are on-going paradigm debates regarding quantitative versus qualitative evaluation methods, but as Oliver (2000) concludes there is no one best way and selection of methodology should take account of the situation in which the evaluation is conducted as highlighted by Oliver and Conole (1998).

Oliver (2000) goes on to point out that the nature of funding provision for learning technology research and development within Higher Education has been such that the project team involved has been required to demonstrate achievement of stated aims, usually by means of evaluation.

Oliver highlights the impact of the diverse range of researchers involved within the arena of learning technology, pointing out that such academics come from disciplines which have their own traditions, values, criteria and practices as highlighted by Becher (1989).

There is now a level of acceptance within the arena of evaluation that different methodologies have their particular strengths and weaknesses and recognition of the value of the use of combinations of qualitative and quantitative methodologies (e.g. Jones et al 1996).

Oliver (2000) also highlights the fact that researchers in the field of learning technology generally seek to make a difference. Evaluation of CBL material may also be described on the basis of what it does, as highlighted by Milne and Heath (1997). This may be considered to be that it investigates the value of the CBL concerned, which within the field of education is likely to involve the pedagogical effectiveness.

"At its best, evaluation can facilitate quality assurance and control, and provide a mechanism which attunes courseware to the needs of the staff and students who will use it."

(Milne and Heath 1997, p7)

As Reeves (1993) reminds us, evaluation of technology based learning may be approached from a "measurement" perspective as highlighted by such as Thorndike (1982), or at the other end of the continuum from a relativistic "constructivist" perspective as highlighted by such as Guba and Lincoln (1989). At the former extreme the view held would be that if it exists it can be measured, while at the latter extreme we are dealing with meaningful constructions from which shared understanding of the world may be generated. It may, as Reeves (1993) suggests, be concluded that the reality for the evaluation of CBL materials is geared to gathering information which best supports decision making regarding the material.

There are issues underlying the evaluation of learning technologies from the cost-effectiveness perspective, which lead to the conclusion that there is still no agreement regarding the effectiveness of learning technologies. Part of the problem relates to the difficulty of clarifying cause and effect where learning technology is involved and part also relates to having adequate control for the feelings and attitudes involved on the part of both students and faculty.

There is support for the view that quantitative approaches to evaluation run the risk of overlooking aspects which may be important but difficult to quantify, such as student enjoyment or orientation to study.

Gunn (1997) highlights the importance of taking a situated approach to the evaluation of CAL, drawing the conclusion that assessment of the true potential for learning with CAL requires that the material concerned be an integral part of a course of study and that the evaluations be conducted with the students taking the course concerned.

The question of how learning technology improves learning and under what conditions has been highlighted as an important area for investigation by Laurillard (in Rowland 1993). She highlights the need to investigate the way in which the use of computer-based materials might impact on the learning experience:

"The questions usually asked are: "Do learning technologies improve learning?" and "Do learning technologies have the potential to improve learning?" to which the answers of most participants were respectively "It depends" and "Yes".

Laurillard (in Rowland 1993, p28)

Haddon et al (1995) consider the ability of the students concerned and related this to the impact of multimedia. The authors found no significant difference in exam performance, between two groups of eight students using conventional lectures and multimedia material on molecular spectroscopy. However, the authors found that the lower the ability of the student in the multimedia group the greater the improvement they achieved in exam performance. The authors do concede that lower ability students have more scope for improvement than high performers. They also point out that those who spent longer using the software tended to be the lower ability students, who then improved most.

Interestingly Haddon et al (1995) comment that they could not discern which factors within the multimedia environment were of particular importance for learners:

"It is not clear which factor or factors within the multimedia environment had any effect on the quality and depth of student learning, but it was apparent that some aspect was beneficial..."

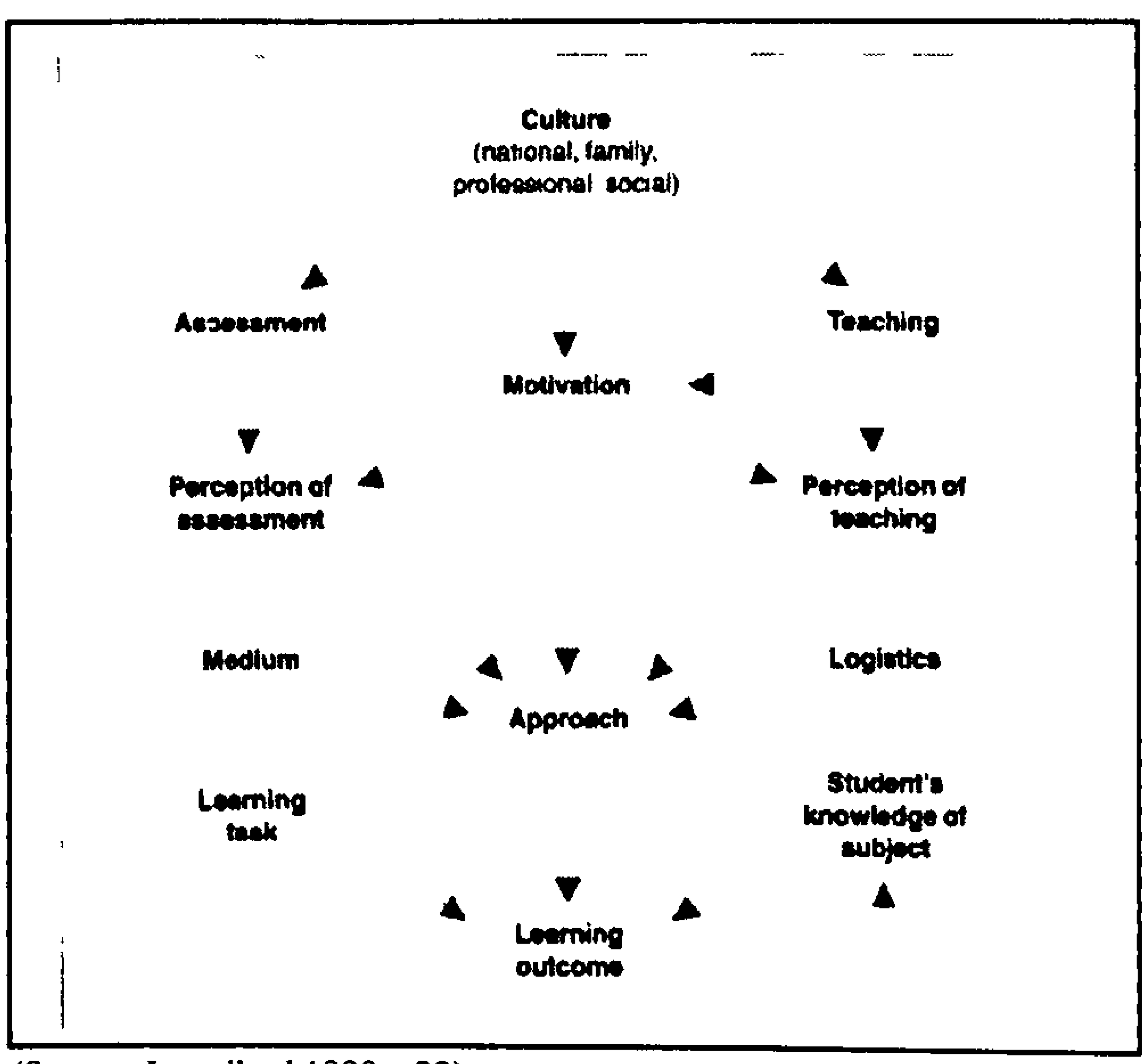
(Haddon et al 1995, P26)

The conclusion reached by Haddon et al (1995) may be argued to be interesting, but not particularly helpful, where decision makers require to choose elements to include or exclude from the design of computer-based materials.

The literature previously discussed shows that learners vary in their wants and needs throughout the learning process and differences of viewpoints exist on the part of developers and providers regarding design elements involved in CBL material.

Laurillard (1998) highlights a range of factors which potentially influence learning from media (see Figure 2.12)

Figure 2.12: Contextual Influences on the Outcomes of Learning Through Media



(Source: Laurillard 1998, p22)

The area of particular interest for this research lies in the evaluation of the perceived value of the design of CBL material from the perspective of the learner or user. The focus of this research is therefore the perceived impact of the computer-based material used. Given that the people who have direct access to such information are the individual learners, the research was designed to elicit their views.

While the impact of educational material may be indirectly evaluated using associated outcomes or other indicators of progress or change in the learner's condition, the overall impact of the educational material is known only to the learners themselves. They alone can say whether they consider that given materials are having a positive or negative impact on their cognitive or affective functioning. The combination of learners alone having the direct access to information regarding the impact of CBL materials as they perceive such, coupled with the need for information in terms of cognitive and affective impact clearly supports the approach of asking the learners concerned for their views.

2.5.1 The Approach Taken to Evaluation in this Research

The National Committee of Inquiry into Higher Education (1996) conclude that there is a growing need to understand how education might best be achieved, and how educational technologies might be most effectively deployed. The authors consider that traditional approaches can no longer be relied upon to provide all the answers. They caution that there is increasing potential for "getting it wrong", which they consider indicates that research is required into the fundamentals of learning, in order to better inform the approach taken to educational interventions. The authors highlight the difficulty of predicting the potential impact of computer technology, citing the forecast concerning artificial intelligence, which failed to materialise and the lack of anticipating the huge impact of the Internet (National Committee of Inquiry into Higher Education (1996)

Coopers and Lybrand (1996) highlight some complex questions they consider worthy of further study. The question they pose which is of particular relevance for this research is:

"What types of CBL are most effective in improving particular types of student learning?" (Coopers and Lybrand, 1996, P63)

This research study set out to investigate the way in which the design of CBL materials impacted on the learning experience of the users concerned. This was investigated with direct regard for current materials and current learners engaged in real learning tasks using CBL materials.

This study sought to address the students' perceptions of the impact of the design of the CBL, irrespective of ability, on the basis that the ability to achieve a university place or professional appointment represented a baseline ability which was sufficient for the purposes of this study.

The focus of this study was on the perceived value of the design concerned, or lack of such, for the learner when using CBL materials.

This study attempted to gain a clearer understanding of which design elements were affecting the learning experience. This was approached from the perspective of the students concerned and considerable importance was given to the affective domain, which is argued by such as Newble and Cannon (1991) to be highly relevant for the success of the learning process:

"Motivation is such a key factor that it appears to be more important in learning than intelligence. The problem is that students are motivated by different things. Common motivators are the relevance of the material to ultimate careers, the generation of a feeling of curiosity early in the lecture, the enthusiasm of the teacher for the subject, positive feedback and, not surprisingly, examinations."

(Newble and Cannon 1991, p2)

It was considered that such issues might apply to computer-based materials for learning and that such factors might provide some clarification as to how, and under which conditions, the design and use of CBL material might benefit learners. To this end scope was given wherever possible for respondents to have as much freedom in their response as possible, in order that the elements which they considered motivating, or otherwise, might surface. This gave rise to the request for "open" responses, both to questions and to statements within questionnaires, and the use of semi-structured interviews where possible. Closed responses were also sought in response to questions and statements within questionnaires in an attempt to gain quantitative feedback which could provide some overview impressions of the level of expressed opinion on the items concerned.

For the purposes of this research the definition of "open" was that used by Habeshaw et al:

"There are several ways of categorising questions. A simple but useful one is the open / closed dimension which groups questions according to how much scope the student has in answering."

(Habeshaw, Habshaw and Gibbs 1988, p77)

It was further considered that the extent to which the use of CBL material was perceived to accommodate the "learning preferences" of the students concerned might be addressed, as highlighted by Jones et al (1997). The issue raised by Jones et al (1997), regarding the importance of "perspective", was taken into account and the student preferences were investigated using a range of approaches, taking the affective domain into consideration.

Clearly the research evidence shows that the design and use of CBL material has much potential to offer. However it is important to be clear about the perspectives from which it may be judged and the priorities given to each perspective, and its inherent criteria, when considering the conclusions drawn by all concerned. The perspective from which the current research has approached the design and use of CBL material has been identified as that of the user, or student in Higher Education and beyond. This perspective was considered particularly worthy of investigation as the current trend in Higher Education is towards a learner centred approach, with learners being categorised as customers, for whom needs and wants must be met by those providing the service for which the customers pay. The central purpose of the investigation was to establish whether the CBL materials being offered in each of the case study groups was considered effective by the learners and to gain some understanding of the impact of the design of the CBL materials concerned.

The areas of particular interest for this study included the perceived impact of the instructional and interface design of the CBL material.

The empirical work carried out for this research sought to establish the value of the various elements within the CBL material from the perspective of the learner and the possible influence of such elements on learner engagement.

The focus of previous research evaluating CBL materials has been largely single project based (e.g. Colgan, McLean and Scotney (1994), Edward (1996), Johnson, Dewhurst and Williams, (1997), Oliver and Lake (1997), Stoney and Oliver (1997), Herrington and Oliver (1997, 1998) Stoney and Oliver (1998), Stoney and Oliver (1999), Wild (1999), Brain, Dewhurst and Williams (1999), Dale, Sullivan and Irvine (1999), Simpson and Edwards (2000)) and has frequently been focussed on comparisons with traditional approaches as highlighted by Russell (1999). This thesis approaches the evaluation of CBL from a slightly different perspective.

The first difference is that this research is not project specific, as it spans five case studies each of which involves different CBL material and contexts within which these are used. The second difference is that this research draws on a range of methods of data collection and analysis as discussed by such as Silver (1992), Cresswell (1994), Miles and Huberman (1994), Conover (1999) and Aczel (1999), some of it longitudinal, from which overall conclusions are drawn. The third difference is that no direct assessment of learning outcomes is attempted in this research, rather the learner perception of their learning is investigated.

The contribution offered by this research is that it provides a holistic overview of the current situation regarding the design and use of CBL material, within Higher Education and beyond, as reflected by students in the University of Strathclyde and the Woolwich Building Society. The materials studied reflect current developments in CBL materials and the classes studied reflect current developments in Higher Education and beyond. The findings of this research are considered to add a level of understanding to the current perspectives on the design and use of CBL material in Higher Education and beyond, by reflecting on a range of stakeholder perspectives, with the perspective of the learners being considered as paramount.

2.6 Review of "Literature Review" Chapter

This chapter has provided an overview of issues highlighted in the literature as important for the design and use of CBL material, from an instructional and interface design perspective. The concept of learning has been outlined and the complexities of such have been highlighted. Theoretical perspectives on the process of learning have been discussed and their implications for the design and use of CBL material have been highlighted. The changing roles of students and academic staff within Higher Education and the importance of expectations for learning have been outlined and implications of such for the design and use of CBL material have been identified. The importance of stakeholder perspectives in relation to the design, use and evaluation of CBL material has been discussed and potential power / interest issues highlighted. The importance of establishing quality of design and the need for author involvement has been discussed and the importance of such factors in achieving user engagement with CBL material has been highlighted. The importance of catering for the needs and wants of a discretional audience has been highlighted and potential implications for media selection and use have been identified. The concept of "usability" has been highlighted as important and the implications of such have been discussed in relation to instructional and interface design for CBL material. The rationale for the current research has been outlined in relation to the literature covered and the contribution made by this thesis in evaluating the learner perceptions regarding the design and use of CBL has been outlined. The methodology employed in this research is described in detail in Chapter 3.

Chapter Three: Methodology

3.1 Overview of Chapter Three

This chapter provides an overview of the methodological issues involved in undertaking this research. The approach adopted is clarified, as is the rationale for such, setting the scene for the presentation of results obtained, which follows in chapter four.

3.2 Methodological Options: Types of Study Considered

Given that the area of interest concerned the effectiveness of CBL materials, we might have conducted controlled experiments using de-layered versions of software. This would have permitted comparisons to be made between versions from simple to elaborate materials, using minimal to complex media combinations and levels of interactivity.

This however would require access to sophisticated technological expertise and permissions at various levels in order to manipulate the software concerned. Were this to be used as an approach with learners engaged in real learning there is a likelihood that ethical issues would also have proven significant. In short it might be argued to be less than ethical if some learners were restricted in their material while others were offered enhanced provision. If in the attempt to avoid such ethical dilemmas learners for whom the material did not constitute part of their current workload were used, then the results obtained may have reflected the fact that any learning involving the research material would have been less than "real" for the students concerned.

Another option available was to gain access to large numbers of learners using CBL material, which could be argued to be representative of the wider population, and have them complete a scale point survey which was then analysed statistically. While this may have offered interesting feedback which could be strongly defended statistically, it was considered that the underlying reasons for the views expressed in the feedback were important and that such views could not easily be clarified using such an approach.

Given the parameters within which the research was conducted and the need for qualitative data from which underlying issues may be understood, it was decided that a case study approach was most appropriate (Miles and Huberman 1994, Yin 1994, Gillham and Buckner 1997), rather than a large scale survey. The "case study" was defined by the specific CBL material in use.

The experimental approach has often been adopted in studies concerning the use of CBL material and the value of multimedia, in relation to measured learning outcomes (Barron and Atkins 1994), and the results of such studies have frequently shown no significant difference (Russell 1999). This research combines the use of the experimental approach with the case study approach in order to address the potential weakness of using a narrowly focussed experimental approach in isolation.

In this research an experimental approach was considered appropriate, within two of the case studies, in order to gain specific feedback regarding the direct comparison of two versions of the CBL materials concerned. The comparison in this case did not concern the learning outcomes, but rather the learner perception of the relative value of the two modes of presentation of the CBL material concerned. This was considered to offer insight into the holistic value for the learner rather than the narrowed focus on learning outcomes as reflected in grades achieved.

Case studies constitute one of the most flexible research designs, offering descriptive accounts and the advantages of natural settings. Case studies are particularly valuable where "how" or "why" questions are being addressed (Miles and Huberman 1994, Yin 1994). The flexible character of the case study design makes for very diverse types of study. The analysis and presentation of case study data, which is generally based on multiple methods of data collection is however more complex than that required in relation to a single type of evidence.

Experimental design requires randomisation and controlled application of the variable concerned (Miller 1975, Cresswell 1994). This involves allocating the subjects taking part in the experiment to a group, which is then exposed to the variable concerned. The allocation requires to be random or matched, in order to avoid bias in the groups. There are general issues concerning the numbers of subjects prepared to voluntarily participate. There are also issues concerning the false nature of the contrived situation engendered by the requirements of the experimental context concerned. Subject responses may be affected towards either acquiescence, where they attempt to say what they consider the experimenter wishes to hear, or towards rebellious responses attempting to go against what they consider the experimenter or researcher wishes to hear. While these issues may be argued to apply to all approaches to data collection, they are particularly relevant in situations where the subjects concerned have been placed within a specific environment which is not part of their usual routine and asked to respond, concerning material with which they would not normally interact. In order to conduct such experiments it is often required that the subjects make themselves available at set times, which can cause difficulty in obtaining numbers of subjects who are able or prepared to make such time available. Therefore the experimental design approach may run the risk of producing statistically significant results based on responses which lack validity due to the contrived nature of the task, or of producing results which may be considered less than representative of the population investigated due to lack of sufficient numbers.

3.3 Case Study Approach Adopted

The approach taken in this research was essentially that of case studies, which was considered most appropriate given the nature of the investigation and the parameters within which it had to be conducted. The cases were considered in relation to the software types being used, rather than the individual student cohorts, or groups concerned. This resulted in five case studies with different types of software, and different numbers of respondents in each case. The cases were selected mainly on an opportunistic basis in relation to researcher access, with the requirement that the software had to be sufficiently different in some respect to that used in the other cases.

The methods of data collection employed reflected the level of researcher access, in that multiple methods of data collection were used for some, but single methods and points of data collection in others.

The experimental method of study design was employed, in the final stages of the research, with the two main case studies, covering the Introduction to Entrepreneurship Class and the Hotel and Hospitality Management Class.

The analysis conducted was initially at the within-case analysis level. This was then de-layered within topic areas and considered in a cross-case pattern search approach. This permitted a level of familiarity to be gained from the data gathered and the results obtained to be considered from a range of perspectives.

The two main philosophical perspectives in social science research are positivism and phenomenology. It is possible to approach research from either of these perspectives, or to combine elements of each.

The philosophical distinction between positivist and phenomenological paradigms may be clear at the theoretical level (Burrell and Morgan 1979), but there tends to be less of a distinction in practice (Bulmer, 1988; Punch, 1986).

Even within a given paradigm, as pointed out by such as Easterby-Smith et al. (1991), the distinction between qualitative and quantitative methods is not quite as clear-cut as it might initially appear. Data arising from such interviews and questionnaires may be analysed using either approach. While particular data collection methods may be more commonly associated with one paradigm rather than the other, it may be argued that a range of data collection methods may be used appropriately within either paradigm.

From the positivist perspective causal explanations are sought and quantitative measurement made, by reducing the problems under investigation to their simplest elements in order to be understood. The focus is on facts, and causality, formulating hypotheses and testing them. The positivist perspective considers that the social world exists externally and that its properties may be measured objectively, offering the benefits of statistical generalisability. From a positivist perspective it might be considered that perceptions of learning may be directly observed in the form of responses obtained. Such external evidence, it may be strongly argued, might then be measured objectively.

The obvious difficulty with this approach would be that in order to obtain the level of quantitative measurement required, the specific concepts involved would have to be reduced to their simplest terms, and measurements taken for large samples. It may be argued that one of the central issues where data collection is concerned may be that, in order to access the real meaning within a given situation, it may be necessary to avoid reducing the variables concerned to their smallest components (Dalton 1964).

The variables involved in learning are not easily simplified. Levels of learning and the complexities involved in facilitating deep learning must be considered. Aspects of human motivation are involved, which are difficult to identify and measure. These issues and the importance of the learning undertaken being real, rather than contrived, add to the complexity and difficulty of attempting any investigation regarding learning. It may be argued that the positivist approach tends to break the subject being studied into smaller parts which are more easily studied in isolation, while the interpretivist approach attempts to take the overall complexity of the real situation into account. There are difficulties involved from either perspective where perceptions of learning are being studied. While it may appear useful to isolate specific aspects of perceived learning and obtain specific feedback which may be analysed for such, there is a possibility that other variables may be influencing such perceptions within the real environment and that such influences may not be revealed when the area being studied is broken into component parts.

Despite the difficulties outlined, some aspects of the current research were approached from a positivist perspective. In the SEI and SHS cases, the elements within the CBL material, which the literature and the subjects in the case studies identified as important for learning, were used as criteria against which subjects were asked to rate CBL material for learning, across two conditions. The hypothesis was that the mode of presentation would affect the ratings given. The ratings given for various elements within the CBL material were collected and their frequency of occurrence calculated.

Where the positivist paradigm is alleged to consider hard “objective” facts, this research clearly looks at subjective opinion and mental constructs. Where the positive paradigm looks to test hypotheses stated at the outset, this work uses what might be described as a form of "post hoc" analysis to form hypotheses, which might lend themselves to investigation using a positivist approach in conjunction with a phenomenological approach.

Central to the design of any questionnaire are the issues of question type and questionnaire format (Oppenheim 1966, Moser and Kalton 1971, Youngman 1984, Silver 1992). The questionnaires used in this research were developed in the light of the literature initially and were thereafter adapted in the light of results obtained. The questions used in this research sought to gain access to opinions which, by their nature, could not be considered to have any definitive, or "right", answer. Closed questions, using responses on a five-point scale, were included on the basis that they were quick for subjects to complete and offered the possibility of some level of statistical analysis. The issue of gaining richer levels of response within the questionnaires was addressed by providing the opportunity for open responses to be offered. The language was kept as straightforward as possible and any use of jargon kept to a minimum.

The questionnaire items and interview questions utilised in this research were based on initial reading of the available literature and on first hand experience in education generally, which might be considered as an element of grounding.

It became clear from the feedback to the initial questionnaires that further information was required in order to gain insight into the areas of interest. The class was by this point an acknowledged success, and there was additional scope available for increasing the level of research carried out. The questionnaires were therefore increased in size, with the intention of obtaining more detailed feedback on areas of interest. This was done initially by adapting the entrance and exit point questionnaires previously used.

It became clear from the feedback to the adapted questionnaires, that additional feedback was required and it was decided that an intermediate questionnaire, administered at the mid-point of the twelve week class would offer useful feedback.

The questionnaires used were developed on an on-going basis, taking account of feedback from previous batches. The intention of such adjustments to the design of the questionnaires was twofold, in that it was intended to reduce the imposition on the respondents, where possible, while gaining further levels of feedback which would offer insight regarding the areas of interest. This led to increased volume of scale point items within the questionnaires, aimed at eliciting which elements within the material were of importance for the respondents, and an increased volume of open response items, aimed at eliciting the underlying reasons for the views held by respondents.

There were several aspects on which researcher bias might have impacted. It was suspected that the use of multi-media presentation would affect the motivation of the learner. The quality of the images and other media used was also thought to be important in terms of learner motivation. It was suspected that the options offered to learners regarding mode of presentation would affect the learners, in that they could choose their preferred option. It was suspected that this would also relate to the ways in which the learners processed the information, and the level to which the material would therefore be understood and retained. It was also suspected that learner expectations would play a role in the level of motivation inspired by the CBL materials. Expectations were thought to relate to awareness of and experience with multi-media materials. It was suspected that the wider the range of experience, on the part of the learner, the greater would be their level of expectation.

3.3 The Philosophical Perspective Adopted

The perspective referred to as "phenomenology" takes the view that people give meaning to the world. The area of interest concerns the different constructions and meanings placed upon the world by the different people therein. From this perspective "reality" is socially constructed (Husserl, 1946, Cresswell 1994). Human interest drives scientific investigation, the focus being on meaning and gaining an understanding of what is happening. The situation being observed is considered in its totality and ideas are developed by induction from the data available.

From the phenomenological perspective, the focus is on understanding the underlying meanings of the various elements involved in the learning process investigated. Multiple research methods are favoured in order to gain a greater insight. The aim from the phenomenological perspective is not generalisability, therefore a small sample size is considered acceptable. The variables are considered in their entirety rather than reducing them to their component parts.

This investigation has its focus on the subjective evaluations made by the learners used as subjects in the study. Any numerical data or statistical analysis must be viewed with this underlying focus in mind. We are therefore dealing with a learner view of the educational environment concerned, and any data obtained regarding the learners' experience with the CBL material was regarded as valuable for the research.

Given the importance attached to the subjective views of the learners concerned, this research takes a phenomenological approach in that it considers meanings attributed by learners, in order to evaluate the effectiveness of the materials concerned for learning purposes. The views of learners were requested in order to gain an understanding of the importance of the elements contained, and processes involved, in the use of CBL material, from the human perspective of the users concerned. The starting point was the learner and the reasoning they employed to evaluate CBL materials. The focus was on meaning attached to views expressed, from the learner perspective, and the potential impact of the overall situation, within which such evaluations were made by learners.

The investigation sought to take the holistic situation for learners into account and a range of data gathering methods were employed to establish the views held, regarding the use of CBL material. The samples obtained ranged from five respondents in the Woolwich Microsoft Networking Essentials (MNE) Case, to several hundred in the Strathclyde Entrepreneurship Initiative (SEI) Case. Where logistically possible the investigations were conducted to a multiple response depth, involving up to four sample points over time. The Scottish Hotel School (SHS) Case was conducted over an academic year and the SEI Case was conducted over a three year period.

As already indicated the approach was also to some extent positivist, in that there was some formulation and testing of hypotheses regarding the mode of presentation of CBL materials. This approach may be argued to be balanced or multiple perspective, in that it contained elements associated with both the positivist and phenomenological perspectives. The methods of data collection ranged from highly qualitative, to scale point quantitative and could therefore be regarded as mixed in that numerical responses were sought as feedback, free text responses were sought then assigned a score within emergent categories, and interview data was gathered which permitted a level of perceived causality to be explored. This balance was considered to provide the research with a level of triangulation, therefore a strength or robustness, from which conclusions may be considered to reflect a more holistic perspective.

3.4 Data Gathering Methods Used

Qualitative approaches have become more acceptable in research over the past decade or so and the use of such may be combined with quantitative measures where researchers consider such mixed methods appropriate. Terms used to label qualitative approaches range from field methods to case study and responsive evaluation. These terms have in many respects become synonymous (Smith 1992). Qualitative data tends to take the form of words rather than numbers, although numbers may be assigned to the words according to some form of coding procedure where considered appropriate.

Qualitative research is concerned with individuals' accounts of their attitudes, motivations and behaviours and is considered to offer levels of richness which quantitative approaches cannot easily match. The levels of descriptive detail relating to individuals' perceptions, or views held, and the meanings and interpretations in use by the subjects concerned, may be explored in addition to their directly observable behaviour. A qualitative approach was therefore particularly appropriate for this research.

The validity of the data obtained using a qualitative approach may be considered high, given that the subjects concerned are given the opportunity to offer a full and self-validated account of their expressed views on the issue being addressed, which was the case in this research. The numbers of interviews carried out in this research were considered sufficient to be representative of the case study population concerned.

This research sought to elicit the views of learners regarding their learning experience, when using the CBL material concerned and any perceived effects of the variables highlighted in the literature as important. It also sought to identify any variables considered important by the subjects themselves.

These views were collected using questionnaires and semi-structured interviews. The use of a mixed method approach may be found in other studies of CBL (Gillham and Buckner 1997, Velde and Cooper 2000, Steele et al 2002). A level of structure was provided in order to focus the attention of the subjects on the elements considered of particular interest for the research. A Likert –type scale was used in the questionnaires, which again is a commonly accepted method of gathering data in this area of research (Yaverbaum, Kulkarni and Wood 1997, Vlosky and Summers 2000, Steele et al 2002). Opportunities were provided for the subjects concerned to raise issues of importance for them, which were not raised by the researcher either in the questionnaires used, or the interviews conducted. This was done primarily by offering an area within the questionnaire for subjects to comment on any issue they wished in an open text format. In the interview setting, subjects were offered the opportunity to comment on any aspect they wished, which had not been addressed earlier in the interview.

It may be argued (Abrahamson 1983, Cresswell 1994) that the use of various methods within an investigation offers significant benefits. This view considers that no measures are perfect and strengths in some will help compensate for weaknesses in others. It is generally accepted that the results obtained in research are seldom, if ever, value-free and that different methods will offer different perspectives. Therefore triangulation combining quantitative and qualitative methods is considered to be worthwhile. A mix of methods may be considered to offer an increased range of perspectives on the phenomena under investigation (Fielding and Fielding 1986, Cresswell 1994). This permits a wider range of perspectives to be considered and offers the maximum possibility for opportunities to be taken as and when they materialise. This research takes an approach which uses mixed methods of data gathering and therefore provides a level of methodological triangulation.

Mixed approaches may also reveal apparently contradictory data, leaving the dilemma of which set to regard as valid. This may also be considered to highlight data which, had a single approach been used, may well have slipped through without question. Rather than considering contradictory data as a difficulty, this investigation set out to explore the meaning and relevance of the feedback obtained, including any apparent contradictions.

Confounding variables may affect the way in which respondents make judgements. Answers obtained on multiple choice ratings might be affected by respondent expectations, or uncertainty of anonymity, while differences in physical environment may alter perceptions of the variable under investigation (Easterby-Smith et al. 1991). In the context of this research, these issues relate to the difficulties involved in evaluating learning itself. It may be argued that by attempting to reduce the whole to its smallest components, we are likely to lose the "real meaning" within the situation. However it must also be recognised that the component parts, in the case of the CBL material, have been identified within the literature as having specific impact and importance in their own right. This has been addressed within the current study by considering the component parts by means of highly structured items within the questionnaires and accessing the holistic situation by means of open response items and interviews.

It may be argued that the interviews and questionnaire feedback supplement each other to a level which can offer insight into the importance of the overall learning environment and the sub-sets of elements within it.

The interviews in particular may be argued to offer insight into the connections between, and the relative importance of, the sub-sets of elements within the learning environment. The interview feedback may be argued to indicate whether the element cited affected the interviewee's level of learning and, if so, in what way this was the case for them.

The quantitative analysis of the questionnaires may be argued to reveal the importance attached by the subjects sampled to the various components within the learning environment investigated.

3.5 Analysis of Scaled Responses

The SPSS package for data analysis was used to analyse the responses given for the scale point elements of the questionnaires completed. The results obtained from the analysis permitted statistical comparisons to be made regarding the variables concerned and some conclusions to be drawn from the quantitative perspective.

3.5.1 Analysis of Open and Interview Responses

The open-ended responses were assigned categories according to the point being expressed by the respondent. The categories were based on the statements made by respondents and the categorisations made were cross checked, for coding reliability. This permitted an understanding to be gained of the extent to which such views were held in the group overall.

The interview responses were individually mapped in order to show perceived causal connections for the individual interviewees.

3.5.2 Summary of Data Sought Within This Research

This research makes use of qualitative options by coding open response items, including interview responses, in order to gain an impression of the general importance of given elements for the respondents as a group, while attending to the words used by the respondents in order to gain insight regarding underlying reasons for expressed viewpoints. This was carried out with the aid of an assistant, which permitted a cross check to be conducted of the categories used and the coding of the responses within the categories concerned.

This research focused on individual ratings and evaluations of learners' attitudes, motivations and behaviours as reflected in their responses to questionnaire items and in interview exchanges. The responses to the scale point items in the questionnaires offered a level of quantitative data, which provided an indication of the views held within the groups studied. The feedback obtained from the interview sessions offered a level of descriptive insight and the highest level of richness in the qualitative sense. The open response items in the questionnaires offered a level of richness, which was between that of the interview responses and the scale-point responses. The responses to the statements, generated from previous responses, offer a level of validation for the conclusions drawn from the feedback concerned. While the number of interviewees is not as high as the number of respondents from the questionnaire based feedback, the responses from the interviews offer a level of insight, which may be used to assist the interpretation of the responses given in the questionnaire. The level of response obtained in the questionnaires offers insight to be gained as to the general relevance of the views expressed across the groups studied and by virtue of the open responses some indication of the underlying reasons for such views.

3.5.3 Selection of Case Studies

Potential Case Studies were sought using personal contacts and established relationships within the University. This was initially restricted to the Strathclyde Entrepreneurship "Introduction to Entrepreneurship" Class using the MENTOR material. The range of cases was extended over time to include the Design & Manufacturing Learning Environment (DMLE) and Harvard Business School (HBS) software used in other Entrepreneurship Classes, the Scottish Hotel School (SHS) Interactive Mediabase material used by the Hotel and Hospitality Class, and the Microsoft Networking Essentials (MNE) software used by the Woolwich Group.

These groups were selected on the basis that they were prepared to offer access to the researcher, they were using CBL materials from which learners were seeking to achieve outcomes within an overall environment geared to their learning and within which successful learning had a perceived value for the learners concerned. The software being used by the groups was similar enough to be comparable while being different enough to enhance the research.

3.5.4 Suitability of Cases: Fundamental Issues

It was considered important that the material in use had to be current and likely to remain in use for the immediate future, or that it should be recognized within the parent domain, or industry sector, as a CBL package of current value for learners.

It was also considered important that feedback was obtained from learners engaged in "real learning", where the CBL materials were part of a current learning programme.

3.5.5 Approach Taken to Establishing Case Studies

Initial meetings were held with the academic staff concerned within the University of Strathclyde, in which the nature of the research was explained and agreements were reached concerning the approach to be taken and the level of access which would be permitted to the researcher, regarding the SEI, SHS, DMLE and HBS Case Studies. This was fairly restricted in the early stages but became more flexible towards the later stages of the research.

The Woolwich group was geographically remote and access was gained via a colleague within the organisation concerned. The communication flow was maintained by email and postal contact, and by telephone using the colleague as intermediary between the researcher and the respondents.

3.5.6 Case Studies Selected

The first case study centred on the introductory class in entrepreneurship, which had been developed using an established authoring platform called MENTOR, and was centrally important to the potential viability of a fledgling unit within the University called Strathclyde Entrepreneurship Initiative. The material had been authored by established figures within the entrepreneurial business arena, with academic staff adding levels of learning activities and assessment. This formed the central case study for the research, to which additional case studies were added on the basis of both pragmatic and empirical considerations. The material concerned was at the pilot stage of its development cycle. The class was being run for the first time within the University of Strathclyde and the researcher had direct access to the class.

The additional case studies (SHS, DMLE, HBS and Woolwich MNE) were selected in order to provide feedback regarding software which differed from the MENTOR material and met the criteria outlined above.

The range of elements used within the materials and the context of use also varied (see Tables 3.1 and 3.2).

Table 3.1: Range of Elements Employed in Case Study CBL Materials

	Text Screens	Interactive Exercises	Still Images	Photorealistic Images	Animations	Sound	Video	Simulation	Game
Case Study 1 (SEI Z1.104)	Yes	Yes	Yes	No	Yes	No	No	No	No
Case Study 2 (SHS)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Case Study 3 (SEI DMLE)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Case Study 4 (HBS)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Case Study 5 (MNE)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

(Note: The fact that given elements are used in more than one set of materials does not indicate that the elements were used to the same degree or in the same instructional design mode, merely that such elements were used.)

Table 3.2: Context In Which Case Study CBL Materials Were Used

	Related to Face to Face Lectures	Related to Face to Face Tutorials	Related to Group Work	Related to Assessed Work	Nature	of	Course	Tutor	Contact	Student Control over Time and Frequency of Individual Sessions
Case Study 1 (SEI Z1.104)	Yes	Yes	No	Yes	UG	Credit-Bearing	Elective	Targeted	Sessions	Yes (24hr)
Case Study 2 (SHS)	Yes	Yes	Yes	Yes	UG	Credit-Bearing	Core Class	Weekly	Sessions	Yes (9-5)
Case Study 3 (SEI DMLE)	Yes	Yes	Yes	Yes	UG	Credit-Bearing	Elective	Single	Class	No
Case Study 4 (HBS)	Yes	Yes	Yes	Yes	PG	Certificated	Elective	Single	Class	No
Case Study 5 (MNE)	No	No	No	Yes	Workplace - Based	Certificated	Elective	None		Yes

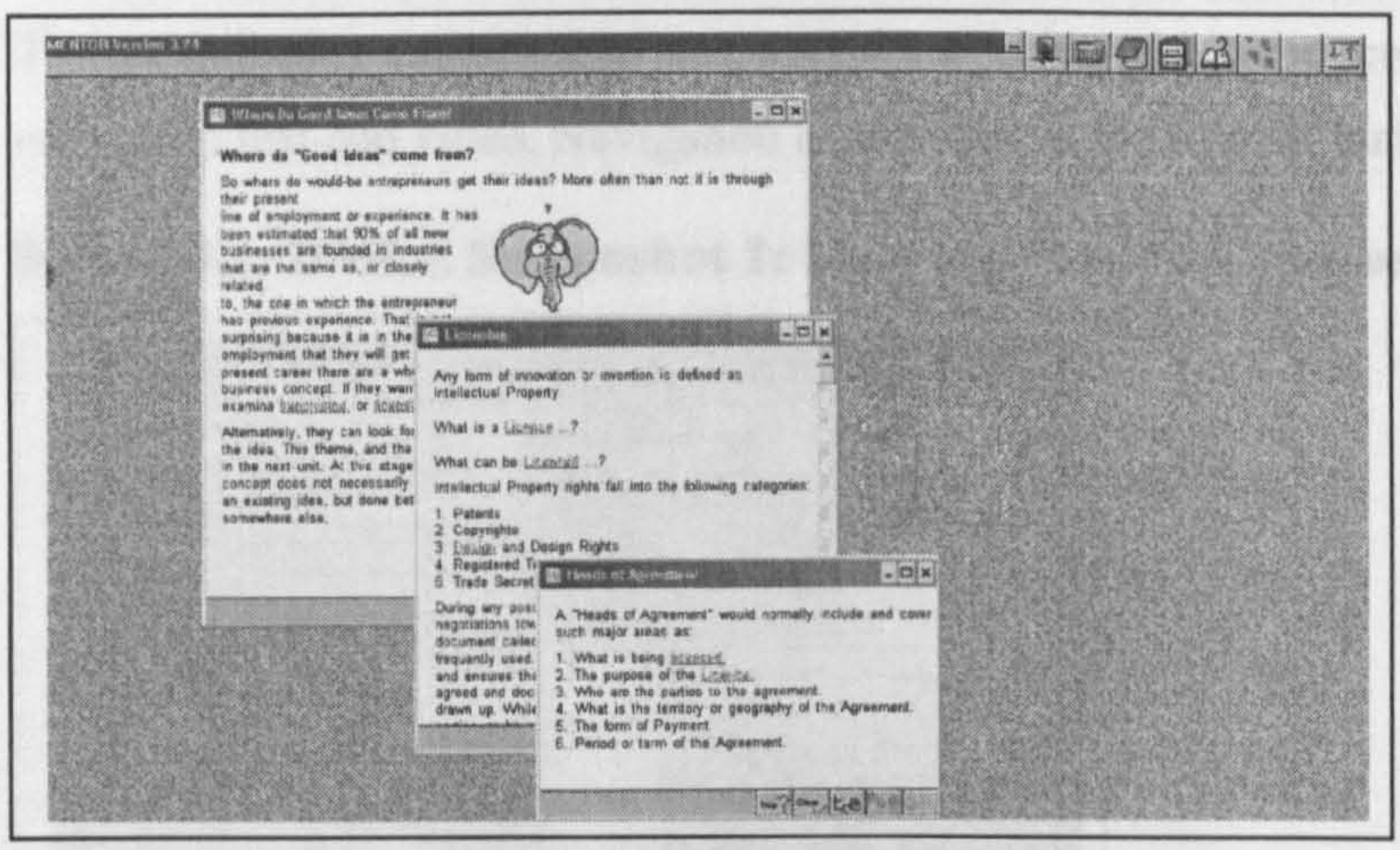
3.6 The Computer-based Material

A brief overview of the types of material concerned and typical screenshots have been included below, with additional screenshots provided in (Appendix 1)

3.6.1 Case Study One SEI: MENTOR Software "Introduction to Entrepreneurship"

The main displays within the MENTOR material consist of text and hypertext links. The text provides the information regarding the topic addressed and the hypertext links offer the option of accessing additional information on specific areas within the topic, or relating to the topic. The windows include small cartoon style graphics (see Fig. 3.1).

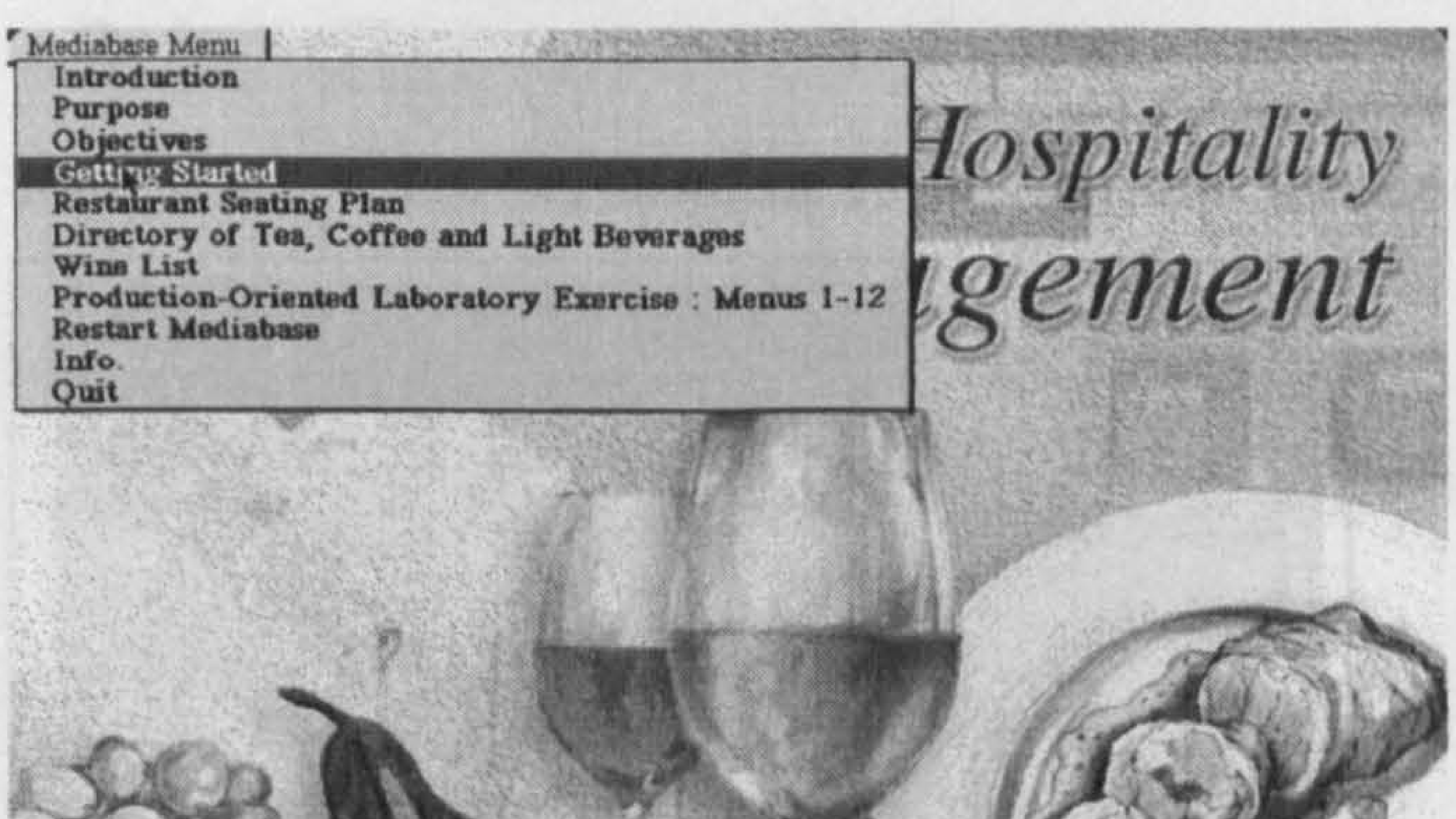
Figure 3.1: MENTOR Screenshot 1 Showing Typical Main Display and Hypertext Navigation



3.6.2 Case Study Two SHS: Mediabase Software Hotel and Hospitality Management (Food and Beverage Management)

The main display makes use of text, sound and video with some screens being entirely text, some with text and video, and others consisting of video scenarios, or navigable maps or exercises. Navigation is provided in the form of menus and sub-menus.

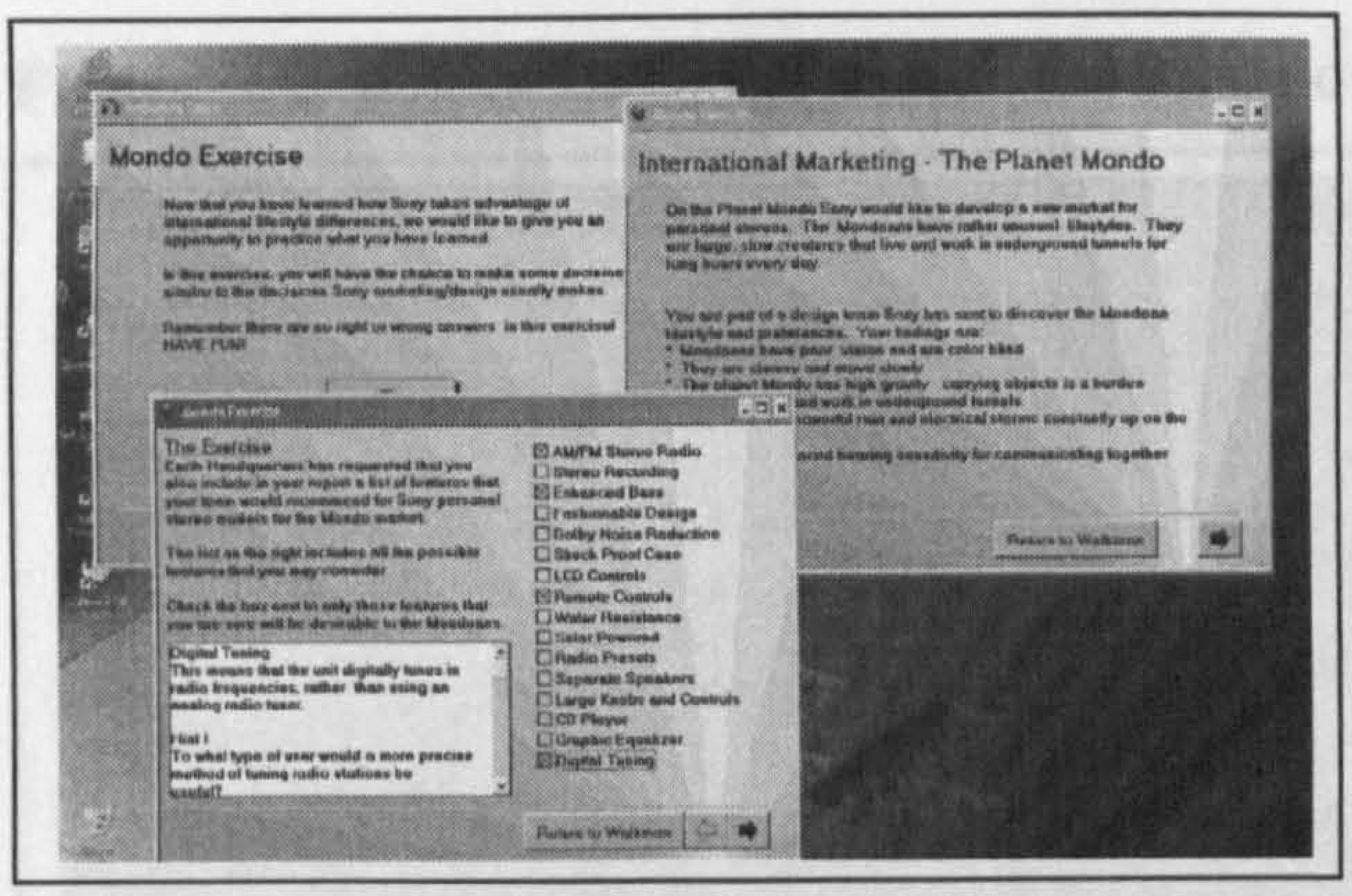
Figure 3.2: SHS Screenshot 1: Screen Showing Main Display



3.6.3 Case Study Three SEI: Design & Manufacturing Learning Environment (DMLE) Software "Innovation and Product Family Management"

The main display makes use of text, sound and video with some screens being entirely text, some with text and video. Navigation is provided in the form of buttons.

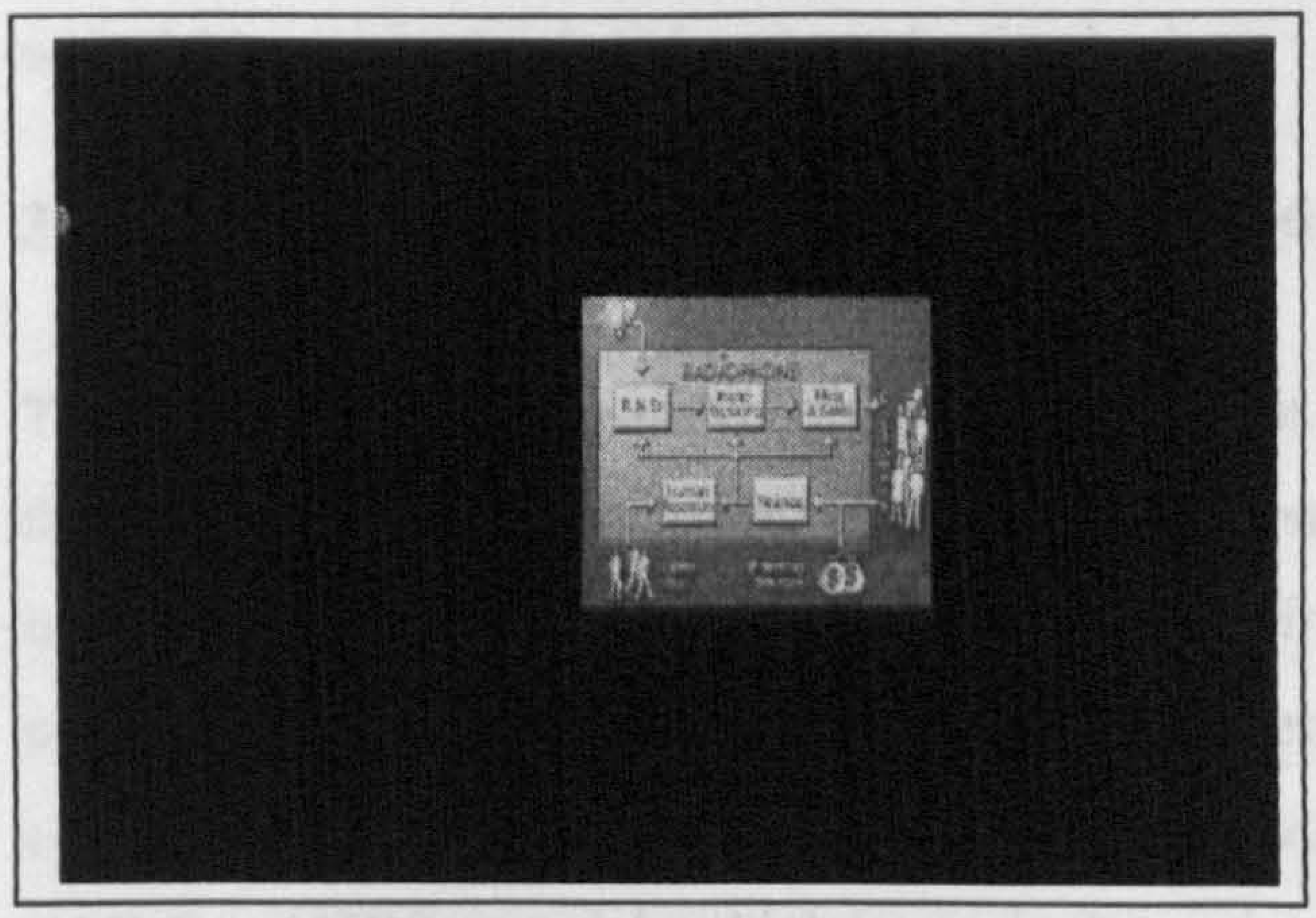
Figure 3.3: DMLE Screenshot 1: Showing Mondo Exercise



3.6.4 Case Study Four SEI: Harvard Business School (HBS) Software "Launching A High Risk Business"

The main display makes use of text, graphics, animation, sound and video with some screens being entirely text, some with text and video, and some with game play. Navigation is provided in the form of buttons, menus and sub-menus.

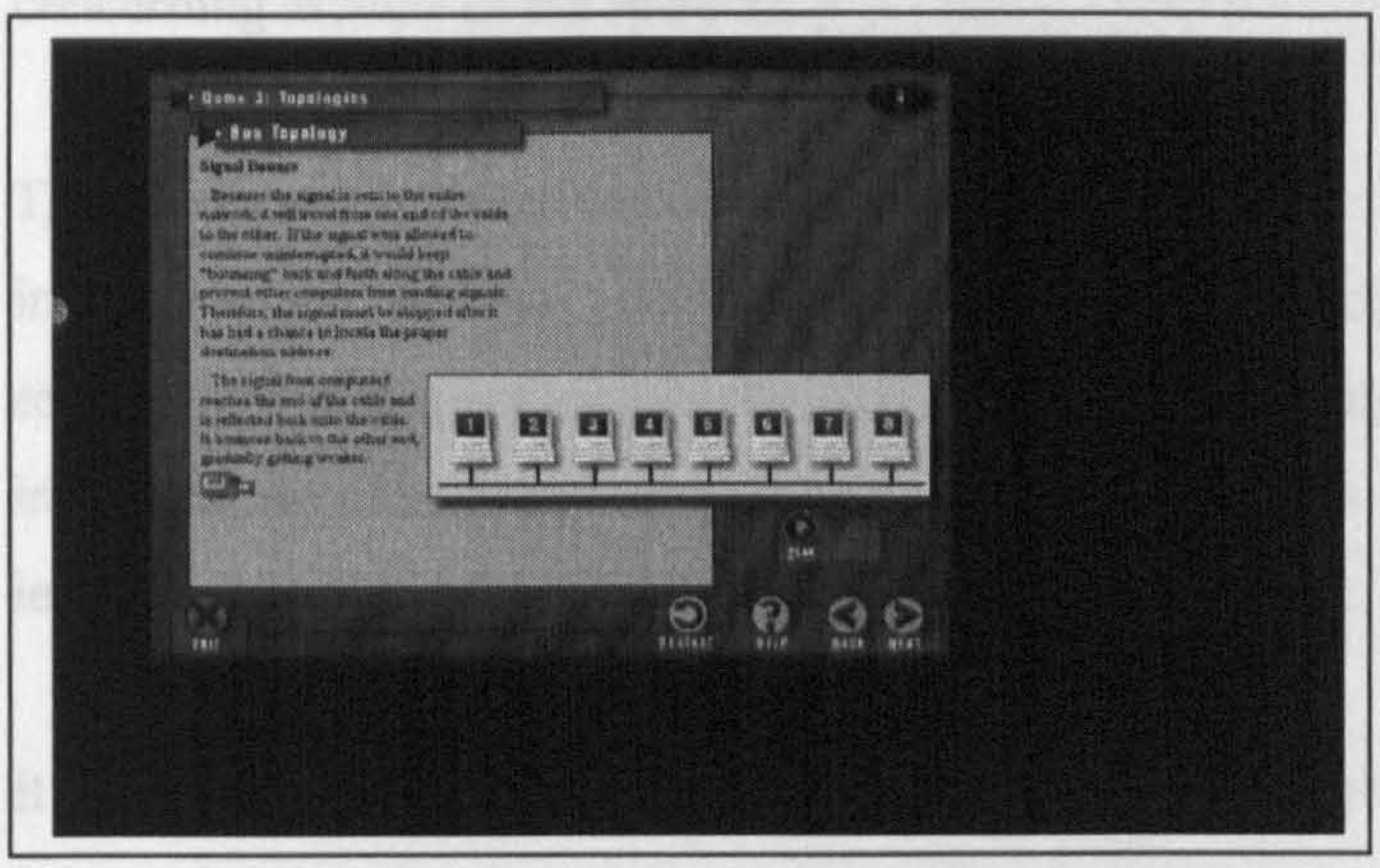
Figure 3.4: HBS Screenshot 1: Simulation Screen Showing Business Outline



3.6.5 Case Study Five Woolwich: Microsoft Networking Essentials (MNE) Software

The main display makes use of text, graphics, animation, sound and video with some screens being entirely text, some with text and video, and some with simulation. Navigation is provided in the form of buttons, menus and sub-menus. Learners may view material relating to the topics addressed by choosing the appropriate "Demo" or "lab session".

Figure 3.5: Woolwich MNE Screenshot 1: Showing Demo Screen



3.7 Approach Taken to Conducting Case Studies

3.7.1 The Learners Studied

The learners concerned spanned the range, from first to fifth year undergraduates and postgraduates with the University of Strathclyde, to those in paid employment who were undertaking courses of study on an elective basis.

3.7.2 The Delivery Modes of the Teaching and Learning

The learners in all of the university based cases were given an introductory session followed by face to face tutor support, as reflected in the tutor contact levels shown in Table 3.2, while those in the workforce had the CBL material and support from colleagues within their workplace. In most cases much of the use of the material was expected to be undertaken by the individuals concerned during their own time and was not supervised by staff. The exceptions to this were the DMLE and HBS materials which were single session use, with any additional use considered entirely discretional.

3.7.3 Data Gathering

In all cases questionnaires were developed to gather feedback from learners. The questionnaire made use of scale point and free text responses. The former provided ratings of elements within the material, which could be considered over the time of the research in a way which allowed clear comparisons to be made. It was considered that free text responses would permit a level of insight to be gained regarding the views held by the respondents and the reasons for such views, concerning aspects of the material and their experience of using such.

The questionnaires were adjusted as the research progressed, with a view to gaining further insight into the learners' views regarding their experiences with the CBL material and the reasons they considered particular elements to be of importance or not so. There was an increased use of both scale point and free text response items over the time of the research. This led at some points to the questionnaires becoming more demanding of respondents.

It was generally requested that the respondents complete the questionnaires and return them prior to leaving the class. In cases where this was not possible, it was accepted that the individuals concerned would complete the questionnaire in their own time and return it to the researcher. It was made clear to all students that completion of the questionnaires was entirely voluntary and that they could choose to retain anonymity by leaving the name section blank.

Where possible, feedback was obtained from respondents at several stages. This permitted a comparison to be made from start to mid-point to exit, for the group generally, where several data gathering points were available. However as the responses were voluntary, and attendance at the face to face sessions varied, the specific respondents varied to some extent from session to session.

In all cases an introductory comment was given to the learners prior to the questionnaires being distributed. This highlighted the value of the research both in terms of the benefit for future development of the class material and the value of the research in relation to the PhD work being undertaken. In the Woolwich case study this was done by an assistant due to the location concerned.

3.7.4 Questionnaires

Case Study One SEI: MENTOR

Data was gathered by questionnaire at the entrance and exit points of the Introduction to Entrepreneurship class in the initial stages, later including a mid-point data collection. There was an attempt made at gathering on-going data using a journal style questionnaire, but this was discontinued due to the low return rates.

Case Study Two SHS: Mediabase

Data for the Hotel and Hospitality Management class was gathered at the entrance, midpoint and exit stages of the class. The questionnaires were given out at the beginning of the class sessions concerned and students were asked to return the completed questionnaire before leaving.

Case Study Three SEI: DMLE

The DMLE material consisted of a single session within an Entrepreneurship class and data was gathered directly at the single two-hour session concerned.

Case Study Four SEI: HBS

The HBS material each consisted of a single session within an Entrepreneurship class and data was gathered directly at the single two-hour session concerned.

Case Study Five Woolwich: MNE

The Woolwich group, using the "Microsoft Networking Essentials" material, were working on an individual basis and were dealt with on an individual basis regarding responses to questionnaires. The initial questionnaire was sent with a range of open responses requested, followed by a second questionnaire seeking verification of response meaning and further clarification of views held, and finally a verification or adjustment of summary statements.

3.7.5 Interviews

Case Study One: SEI MENTOR

It was considered that interviews would offer the opportunity to gain additional insight regarding the views of learners. However the logistical constraints involved, limited the use of learner interviews to Case Study One: SEI MENTOR.

A request was made for interview volunteers in the introductory sessions of the class. It was made clear that participation was entirely voluntary and that participation, or non-participation, would not influence their class grades in any way. The intention of the interview approach was to gather more detailed feedback from the subjects and to explore the underlying reasons for their views. It was explained to the students that volunteers would be expected to attend a first interview around the mid-point of the class, and another close to the exit point. It was also explained that these interviews would be informal in their nature.

The interviews were designed to be semi-structured in approach, which meant that the direction taken and questions put to the subjects would vary according to the particular interview. In an attempt to help subjects relax and to start the communication flow, the opening questions were kept fairly general, though focussed in the area of interest for this research. Each interview offered a learning experience for both interviewee and interviewer, therefore the approach taken developed over time.

The interviews sought to address issues of helping subjects learn, pathways through the material, ease of use, comparisons with other learning experiences, interface elements and their effect on learning, options for improving the material, use made of the range of elements, approach taken to screen displays, level of thought inspired by the material and other influences affecting use of the material (e.g. time pressure). The interviews also addressed issues of enjoyment, engagement, expectations, impact of tutor input, and suggestions for changes. The interviews were considered to offer an opportunity to gain an understanding, beyond that offered by responses to questionnaires. The range and depth of issues covered varied across interviews and was largely determined by the interviewee's responses at the time.

Mapping was chosen as the means of recording the interviews. This was decided on the basis that it permitted any connections to be clearly represented and discussed with subjects. It was decided that taping the interviews would be potentially counter-productive for both the subject and the interviewer, in relation to level of response by the subject and level of concentration by the interviewer. A compromise approach was adopted whereby the interview was taped only where subjects were relaxed about the use of such and the interviewer worked on the basis that these would not be used other than as backup.

Case Study Two SHS: Mediabase Staff Focus Group Meeting

Meetings were held with two groups of staff concerned, academic staff and technicians (with the approval of the class tutor).

A brief explanation was given to the chef technicians prior to questions being posed to them. This was not required for academic staff as they had been involved from the outset.

Focus questions (see Appendix 9, A9.6) were put to the members of staff concerned and notes made of the responses obtained and resulting discussion. It was decided not to tape the sessions as this was thought likely to impede the flow of the meetings. Once the focus questions and any points arising from such had been addressed, the staff were shown the summaries of the feedback obtained from the students and asked for their comment on such. Staff agreed with the points made by the student feedback.

The feedback obtained in these focus groups was summarised and submitted to the staff concerned for confirmation or adjustment as they considered appropriate. The feedback, which was accepted by staff as representative of the views expressed in the focus groups, illustrates the complexity of using CBL material and highlights the importance of stakeholder perspective when evaluating the use of such. (see Appendix 4, A4.8 and A4.9)

3.7.6 Experimental Investigation

Case Studies One and Two: SEI MENTOR and SHS Mediabase

The responses gained from the questionnaires and interviews suggested that there was likely to be a preference on the part of learners regarding the use of multimedia material and that this preference might be influenced by a range of factors.

A controlled investigation was therefore designed and conducted in order to gain further insight regarding the subjects' views on mode of presentation and the implications of this for their learning. The investigation was carried out during the scheduled lab session for the classes concerned and the subjects completed the tasks set using the sub-set of material they were studying as part of the class.

In the SEI case study this was a screen-based exercise titled "Interview with an entrepreneur". The on-screen exercise material was accessed by using the structure map provided within the MENTOR material. The on-screen exercise version included graphics and interactivity in the form of button selection and response was available in the exercise. The on-screen text version of the same exercise was accessed via the Web and contained the same information in a text only format. In the on-screen text version there were no graphics or active buttons and the only action required of the user was that of scrolling through the text document.

In the SHS case study this was a screen based exercise in the form of a video clip titled "Good Waiter – Single Tourist – Responding to Client Concerns" with follow up questions designed to inspire reflective thought. The questions were voiced by the "Narrator". The on-screen exercise material was accessed by using the menu provided within the Mediabase material. The on-screen text version, which was a transcript of the conversation involved in the same exercise, was accessed via the Web and contained the same information in a text only format.

In order to obtain the level of feedback which would enable a comparison to be made between on-screen text presentation, and the on-screen exercise style presentation, a questionnaire was developed which was designed to be completed in relation to the specified sections of the

MENTOR / Mediabase material. The questionnaire was developed in a format which was considered to enable its use across the case studies.

All students completed the exercises in both text and on-screen exercise modes. Order of presentation was randomised and a questionnaire was completed at each stage.

3.8 Approach Taken to Analysis of Results

3.8.1 Emergent Themes

The themes for the development of the questionnaires were initially derived from the early literature reviewed (e.g. Herrington and Oliver 1995, Herrington et al 1997, Stoney and Oliver 1997, Stoney and Wild 1998, Wild and Quinn 1998, Oliver and Herrington 1995) These were then developed from a combination of literature and results obtained from earlier questionnaires and interviews where applicable.

The free text responses were considered by allocating categories based on the meanings of the feedback obtained from the statements entered by respondents. This required some level of interpretation / categorisation, on the part of the researcher and the aid of an assistant was required to facilitate reliability in categorisation of statements.

The interview responses were considered also by allocating categories based on the meanings of the feedback obtained from the statements made by interviewees. This required some level of interpretation on the part of the researcher and the aid of an assistant was required to facilitate reliability in categorisation of statements, as with the free text responses in the questionnaires. The responses obtained in interviews and those obtained in questionnaires were treated as being from independent sources. The categories were generated on the basis of responses as they were obtained and the categories were increased in number as the research progressed. The interview responses offered a greater level of clarity in that links were represented within the recorded map, which clarified the meaning and relevance of the specific statement, therefore aiding the categorisation of the statement.

From these categorisations of the qualitative responses a range of themes emerged, which could be evaluated on the basis of numbers of respondents for whom the issue or element was highlighted as important enough to mention within a free response environment.

3.8.2 Presentation of Results

The scale-point responses were calculated using the SPSS package and frequencies determined for the items concerned. Statistical analyses were carried out on the scale-point responses in order to establish the results obtained had any statistical significance.

For the purposes of this research it was decided that a single open-response within the sample batch concerned (i.e. entrance, midpoint, exit) would be counted for each respondent and interviewee, within each of the categories highlighted by them as important. This it was considered would offer an overview of the relevance or importance of such categories for the group sampled and would enable some conclusions to be drawn regarding the likely importance of the issues concerned, thereby offering possibilities for future investigations.

The individual interview material, while offering the overview feedback described above, was also considered in depth on an individual basis. This provided feedback which clarified the relevance, importance and relationship of information required to gain some understanding of why some issues or elements were considered in the way they were by the individuals concerned. This level of analysis was approached using the mapping technique and enabled a level of comparison to be made of the various viewpoints expressed by interviewees.

3.8.3 Potential Limitations of the Research

The approach taken to this research was influenced to some considerable extent by the prevailing circumstances at various points in time. This largely concerned the working environment and the position held within this by the researcher. Central to the use of any measuring instruments in the gathering of data is the importance of validity and reliability, which were addressed as outlined below.

3.8.4 Validity Issues

From a positivist perspective validity would be considered to relate to whether the instrument concerned in the data collection actually measured that which it claimed to measure. From a phenomenological perspective validity would be considered to relate to whether the researcher had actually gained access to the meanings intended by the subjects studied, or respondents. Validity may be considered as the correspondence between the measures used and the construct they are claimed to measure. Construct validity is particularly important when there is no independent criterion against which the construct may be validated (e.g. by being directly observable) (Miller 1975). Given the nature of this research, validity was addressed by having the subjects validate material where possible, using interview maps, and drawing on such validated feedback as a guide for questionnaire items. Within the concept of validity we must consider the "truth value" of the data obtained (Easterby-Smith et al 1991) and it was considered that real subjects, using real material, for real learning, satisfied this requirement.

Validity of Feedback from Questionnaires

This research requires feedback from subjects who are "learners", which in itself, raises questions in terms of validity, as the subjects are relying on their reflections or memories regarding the material concerned. This may be affected by other factors which have intervened at some stage, or by inaccurate recall of their experiences at the time of using the CBL material concerned. The responses may have been affected by the subject's perception of the situation, and / or the researcher, who was also the tutor in the SEI "Introduction to Entrepreneurship" case study. There is clearly a possibility that some of the subjects were less than totally frank in their responses. The questionnaires were completed in lab time and may have been given a reduced level of thought due to other pressures on the subjects at the time. There was an element of selection involved in the range of questions asked within the research and the questions asked may have been interpreted in slightly different ways by different subjects. The open text responses given by the subjects may have been interpreted in a different way by the researcher than subjects intended, or subjects may have responded to an individual interpretation of the question concerned, which the researcher had not intended. All of these aspects must be taken into account when considering the conclusions that may be drawn from the data analysis.

3.8.5 Reliability Issues

From a positivist perspective reliability would be considered to relate to whether the measure concerned in the data collection would offer the same results on subsequent occasions, given that there had been no change in that which had to be measured. From a phenomenological perspective reliability would be considered to relate to whether other researchers might be expected to make similar observations on subsequent occasions, given that there had been no change in that which had to be observed. Within the concept of reliability we must consider any factors likely to affect the data obtained (Easterby-Smith et al 1991). Reliability may be considered as the consistency of the measurement, or the extent to which the measurement would remain constant given the same subject being tested repeatedly under identical conditions. It is of course possible for a measurement to be fully reliable, yet totally lack validity (Miller 1975). The level of reliability, which is of importance regarding this research, concerns the provision of sufficient information regarding the methodological approach, such that other researchers might replicate the study should they so wish. The approach taken in the current research was to make use of existing data collection instruments where possible, and to generate data collection instruments based on a combination of findings from literature and current research.

3.8.6 Analysis and Interpretation

One of the dangers with the positivist perspective is that the researcher may be so focussed on statistical significance that underlying design weaknesses are not taken as fully into consideration as they might otherwise have been. As Miller points out, the importance of the entire exercise is to reflect on the extent to which original predictions may have been confirmed and the level of insight gained with regard to the theoretical basis on which such predictions were based.

"The point we wish to emphasize here is that many considerations external to the statistical analysis will determine the practical and theoretical significance of the results."
(Miller 1975, p119)

The approach taken in this research addresses these issues by gathering data using a range of methods and analysing responses both quantitatively and qualitatively.

3.8.7 Generalisability

From a positivist perspective, generalisability would be considered to relate to the probability that patterns observed in the data collected from the sample studied, would also be observed in the population from which the sample had been taken. From a phenomenological perspective generalisability would be considered to relate to whether the ideas or theories, generated in the investigation, would apply in other settings. Within the concept of generalisability we must consider the "applicability" of the conclusions drawn from the data obtained (Easterby-Smith et al 1991). Given that this research used a case study approach the issue of generalisability is open to some debate, however it may be considered that the issues revealed by the research are likely to be generally of interest to those in the higher, or tertiary education, field.

3.8.8 The Research Sample

One of the major problems for this research related to the accessing of subjects who were using interactive technology within a training / educational environment. The approach to gaining access had to be largely "opportunistic" and therefore the empirical research was limited to the students undertaking classes to which access could be gained for research purposes. The issue of volunteering to assist with research introduces further issues in relation to the subjects studied. There were two main aspects concerning sampling to be considered in this research. The first concerned whether the students taking the class concerned were representative of the parent population of learners in Higher Education generally, or a sub-set of learners in Higher Education. The second concerned the issue of those who volunteered to participate in the research and whether they were representative of the class participants as a group.

The results of this investigation have been offered as valid within the case study groups concerned, but are not necessarily generalisable to the larger population, due to the nature of the sample studied. While in some respects the students concerned might be argued to be cross faculty and cross year, therefore representative of HE students at the University of Strathclyde, the entrepreneurship classes were elective classes, and that in itself made it unlikely that the sample would be representative of the total student population. However, given that the students in the SEI electives are cross faculty it may be argued that they represent to some degree a wider range of students within H.E. than single batches of students within subject specialisms. These students may be considered to be representative of students in H.E. who have some interest in entrepreneurship. For the SEI interviews (and mapping), the group had to actively volunteer and may be considered as a sample of students from within the class, the issue of self-selection introducing a bias in itself. The SHS class was not an elective and the students concerned may be considered as representative of SHS students generally.

3.8.9 Response Rates

One of the difficulties encountered when questionnaires are employed is that response rates tend to be much less than 100%. This issue of non-response adds a further complication in that it may well introduce a level of bias for the data obtained. In this research reminders were issued in an attempt to address the response rate issues. Verbal reminders were given at the mid-point and fifteen minutes before the end of the lab sessions concerned. Email reminders were sent in relation to the interviews, mapping of learning summaries, and journal completion.

Response rates were close to 100% of those who attended lab sessions and completed the questionnaires before leaving. Journals, which had to be completed outwith lab sessions, achieved a very low response rate, to the extent that they were disregarded in the results and analysis of the research. Interviews and mapping of learning summaries achieved a low volunteer rate, though most who said they would volunteer did actually do so.

The response rates for the SHS were practically 100% in the lab sessions and all who attended the lecture responded. However, attempts to get a response from those who were not present in the lecture proved to be unsuccessful.

3.8.10 Subject Motivation to Participate in Research

Once the difficulties of access to the subjects concerned, had been overcome, the difficulty faced became that of establishing and maintaining the willingness of the subjects to offer feedback to the level required. Given that participation was entirely voluntary, the interview element raised difficulties in that volunteers had to be motivated to attend outwith class contact time and on two separate occasions. All who completed questionnaires had to be motivated to spend time, which they would otherwise have used to progress their study of the material. These difficulties were successfully overcome to the level where responses were obtained for sufficient numbers to enable the research to be undertaken.

3.8.11 Approach to Learning : ASSIST Questionnaire

It became clear from the research results, that variations in approach to learning were having some impact on the evaluations made of the CBL material. It was therefore considered appropriate to investigate the approach taken to learning by the respondents. It was considered that this would offer some insight into evaluations of elements within the CBL material.

In order to address this aspect the questionnaires were further developed to include the ASSIST material developed by Professor Entwistle. The intention was to gain an understanding of the approach taken to learning and the preferences for teaching and learning delivery modes held by the respondents.

It was considered that, given the respondents concerned were students within a Scottish University, it would be appropriate to employ the ASSIST instrument for measuring approaches to learning, as it had been designed and tested with subjects from a similar background in terms of culture and educational level.

3.8.12 The Interview Approach

In-depth interviewing is regarded as one of the most fundamental techniques in qualitative research, as interviews offer the researcher the opportunity to gain a deeper understanding of the meanings interviewees attach to the issues raised (Burgess 1982).

It was decided that by allowing maximum freedom of expression interviews offered the best way of gaining the level of qualitative feedback desired, regarding the areas of research interest. The intention was to elicit feedback which would clarify the aspects of importance for the interviewees and clarify the reasons for the level of importance they attached to such elements from a learner perspective. The interviews were semi-structured in design in order that the areas of particular interest could be addressed while maintaining the level of freedom of expression desired. It was considered that a completely non-directive approach would fail to produce the level of feedback sought (Jones1985).

The interviews enabled information to be elicited and clarified, which interviewees may not have clearly articulated in questionnaire responses. A grounded theory approach was used to the extent that themes or patterns were sought in the data gathered. Links were then sought between the data and the views expressed in the relevant literature.

The interviews conducted offered a level of "grounded understanding" which impacted on the next stage of the research. Confirmation of researcher understanding of the feedback given, was made at the time of the first interview and again at the follow up interview (for those who were available to attend on a second occasion). This was done to ensure that the message sent by the interviewee was the same as the message received by the interviewer and to validate the resultant cognitive maps as acceptable representations of the interview. This was also considered likely to increase the level of trust achieved and provide a means of gaining new insights into the data concerned (Easterby-Smith et al 1996). The second interview session also allowed any changes in the subjects view to be accommodated.

3.8.13 Cognitive Mapping of Interviews

The advantages of the approach taken in this research were that constructs were made explicit which might otherwise have remained concealed. The data obtained was based specifically on the particular individual's framework, rather than being imposed on the individual, and the method offered insights to be gained by both the researcher and those being interviewed.

The advantages of using mapping to record the interviews included the identification of linkages showing causality and an increased likelihood of reflective thought on the part of the subject concerned. The act of sharing the developing map was considered to reduce stress in the interviewees and to offer an increased richness of data gathered.

The mapping approach adopted for this research was considered less likely to lead to too much reliance being placed on the process within the technique, as may be argued to happen with the Repertory Grid (Stewart and Stewart 1981). The use of the mapping approach ensures that the interviewer remains constantly in tune with the interviewee, the mapped representation is constantly being checked and validated by the interviewee, and the overall picture emerging from the interview is maintained in the minds of both interviewer and interviewee. This increases the likelihood that any interpretations made of interviewee responses are as the interviewee intended. The possibility of meaningful analysis was, therefore, more likely to be enhanced, than endangered by the process.

The social context of research interview interaction is considered relevant to the information obtained (Jones 1985). It may be argued that if the level of trust established is poor this may result in the interviewee simply telling the researcher whatever they consider the interviewer would wish to hear (Easterby-Smith et al 1996). The trust level in this research was built by reassuring the subjects that the interviews were for research purposes and would not relate in any way to their class grades. The interviews were conducted in a seminar room which had not been used for the class concerned in the study. The students were offered the option of light refreshments (tea / coffee) prior to the interview commencing. Notes made by the interviewer were openly available to the interviewees at all times and initial questions were selected to enable responses to be straightforward and maintain the flow of communication at the initial stages. It was stressed at the outset with the interviewee that they should feel free to be open and honest, and that in doing so more would be gained from the exchange.

Trust levels were also addressed by taping feedback only where subjects were clearly relaxed about such and allowing subject control over taping where used. The use of tape facilities as backup was negotiated with the subjects concerned. Taping was considered to be counter-productive where subjects in any way appeared less than willing to have their response recorded in this way. It was therefore made clear to all concerned that they had complete control over the use of taping facilities and that these would not be used without their complete consent. It was also made clear that subjects were free to stop and start the tape at any stage during the interview (the controls concerned were demonstrated to each subject where the tape was in use).

An area of concern regarding interviews was the possibility that the interviewer's frame of reference might be imposed on the interviewees. There was inevitably, some influence due to the interviewer's frame of reference, in that the questions asked, directed the interviewees to reflect on particular elements of their learning and experience when using the CBL material concerned. This level of influence is practically unavoidable in such research, as questions require to be phrased in some form that permits useful feedback to be obtained. For the purposes of this research there was a need to gain feedback on a particular range of aspects, and therefore in some instances the questions had to be focussed on specific elements within the package. Where such questions were asked, care was taken not to lead in a positive or negative way but simply to focus the thoughts of the interviewee on the aspect concerned and note the response obtained and the way in which it linked to the other points raised in the interview.

It was considered appropriate to make use of probes as supplementary questions within the interview exchanges. This allowed greater levels of qualification to be offered by the interviewee. The probes ranged from simply repeating the question asked, to feeding back the interviewee's response and requesting additional clarification. Probe questions were asked therefore, when the interviewer considered it appropriate to seek confirmation and clarification of points made by the interviewees. The phrasing of such probes was kept as open as possible in order to avoid leading the response obtained. No statement was made regarding the interviewer's personal viewpoint and all answers provided by the subjects concerned were treated as being equally accepted (Moser and Kalton 1971).

3.8.14 Experimental Investigation

The feedback from the research suggested that there were differing views held by respondents regarding the range of elements contained within the CBL material. It was decided that further clarification should be sought regarding the level of preference for a screen-based text mode of the material in use, as compared to a version using additional screen display options.

Given the need to minimise intrusion for the students concerned, while eliciting the level of feedback required for research purposes, it was decided to use a sub-set of the CBL material for the experimental investigation of the two modes of on-screen delivery. The items selected consisted of a self-contained exercise from the MENTOR material used in the SEI "Introduction to Entrepreneurship" Class, and a restaurant scenario used in the SHS Class (see Appendix 8, A8.19, A8.20 and Appendix 9, A9.3).

The controlled investigation was the least "natural" of the settings used and the restricted use of sub-elements within the material clearly raises issues of generalisability to the overall package. It was considered that this investigation was justifiable in that it offered clear feedback on a direct comparison of presentational styles. The results of this part of the research, tempered by the other data gathered using more natural settings and addressing the full package of material, were considered to offer a robust base of representative feedback, from which conclusions could be drawn regarding the value of CBL materials of different types, for the learners concerned.

3.9 Review of "Methodology" Chapter

This chapter has provided an overview of the methodological issues relating to this research and has indicated the chosen methodology and offered a justification for such. The value of the case study approach combined with the mixed methods of data gathering has been outlined. A rationale has been offered for the specific cases studied and a justification of their suitability has been provided. An overview of the CBL material used in each case study and the similarities and differences in terms of media elements and educational context, has been provided. Relevant information regarding the learners involved in the case studies has been provided together with an outline of the courses of study for which the CBL material was used. A detailed account of the data gathering procedures used has been provided including any specific detail relating to the particular case study concerned. The approach taken to the analysis of data gathered has been detailed and the value of the mixed methods of analysis employed has been outlined. The perceived limitations of this research have been highlighted and issues of reliability and validity have been addressed. The detailed presentation of results which follows in Chapter Five provides the direct empirical evidence to support the conclusions drawn from this research. The results include quantitative and qualitative material and have been classified according to the mode in which they were obtained. We may therefore identify which aspects of the CBL materials concerned are highlighted in more than one mode and therefore be considered to be centrally important for users. Where additional information is offered in the open or interview responses, concerning these centrally relevant aspects, we may draw conclusions concerning the underlying reasons for their importance.

Chapter Four: Results

4.1 Overview of Results Chapter

This chapter presents the results obtained, categorised according to the emergent themes which were derived in part from the literature reviewed, and in part from responses obtained in interviews and free text responses in questionnaires.

The initial sections present the results obtained in pilot studies for the Case Study One: MENTOR Software "Introduction to Entrepreneurship" and Case Study Two: Mediabase Software Hotel and Hospitality Management (Food and Beverage Management). The subsequent sections present the results obtained within the post pilot phases of these cases, and for Case Study Three: DMLE Software "Innovation and Product Family Management", Case Study Four: HBS Software "Launching A High Risk Business" and Case Study Five: MNE Software "Networking Essentials".

The results have been presented according to the emergent themes in order to facilitate the reader in gaining an understanding of the common issues emerging, and of any differentiating issues within the case study results.

Table 4.1: Emergent Themes

The Emergent Themes:	
Learner "Overhead" Issues	**Learner Perceptions of Computer-based Material**
Computer Literacy Level (of users)	Perceived Impact on Learning / Understanding (Cognitive)
Content Appropriateness	Perceived Impact on Learning / Motivation (Affective)
Approach to Learning (of user)	Expressed Preferences for Computer-based Environment Types
Human Contact Issues (& Tutor Related Issues)	Perceived Effectiveness of Elements Within The Material
Learner Management Issues (self management)	"Usability" Related Responses
	Perceived Impact of Presentation Elements
	Perceived Impact of On-Screen Text
	Perceived Impact of Graphics / Multimedia Elements
	Perceived Comparison With Other Modes
	Preferences Expressed in Controlled Investigation

4.2 Overview of Approach Taken Regarding Results Obtained

Questionnaires Used

A range of questionnaires were developed and used over the time of the study. These were developed on an ongoing basis and addressed aspects of the material which were initially considered important, followed by additional aspects which emerged in the course of the study.

Table 4.2: Approach Taken to the Development of the Data Gathering Instruments

(Note: Items addressed in questionnaires stated for the first questionnaire in which they occur.)

Pilot Study SEI Semester 2 1996/7	**Entrepreneurship Material** **Comments re Questionnaire Items**
Entrance Questionnaire: Week One	Based largely on discussions with other researchers Addressed • confidence levels of learners.
Exit Questionnaire: Week Twelve	Based largely on best guess from personal experience and discussions with other researchers. Addressed learners' • confidence levels • perceptions of effectiveness • approach to working • perceptions of the value of elements • preferences • expectations
SEI Semester 1 1997/8	**Entrepreneurship Material** **Comments re Questionnaire Items**
Entrance Questionnaire: Week One	Based largely on discussions with academic staff, feedback from previous questionnaires and literature accessed Also addressed learners' • experience with computers • interest areas • motivation • ease of access to IT Used open response items to gather qualitative responses.
Exit Questionnaire: Week Eleven	Addressed • perceived ideal way of learning using a computer as an aid • perceived appropriateness of the content Increased the number of responses requested, rating elements in the material.

SEI Semester 2 1997/8	**Entrepreneurship Material** **Comments re Questionnaire Items**
Entrance Questionnaire: Week One	Also Addressed learners' • perceived ideal way of learning using a computer as an aid Used open response items to gather qualitative responses.
Journal Questionnaire: Week Two	Addressed learners' • approach to working with material, • perceived effectiveness of elements within the material Responses to value judgement statements regarding • learning experience using material • comparisons with other modes of presentation • self awareness of learning • desire for tutor input, • perception of email communication with tutor • affective impact of using material. Open responses requested regarding experiences which student perceived to have worked well and those which had not
Midpoint Questionnaire: Week Six	Addressed learners' • confidence levels • experience with computers • perceived ideal way of learning using a computer as an aid • interest areas • motivation • ease of access to IT • perceived appropriateness of the content
Interviews: Week Six	Semi structured interviews addressed student perceptions regarding • what had been helpful for their learning, • how they had used the material • which aspects they considered better or worse than others • their evaluations of the material compared to other options • their suggestions for improvements • their views regarding tutor input • the affective impact of elements within the material • the social impact of the material Constructed mapped representation of interviews and validated maps with interviewees.
Exit Questionnaire: Week Eleven	Addressed learners' Requested ratings of elements in the material
Interviews: Week Twelve	Semi structured interviews addressed learners' views as per previous interviews For those undertaking follow-up interviews, confirmed / adjusted mapped records of first interviews
SEI Semester 1 1998/99	**Entrepreneurship Material** **Comments re Questionnaire Items**
Entrance Questionnaire: Week One	Also Addressed learners' • preferred environment for computer-based material • perceived level of comfort in using a computer for this material • motivation and frequency of use for email and |Internet Used open response items to gather qualitative responses.

SEI Semester 1 1998/99 cont'd	**Entrepreneurship Material** **Comments re Questionnaire Items**
Journal Questionnaire: Week Two	Also addressed responses to value judgement statements regarding • use of other multi-media materials Open responses requested regarding experiences which student perceived to have worked well and those which had not
Midpoint Questionnaire: Week Six	Addressed items as per previous Midpoint Questionnaire
Interviews: Week Six	Semi structured interviews addressed learners' views as per previous interviews Constructed mapped representation of interviews and validated maps with interviewees
Exit Questionnaire: Week Eleven	Requested ratings of elements in the material Also addressed • suggested changes to bring the module closer to their ideal for learning, • preferred environment for computer-based material, • perceived level of comfort in using a computer for this material, • interest areas with an explanation of why so, • learner motivation and frequency of use for email and Internet. Used open response items to gather qualitative responses.
Interviews: Week Twelve	Semi structured interviews addressed learners' views as per previous interviews For those undertaking follow-up interviews, confirmed / adjusted mapped records of first interviews
SEI Semester 2 1998/99	**Entrepreneurship Material** **Comments re Questionnaire Items**
Entrance Questionnaire: Week One	Addressed items as previous Entrance Questionnaires Used open response items to gather qualitative responses
Journal Questionnaire: Week Two	Open responses requested, regarding experiences which student perceived to have worked well and those which had not.
Midpoint Questionnaire: Week Six	Also addressed learners' • preferred environment for computer-based material
Interviews: Week Six	Semi structured interviews addressed learners' views as per previous interviews Constructed mapped representations of interviews and validated maps with interviewees.
Exit Questionnaire: Week Eleven	Addressed learners' • Requested ratings of elements in the material Used open response items to gather qualitative responses
Interviews: Week Twelve	Semi structured interviews addressed learners' views as per previous interviews For those undertaking follow-up interviews, confirmed / adjusted mapped record of first interviews.
SEI Semester 1 1999/00	**Entrepreneurship Material** **Comments re Questionnaire Items**
Entrance Questionnaire: Week One	Addressed learners' • Addressed individual learning style using Learning Style Inventory (Cerny). Used open response items to gather qualitative responses.
Journal Questionnaire: Week Two	Discontinued due to low response rates. Material incorporated into exit point questionnaires.

SEI Semester 1 1999/00 cont'd	**Entrepreneurship Material** **Comments re Questionnaire Items**
Midpoint Questionnaire: Week Six	Also addressed learners' • previous experience with multi-media • frequency of email use • evaluation of which environment category applied to material in use • statements previously contained within journals • approach taken to working with the material • approach to learning using ASSIST Study Skills Inventory (Entwistle)
Interviews: Week Six	Semi structured interviews addressed learners' views as per previous interviews Constructed mapped representations of interviews and validated maps with interviewees
Exit Questionnaire: Week Eleven	Also addressed • experience with computers • previous experience with multi-media • statements previously contained within journals Expanded open response items to gather further levels of qualitative responses including areas beyond the immediate class. (Items as used with Woolwich MNE Group)
Interviews: Week Twelve	Semi structured interviews addressed learners' views as per previous interviews For those undertaking follow-up interviews, confirmed / adjusted mapped record of first interviews.
SEI Semester 2 1999/2000	**Entrepreneurship Material** **Comments re Questionnaire Items**
Entrance Questionnaire: Week One	Used open response items to gather qualitative responses Questionnaire reduced in volume in light of additional research in controlled investigation
Controlled Investigation: Week Two	Selected on-screen exercise (Entrepreneur Interview) presented in two formats, in order to obtain clarification of learners perception of each mode of presentation Addressed learners' • learning experience offered by each version, • impact of multimedia elements within the material, • previous experience • comparison with other modes.
Midpoint Questionnaire: Week Six	Addressed learners' • perception of appeal • level of engagement • depth of thought • ease of use • impact on learning • value of interactive / multimedia elements • Used 14 open response questions, as given to SHS, DMLE and HBS groups • Addressed approaches to learning using ASSIST questionnaire (Entwistle)
Exit Questionnaire: Week Eleven	Addressed learners' • learner appeal, • level of engagement, • depth of thought, • ease of use, • impact on learning • value of interactive / multimedia elements Used 14 statements generated from midpoint responses and requested adjustments or validation as appropriate for individual students. Provided feedback summaries compiled from midpoint open response items for adjustment / validation as representative of individual's evaluation of their learning experience and the value of the material concerned (Approach as used with Woolwich MNE Group) Also addressed • statements previously contained within journals

SHS Semester 2 1998/99 (Pilot)	**Mediabase Material** **Comments re Questionnaire Items**
Exit Questionnaire: Week Eleven	Addressed learners' • confidence levels • perceptions of how effective the material had been for their learning • ratings of elements in the material Also addressed • perceptions of the value of elements offered within the material • preferences and expectations • suggested changes to bring the course closer to their ideal for learning • perceived level of comfort in using a computer for this material • interest areas with an explanation of why so • motivation and frequency of use for email and Internet
SHS Semester 1 1999/2000	**Mediabase Material** **Comments re Questionnaire Items**
Entrance Questionnaire: Week One	Addressed learners' • confidence levels preferred environment for computer-based material, • perceived level of comfort in using a computer for this material • interest areas with an explanation of why so • individual learning style using Learning Style Inventory (Cerny). Used open response items to gather qualitative responses.
SHS Semester 2 1999/2000	**Mediabase Material** **Comments re Questionnaire Items**
Controlled Investigation: Weeks Two ... onwards to cover entire class in small group sessions	Selected on-screen exercise (Good waiter - Single tourist - Responding to Client Concerns) presented in two formats, in order to obtain clarification of learners perception of each mode of presentation Addressed learners' • learning experience offered by each version • impact of multimedia elements • previous experience • comparison with other modes
Midpoint Questionnaire: Week Six	Addressed learners' • appeal • level of engagement • depth of thought • ease of use • impact on learning • value of interactive / multimedia elements • approaches to learning using ASSIST questionnaire (Entwistle). Used 14 open response questions, as given to SEI, DMLE and HBS groups.

SHS Semester 2 1999/2000 cont'd	**Mediabase Material** **Comments re Questionnaire Items**
Exit Questionnaire: Week Eleven	Addressed learners' • appeal • level of engagement • depth of thought • ease of use • impact on learning • value of interactive / multimedia elements Used 14 statements generated from midpoint responses and requested adjustments or validation as appropriate for individual students. Requested ratings of • elements in the material • perceptions of the value of elements • preferred environment for computer-based material, • learner interest areas, • learner motivation using statements previously contained within journals as used with SEI case. Provided feedback summaries compiled from midpoint open response items for adjustment / validation as representative of individual's evaluation of their learning experience and the value of the material concerned (Approach as used with Woolwich MNE Group).
SEI DMLE Semester 1 1998/1999	**DMLE Material** **Comments re Questionnaire Items**
Questionnaire: Week Six	Addressed learners' evaluations of • effectiveness of elements in the material • statements contained within SEI journals • experience with other multi-media • experiences when using current material which were considered to have worked well, or to have worked badly for the learner
SEI DMLE Semester 1 1999/2000	**DMLE Material** **Comments re Questionnaire Items**
Questionnaire: Week Six	Expanded open response items to gather further levels of qualitative responses, including areas beyond the immediate class (Items as used with Woolwich MNE Group) Addressed learners' • perceived level of comfort in using a computer for this material • interest and motivation areas with an explanation of why so • Addressed individual learning style using Learning Style Inventory (Cerny) Used open response items to gather qualitative responses
SEI DMLE Semester 1 2000 / 2001	**DMLE Material** **Comments re Questionnaire Items**
Questionnaire: Week Six	Addressed learners' • appeal • level of engagement • depth of thought • ease of use • impact on learning • value of interactive / multimedia elements Used 14 open response questions, as given to SHS, DMLE and HBS groups. Questionnaire greatly reduced to increase level of response and to offer similar level of detail to those developed for other case studies

SEI HBS Semester 1 1999/2000	**HBS Material** **Comments re Questionnaire Items**
Questionnaire: Week Twelve	Addressed learners' • level of engagement • depth of thought • ease of use • impact on learning and value of interactive / multimedia elements Used 14 open response questions, as given to SHS, DMLE and HBS groups Questionnaire greatly reduced to meet the requirements of academic staff and to increase level of responses obtained.
Woolwich MNE Semester 1 1999/2000	**Networking Essentials Material** **Comments re Questionnaire Items**
Questionnaire One	Used open response items to gather levels of qualitative response, including areas beyond the immediate class Addressed learners' • perceived level of comfort in using a computer for this material • interest and motivation areas with an explanation of why so • individual learning style using Learning Style Inventory (Cerny) • approaches to learning using ASSIST Study Skills Inventory (Entwistle)
Questionnaire Two	• Provided individual feedback summaries compiled from questionnaire one, open response items, for adjustment / validation as representative of individual's evaluation of their learning experience and the value of the material concerned • open responses to further questions related to responses obtained in questionnaire one • verification of mapped summary of conclusions drawn from responses to questionnaire one.
Questionnaire Three	Provided collective feedback summaries compiled from questionnaire one and two open response items for adjustment / validation as representative of individual's evaluation of their learning experience and the value of the material concerned

Table 4.3: Areas Covered by SEI Questionnaire Items

SEI Chronology of Investigation / Areas Covered in Questionnaires Area Covered	Questionnaires Containing Items Concerned	Chronology
Learner Confidence with Content / Subject Area	1 – 19	Jan 97 – April 00
Aspects of Induction / Support / Reference Books / Time Spent	2 Only (PILOT STAGE)	April 97
Effectiveness of Component Elements for Learning Experience	2 - 19	April 97 – April 00
Open Responses re Meeting of Learner Expectations & Learner Suggestions for Improvement	2 - 16	April 97
Open Responses re Learner 's Level of Computer Literacy, Motivation, Interest Levels	3 - 15	Oct 97
Open response on how and why confidence was affected	4 - 16	Dec 97
Preferred "ideal" way of learning using computer as aid	4 - 16	Dec 97
Rating of Content Level Appropriateness	4 - 19	Dec 97
Detailed Ratings of Self Contained Exercises	4 - 19	Dec 97
1st Journal Questionnaire		Feb 98
2nd Journal Questionnaire		Oct 98
Preferred Computer Based Environment	8 - 13 (made non-ambiguous in Q14 – 19)	Oct 98
Added item asking respondents to categorise current material as type of environment	15 - 19	Nov 99
Suggested changes to bring material closer to ideal for learning (replaced item on preferred ideal way of learning using computer as an aid)	10 & 12 & 15 (changed back in Q11 Jan 99) (changed back again in Q13 Apr 99)	Dec 98
Added Robbie Robson Learning Style Questionnaire	14 and 17	Oct 99
Added item requesting names of other multi-media materials used	15 and 16	Nov 99
Added statements with which respondents expected to indicate level of agreement	15 - 19	Nov 99
Added item requesting units completed by date and time	15 - 16	Nov 99
Added item requesting detail of experiences that worked well / badly and why so	15 - 16	Nov 99
Added Noel Entwistle ASSIST Questionnaire	15 and 18	Nov 99
Added range of open response items (42) to focus on literature issues	16	Dec 99
Full Version Exe v Web Based Text Version Exe Investigation	Separate Questionnaires	Jan 2000
Used 14 Open Response Items as per HBS Group	18	April 2000
Used Statements Generated from Midpoint Questionnaires for students to confirm / validate / adjust	19	April 2000

4.3 SEI Results Obtained From Interviews

Table 4.4: Participants by Interview 1 & 2

	Interviewees for Interview 1	Interviewees for Interview 2
Semester 2 1997 / 1998	1 - 16	1
Semester 1 1998 / 1999	17 - 34	17, 18, 19, 20, 23, 24, 25, 27, 28, 29, 32, 33, 34
Semester 2 1998 / 1999	35 - 45	35, 36, 37, 38, 40, 41, 42, 45
Semester 1 1999 / 2000	46 - 53	46, 50
Semester 2 1999 / 2000	54 - 61	54, 56

4.3.1 Interview Questions

The interview questions (see Appendix 8: A8.6) were designed to elicit the interviewee's perception of the value, for them, of the material concerned. The questions were initially based on the themes emerging from the literature relating to the use of computer-based materials for learning and discussions with fellow researchers.

The nature of the interviews permitted the interviewees significant flexibility of response, which resulted in follow-up questions being tailored to earlier responses by interviewees, therefore only a few of the initial bank of questions were used in each case.

4.3.2 Derivation of Themes

The results obtained from the semi-structured interviews have been grouped within the themes which were considered to have emerged from the responses given by interviewees.

The comments made during the interview sessions covered a range of issues, with variation in comment by the interviewees. This permits an indication to be gained of the issues which are of general relevance, in that they have been raised by a number of interviewees, and allows significant insight to be gained, as to why these issues are considered important by the individuals concerned.

The level of understanding gained from the interview results permits an additional level of insight to be brought to bear on the interpretation of the results obtained from the questionnaire items.

4.3.3 Overview of Approach Taken in SEI Case Study 1

(Note approach also applied where appropriate to other cases)

At the initial stages of this investigation it was considered valuable to seek information regarding the confidence levels of those seeking to learn from the computer based material. This was considered to offer some indication of the impact of the content element on the learner. It was also considered that some comparison might be made of the individual's confidence level over the duration of the class. Based initially on discussion with fellow researchers, and the interests of those offering the class, feedback was sought on how the learners concerned allocated their time and effort, and the extent to which additional sources of reference were used. Feedback was also sought regarding the effectiveness of the component parts of the computer based material for the learners concerned. (see Appendix 8: Questionnaires 1 & 2 onwards)

As the research progressed, additional feedback was sought regarding learner experience, expectations and suggestions for improvement. (see Appendix 8:Questionnaire 3 onwards)

Feedback was then sought to clarify the reasons for the impact of the computer based material on learner confidence level and their view of their "ideal way" of learning using a computer as an aid. Learners were also asked to comment on the appropriateness of the content offered in the material and to comment in some detail regarding the on-screen exercises within the material. (see Appendix 8:Questionnaire 4 onwards)

With a view to gaining more detailed feedback on the learner's approach when using the material, developing views on the effectiveness of the material, and comparative views of the material considering available alternatives, a journal style questionnaire was developed and given to students at the start of the semester. It was intended that the journal be completed by the learners as they worked through the units and this would offer more in-depth feedback which would be comparable over time. The return rate for these journals was not good enough to merit their continued use however and the class administered questionnaires were therefore adjusted to allow feedback on the areas addressed by the journals (see Appendix 8:Questionnaires 15 onwards).

More specific feedback was sought regarding the learner's preferred type of computer-based "environment" (see Appendix 8: Questionnaires 8 onwards). The response style required for this item was adjusted in later questionnaires (see Appendix 8: Questionnaires 14 onwards) and learners were then asked to categorise the material in use in relation to the environment types (see Appendix 8: Questionnaires 15 onwards).

Feedback was sought regarding the learner's style of and approach to learning (see Appendix 8: Questionnaires 14 onwards)

Feedback was also sought regarding other "multi-media" material used by learners, with a view to clarifying their perception of material coming under the "multi-media" banner. The statements developed for the journal questionnaires were integrated with the class based questionnaires with a view to gaining a "snapshot" of the learners' views on the areas addressed by the statements. Learners were also asked to identify learning experiences which had worked well / badly for them when using the material and to offer some explanation as to why this had been so (see Appendix 8: Questionnaires 15 onwards).

With a view to gaining additional feedback on aspects of learner motivation, value of learning gained, value of interactive elements and opportunities for problem solving within the material, and levels of engagement achieved a range of open response items were added to the items in the class based questionnaire (see Appendix 8: Questionnaire 16).

A controlled investigation was conducted in which learners were asked to respond to two distinct versions of a sub-set of the material within the class concerned. This was carried out in order to identify whether any significant difference existed in the learners' views in relation to the mode of presentation used. (see Appendix 8: Questionnaires on On-Screen Exercise v Computer-based Text Versions of material)

With a view to gaining a level of comparison across groups, a range of open response items was introduced requesting feedback on learner motivation, engagement, learning achieved, screen display impact, multimedia use, and comparison with other options available (see Appendix 8: Questionnaire 18).

With a view to validating the overview summaries generated from the open responses recorded in Questionnaire 18 and thereby clarifying the conclusions which might be appropriate, statements were generated using the responses concerned and the learners were asked to offer comment to confirm, or adjust, the statements in order that a true representation of their viewpoint was recorded (see Appendix 8: Questionnaire 19)

An overview summary of the case studies is provided in Table 4.5 below.

Table 4.5: Chronological Overview of Research

Semester	Case Study 1 SEI Introduction to Entrepreneurship	Case Study 2 SHS Mediabase	Case Study 3 SEI: DMLE	Case Study 4 SEI: HBS	Case Study 5 Woolwich: MNE
1996 / 97 Semester 2	SEI (Pilot) Entrance Q1 (N=45) Exit Q2 (N=25) No Registered as completing class = 36				
1997 / 98 Semester 1	SEI Entrance Q3 (N=84) Exit Q4 (N=15) No Registered as completing class = 30				
1997 / 98 Semester 2	SEI Entrance Q5 (N=41) Journal Q (N=6) Midpoint Q6 (N=23) Interviews (N=16) Exit Q7 (N=24) No Registered as completing class = 64				
1998 / 99 Semester 1	SEI Entrance Q8 (N=123) Journal Q (N= 10) Midpoint Q9 (N=48) Interviews (N=18) Exit Q10 (N=56) No Registered as completing class = 143		SEI DMLE Single Questionnaire (N=7) No Registered as completing class = 38		
1998 / 99 Semester 2	SEI Entrance Q11 (N=69) Journal Q (N= 9) Midpoint Q12 (N=32) Interviews (N=11) Exit Q13 (N=36) No Registered as completing class = 139	SHS (Pilot) Exit Q (N=26) No Registered as completing class = 78			
1999 / 00 Semester 1	SEI Entrance Q14 (N=85) (Journal Discontinued) Midpoint Q15 (N= 39) Interviews (N=8) Exit Q16 (N=10) No Registered as completing class = 106	SHS Entrance Q (N=81)	SEI DMLE Single Questionnaire (N=7) No Registered as completing class = 33	SEI HBS Single Questionnaire (N=17) No Registered as completing class = 38	Woolwich MNE Three Iterative Questionnaires (N=5) No Registered as completing class = 5
1999 / 00 Semester 2	SEI Entrance Q17 (N=65) Controlled Investigation (N=65) Midpoint Q18 (N=48) Interviews (N=8) Exit Q19 (N=36) No Registered as completing class = 100	SHS Controlled Investigation (N=73) Midpoint Q (N=51) Exit Q (N=34) No Registered as completing class = 81 * class run over 2 Semesters			Woolwich MNE Three Iterative Questionnaires * for those not completed in Semester 1 No Registered as completing class = 5

Semester	Case Study 1 SEI Introduction to Entrepreneurship	Case Study 2 SHS Mediabase	Case Study 3 SEI: DMLE	Case Study 4 SEI: HBS	Case Study 5 Woolwich: MNE
2000 / 01 Semester 1			SEI DMLE Single Questionnaire (N=32) No Registered as completing class = 33		

4.3.4 SEI Approach taken to Calculation of 5 Point Scale Response Rates

The responses obtained to the five point scale items by batch have been tabulated for all responses at the 4 to 5 levels. In the SEI Case Study One the responses obtained to the five point scale items were aggregated by batch and the results have been tabulated for all responses at the 4 to 5 levels. The results have been shown by sample point of entry, midpoint, and exit batch. The aggregated results have been shown by sample point of entry, midpoint, and exit batch in SEI Case Study One. Percentages have been calculated by treating the number of responses concerned as a fraction of the total number of returned questionnaires.

It is open to debate whether the 3 rating in a 5 point scale should be considered an indication of positive rating or not, therefore some ambiguity could be argued to be present in the interpretation of the results at the 3 to 5 levels. The decision to present the results of the responses at the 4 and 5 levels was made in order that the conclusions drawn could be based on unambiguous expressions of viewpoint on the part of respondents.

The exit questionnaires for Semester 2 in 1999 to 2000 SEI Q19 were treated differently and separate totals are given for the particular batch concerned. This was due to these questionnaires presenting statements for validation and / or adjustment by respondents in order to offer a statement which would be representative of the respondent's individual view.

4.3.5 SEI Approach Taken To Open Responses

The open responses received were categorised according to the expressed meaning in the statements made by respondents. The categories were generated using terminology which was as close to the original phrasing as possible, while permitting some level of summative categorisation to be achieved. Although opportunity was given for respondents to offer open responses within a comments column, regarding 5 point scale items, very few responses were received in this category, therefore these were not included in the analysis.

The objective of the analysis was to reveal which issues were mentioned by how many respondents. Only one score point was assigned to any categories by respondent in any given batch of questionnaires. (e.g. a respondent stating once, and another respondent stating three times that graphics aided their learning would each be given a single point in that category, for that batch of questionnaires)

Where open responses have been obtained to questionnaire items, the responses have been assigned to categories and a score entered against the categories concerned. The score indicates that this category has been highlighted as important by the respondent concerned in at least one open response. The number of responses by category within each batch were then added together to give an overall total of responses by category by sample point of entry, midpoint, and exit batch.

The decision to allocate one score point per respondent in relation to the open response items identified was taken in order that an overview might be obtained regarding the issues which respondents identified as important when offered the opportunity to give an open response. It was decided that by counting the category concerned only once per respondent this would offer an indication of the relevance of the item concerned for the sample group concerned. It was recognised that this did not offer the additional information which might have been provided by totalling the actual number of times the item identified was mentioned by each individual, but the overview was considered more important for this element of the feedback as it allowed some clarification to be gained regarding the possible relevance of interview feedback in relation to the larger group. It was considered that where an issue was raised in interviews and also was shown in the open responses to be considered important for the group overall, this would allow more robust conclusions to be drawn regarding the CBL material.

The responses to the open response items were considered by sample point batch, i.e. entrance, midpoint and exit. The one exception was that of SEI Q19 (Exit Semester 2 1999 / 2000), which was considered as stand alone as the questionnaire concerned consisted of summary statements with which respondents had to indicate their level of agreement or disagreement, and offer a free text response adjusting the statements accordingly.

4.3.6 SHS Approach Taken to Open Responses

The questionnaires used in this case study sought open responses at the entry, mid-point and exit stages. The responses to the open response items were considered by sample point batch, i.e. entrance, and midpoint, with SHS Q4 (Exit Semester 2 1999 / 2000), considered as stand alone as the questionnaire concerned consisted of summary statements with which respondents had to indicate their level of agreement or disagreement, and offer a free text response adjusting the statements accordingly. The exit responses SHS Q4 (Exit Semester 2 1999 / 2000) were sought in relation to summary statements compiled from the mid-point responses received. Where the responses agreed with the statement concerned the range of categories embodied in the statements gained a point score for analysis purposes.

The categories were generated using the categories developed for the SEI case study and additional categories were added where it was considered statements, made by respondents, required additional categories.

The responses obtained were totalled for each batch of questionnaires, and the total for each category was treated as a fraction of the number of questionnaires returned at entrance, midpoint, or exit respectively.

The results obtained from the pilot studies and subsequent main case studies are detailed in the following sections. The results are presented as previously outlined with additional levels of responses available in appendices.

4.4 Results Obtained From Case Studies

Results are presented in text-based formats within the following sections of Chapter 4. Results are also provided by topic addressed in tabular format, with examples of associated question types, in Appendix 2.

This approach has been adopted in order to minimise repetition throughout the presentation of results while providing the reader with an appropriate choice of presentation format.

"Open Responses" for the purposes of this research are responses which have been provided using free text entry, therefore open in that respondents chose their own wording.

Results are also provided by batch of questionnaires in order to provide the reader with the full range of responses given. These are provided in Appendices 3, 4, 5, 6 and 7, for Cases 1, 2, 3, 4 and 5 respectively.

4.4.1 SEI Pilot Study (Semester 2 1996 – 1997)

The pilot study items focussed on areas which were initially considered of relevance to this research. The focus of the questionnaires was significantly adjusted in future versions however and therefore the data gained from the pilot material is of limited use in the final analysis, both in terms of focus and sample size for responses concerned ($n < 30$).

We may draw some tentative conclusions from the pilot study however, which helped when reflecting on the focus for the rest of the research undertaken.

The majority of respondents considered the first induction session and the self-study sessions to be particularly effective for their learning. As the table shows, where the scale points four and five are considered in the analysis, we find 64% rating the first induction session, 60% rating the self-study sessions, 44% rating the personal notes and 36% rating speaking with friends to be more than, or highly effective.

This was the "pilot phase" of the research conducted with the SEI groups. The focus of the questions asked was changed for groups beyond the pilot stage, given that decisions were taken which eliminated any likelihood of group work or seminar activities for the students concerned.

The results (see Appendix 2.1, Table 2.1.1) indicate that induction sessions, self study sessions, personal notes and additional sources of reference had some value for the learners concerned. The area of interest for this research concerned the question of why this was so and in what way some elements offered particular value or failed so to do. (The feedback regarding speaking to friends was not explored as this was not a featured element in the class as it developed).

The items relating to confidence levels were used in later questionnaires and the results obtained within the pilot stage are also shown alongside the results for later questionnaires. (see Appendix 2.3)

4.4.2 SHS Pilot Study (Semester 2 1998 – 1999)

A pilot run was undertaken which sought to gain feedback on areas of importance to both the department concerned and the research focus. The pilot phase drew on discussions with academic staff and technicians within the Scottish Hotel School and with developers from Audio Visual Media Services. The focus of the questions asked was therefore influenced by the interests of the department, and the developers of the multi-media material. Feedback was sought regarding the effectiveness of elements within the material, ranging from relevance to the class concerned to screen display, and the effect of the material on learner motivation. The pilot phase made use of questionnaires at the exit point to the class.

The pilot responses enabled credibility to be established with the department concerned and assisted with the departmental evaluation of the materials studied. This enabled an additional level of research to be undertaken and the focus of the research to be further refined.

SHS Pilot Study Responses Obtained to 5 Point Scale Questions

The questionnaires were analysed using the SPSS package and the results offer some insight as to the perceived value of the elements within the material from the learner viewpoint.

A large majority of 65% (17) at the 4 to 5 level considered a combination environment would be motivating, 46% (12) at the 4 to 5 level considered a simulated environment, 38% (10) a game approach and 15% (4) an electronic book. (see Appendix 2.2, Table 2.2.1)

The Directory of Tea, Coffee and Light Beverages was rated as effective, or above by 69% (18) of respondents at the 4 to 5 point level. The Wine List was equally rated as effective, or above, by 69% (18) of respondents. (see Appendix 2.2, Table 2.2.2)

A large minority of 35% at the 4 to 5 level indicated that they revisited sections where they found other things related to such, with 27% adopting a skimming approach, and 12% regarding the table setting exercise as non-essential at the 4 to 5 level. No respondents claimed to have covered all elements of the material in the Mediabase. (see Appendix 2.2, Table 2.2.3)

A large minority 38% (10) of respondents considered additional input from the class tutor would be desirable, with 35% (9) indicating they would prefer this in face to face mode. Email was perceived as useful for maintaining tutor contact by 35% of respondents. Isolation was perceived to be an issue by 15% of respondents. (see Appendix 2.2, Table 2.2.4)

A large majority of 73% (19) at the 4 to 5 level considered multiple choice tests would be helpful to check they were learning. A minority of 19% (5) at the 4 to 5 level were uncertain that they were learning what they should from the material (see Appendix 2.2, Table 2.2.5).

The interactive table setting exercise was considered helpful by 19% (5) at 4 to 5 level, the feedback for such was considered sufficient by 4% (1), and to have helped check learning by 19% (5) at 4 to 5 level (see Appendix 2.2, Table 2.2.5).

A large minority of 46% (12) at 1 to 2 level, who disagreed with the statement that the exercise helped them learn the setting layout. A majority of 58% (15) at 1 to 2 level disagreed with the statement that the table setting exercise gave enough feedback (see Appendix 4.10.1)

Depth of thought was considered to be increased by the video clips of Cailein Gillespie 35% (9), of Mathew Algie 8% (2), and by using the interactive maps 12% (3) (see Appendix 2.2, Table 2.2.5).

The look of the windows was considered motivating by 35% (9) of respondents at the 4 to 5 level, while 31% (8) at 1 to 2 level considered this not to be so. The presentation of the material was considered as good as 42% (11), or better than 19% (5), other materials experienced by respondents. A small minority 8% (2) considered the presentation was not as good as other materials they had experienced. Time flexibility was highlighted as more important than presentation by 27% (7) of the respondents. Previous experience with other multi-media material was considered by 23% (6) of the respondents to have influenced their viewpoint regarding this material. (see Appendix 2.2, Table 2.2.6).

The pull-down menus, clickable screen areas, and "click to view" settings for wines / beverages & dishes were highly rated aspects within the directory. The pull down menus were rated as effective, or above by 81% (21) of the respondents. The clickable screen areas gained similar ratings to the pull down menus in terms of their effectiveness. These were considered more than to highly effective by 81% (21) of the respondents. The click to view settings for wines / beverages, and the click to view dishes options were rated as effective, or more than effective, by 77% (20), and 85% (22) of respondents respectively. The hand tool used for the navigable map was rated as effective by 27% (7), and the arrow tool in the VR restaurant / bar by 12% (3) of the respondents. (see Appendix 2.2, Table 2.2.7).

Some respondents considered there was insufficient text content in the material 15% (4), while some considered there was too much 4% (1). Reading from the paper-based metablock was considered preferable to reading from screen by 27% (7) of respondents. (see Appendix 2.2, Table 2.2.8).

The Metablock materials were rated as effective, or above by 69% of respondents at 4 to 5 level. (see Appendix 2.2, Table 2.2.9).

A large minority of 31% at 4 to 5 level claimed to be uncertain of what they had to do with the interactive maps (see Appendix 2.2, Table 2.2.10), while 50% at 1 to 2 level considered they were not unsure (see Appendix 4.10.1)

A perception that they would have been better reading from a book was expressed by 4% (1) of the respondents at the 4 to 5 level (see Appendix 2.2, Table 2.2.11)This suggests that while a larger minority 27% (7) expressed the view that they would have preferred to read from the printed version of the Metablock (which may be regarded as highly similar to a book) rather than from screen text, they also accepted that the computer-based material offered a value which was considered by them to outweigh that of a book.

A large majority of 62% (16) at the 4 to 5 level considered the material to be more motivating than some lectures, while 12% (3) at the 4 to 5 level considered the material more motivating than most lectures. None of the respondents at the 4 to 5 level considered the material to be more motivating than the best lectures they had experienced (see Appendix 2.2, Table 2.2.11).

The voice over of pronunciation with accompanying text was rated as effective or above by 81% (21) of respondents at 4 to 5 level. This was considered particularly valuable for learning the pronunciation of foreign words within menu items. The expert video clips (Cailein Gillespie) were rated as effective by 58% (15) of respondents at 4 to 5 level (see Appendix 2.2, Table 2.2.12).

The Mathew Algie production video clips were rated as effective or above by 23% (6) of respondents at 4 to 5 level, and the red, or white wine production clips, were rated as effective or above by 31% (8) and 23% (6) of the respondents respectively (see Appendix 2.2, Table 2.2.12).

The screen displays of serving settings were considered as effective for red wine by 38% (10), white wine by 38% (10), the navigable map for red wine by 35% (9) white wine by 31% (8). The screen displays of serving settings were considered as effective for tea by 19% (5), and for coffee by 19% (5). The voice over introduction was considered effective by 12% (3), the restaurant table layout by 19% (5), the restaurant table plan by 12% (3), the function space management system by 8% (2), and the interactive table setting exercise by 4% (1) (see Appendix 2.2, Table 2.2.12).

The results obtained from the pilot studies have been presented for the SEI Case Study 1 and the SHS Case Study 2. The pilots concerned enabled the approach taken to data collection to be further developed and used in the full case studies conducted thereafter. The results obtained are presented in the following sections.

4.5 Results Obtained From Main Case Studies

The following sections present the results obtained in the case studies conducted beyond the pilot stages. These are presented within the emergent themes as previously described. The results have been presented in a text based style within the current chapter and have also been presented in tabular form in Appendix 2.3.

4.5.1 Learner "Overhead" Issues

This section offers a summary conclusion based on the results obtained from the investigation of learner overhead issues.

4.5.1.1 Computer Literacy

The SEI open response results (see Appendix 2.3, Table 2.3.1) indicate that the majority of respondents were not complete novices in using computers, with 71% indicating they had experience in using computers at the entrance points, 60% experience with email and 59% experience with Internet. As might be expected within the business education domain, the use of "office type" software was more common 21%, than use of specialized software 6% at entrance.

The SHS users level of "computer literacy" was considered in terms of their use of such facilities as email and Internet, based on the premise that those who used such elements could therefore be classified as beyond the level of novice. The SHS open responses (see Appendix 2.3, Table 2.3.2) at the entrance point indicate that email was used by 67% (54) of the respondents, with 52% (42) indicating this was for social communication, and 4% (3) for e-commerce. The Internet was used by 69% (56) of the respondents, with 1% (1) respondent indicating an additional level of interest in the Internet area. Previous experience using computers was highlighted by 17% (14) of the respondents. Simple language was highlighted by 7% (8) of the respondents as helpful, with "computer jargon" being identified as best avoided. Only 1% (1) of the respondents indicated that they had access to a computer at home. With regard to using the computer based material for the class concerned, 67% (54) of the respondents indicated that they were comfortable with the use of computers.

4.5.1.2 Content Appropriateness

The SEI 3 point scale results obtained (see Appendix 2.3, Tables 2.3.3, 2.3.4 and 2.3.5) show that the content level for all units was considered by the majority of the respondents to be appropriate at the exit stage. Patents, Licences & Legal Issues is considered appropriate by 62% of respondents and is therefore the lowest ranking of the units at this stage.

SEI Content Appropriateness: Interview Responses

The SEI interview responses indicate the perceived impact of content level and previous experience with computers. Some highlighted their previous experience as helpful, in relation to the content of the material (see Appendix 3 A3.35, SEI 12), though some commented that this results in their learning from this material appearing to be minimal as they have already covered the material elsewhere (see Appendix 3 A3.35, SEI 46, SEI 30). Others commented that their experience with computers was helpful (see Appendix 3 A3.35, SEI 26, SEI 40, SEI 19), some having used the specific platform of MENTOR previously (see Appendix 3 A3.35, SEI 56, SEI 57).

4.5.1.3 Confidence Levels

The SEI results for levels of confidence (see Appendix 2.3, Table 2.3.6) at entrance indicate that 12% (60) or above of respondents already rate themselves as confident or very confident for most of the areas. Survival strategies, and patents, licences and legal issues, were identified as the areas of least confidence at this stage.

The SEI results at midpoint (see Appendix 2.3, Table 2.3.6) indicate above 25% of respondents rate themselves as confident for six of the twelve areas. Lower levels of confidence are indicated for Finance Issues, Funding, patents, licences and legal issues, The Investor's Viewpoint, and Survival Strategies, with Survival Strategies being identified as the area of least confidence at this stage.

The SEI results at exit (see Appendix 2.3, Table 2.3.6) for levels of confidence at exit indicate 60% of respondents to rate levels of confidence for nine of the twelve areas, and above 45% for the remainder. Finance Issues and Patents, Licences & Legal Issues are identified as the areas of least confidence at this stage. The results show an increase in perceived confidence from entrance to exit (see Appendix 2.3, Table 2.3.7).

The SEI results show that the majority of respondents considered themselves to be confident, or more than confident, with the material. If we consider the material by category, over time, we see an increase in the percentage of respondents rating themselves as confident or more than confident, when we compare the entrance, midpoint and exit results for most units. The exceptions to this pattern are the units on finance issues (-6%), the investor's viewpoint (-6%), and survival strategies (-5%), which show a reduction at the midpoint stage. The unit on funding shows the same percentage response at entrance and midpoint, with an increase on exit.

The SEI open response results on exit (see Appendix 2.3, Table 2.3.8) indicate that confidence was considered to have been improved for 55% (91), with initial confidence levels confirmed for 30% (49), and initially high confidence levels confirmed for 16% (27) of the respondents.

4.5.1.4 Approaches to Learning and Learning Styles

Approaches to learning and learning styles were addressed in some detail in Case Studies 1, 2 and 5. To a lesser extent some items addressing approaches to learning were included within Case studies 3 and 4. The results obtained are presented in the following sections.

The SEI midpoint 5 point scale results (see Appendix 2.3, Table 2.3.9) indicate that the majority, 65% (26), of the respondents covered all of the material, with 43% (17) of the respondents reflecting on the material to the extent that they revisited material when they found related items. The skimming approach was adopted by 20% (8) of the respondents.

The SEI exit 5 point scale results obtained (see Appendix 2.3, Table 2.3.9) indicate that the majority, 74% (34) of the respondents covered all of the material, with 57% (26) of the respondents reflecting on the material to the extent that they revisited material when they found related items. The skimming approach was adopted by 9% (4) of the respondents.

Approach Taken by Learners

The SHS 5 point scale results (see Appendix 2.3, Table 2.3.10) indicate that 26% (9), of the respondents covered all of the material, with 59% (20) of the respondents reflecting on the material to the extent that they revisited material when they found related items. The skimming approach was generally adopted by 59% (20) of the respondents, with 62% (21) skimming where the material was perceived as "non-central" by the learners concerned.

The DMLE 5 point scale results (see Appendix 2.3, Table 2.3.11) indicate that 57% (4), of the respondents covered all of the material, with 43% (3) of the respondents reflecting on the material to the extent that they revisited material when they found related items. The skimming approach was generally adopted by 43% (3) of the respondents, with 14% (1) considering the video material as "non-essential".

The DMLE 5 point scale results (see Appendix 2.3, Table 2.3.12) indicate that 100% (7), of the respondents covered all of the material, with 29% (2) of the respondents reflecting on the material to the extent that they revisited material when they found related items. The skimming approach was generally adopted by 14% (1) of the respondents, with 43% (3) of the respondents considering the video material as "non-essential".

ASSIST Results

In order to evaluate the approaches to learning adopted by the students concerned, the ASSIST questionnaire, developed by Professor Entwistle was incorporated within the midpoint questionnaires used in the 1999 to 2000 academic year, for the SEI and SHS case studies. The ASSIST questionnaire was also given to DMLE and MNE participants, however the numbers involved were much lower in these cases, therefore only the results for the SEI and SHS cases have been presented and discussed in detail.

SEI ASSIST Results Regarding Approach to Learning

The SEI results obtained within the ASSIST section of the questionnaires (see Appendix 2.3, Table 2.3.13) suggest that the vast majority of the students concerned (SEI 85% and 83%) preferred an information transfer approach to learning and teaching, which Entwistle considers to relate to a surface approach to learning. The results indicate that the vast majority of the students taking the Strathclyde Entrepreneurship Initiative elective class take an approach to learning which is surface-apathetic. The results show 95% (38) of respondents in Semester 1 99 to 00 to take a surface-apathetic approach and 88% (42) of respondents in Semester 2 99 to 00 to take a surface-apathetic approach. The results also indicate that the majority of the students taking the Strathclyde Entrepreneurship Initiative elective class prefer an information transmission type of course and teaching. The results show 85% (34) of respondents in Semester

1 99 to 00 to prefer an information transmission type of course and teaching and 83% (40) of those in Semester 2 99 to 00 to prefer an information transmission type of course and teaching.

The SEI results for semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.14) indicate that a majority of 72% (61) in this group had a visual learning style, with 13% (11) tactile and 5% (4) aural.

The SEI results for semester 2 1999 to 2000 (see Appendix 2.3, Table 2.3.15) indicate that a majority of 71% (46) in this group had a visual learning style, with 2% tactile and 14% aural.

SEI Approach To Learning Issues: Interview Feedback

Some commented that with the computer-based material they approached learning with a view to knowing, rather than simply remembering as they would for an exam (see Appendix 3 A3.35, SEI 2), with some perceiving they are not simply doing the work because they have to (see Appendix 3 A3.35, SEI 41), while others take the view that by being computer-based it keeps their attention because they have to do it (see Appendix 3 A3.35, SEI 45) and that revisiting material requires time which students must decide whether they can afford to spend doing so (see Appendix 3 A3.35, SEI 45), while others admit it is time consuming but do it nonetheless (see Appendix 3 A3.35, SEI 46).

In terms of time management, some blocked off enough time to complete a unit in a single session (see Appendix 3 A3.35, SEI 9) and some took a strategic approach by checking the stated objectives then deciding what they would focus on in the material (see Appendix 3 A3.35, SEI 13).

The history or glossary options were clearly unused by some, who preferred to check their position using the structure map (see Appendix 3 A3.35, SEI 7).

Some comment that they were motivated by the subject matter itself (see Appendix 3 A3.35, SEI 18, SEI 19, SEI 24, SEI 34, SEI 40, SEI 56), while others commented that they wanted to study using computers (see Appendix 3 A3.35, SEI 33).

SHS ASSIST Results Regarding Approach to Learning

The SHS ASSIST results (see Appendix 2.3, Table 2.3.16 and 2.3.17) indicate that the majority of the respondents from the Scottish Hotel School take an approach to learning which is deep and a large minority adopt a strategic approach. The results show 55% (28) of those in Semester 2 99 to 00 to take a deep approach, 39% (20) strategic and 8% (4) to take a surface-apathetic approach. The results also indicate 78% (40) of those in Semester 2 99 to 00 to prefer an information transmission type of course and teaching and 27% (14) to prefer supported understanding.

The SHS results (see Appendix 2.3, Table 2.3.18) indicate that 57% (37) of the respondents are visual learners, 18% (12) are auditory and 11% (7) are tactile.

The DMLE results (see Appendix 2.3, Table 2.3.19) indicate that 71% (5) of the respondents are visual learners, 14% (1) are auditory and 14% (1) show a balance between auditory and visual.

The Woolwich MNE results (see Appendix 2.3, Table 2.3.20) indicate that 60% (3) of the respondents adopt a deep approach to learning, 20% (1) adopt strategic approach, and 20% (1) adopt a surface apathetic approach. The results indicate that 60% (3) of the respondents prefer a supporting of understanding type of course and teaching, 20% (1) of the respondents prefer a supporting of understanding type of course and teaching, and 20% (1) gave a nil response to this section of the questionnaire.

The Woolwich MNE results (see Appendix 2.3, Table 2.3.21) indicate that 60% (3) of the respondents are visual learners, 20% (1) show a balance between auditory and visual, and 20% (1) show a balance between auditory and tactile.

4.5.1.5 Human Contact and Tutor Related Issues

The following sections cover the responses obtained regarding human contact and tutor related issues.

The SEI midpoint 5 point scale results (see Appendix 2.3, Table 2.3.21) indicate that 15% of the respondents felt isolated when working with the computer-based material.

The SEI exit point 5 point scale results (see Appendix 2.3, Table 2.3.22) indicate that 33% of the respondents felt isolated when working with the computer-based material.

The SEI open response results (see Appendix 2.3, Table 2.3.23) indicate that human contact was considered important by 18% (84) respondents at the entrance point, 24% (45) at the midpoint, and 17% (28) of respondents at the exit point.

The SEI interview results (see Appendix 2.3, Table 2.3.24) indicate that the human contact element is perceived as valuable by approximately half, 51% (31), of the interviewees.

The SHS open response results (see Appendix 2.3, Table 2.3.25) indicate that the human contact element is perceived as important at exit by 76% (26) of the respondents. Tutorials were preferred in face-to-face mode by 76% (26) of the respondents, question and answer sessions by 76% (26). The importance of avoiding the possibility of all learning being offered via a computer-based provision was highlighted by 18% (6) of the respondents. At the midpoint stage a preference was expressed for face to face delivery of general academic learning and presentations from guest speakers by 10% (5), and 6% (3) of the respondents respectively.

The SHS exit point 5 point scale results (see Appendix 2.3, Table 2.3.26) show that 26% (9) of the respondents felt isolated when working with the computer-based material.

The DMLE 5 point scale results (see Appendix 2.3, Table 2.3.27) reveal an equal preference for individual and for team involvement when using the DMLE software, with 43% (3) of the respondents favouring each.

The DMLE 5 point scale results (see Appendix 2.3, Table 2.3.28) reveal a preference for individual and for team involvement when using the DMLE software, with 100% (7) of the respondents favouring such. The results indicate 86% (6) of the respondents considered they learned more by working in a team.

The DMLE open responses (see Appendix 2.3, Table 2.3.29) indicate the importance of having human contact was highlighted as an important issue by a minority 14% (1), 14% (1), and 9%

(3) of the respondents who used the DMLE material.

The Woolwich MNE results (see Appendix 2.3, Table 2.3.30) indicate that human contact is considered important by a small minority 20% (1), of the respondents using the MNE material.

The SEI midpoint 5 point scale results (see Appendix 2.3, Table 2.3.31) show that 20% (8) of the respondents would have favoured more tutor input, with 20% (8) of the respondents expressing a preference more for face to face tutor contact. Email was considered by 20% (8) of the respondents to be useful for maintaining contact with the class tutor. The SEI exit results obtained, at the scale point 4 to 5 level, show that 39% (18) of the respondents would have favoured more tutor input, with 33% (15) of the respondents expressing a preference more for face to face tutor contact. Email was considered by 54% (25) of respondents to be useful for maintaining contact with the class tutor. This reflects an increase from midpoint of 19%, 13% and 24% respectively. A small majority of respondents (54% at exit) considered the email mode useful for maintaining contact with the class tutor. Given the level of email contact received as tutor, this figure should be taken as indicative of perceived usefulness rather than actual use.

SEI Interviews: Human Contact and Tutor Related Issues

The individual interviews offer some insight as to why face to face contact was considered to be of such value for learners and where the value of such contact lay from the learner perspective.

Some make the point that they would not wish all classes to be computer-based (see Appendix 3 A3.35, SEI 40, SEI 34) with some expressing their desire for wish face to face contact (see Appendix 3 A3.35, SEI 5, SEI 36, SEI 56, SEI 57, SEI 30) while some indicated they would only call at the tutor's office regarding big issues (see Appendix 3 A3.35, SEI 7), and some expressed a desire for non-compulsory tutorials (see Appendix 3 A3.35, SEI 10), which some considered should not be held during lab time (see Appendix 3 A3.35, SEI 54). Others indicated that if tutorial sessions were not made compulsory students would be unlikely to attend (see Appendix 3 A3.35, SEI 34)

Some commented that the opportunity to speak with others in groups would be valued, adding that electronic would not be the same as face to face (see Appendix 3 A3.35, SEI 18, SEI 27), while others considered that hearing what others have to say important and while small group tutorials would be good, they would find an electronic chat facility acceptable (see Appendix 3 A3.35, SEI 34). It was considered important by some interviewees to be able to see and hear the other parties (see Appendix 3 A3.35, SEI 40), while others considered a "chat room" option acceptable, but having contact with real people to be preferable (see Appendix 3 A3.35, SEI 55).

The SHS 5 point scale results (see Appendix 2.3, Table 2.3.32) indicate that more face to face contact would be preferred by 47% (16) of the respondents at the 4 to 5 level.

The DMLE 5 point scale results (see Appendix 2.3, Table 2.3.33) indicate that more tutor input would be preferred by 57% (4), with 71% (5) of respondents indicating that this would be helpful for them at the 4 to 5 level.

The DMLE 5 point scale results (see Appendix 2.3, Table 2.3.34) indicate that more tutor input would be preferred by 29% (2), with 14% (1) of respondents indicating that this would be helpful for them at the 4 to 5 level.

The DMLE open response results (see Appendix 2.3, Table 2.3.35) indicate a preference for face to face tutorials by 43% (3) of respondents. A preference for a face to face approach for academic learning was expressed by 29% (3).

4.5.1.6 Learner Management Issues

The following sections offer a detailed analysis of the responses obtained regarding perceived impact on learner management issues.

The SEI open response results (see Appendix 2.3, Table 2.3.36) indicate that 13% (59) of the respondents considered pace flexibility important at the entrance point, 11% (53) self management with 4% (21) taking this to the level of personal control, 11% (53) location flexibility, 4% (21) time flexibility, and 1% (6) of the respondents considering route flexibility to be important. The results at the midpoint indicate that 26% (49) of the respondents considered pace flexibility important, 37% (71) self management with 6% (12) taking this to the level of personal control, 17% (33) location flexibility, 1% (1) time flexibility, and 7% (13) of the respondents considering route flexibility to be important. The results show that 27% (45) of the responses at the exit point indicate that self-management issues are important, with 9% (15) indicating more emphatically to the extent where such self-management may be regarded as having personal control. The restriction to using only specific labs on campus was raised as an issue by 22% (37) of the respondents at exit. The importance of pace flexibility is highlighted by 16% (26) of the respondents at the exit point and the time flexibility aspect is valued by 17% (28).

The SEI interview responses (see Appendix 2.3, Table 2.3.37) indicate that self-management was identified as important by 87% (53) of the respondents, with 15% (9) indicating that they particularly valued being able to exert a level of personal control over their learning situation. Time flexibility was identified by 67% (41) as important, route flexibility by 66% (40) and pace flexibility by 51% (31). The lack of location flexibility was identified as an issue by 46% (28). The results from the interviews indicate that self management offering flexibility and choice is centrally important for the interviewees (see Appendix 3 A3.35, SEI 17, SEI 21). There is clear value for the interviewees in being able to choose the time of day at which they access the material, and to be able to progress through the material at their chosen pace (see Appendix 3 A3.35, SEI 1, SEI 2). This is clearly related to the need for the individuals concerned to manage the demands of a crowded timetable, and the related pressures from a range of academic departments (see Appendix 3 A3.35, SEI 20, SEI 31, SEI 49, SEI 58). The interviewees clearly indicate that the flexibility offered by the computer-based material is valuable in this regard, even to the extent that they may increase the academic options available to students (see Appendix 3 A3.35, SEI 19), but also point out that this can have a down side, in that the material may be left to the last minute and then may be rushed, skimmed, badly done, or abandoned (see Appendix 3 A3.35, SEI 20, SEI 24, SEI 26, SEI 30, SEI 5, SEI 40, SEI 4, SEI 55). While the material offers the potential for the learners to manage their own time, the central lab access system, currently used in the University, restricts the level to which this is logistically possible (see Appendix 3 A3.35, SEI 5, SEI 13, SEI 10, SEI 42), and the issue becomes more pronounced for those students who live a distance from the campus (see Appendix 3 A3.35, SEI 7, SEI 32, SEI 9). Given that there is a high level of personal choice regarding the time of study, there is a greater need for self-motivation on the part of the learner, than might be demanded for classes which are clearly timetabled (see Appendix 3 A3.35, SEI 29, SEI 34, SEI 36, SEI 46, SEI 55, SEI 56). The use of self-managed computer-based material is considered by some interviewees to be more motivating, in that it is being done for the individual concerned rather than for a lecturer, and the personal responsibility involved is preferred (see Appendix 3 A3.35, SEI 23, SEI 27).

The DMLE and HBS open responses (see Appendix 2.3, Table 2.3.38) do not highlight personal control, or self management as important to the level identified by the Z1.104/6 classes, or the SHS class.

The Woolwich MNE open responses (see Appendix 2.3, Table 2.3.39) highlight personal control, or self management, as important.

4.6 Learner Perceptions of CBL Material

These sections offer a detailed presentation of the responses obtained regarding learner perceptions of Computer-based Material

4.6.1 Perceived Impact on Learning / Understanding (Cognitive)

The following sections offer a presentation of the responses obtained regarding perceived impact on learning / understanding (cognitive).

The SEI midpoint 5 point scale results (see Appendix 2.3, Table 2.3.40) show that 53% (21) of the respondents considered the learning summaries increased their depth of thought, with 23% (9) considering this was so for the notepad exercises. Multiple choice tests were considered potentially helpful for checking learning by 63% (25) of the respondents. The midpoint results indicate that 28% (11) of the respondents considered they were unsure whether they were learning what they should have been. The SEI exit 5 point scale results (see Appendix 2.3, Table 2.3.40) show that 52% (24) of the respondents considered the learning summaries increased their depth of thought, with 20% (9) considering this was so for the notepad exercises. Multiple choice tests were considered potentially helpful for checking learning by 67% (31) of the respondents. The exit point results indicate that 28% (13) of the respondents considered they were unsure whether they were learning what they should have been.

The SEI open response results (see Appendix 2.3, Table 2.3.41) show that the exercises were considered to have aided learning / understanding by1% (5), 36% (68) and 14% (24) at entrance, midpoint and exit respectively (see also Appendix 3 for results by batch).

The SEI interview results (see Appendix 2.3, Table 2.3.42) indicate that the exercises were considered to have aided learning / understanding by 59% (36) of the interviewees. The exercises were considered to have clarified issues raised in the material (see Appendix 3 A3.35, SEI 6, SEI 26) and aided learners' understanding of the material (see Appendix 3 A3.35, SEI 33, SEI 14), with some commenting that the exercises ensured that they were learning rather than skimming the material (see Appendix 3 A3.35, SEI 16). Some interviewees commented that the "quizzes" increased their recall of the material (see Appendix 3 A3.35, SEI 41).

The SEI open response results (see Appendix 2.3, Table 2.3.43) indicate that at entrance point the computer-based material was considered to aid learning / understanding by 15% (70) and information retrieval by 39% (184) of the respondents. The hyperlinks were highlighted as aiding learning / understanding by 1% (3) of the respondents. The SEI open response results at midpoint indicate that the computer-based material was considered to aid learning / understanding by 22% (42) and information retrieval by 20% (38) of the respondents. The hyperlinks were highlighted as aiding learning / understanding by 5% (10) of the respondents. The SEI open response results at exit indicate that the computer-based material was considered to aid learning / understanding by 23% (39) and information retrieval by 13% (21) of the respondents. The hyperlinks were highlighted as aiding learning / understanding by 3% (5) of the respondents.

The SEI interview responses (see Appendix 2.3, Table 2.3.44) indicate that the computer-based material was considered to aid learning / understanding by 39% and information retrieval by 52% of interviewees. The hyperlinks were highlighted as aiding learning / understanding by 20% of interviewees.

The SHS exit point 5 point scale results (see Appendix 2.3, Table 2.3.45) indicate that the multiple choice tests were considered helpful by 35% (12) of the respondents, and that 38% (13) of the respondents considered they were unsure whether they were learning what they should have been when working with the computer-based material.

The DMLE 5 point scale results (see Appendix 2.3, Table 2.3.46) indicate that on-screen text was considered important in aiding understanding by 86% (6) of the respondents, the simulations and video clips by 71% (5) and 57% (4) respectively. The sound element was considered helpful by 29% (2) of the respondents. The on-screen feedback was considered helpful by 57% (4) of the respondents with 71% (5) considering that multiple choice tests would have been helpful. There is uncertainty expressed by 29% (2) of the respondents, who considered they were unsure whether they were learning what they should from the material.

The DMLE 5 point scale results (see Appendix 2.3, Table 2.3.47) indicate that on-screen text was considered important in aiding understanding by 100% (7), the simulations by 100% (7) and video clips by 43% (3) of the respondents. The interactive exercises were considered helpful by 86% (6) of the respondents with the Mondo exercise being rated by 71% (5), and the Slideman exercise by 57% (4) of the respondents as increasing their depth of thought. The sound element was considered helpful by 29% (2) of the respondents. The on-screen feedback was considered helpful by 71% (5) of the respondents with 43% (3) considering that multiple choice tests would have been helpful. There is uncertainty expressed by 14% (1) of the respondents, who considered they were unsure whether they were learning what they should from the material.

The Woolwich MNE open responses to questionnaire one (see Appendix 2.3, Table 2.3.48) indicate that with regard to aspects which may be considered to be impacting on the cognitive dimension of the learning process, feedback is clearly highlighted by 100% (5) of the respondents as centrally important in terms of the level of explanation offered. Problem solving is highlighted as provoking thought by 80% (4), and exercises as aiding learning by 60% (3) of the respondents. Graphics, simulations and the visual display used are highlighted as important in aiding learning by 40% (2), and the "demonstrations" by 20% (1) of the respondents.

The Woolwich MNE open responses to questionnaire two (see Appendix 2.3, Table 2.3.48) indicate that as with the first questionnaire, feedback is clearly considered as centrally important in terms of the level of explanation offered 100% (2). Problem solving is highlighted by 100% (2) as provoking thought, and exercises by 50% (1) of the respondents, as aiding learning. Graphics, and simulations, are considered by 100% (2) to aid learning, the visual display by 50% (1), and the demonstrations are considered valuable by 50% (1). The use of simple language was considered helpful by 50% (1) of the respondents.

The Woolwich MNE open responses to questionnaire three (see Appendix 2.3, Table 2.3.48) indicate that information retrieval and feedback to be highlighted as centrally important by 80% (4), of the respondents. Problem solving is highlighted as provoking thought by 40% (2), and exercises as aiding learning by 80% (4) of the respondents. Graphics, and simulations are highlighted as aiding learning by 80% (4), and demonstrations are identified as valuable by 40% (2) of the respondents.

4.6.2 Perceived Impact on Learning / Understanding (Affective)

The following sections offer a detailed presentation of the responses obtained regarding learning / understanding (affective).

The SEI open response results (see Appendix 2.3, Table 2.3.49) indicate that relevance of the material was identified as important on entrance by 54% (252), with the inclusion of examples, particularly real life, valued by 3% (15), and having variety in link / unit contents was considered important by 3% (12) of the respondents. Assessment was regarded as motivating on exit by 11% (51), Interactivity identified as important by 25% (117), feedback on demand by 11% (52) and feedback explanation by 4% (18). Novelty value was highlighted as adding interest on entrance by 10% (46) and the use of fun / humour was considered as positive by 3% (15) of the respondents. Relevance of the material was identified as important at midpoint by 50% (96), with the inclusion of examples, particularly real life, valued by 10% (20), and having variety in link / unit contents was considered important by 15% (28) of the respondents. Assessment was regarded as motivating at midpoint by 11% (21), Interactivity identified as important by 28% (54), feedback on demand by 9% (17) and feedback explanation by 12% (23). Novelty value was highlighted as adding interest on exit by 11% (21) and the use of fun / humour was considered as positive by 3% (6) of the respondents. Relevance of the material was identified as important on exit by 47% (78), with the inclusion of examples, particularly real life, valued by 10% (17), and having variety in link / unit contents was considered important by 13% (21) of the respondents. Assessment was regarded as motivating on exit by 20% (33), Interactivity identified as important by 18% (30), feedback on demand by 12% (20) and feedback explanation by 16% (26). The workload for the class was considered to be too heavy by 7% (11) of the respondents. Novelty value was highlighted as adding interest on exit by 10% (16) and the use of fun / humour was considered as positive by 3% (5) of the respondents.

The SEI interview responses (see Appendix 2.3, Table 2.3.50) indicate that relevance is considered important by 87% (53) of interviewees, feedback on demand is highlighted as important by 77% (47) and feedback explanation by 57% (35). Interactivity was identified as valuable by 46% (28), the use of fun / humour is identified as valuable by 43% (26), use of real life examples by 41% (25) and variety in the content material accessed by 34% (21). Engagement of interest was indicated by 13% (8). Exemplars were considered desirable by 10% (6), which is likely to relate to the assessment focused requirements. Novelty value was considered by 38% (23) to add interest. It was considered by a small minority, 5% (3) interviewees, that their expectations were not met by the computer-based material and that the use of fun / humour had a negative impact for them 3% (2).

SEI Perceived Impact on Learning / Motivation (Affective): Qualitative Analysis of Responses Obtained in Interviews

The importance of having relevant material used within the computer-based material was clearly indicated in the results from the interviews. Relevance was considered important by a large majority of interviewees and the use of real life examples by a large minority of interviewees. The importance of being able to relate the material being studied to their other areas of interest or experience was highlighted by some interviewees (see Appendix 3 A3.35, SEI 12), as was the importance of relevance beyond the university arena (see Appendix 3 A3.35, SEI 17). Additional real life examples in the material were considered likely to increase understanding of the material concerned (see Appendix 3 A3.35, SEI 19, SEI 24, SEI 48). Being able to relate the material to "normal people" was highlighted as important by some (see Appendix 3 A3.35, SEI 22), as was being able to apply the material to real world situations (see Appendix 3 A3.35, SEI 37, SEI 52). The responses indicate the value of variety in content, and presentation (see Appendix 3 A3.35, SEI 27, SEI 28), with some commenting that the aspect of being "different" made the material interesting (see Appendix 3 A3.35, SEI 31). Some commented that they expected new material to be accessed when they visited new windows and that where this was so they were more motivated (see Appendix 3 A3.35, SEI 1). Expectations were reduced when the same material was accessed via a number of links (see Appendix 3 A3.35, SEI 1) and some became annoyed by the same windows appearing via links (see Appendix 3 A3.35, SEI 45). Some stopped following links which had led to the same material previously (see Appendix 3 A3.35, SEI 9, SEI 53). Some considered that there was too much overall similarity between units in the material (see Appendix 3 A3.35, SEI 10). Some considered that the material needed more interactivity (see Appendix 3 A3.35, SEI 14), with some commenting that it was not as interactive as originally described and that it tended to be more reading (see Appendix 3 A3.35, SEI 32), others simply stated that the material should be made more interactive in order to improve it (see Appendix 3 A3.35, SEI 54). Some commented that interactivity was the most important point, leading to increased attention over time, and some offered the comment that clicking the buttons was "interactive" (see Appendix 3 A3.35, SEI 35). Others took the view that the exercises made the user do things and get feedback, commenting that making choices made the material interactive (see Appendix 3 A3.35, SEI 56), with some commenting that learning by doing was interactive (see Appendix 3 A3.35, SEI 57). Some considered that the interactivity within the material helped to compensate for "waffle" in the text material (see Appendix 3 A3.35, SEI 16) and that having to click the buttons helps keep the attention of the learner (SEI 45). Some considered the fun element encouraged them and kept them going (see Appendix 3 A3.35, SEI 23, SEI 45), with some commenting that the use of humour added an entertainment value (SEI 35). Others specifically stated that the fun aspect helped them to learn (see Appendix 3 A3.35, SEI 41). The humour element was considered by some to have made working with the material less of a chore, without taking away from the serious message in the material (see Appendix 3 A3.35, SEI 59). Some considered a game option would be preferable to reading and would lead to greater engagement with the material (see Appendix 3 A3.35, SEI 40), with some commenting that a game would add competitiveness but that they would prefer to compete against existing track records (see Appendix 3 A3.35, SEI 37). The content of the game is highlighted by some as more important than the visual presentation, with the main advantage of the game approach highlighted as the opportunity to make changes in order to achieve an outcome and then observe the results of actions taken (see Appendix 3 A3.35, SEI 40, SEI 40). Others considered a simulation approach linked to an assessment would improve the material (see Appendix 3 A3.35, SEI 42).

The learning summary assignments, though not computer-based, did require the use of the computer-based material, and offer a level of insight into the approach taken by the learners concerned. Some considered that the linkages requested to their other areas of development made the material relate more to real life (see Appendix 3 A3.35, SEI 13) and were helpful (see Appendix 3 A3.35, SEI 36, SEI 37), while some considered this element more "hassle" than help (see Appendix 3 A3.35, SEI 5) and others considered it annoying and difficult to find linkages (see Appendix 3 A3.35, SEI 8). Some referred to the self assessment in the on-screen exercises as helpful for making sure they were learning what they should (see Appendix 3 A3.35, SEI 16). Others commented that there was too much time required for this class, given that it was only single credit and they'd rather spend their time working towards their exams in their core studies (see Appendix 3 A3.35, SEI 26), while others regarded the written summaries as regurgitation of the material covered (see Appendix 3 A3.35, SEI 30).

The SHS open response results (see Appendix 2.3, Table 2.3.51) indicate that aspects of the material become irritating by the exit point, which suggests that perceptions of the material change over time.

The DMLE open response results Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.52) indicate that feedback on demand was considered important by 57% (4) of the respondents, relevance of the material was considered important by 43% (3), with interactivity considered important by 43% (3), feedback explanation considered important by 14% (1), as was human contact, novelty and the use of fun / humour.

The DMLE open response results Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.52) indicate that relevance of the material was considered important by 100% (7) of the respondents, feedback explanation by 86% (6), interactivity by 71% (5), assessment by 57% (3), and feedback on demand by 43% (3). The importance of real life examples was highlighted by 43% (3) of the respondents. The use of a computer was considered to add interest by 29% (2) and the use of fun / humour was considered important by 14% (1) of the respondents.

The DMLE open response results Semester 1 2000 to 2001 (see Appendix 2.3, Table 2.3.52) indicate that relevance of the material was considered important by 84% (27) of the respondents, challenge by 50% (16), feedback explanation by 34% (11), interactivity by 28% (9), and feedback on demand by 22% (7). The computer based material was considered engaging by 22% (7), visual display to have added interest by 22% (7), and video to have added interest by 22% (7) but failed to do so for 9% (3) of respondents. Assessment was regarded as motivating by

19% (6), the use of fun / humour to be positive by 19% (6) and variety to be important by 19% (6). Novelty value was considered to have added interest by 6% (2) and the simulations to have added interest by 6% (2). The results indicate that the use of the computer was considered to have added interest for 44% (14) of respondents and added enjoyment for 13% (4) of respondents. The use of too much text was considered by 34% (11) of respondents to have a negative impact, with text alone considered boring by 6% (2), Graphics were considered to add interest and variety in the style of presentation was considered important 3% (1), with content being found unsatisfactory and malfunctions being found by 3% (1). Eye strain / fatigue was identified as a problem by 6% (2) of respondents.

The HBS open response results (see Appendix 2.3, Table 2.3.53) indicate that relevance was considered important by 71% (12) of respondents. Games were considered important by 18% (3) of respondents. Issues of feedback on demand, interactivity, fun/humour, examples and simulations, were highlighted by 6% (1) of the respondents as important.

The Woolwich MNE Q1 open response results (see Appendix 2.3, Table 2.3.54) indicate the central importance of relevance and assessment for all of the respondents 100% (5), which suggests that these are crucial elements in terms of motivating these learners.

The Woolwich MNE Q2 open response results (see Appendix 2.3, Table 2.3.54) again show the central importance of relevance and assessment for the respondents 100% (2), which again suggests that these are crucial elements in terms of motivating these learners. The issues of too much text being used 50% (1), breaks in text being important 50% (1), and variety being important 50% (1), are raised, and may be considered as having an impact on the motivational side of the learning process.

The Woolwich MNE Q3 open response results (see Appendix 2.3, Table 2.3.54) indicate the central importance of assessment for the respondents 80% (4), and that examples should be real life where possible 80% (4), suggests that these are crucial elements in terms of motivating these learners. The importance of the use of real life examples 80% (4), suggests relevance as the central value. The issue of too much text being used is highlighted as important (60% (3), with interactivity and the use of fun / humour within the material also mentioned 20% (1). All of these elements may be considered as having an impact on the motivational side of the learning process for the learners.

4.6.3 Expressed Preferences for Computer-based Environment Types

The following sections offer a detailed presentation of the responses obtained regarding expressed preferences for computer-based environment types.

SEI Preferred Computer-based Environments

It was considered that feedback regarding the respondent's preference, for computer-based environment, would help to clarify the responses obtained to the range of questions posed in this research. This element was introduced as part of the on-going development of the questionnaires. The questionnaires were then developed further to elicit the respondents' categorisation of the computer-based material in use.

The SEI 5 point scale responses at entrance (see Appendix 2.3, Table 2.3.55) show that a large majority of respondents expressed a preference, at the entrance point, for a combination of modes of presentation within the computer based material, 75% (112), rather than for individual metaphor styles, of which the electronic book was least rated 45% (67) of the options considered. The use of a simulated environment was rated by 59% (88) and of a game approach by 55% (82), which placed them within a majority preference though below that of a combination.

The SEI 5 point scale responses at midpoint (see Appendix 2.3, Table 2.3.55) show that the majority of respondents expressed a preference, at the midpoint, for a combination of modes of presentation within the computer based material, 70% (28) at the 4 to 5 point rating, rather than for individual metaphors or styles, of which the electronic book was least rated 43% (20) of the options considered. As was found in the entrance results, the use of a simulated environment was rated by 55% (22) and of a game approach by 63% (25), which placed them within a majority preference though below that of a combination.

The SEI 5 point scale responses at exit (see Appendix 2.3, Table 2.3.55) show that the majority of respondents expressed a preference, at the exit point, for a combination of modes of presentation 78% (36), or Simulated Environment 78% (36) within the computer based material, at the 4 to 5 point rating, than for the Game Approach 65% (30) or electronic book 43% (20) which was least rated of the options considered.

The SHS 5 point scale responses at entrance (see Appendix 2.3, Table 2.3.56) show that the majority of respondents expressed a preference, for a combination of modes of presentation within the computer based material at the 4 to 5 point rating 75% (61), than for individual metaphor styles. The electronic book was least rated of the options considered 47% (38). The use of a simulated environment was rated by 68% (55) and of a game approach by 59% (48) which placed them within a majority preference but less so than a combination approach.

The DMLE 5 point scale results Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.57) show that respondents expressed a preference, for a combination of modes of presentation within the computer based material at the 4 to 5 point rating 100% (7), than for individual metaphor styles. The electronic book was least rated of the options considered 57% (4).

The Woolwich MNE 5 point scale results Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.58) show that the majority of the respondents 60% (3) expressed a preference for a combination of modes of presentation within the computer based material rather than for individual metaphor styles. The electronic book was least rated of the options considered 0% (0).

4.6.4 Perceived Effectiveness of Elements Within The Material

The following sections offer a detailed presentation of the responses obtained regarding perceived effectiveness of elements within the material.

4.6.4.1 Effectiveness of Navigation Elements

The SEI 5 point scale responses at midpoint (see Appendix 2.3, Table 2.3.59) show the navigation feet and structure map to be considered effective by 83% (118) of the respondents, with the main map being next closest at 68% (97) of respondents. Hypertext links were considered effective by 53% (76) of respondents, button links (other than the navigation feet) 52% (75), the glossary window by 33% (47) and the history window 19% (27).

The SEI 5 point scale responses at exit (see Appendix 2.3, Table 2.3.60) indicate the navigation feet and structure map to be considered effective by 82% (145) and 84% (148) of the respondents, with the main map being considered effective by 67% (118) of the respondents. Hypertext links were considered effective by 56% (114) of the respondents, with button links (other than the navigation feet) considered effective by 53% (108), the Glossary window considered effective by 36% (63) and the History window considered effective by10% (18) of respondents.

SEI Exit Effectiveness of Navigation Elements: Qualitative Analysis of Interview Responses

Some interviewees considered the hypertext links allowed them to maintain their train of thought and helped their understanding (see Appendix 3 A3.35, SEI 4), or highlight the importance of aspects of the material, offering a sense of connection between elements (see Appendix 3 A3.35, SEI 17).

The hypertext links were considered by some to have helped by breaking up the text element (see Appendix 3 A3.35, SEI 6, SEI 13), while others considered the hypertext links allowed them to access the level of detail they wished (see Appendix 3 A3.35, SEI 31), and clarify the terms used (see Appendix 3 A3.35, SEI 33). Others commented that the hypertext links added interest (see Appendix 3 A3.35, SEI 26), or entertainment value (see Appendix 3 A3.35, SEI 35), helped them recall the material concerned (see Appendix 3 A3.35, SEI 41), and allowed them to quickly view related material (see Appendix 3 A3.35, SEI 43).

The main criticisms of the hypertext links were that they could be confusing, often resulting in users becoming lost in the material (see Appendix 3 A3.35, SEI 6, SEI 15, SEI 50) and that the hypertext links were particularly useful at the start, but became boring when they led to material which had previously been accessed (see Appendix 3 A3.35, SEI 2).

Some commented that the volume of text and hyperlinked material contained in some units made the material tedious for learners (see Appendix 3 A3.35, SEI 12). One interviewee commented that hypertext links are not helpful for those attempting to speed-read the material (see Appendix 3 A3.35, SEI 35).

4.6.4.2 Effectiveness of Exercise / Simulation Elements

The SEI 5 point scale responses at midpoint (see Appendix 2.3, Table 2.3.61) indicate that the interactive exercises were considered effective by 66% (95) of the respondents. The scenarios used within the exercises and the relevance of the exercises to the module of study were each considered effective by 69% (99 and 98 respectively). The text used within the interactive exercises was considered effective by 60% (86) of the respondents, which mirrored the ratings achieved by the main text windows. The tasks specified and the graphics used within the exercises were considered effective by 56% (80) of the respondents, while the colours used and feedback given within the exercises were each considered effective by 55% (79) of the respondents. The difficulty level of the exercises was considered effective by 38% (55) of the respondents. The notepad exercises were considered effective by 24% (34) of the respondents.

The SEI 5 point scale responses at exit (see Appendix 2.3, Table 2.3.62) indicate that the interactive exercises were rated as effective by 69% (139) of the respondents. The scenarios used within the exercises and the relevance of the exercises to the module of study were considered effective by 71% (126) and 74% (131) of the respondents respectively. The text used within the interactive exercises was considered effective by 62% (110) of the respondents, which mirrored the ratings achieved by the main text windows. The tasks specified and the graphics used within the exercises were considered effective by 50% (88) and 67% (118) of the respondents, respectively, while the colours used and feedback given within the exercises were considered effective by 67% (119) and 53% (94) of the respondents respectively. The difficulty level was considered effective by 41% (73) of the respondents. The notepad exercises were considered effective by 24% (49) of the respondents.

The SEI 5 point scale responses at midpoint (see Appendix 2.3, Table 2.3.63) indicate that 63% (25) of the respondents considered the interactive exercises helped them to understand the material, with 60% (24) considering the on-screen feedback given for the interactive exercises helped them check their learning. The interactive exercises were considered as non-essential by 23% (9) of the respondents, who therefore focused on other material.

The exit results (see Appendix 2.3, Table 2.3.63) show that 80% (37) of the respondents considered the interactive exercises helped them to understand the material, with 52% (24)

considering the on-screen feedback given for the interactive exercises helped them check their learning. The interactive exercises were considered as non-essential by 15% (7) of the respondents, who therefore focused on other material.

The SEI open responses results (see Appendix 2.3, Table 2.3.64) indicate that the exercises were considered, at entrance, to have aided learning / understanding by1% (5) of the respondents and added interest by 4% (19). The exercises were considered to have helped check learning by 1% (3) of the respondents. More complex exercises were desired by 1% (3) of the respondents, with 1% (3) highlighting exercise variety as important.

The exercises were considered at midpoint (see Appendix 2.3, Table 2.3.64), to have aided learning / understanding by 36% (68) of the respondents and added interest by 16% (31). The exercises were considered to have helped check learning by 15% (28) of the respondents. More complex exercises were desired by 7% (14) of the respondents, with 2% (3) highlighting exercise variety as important. The exercises were considered by 5% (9) of the respondents to have added fun / enjoyment. A small minority of respondents considered exercises offered practice 1% (2), that there should be fewer exercises 1% (2) and that exercises should be made less complex 1% (1).

The exercises were considered, at exit (see Appendix 2.3, Table 2.3.64), to have aided learning / understanding by14% (24) of the respondents and added interest by 14% (24), with 5% (9) considering them to offer a level of fun / enjoyment. The exercises were considered to have provoked thought by 4% (7), and to have helped check learning by 8% (13) of the respondents. More exercises were desired by 17% (28) of respondents, with 7% (11) expressing a desire for more complex exercises. The results indicate that a small minority considered exercise variety important 1% (1), that exercises offered them practice 4% (6), that there should be fewer exercises in the material 1% (2) and that the exercises failed to provoke further thought 1% (1).

The SEI interview responses (see Appendix 2.3, Table 2.3.65) indicate that the exercises were considered to have provoked thought by 62% (38) of interviewees, to have aided learning / understanding by 59% (36), were considered to help check learning by 57% (35) of interviewees, and to have offered practice by 41% (25). The results also indicate that the exercises added interest for 57% (35), an element of fun / enjoyment by 26% (16) and having variety in the exercises offered was highlighted as important by 13% (8) of the interviewees. A desire for more exercises was expressed by 30% (18) of the interviewees, and more complex exercises would have been preferred by 33% (20) of the interviewees. The results indicate that the exercises were considered to add to the element of realism by 5% (3) of the interviewees. It was considered by 5% (3) of the interviewees that exercises should be made less complex, and by 5% (3) that the exercises made the material more realistic, while 3% (2) of the interviewees considered the exercises to be too long and 3% (2) did not consider that the exercises were helpful in provoking them to think. Fewer exercises would have been the preference of 2% (1) of the interviewees.

Qualitative Analysis of Responses Obtained to Interview Questions

It was considered by some interviewees that the exercises added interest (see Appendix 3 A3.35, SEI 16, SEI 33), while others considered the exercises maintained their interest (see Appendix 3 A3.35, SEI 49). The exercises were considered to have made individuals laugh, then think about the issues concerned (see Appendix 3 A3.35, SEI 1), adding an element of fun to the material (see Appendix 3 A3.35, SEI 19), increasing attention levels (see Appendix 3 A3.35, SEI 20, SEI 39) and some commented that the humour element helped them keep going when they were getting tired (see Appendix 3 A3.35, SEI 6). With some commenting that they enjoyed the exercises (see Appendix 3 A3.35, SEI 21), and that the level of fun offered by the exercises was entertaining (see Appendix 3 A3.35, SEI 35, SEI 56).

Some commented that exercises added interest (see Appendix 3 A3.35, SEI48), though some exercises were less interesting than others, particularly where alternative answers may have been acceptable but were not acknowledged (see Appendix 3 A3.35, SEI 42). Others comment that while the exercises encouraged users to seek answers, where further attempts on the part of the learner do not show improvement frustration may result (see Appendix 3 A3.35, SEI 59)

As to the expectations held, regarding the exercises, some considered that exercises should be both simple and fun to use (see Appendix 3 A3.35, SEI 8)

Some commented that the exercises offered a level of challenge (see Appendix 3 A3.35, SEI 6). This might be taken as reflected in the exercises being referred to as "games". Some commented that the game element added interest (see Appendix 3 A3.35, SEI 5, SEI 24, SEI 48, SEI 43) and even to have made some users feel happy when achieving high scores (see Appendix 3 A3.35, SEI 17). Some commented that the exercises got them active and doing, rather than simply reading (see Appendix 3 A3.35, SEI 10, SEI 29, SEI 55). Others referred to the exercises as "quizzes" and considered these kept their mind going (see Appendix 3 A3.35, SEI 22).

Some highlighted the value of being able to put into practice the learning gained from the other elements in the material (see Appendix 3 A3.35, SEI 30, SEI 39, SEI 11, SEI 61).

For some interviewees exercises which were too long, or required too many inputs from users, were off-putting (see Appendix 3 A3.35, SEI 1, SEI 8).

For some interviewees the number of attempts required before answers became accessible led to annoyance, highlighting the importance of feedback on demand (see Appendix 3 A3.35, SEI 1). Others considered the approach taken to feedback in the exercises to be acceptable (see Appendix 3 A3.35, SEI 8, SEI 49). Some commented that immediate feedback boosted confidence (see Appendix 3 A3.35, SEI 9), while others regarded the exercises as little tests and valued the immediate feedback (see Appendix 3 A3.35, SEI 18). Some preferred a delay in answers being made available as this gave them a chance to think further (see Appendix 3 A3.35, SEI 13) and others commented that having to repeat exercises made the material more likely to be remembered (see Appendix 3 A3.35, SEI 30).

Some of the exercises were considered to be dull and tedious, or too simple, compared to others (see Appendix 3 A3.35, SEI 3), while some exercises were considered to be more useful (see Appendix 3 A3.35, SEI 46), and to have provoked thought (see Appendix 3 A3.35, SEI 4).

The results show that the exercises offered a means of self monitoring or assessment, by which learners could check if they were taking the material in. The feedback offered by the exercises clearly allowed users to confirm their own learning (see Appendix 3 A3.35, SEI 49, SEI 3, SEI 13, SEI 16, SEI 18, SEI 20, SEI 23, SEI 27, SEI 31, SEI 51, SEI 44, SEI 52, SEI 12, SEI 43).

The exercises were considered to have clarified issues raised in the material (see Appendix 3 A3.35, SEI 6, SEI 26) and aided learners' understanding of the material (see Appendix 3 A3.35, SEI 33, SEI 14), with some commenting that the exercises ensured that they were learning rather than skimming the material (see Appendix 3 A3.35, SEI 16). Some interviewees commented that the "quizzes" increased their recall of the material (see Appendix 3 A3.35, SEI 41).

In some cases the exercises inspired users to think further on material covered elsewhere, thereby aiding understanding of the material (see Appendix 3 A3.35, SEI 7, SEI 36, SEI 17, SEI 37, SEI 50, SEI 53, SEI 21), while others revisited the material within the exercise concerned re-thinking on their responses to the questions asked (see Appendix 3 A3.35, SEI 6, SEI 23, SEI 24, SEI 5).

In some cases the exercises inspired users to refer back to material covered elsewhere (see Appendix 3 A3.35, SEI 4), while others revisited the material within the exercise concerned re-thinking on their responses to the questions asked (see Appendix 3 A3.35, SEI 6).

The results clearly indicate that interviewees considered feedback including a level of explanation was important in understanding why some answers were correct or incorrect (see Appendix 3 A3.35, SEI 13 , SEI 60, SEI 25, SEI 26, SEI 27, SEI 29, SEI 31, SEI 51, SEI 37, SEI 43, SEI 47, SEI 55, SEI 54, SEI 57). Some considered the feedback helpful where the specific answer was not provided (see Appendix 3 A3.35, SEI 6).

The suggestion that exercises might be made more complex and larger, thereby decreasing the need for the volume of text in use, indicates that the exercises were preferred to text and a decrease in the volume of text was desired (see Appendix 3 A3.35, SEI 5). Some commented that they preferred the more complex exercises, but the more trivial exercises were also valued as they gave a break from the text based material (see Appendix 3 A3.35, SEI 10).

The issue of underlying complexity, touching on issues relating to levels of artificial intelligence, is raised in the comment that the exercises should have questions which changed thereby requiring different answers and more thought on the part of learners (see Appendix 3 A3.35, SEI 32).

Some commented that the exercises increased the time taken to work through the material and indicated that when under pressure for time they would either quickly look at the exercises and reveal the answers (see Appendix 3 A3.35, SEI 6), or avoid doing the exercises (see Appendix 3 A3.35, SEI 26). Other elements in the material had caused a level of fatigue for some individuals, which led to them choosing not to do exercises (see Appendix 3 A3.35, SEI 38).

The responses indicate that more complex exercises were preferred by some learners (see Appendix 3 A3.35, SEI 9, SEI 51, SEI 38).

Some commented that the exercises helped break up the text element of the material (see Appendix 3 A3.35, SEI 19, SEI 36, SEI 29, SEI 37).

Some commented that the exercises added an element of activity, or interactivity, to the material (see Appendix 3 A3.35, SEI 24, SEI 26, SEI 28, SEI 40, SEI 54), with some commenting that clicking the buttons was considered by them to be interactive and that interactivity was probably the most important thing about the exercises (see Appendix 3 A3.35, SEI 35). Others took the view that thinking about the issues constitutes interactivity (see Appendix 3 A3.35, SEI 52).

Some expressed a desire for more exercises to be added to the material (see Appendix 3 A3.35, SEI 13, SEI 37, SEI 18).

The SHS open responses (see Appendix 2.3, Table 2.3.66) indicate that the exercise elements were highlighted at the entrance point by 6% (5) as having offered practice which the respondents valued, by 2% (2) as adding interest, and 4% (4) as aiding their learning. A practical focus was highlighted by 6% (5) as important, in terms of their motivation.

At the midpoint (see Appendix 2.3, Table 2.3.66) the exercise elements were highlighted by 20% (1) as adding interest, and 59% (3) as aiding their learning. A practical focus was highlighted by 39% (2) as important, in terms of their motivation. More exercises were considered desirable by 39% (2) of the respondents.

At the exit point (see Appendix 2.3, Table 2.3.66) a practical focus was highlighted as important in terms of their motivation by 76% (26) and the exercises were considered to offer practice by 85% (29) of the respondents.

The SHS 5 point scale responses at exit (see Appendix 2.3, Table 2.3.67) indicate that 44% (15) of the respondents considered the interactive table setting exercise helped them to learn, with 35% (12) considering the on-screen feedback given for the interactive exercise was sufficient and considered by 24% (8) to have helped them check their learning. The interactive table setting exercise was considered as non-essential by 38% (13) of the respondents, who therefore focused on other material. The interactive maps were considered confusing by 41% (14), but considered by 24% (8) to have increased their depth of thought.

The SHS open responses at exit (see Appendix 2.3, Table 2.3.68) indicate that the role play exercises were considered to have provoked thought in a large majority, 79% (27), of the respondents.

The DMLE 5 point scale responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.69) indicate that 57% (4) of the respondents considered the simulation elements to be effective, with 57% (4) considering the on-screen feedback given for the simulation exercise to have been effective. The simulations were considered to have helped understanding by 71% (5) of the respondents.

The DMLE 5 point scale responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.70) indicate that 71% (5) of the respondents considered the simulation elements to be effective, with 100% considering the simulations helped their understanding of the material. The on-screen feedback given for the simulation exercise was considered effective by 57% (4) of the respondents. The interactive exercises within the material were considered by 86% (6) of the respondents to have helped their understanding, with 71% considering the Mondo Exercise to have increased their depth of thought and 57% considering the Slideman to have increased their depth of thought.

The DMLE open responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.71) indicate that the exercises were considered to have aided learning by 57% (4) of the respondents and to have offered practice by 14% (1). The simulations were considered to add interest and aid learning by 14% (1) of the respondents. The element of challenge within the material was considered important by 29% (2) of the respondents. Feedback was identified as important in terms of explanation by 14% (1), and immediacy by 57% (4) of the respondents. Interactivity was highlighted as important by 43% (3) of the respondents.

The DMLE open responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.71) indicate that the simulations were considered to have aided learning by 71% (5) of the respondents and added interest by 57% (4). The element of challenge was highlighted as important by 57% (4) of the respondents. The exercises involved were considered to have helped check learning by 43% (3), and directly aided learning by 14% (1) of the respondents. Feedback was identified as important in terms of explanation by 86% (6) and immediacy by 43% (3) of the respondents. Interactivity was highlighted as important by 71% (5) of the respondents. That exercises aided learning and a game element was valued was highlighted by 14% (1).

The DMLE open responses Semester 1 2000 to 2001 (see Appendix 2.3, Table 2.3.71) indicate that the simulations were considered to have aided learning by 91% (29), and added interest by 6% (2)of respondents. The element of challenge was highlighted as important by 50% (16), as was the game approach, and the exercises were considered to have helped check learning, and to offer practice, by 3% (1) of the respondents. Feedback was identified as important in terms of explanation by 34% (11) and immediacy by 22% (7) of the respondents. Interactivity was highlighted as important by 28% (9) of the respondents.

The Woolwich MNE open responses in Questionnaire 1 (see Appendix 2.3, Table 2.3.72) indicate that the exercises were considered to have aided learning by 60% (3), offered practice by 80% (4), and that multiple attempts were useful 80% (4) of the respondents. There was an expressed desire that exercises should be made more complex by 60% (3) of the respondents. Feedback was highlighted as important in terms of explanation and immediacy by 100% (5) of the respondents. Problem solving was considered to have provoked thought by 80% (4) of the respondents, more exercises were desired by 60% (3) and demonstrations were considered valuable by 20% (1) of the respondents

The Woolwich MNE open responses in Questionnaire 2 (see Appendix 2.3, Table 2.3.72) indicate that the exercises were considered to have aided learning by 50% (1), offered practice by 100% (2) of the respondents. There was an expressed desire that exercises should be made more complex by 50% (1) of the respondents. Feedback was highlighted as important in terms of explanation and immediacy by 100% (2) of the respondents. Problem solving was considered to have provoked thought by 100% (2) of the respondents, more exercises were desired by 50% (1) and demonstrations were considered valuable by 50% (1) of the respondents.

The Woolwich MNE open responses obtained to summary statements in Questionnaire 3 (see Appendix 2.3, Table 2.3.72) indicate that the simulations and exercises were considered to have aided learning by 80% (4), offered practice by 80% (4), and that multiple attempts were useful 80% (4) of the respondents. There was an expressed desire that exercises should be made more complex by 80% (4) of the respondents. Feedback was highlighted as important in terms of explanation by 80% (4) and immediacy by 60% (3) of the respondents. Interactivity was highlighted as important by 20% (1) of the respondents.

4.6.4.3 "Usability" Related Responses

The following sections offer a detailed presentation of the responses obtained regarding "usability" related responses.

The SEI open responses at entrance (see Appendix 2.3, Table 2.3.73) indicate that ease of use was important for 59% (276) of the respondents, and eye strain or fatigue was experienced 7% (33). Malfunctions were considered an issue for 6% (27) of the respondents. A small minority of respondents 1% (7) considered that the material enabled them to revisit information easily. Where note-taking was involved 2% (11) respondents considered that this was better using the computer while 5% (25) held the opposite view.

The SEI open responses at midpoint (see Appendix 2.3, Table 2.3.73) indicate that ease of use was important for 64% (123) of the respondents, hyperlinks were confusing for 32 % (61) and eye strain or fatigue was experienced 8%(16). Malfunctions were considered an issue for 8% (16) of the respondents. The map facility was highlighted as an aid to navigation by 19% (36) of the respondents, and not to have helped navigation by 1% (1) of the respondents. A small minority of respondents highlighted that there were too many links contained in the material 5% (9), too many windows on screen 6% (11), and that the layout was not consistent 6% (11), with 13% (24) considering that the material enabled them to revisit information easily. Where note-taking was involved 3% (5) respondents considered that this was better using the computer while 9% (17) held the opposite view.

The SEI open responses at exit (see Appendix 2.3, Table 2.3.73) indicate that ease of use was important for 58% (97) of the respondents, hyperlinks were confusing for 15% (25) and eye strain or fatigue was experienced 11%(19). Malfunctions were considered an issue for 14% (24) of the respondents. The map facility was highlighted as an aid to navigation by 13% (22) of the respondents. A small minority of respondents highlighted that there were too many links contained in the material 1% (2), too many windows on screen 1% (2), and that the layout was not consistent 5% (9), with 10% (17) considering that the material enabled them to revisit information easily. Where note-taking was involved 2% (3) respondents considered that this was better using the computer while 8% (14) held the opposite view.

The SEI interview responses (see Appendix 2.3, Table 2.3.74) indicate that ease of use was considered important by 72% (44) of the interviewees. Hyperlinks were highlighted as confusing by 51% (31) with 7% (4) considering that there were too many links in the material. Eye strain / fatigue and Malfunctions were reported by 26% (16) of the interviewees. The map facility was highlighted as an aid to navigation by 41% (25) of the interviewees, while 7% (4) found even the map to be less than helpful.

The number of windows on screen was highlighted as confusing by 21% (13), with layout inconsistency causing difficulty for 33% (20) of the interviewees. The facility for note taking using the computer was found to be preferable to traditional paper mode by 13% (8), but less favourable by 16% (10) of the interviewees. The capability to revisit information easily was identified as valuable by 38% (23) of the interviewees.

SEI "Usability" Related: Qualitative Analysis of Responses Obtained in Interviews

The results indicate that getting lost when using the material was a major problem for the learners. Many reported that they had unexpectedly found themselves in other units within the material. In some cases this resulted from using hypertext links to related topics (see Appendix 3 A3.35, SEI 1, SEI 5, SEI 7, SEI 39), while for others this happened even when using the sequential buttons (see Appendix 3 A3.35, SEI 6, SEI 8, SEI 28, SEI 13, SEI 2).

Some interviewees commented that they resorted to using the structure map to navigate the material in order to avoid getting lost (see Appendix 3 A3.35, SEI 59, SEI 8, SEI 6, SEI 9, SEI 28, SEI 50). For some learners even the structure map was considered to be confusing (see Appendix 3 A3.35, SEI 1, SEI 7) and some commented that they became lost when using the structure map to navigate (see Appendix 3 A3.35, SEI 19), while others considered that the structure map did not work as it should have (see Appendix 3 A3.35, SEI 19, SEI 40, SEI 42).

It was suggested by a number of interviewees that having a constant display on screen to indicate their position would have been helpful (see Appendix 3 A3.35, SEI 27, SEI 28, SEI 29, SEI 39).

The number of windows open on screen was considered by some to have caused some of their difficulties with the material (see Appendix 3 A3.35, SEI 10, SEI 16, SEI 19, SEI 33, SEI 36, SEI 37, SEI 45, SEI 42), while others considered this was acceptable (see Appendix 3 A3.35, SEI 18), or even had some advantages in that it allowed related elements to be viewed simultaneously (see Appendix 3 A3.35, SEI 47).

The results indicate that the pop-up windows, which closed immediately any further actions were taken using the mouse or keyboard, were unhelpful for interviewees attempting to use the computer facility for note-taking (see Appendix 3 A3.35, SEI 6, SEI 18, SEI 29, SEI 38, SEI 47), while others considered them useful as they did not add to the number of windows remaining open on-screen (see Appendix 3 A3.35, SEI 37).

Some considered that it was counter-productive having to take notes using the Notepad only to have to revise it in Word, therefore resorted to using paper notes (see Appendix 3 A3.35, SEI 6), while others took the opposite view, considering that using notepad saved them having to re-type the material (see Appendix 3 A3.35, SEI 33), and appreciating the value of having their notes on disk (see Appendix 3 A3.35, SEI 43, SEI 21).

Some commented on the difficulty involved when using both mouse and keyboard when using a wordprocessor, and the need to keep moving the Notepad window on screen, rather than mouse only with hand-written notes (see Appendix 3 A3.35, SEI 37). Others commented simply that they could write faster than they could type (see Appendix 3 A3.35, SEI 41) and some highlighted the difficulty of making notes in Notepad where pop-up windows were involved (see

Appendix 3 A3.35, SEI 55).

Some interviewees commented on the lack of automatic adjustment in exercises and the possible confusion resulting from feedback failing to clarify which responses had been correct or incorrect (see Appendix 3 A3.35, SEI 4).

The material was considered to have contained too many links by some interviewees, who expressed the view that fewer links would offer ease of use (see Appendix 3 A3.35, SEI 3, SEI 5, SEI 16). Some interviewees commented on the negative effect of links leading to the same material (see Appendix 3 A3.35, SEI 28, SEI 54).

Some expressed the view that there should be greater consistency of design in the text windows used in the material (see Appendix 3 A3.35, SEI 10). The fact that the material did not allow users to re-start where they had left off at the previous session was highlighted by some interviewees as an issue affecting ease of use (see Appendix 3 A3.35, SEI 33, SEI 51, SEI 50). The computer-based material was considered to have made it easy for learners to re-visit information (see Appendix 3 A3.35, SEI 7, SEI 27, SEI 43). Some considered the use of simple language helpful (see Appendix 3 A3.35, SEI 55, SEI 16).

A clear issue raised by the interviewees concerned the difficulty in accessing computers within the central lab system (see Appendix 3 A3.35, SEI 8, SEI 9, SEI 51, SEI 58, SEI 61). One of the central issues regarding the current facilities is that of distraction, often due to noise levels (see Appendix 3 A3.35, SEI 19, SEI 49, SEI 36). Some expressed a preference to access the material from home (see Appendix 3 A3.35, SEI 35, SEI 38, SEI 49), while others expressed a desire for more acceptable facilities within the campus (see Appendix 3 A3.35, SEI 36), additional labs (see Appendix 3 A3.35, SEI 51), or access to laptop facilities (see Appendix 3 A3.35, SEI 45). The issue of home access was particularly highlighted regarding those who lived a distance from campus, though the point was made that having a restricted facility did result, for some, in a more disciplined approach to their use of the material (see Appendix 3 A3.35, SEI 9).

Having to access the material from the central labs is considered by some as an "inconvenience", which might indicate some expectation of "convenience" on the part of Higher Education students, using computer-based materials (see Appendix 3 A3.35, SEI 35). For some the desire for printed material is related to the difficulty in accessing the material from central labs (see Appendix 3 A3.35, SEI 58).

The SHS open responses at entrance (see Appendix 2.3, Table 2.3.75) indicate that ease of use was considered to be an important element with 65% (53) of responses highlighting the importance of such. The ease with which material could be re-visited was identified as important by 20% (16) of the respondents, with 10% (8) indicating malfunctions affected their learning negatively when using computer based material.

The SHS open responses at midpoint (see Appendix 2.3, Table 2.3.75) indicate that ease of use was considered to be an important element with 86% (44) of responses highlighting the importance of such. Hyperlinks were considered confusing by 2% (1) of the respondents. The ease with which material could be re-visited was identified as important by 16% (8) of the respondents, with 22% (11) indicating malfunctions affected their learning negatively when using computer based material. It was considered by a small minority 8% (4) that there was too much information contained in the material and that links in the material were confusing 2% (1).

The SHS open responses at exit (see Appendix 2.3, Table 2.3.75) indicate that ease of use was considered to be an important element with 97% (33) of responses highlighting the importance of such. This may relate to the expressed desire for a printed user manual by 79% (27) and in the expressed desire for a tutorial in the use of the computer by 74% (25). The ease with which material could be re-visited was identified as important by 76% (26) of the respondents, with 35% (12) indicating malfunctions affected their learning negatively when using computer based material. It was considered by a large minority 32% (11) of the respondents that there was too much information in the material and by 38% (13) of the respondents that the content was not satisfactory for them.

The DMLE open responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.76) indicate that 57% (4) of the respondents considered ease of use issues important, with malfunctions highlighted as a problem by 29% (2) and eye strain / fatigue considered to be a problem by 14% (1) of the respondents.

The DMLE open responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.76) indicate that 100% (7) of the respondents considered ease of use issues important. The visual display used in the material was considered to aid learning by 14% (1) of the respondents. Malfunctions and too much text were each highlighted as problems by 14% (1) of the respondents.

The DMLE open responses Semester 1 2000 to 2001 (see Appendix 2.3, Table 2.3.76) indicate that 50% (16) of respondents considered ease of use issues important, 6% (2) considered eye strain / fatigue to be a problem and malfunctions were highlighted as a problem by 3% (1) of the respondents.

The HBS open responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.77) indicate that ease of use was highlighted by 35% (6) of the respondents as important.

The Woolwich MNE open responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.78) indicate that ease of use was highlighted as important by 20% (1), 50% (1), and 80% (4) of the respondents in the first, second and third questionnaires respectively.

4.6.4.4 Perceived Impact of On-Screen Presentation

The following sections offer a detailed presentation of the responses obtained regarding the perceived impact of presentation elements.

The SEI 5 point scale responses at midpoint (see Appendix 2.3, Table 2.3.79) indicate that 30% (12) of the respondents considered the visual elements of the windows were motivating, with 43% (17) considering the presentation to be as good as others they had experienced, and 13% (5) concluding their view had been influenced by other multi-media material they had used. Time flexibility was considered more important than quality of presentation by 30% (12) of the respondents.

The SEI 5 point scale responses at exit (see Appendix 2.3, Table 2.3.79) indicate that 48% (22) of the respondents considered the visual elements of the windows were motivating, which shows an increase of 18% on the midpoint response. The presentation of the material was considered by 61% (28) to be as good as others they had experienced, which shows an increase of 18% on the midpoint response. Time flexibility was considered more important than quality of presentation by 33% (15) at exit which reflects an increase of 3% on the midpoint response. The results also indicate that 10 respondents (30%) disagreed that quality of presentation was considered to be less important than time flexibility at the 1 to 2 level, while 12 (35%) gave a neutral response (level 3) to the statement. Respondents concluding that their view had been influenced by other multi-media material they had used doubled from 13% at midpoint to 26% at exit.

SEI Perceived Impact of Presentation Elements: Qualitative Analysis of Interview Responses

Some highlighted the importance of presentation, being the first thing they see, commenting that they only became aware of the content after they had experienced the impact of the presentation (see Appendix 3 A3.35, SEI 1). Others highlighted the importance of the interface used looking up to date (see Appendix 3 A3.35, SEI 37). Some commented that the use of colour was considered less boring (see Appendix 3 A3.35, SEI 50).

The SHS 5 point scale responses at exit (see Appendix 2.3, Table 2.3.80) indicate that 62% (21) of the respondents considered the visual elements of the windows were motivating, with 41% (14) considering the presentation to be as good as others they had experienced, and 32% (11) concluding their view had been influenced by other multi-media material they had used. Time flexibility was considered more important than quality of presentation by 29% (10) of the respondents. The presentation of this material was considered not to be as good as other material experienced by a minority 18% (6) of the respondents.

The question regarding the presentation being as good as, or better than other material experienced was asked with the intention of differentiating the two levels. It was considered useful to know which of these categories might be perceived by respondents as applicable.

Those respondents who disagreed at the 1 to 2 level with the statements consisted of 12% (4) who disagreed that the material was as good as others, and 9% (3) who disagreed that the material was better than others.

The SHS open responses (see Appendix 2.3, Table 2.3.81) indicate that the overall visual display used in the computer-based material was considered by 63% (32) of respondents at midpoint and by 91% (31) of respondents at exit, to aid their learning, and to have added interest by 18% (9) of the respondents at midpoint. The issue of eye-strain / fatigue was highlighted as a problem by 15% (12) of the respondents at entrance.

The SHS open responses (see Appendix 2.3, Table 2.3.82) indicate that at the entrance point the variety in the style of presentation was highlighted as important by 9% (7) of the respondents, with the use of colour being identified as important by 7% (6) of the respondents. Variety, generally, was identified by 2% (2) of the respondents as important. At the midpoint variety in the style of presentation was highlighted as important by 2% (1) of the respondents, with the use of colour being identified as important by 12% (6) of the respondents. Variety, generally, was identified by 16% (8) of the respondents as important. At the exit point variety in the style of presentation was not highlighted as important by the respondents. The use of colour was identified as important by 97% (33) of the respondents. Variety, generally, was identified by 97% (33) of respondents as important.

The DMLE 5 point scale responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.83) indicate that 86% (6) of the respondents considered the visual elements of the windows were motivating, with 43% (3) considering the presentation to be as good as others they had experienced, and 43% (3) concluding their view had been influenced by other multi-media material they had used. Content was considered more important than quality of presentation by 29% (2) of the respondents.

The DMLE 5 point scale responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.84) indicate that 71% (5) of the respondents considered the visual elements of the windows were motivating, with 57% (4) considering the presentation to be as good as others they had experienced, and 43% (3) concluding their view had been influenced by other multi-media material they had used. Content was considered more important than quality of presentation by 14% (1) of the respondents.

The DMLE 5 point scale responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.85) indicate that in the presentation of the exercise elements, the graphics were considered effective by 71% (5) of the respondents, colours used by 86% (6), text used by 71% (5) and videos used by 14% (1) of the respondents.

4.6.4.5 Perceived Impact of On-Screen Text

The following sections offer a detailed presentation of the responses obtained regarding perceived impact of on-screen text.

The SEI open responses at entrance (see Appendix 2.3, Table 2.3.86) indicate that while it is acknowledged by 3% (12) of the respondents that text is valuable for learners, 3% (12) commented that there was too much text, and text alone was considered boring by 23% (107). This is likely to account, in part, for the expressed view by 2% (11) of the respondents that they would have preferred a hard copy of the material. Breaks in text were highlighted as important by 1% (6), and simple language highlighted as beneficial by 2% (8), of the respondents.

The SEI open responses at midpoint (see Appendix 2.3, Table 2.3.86) indicate that, while it is acknowledged by 14% (27) of the respondents that text is valuable for learners, 23% (44) commented that there was too much text, and text alone was considered boring by 32% (62). This is likely to account, in part, for the expressed view by 14% (27) of the respondents that they would have preferred a hard copy of the material. Breaks in text were highlighted as important by 10% (19), and simple language highlighted as beneficial by 6% (12), of the respondents.

The SEI open responses at exit (see Appendix 2.3, Table 2.3.86) indicate that, while it is acknowledged by 11% (18) of the respondents that text is valuable for learners, 20% (33) commented that there was too much text, and text alone was considered boring by 25% (42). This is likely to account, in part, for the expressed view by 17% (28) of the respondents that they would have preferred a hard copy of the material. Breaks in text were highlighted as important by 8% (14), and simple language highlighted as beneficial by 4% (7), of the respondents.

The SEI interview responses (see Appendix 2.3, Table 2.3.87) indicate that, while it is acknowledged by 39% (24) of the interviewees that text is valuable for learners, 26% (16) commented that there was too much text and 46% (28) considered text alone to be boring. This is likely to account, in part, for the expressed view by 33% (20) of respondents that they would have preferred a hard copy of the material. Breaks in text were highlighted as particularly important by 66% (40), and simple language highlighted as beneficial by 16% (10) of the respondents.

The SEI 5 point scale responses at midpoint (see Appendix 2.3, Table 2.3.88) indicate that 35% (14) of respondents considered the material contained too much text, with 35% (14) considering they would have preferred to read this material from a print out rather than on screen, and 8% (3) considering they would have been better off reading a book.

The SEI 5 point scale responses at exit (see Appendix 2.3, Table 2.3.88) indicate that 28% (13) of respondents considered the material contained too much text, with 59% (27) considering they would have preferred to read this material from a print out rather than on screen, and 4% (2) considering they would have been better off reading a book.

SEI Interview Responses Regarding On-Screen Text

The results show that too much text becomes boring for learners (see Appendix 3 A3.35, SEI 1, SEI 3, SEI 14, SEI 15, SEI 29, SEI 30, SEI 51, SEI 52, SEI 54, SEI 42, SEI 39). Where long sections of text are used this can result in learners skimming the material (see Appendix 3 A3.35, SEI 1, SEI 8, SEI 54). Where learners are faced with too much text they are likely to lose interest in, or concentration on the material (see Appendix 3 A3.35, SEI 3, SEI 12, SEI 14, SEI 17, SEI 28, SEI 29, SEI 30, SEI 46, SEI 53, SEI 54, SEI 56, SEI 58).

The results show that reading text from the screen results in learners experiencing fatigue and eye strain (see Appendix 3 A3.35, SEI 3, SEI 6, SEI 9, SEI 29, SEI 36, SEI 40, SEI 41, SEI 42, SEI 43, SEI 45, SEI 53) for learners and in some cases headaches (see Appendix 3 A3.35, SEI 30) are experienced following the two hour sessions concerned.

Where reading is involved there is an expressed preference for printed material rather than screen text (see Appendix 3 A3.35, SEI 4, SEI 48, SEI 9). There is also an expressed preference for a quiet atmosphere where reading has to be undertaken (see Appendix 3 A3.35, SEI 19). The underlying reasons for the desire for printed material range from reducing eye strain and fatigue to ease of use. Some comment that having printed material would allow them to refer to such at a later date (see Appendix 3 A3.35, SEI 58, SEI 61), while others express the desire to have copies that they may annotate (see Appendix 3 A3.35, SEI 48), or read as they travel (see Appendix 3 A3.35, SEI 59).

Interviewees expressed dislike of the pop-up windows as they could not be kept open on screen (see Appendix 3 A3.35, SEI 2, SEI 6) which relates to the difficulty in taking notes on computer. This might suggest that such windows should not be used for text material which cannot be taken in fully at a glance.

Some expressed a preference for full screen displays (see Appendix 3 A3.35, SEI 2) and larger windows (see Appendix 3 A3.35, SEI 36, SEI 13), while others valued the staged display using reveals (see Appendix 3 A3.35, SEI 51).

The SHS 5 point scale responses at midpoint (see Appendix 2.3, Table 2.3.89) indicate that 12% (4) of respondents considered the material contained too much text, with 24% (8) considering they would have preferred to read this material from a print out (Metablock) rather than on screen, and 8% (3) considering they would have been better off reading a book. Some form of question and answer type workbook was considered desirable by 74% (25) of the respondents.

The SHS open responses at entrance (see Appendix 2.3, Table 2.3.90) indicate that the use of text based material alone was considered boring by 42% (34) of the respondents. Text was highlighted as valuable by 10% (8) of the respondents. Too much text was identified as having a negative effect by 25% (20) of the respondents, with 2% (2) of the respondents highlighting the importance of having breaks in the text based elements.

The SHS open responses at midpoint (see Appendix 2.3, Table 2.3.90) indicate that the use of text based material alone was considered boring by 10% (5) of the respondents. Text was highlighted as valuable by 6% (3) of the respondents. Too much text was identified as having a negative effect by 6% (3) of the respondents, with 4% (2) of the respondents highlighting the importance of having breaks in the text based elements.

The SHS open responses at exit (see Appendix 2.3, Table 2.3.90) indicate that the use of text based material alone was considered boring by 79% (27) of the respondents. Too much text was identified as having a negative effect by 35% (12) of the respondents.

The DMLE 5 point scale responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.91) indicate that 86% (6) of the respondents considered the text elements of the program were effective, with 86% (6) considering the text elements helped their understanding. The perception that there was too much text in the material was held by 14% (1) of the respondents, with 29% (2) expressing the view that they would rather read the text material from a print out.

The DMLE 5 point scale responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.92) indicate that 100% (7) of the respondents considered the text elements of the program were effective, with 100% (7) considering the text elements helped their understanding. The perception that there was too much text in the material was held by 14% (1) of the respondents, with 43% (3) expressing the view that they would rather read the text material from a print out. The DMLE 5 open responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.93) indicate that 29% (2) of the respondents considered the material contained too much text with 14% (1) considering breaks in text important, and 14% (1) considering they would have preferred to read this material from a print out.

The DMLE 5 point scale responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.93) indicate that 43% (3) of the respondents considered text to be valuable, 14% (1) considered the material contained too much text and 14% (1) considered simple language helpful and text alone to be boring.

The DMLE 5 point scale responses Semester 1 2000 to 2001 (see Appendix 2.3, Table 2.3.93) indicate that 34% (11) of the respondents considered the material contained too much text, 6% (2) considered too much text to be boring, 3% (1) would have preferred to read text from a print out, 6% (2) reported problems of eye strain / fatigue, and 3% (1) expressed a preference for simple language to be used.

The Woolwich MNE open responses obtained in the first questionnaire (see Appendix 2.3, Table 2.3.94) indicate that text was acknowledged as having value by 60% (3) of the respondents, but a negative effect was perceived by 20% (1) of the respondents where too much text was considered to have been used on screen, and where reading large amounts of text was required a print out was preferred to reading from screen by 20% (1) of the respondents. To have to recall from screen text was considered boring by 20% (1) of the respondents.

The Woolwich MNE open responses obtained in the second questionnaire (see Appendix 2.3, Table 2.3.94) indicate that text was acknowledged as having value by 100% (2) of the respondents, but a negative effect was perceived by 50% (1) of the respondents where too much text was considered to have been used on screen. Breaks in text were considered important by 50% (1) of the respondents.

The Woolwich MNE open responses obtained in the third questionnaire (see Appendix 2.3, Table 2.3.94) indicate that text was acknowledged as having value by 80% (4) of the respondents, but a negative effect was perceived by 60% (3) of the respondents where too much text was considered to have been used on screen, and where reading large amounts of text was required a print out was preferred to reading from screen by 60% (3) of the respondents.

4.6.4.6 Perceived Impact of Graphics / Multimedia Elements

The following sections offer a detailed presentation of the responses obtained regarding the perceived impact of graphics / multimedia presentation elements.

The SEI open responses at entrance (see Appendix 2.3, Table 2.3.95) indicate that use of multimedia is considered important by 14% (64) of the respondents. Graphics within the material were identified as valuable by 1% (7), adding interest by 6% (30), and aid learning by 2% (8). The use of colour was identified as important by 4% (20).

The SEI open responses at midpoint (see Appendix 2.3, Table 2.3.95) indicate that use of multimedia is considered important by 18% (34) of the respondents. Graphics within the material were identified as adding interest by 17% (32), aid learning by 10% (19), offer breaks in the text content of the material 4% (8), and add a level of fun / humour 3% (6) of respondents. The presence of the graphics was considered valuable by 5% (9) of respondents with 3% (5) indicating a desire for more graphics. The use of colour was identified as important by 15% (28).

The SEI open responses at exit (see Appendix 2.3, Table 2.3.95) indicate that use of multi-media is considered important by 13% (21) of the respondents. Graphics within the material were identified as adding interest by 11% (19), aid learning by 3% (5), offer breaks in the text content of the material 2% (4), and add a level of fun / humour 3% (5) of respondents. The presence of the graphics was considered valuable by 4% (6) of respondents with 2% (3) indicating a desire for more graphics. The use of colour was identified as important by 12% (20).

The SEI interview responses (see Appendix 2.3, Table 2.3.96) indicate that the graphics used in the material were considered valuable by 52% (32) of the interviewees, to have created breaks in the text material by 38% (23), to have added a level of fun / humour by 43% (26), and to have added interest by 44% (27) of the interviewees. The graphics were considered to aid learning by 30% (18), with 5% (3) of interviewees, indicating a desire for more graphics. The results indicate the importance of multi-media in 39% (24) of the interview responses. The use of colour was identified as important by 39% (24) of interviewees. Some interviewees indicated that, in their opinion, the current material was not making sufficient use of the multi-media dimension.

SEI Impact of Graphics / Multimedia Qualitative Analysis of Responses Obtained in Interviews

Interviewees considered that the use of cartoon style graphics added interest and even a level of enjoyment (see Appendix 3 A3.35, SEI 1, SEI 50), or entertainment (see Appendix 3 A3.35, SEI 40), with some commenting that the pictures helped them relax which made the reading and learning easier (see Appendix 3 A3.35, SEI 38, SEI 41) and others commenting that by breaking up the monotony of the text windows they made them feel happier (see Appendix 3 A3.35, SEI 56).

One interviewee commented that the large cartoons, which appeared in separate windows, were considered to be rather patronizing, but diagrams related to the material were considered useful (see Appendix 3 A3.35, SEI 2). Others directly contradict the view that the use of cartoon images is patronizing to them, considering the images to increase their attention (see Appendix 3 A3.35, SEI 55). Others commented that diagrams explained more for them than text (see Appendix 3 A3.35, SEI 16). The use of humour is considered refreshing by some and makes individuals think about the material covered (see Appendix 3 A3.35, SEI 4, SEI 20, SEI 39, SEI

25, SEI 45). Some point out that the use of humorous graphics influences their attitude (see Appendix 3 A3.35, SEI 17) and others comment that the graphics can help keep them going (see Appendix 3 A3.35, SEI 26).

Some individuals expressed a desire for more graphics to be used in the material and the role of the graphics in providing relief from the text windows was highlighted (see Appendix 3 A3.35, SEI 15, SEI 9, SEI 17, SEI 28, SEI 30, SEI 40, SEI 54).

Others considered the subject being studied to be serious and that it should be treated seriously, by having real images rather than humorous (see Appendix 3 A3.35, SEI 36, SEI 57), while others take the opposing point of view that the cartoon images are preferable (see Appendix 3 A3.35, SEI 49). Some commented that the pictures being funny helped them to remember the material (see Appendix 3 A3.35, SEI 37, SEI 42), though in some cases it was considered that the pictures should be made optional to facilitate times when time pressures were high (see Appendix 3 A3.35, SEI 37). One individual commented that the graphics made little difference (see Appendix 3 A3.35, SEI 43).

Some considered that the material claimed to be multimedia but was not (see Appendix 3 A3.35, SEI 2), while others commented that the material needed videos or animation added to improve attention on the part of learners (see Appendix 3 A3.35, SEI 32).

The use of video material, of people talking about the subject, was considered likely to make the material more attractive and reduce feelings of isolation (see Appendix 3 A3.35, SEI 36), while the use of voice, which could be controlled by the learner, would make the material more interactive (see Appendix 3 A3.35, SEI 36). The use of sound and video material was considered likely to make the experience more realistic and add interest value (see Appendix 3 A3.35, SEI 37). Some considered the use of animations, video and sound would help them to understand the material (see Appendix 3 A3.35, SEI 38). Some comment that video material would add interest and relevance and make comparison with other computer-based materials they've experienced (see Appendix 3 A3.35, SEI 59). Some comment that the content would determine the value of video material, rather than the entertainment value (see Appendix 3 A3.35, SEI 56). Some comment that exercises could be made more interesting if sound and moving images had been used (see Appendix 3 A3.35, SEI 42). Some consider that having the text material read out might improve the material (see Appendix 3 A3.35, SEI 45). One interviewee questioned whether video material would get any attention, based on their experience in other classes where video tapes had been used (see Appendix 3 A3.35, SEI 40).

The SHS open responses at entrance (see Appendix 2.3, Table 2.3.97) indicate that the use of graphics was considered to aid learning for 17% (14) of the respondents, with 31% (25) of the respondents considering that graphics added interest for them. That graphics were of general value was indicated by 21% (17) of the respondents.

The SHS open responses at midpoint (see Appendix 2.3, Table 2.3.97) indicate that the use of graphics was considered to aid learning for 39% (20) of the respondents, with 12% (6) of the respondents considering that graphics added interest for them. That graphics were of general value was indicated by 16% (8) of the respondents, with 2% (1) indicating that more graphics were desired.

The SHS open responses at exit (see Appendix 2.3, Table 2.3.97) indicate that the use of graphics was considered to aid learning for 94% (32) of the respondents, with 91% (31) of the respondents considering that graphics added interest for them. That graphics were of general value was indicated by 94% (32) of the respondents.

The SHS open responses at entrance (see Appendix 2.3, Table 2.3.98) indicate that the use of multimedia elements was considered important by 35% (28) of respondents, with 25% (20) indicating that the simulations helped them to check their learning. The use of a simulated environment was considered motivating by 4% (3) of the respondents, with 5% (4) considering a virtual reality element desired.

The SHS open responses at midpoint (see Appendix 2.3, Table 2.3.98) indicate that the use of multimedia elements was considered important by 73% (37) of respondents, with 86% (44) indicating the use of video aided their learning. The use of video was considered by 43% (22) of the respondents to add interest. Simulations were considered by 22% (11) of the respondents to add interest, and 67% (34) to aid learning, with 6% (3) indicating that the simulations helped them to check their learning.

The SHS open responses at exit (see Appendix 2.3, Table 2.3.98) indicate that the use of multimedia elements was considered important by 94% (32) of respondents, with 97% (33) indicating the use of video aided their learning. The use of video was considered by 91% (31) of the respondents to add interest.

The DMLE 5 point scale responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.99) indicate that 57% (4) of the respondents considered the look of the material to be effective, 43% (3) considered the sound and picture elements of the video clips effective, and 14% (1) considered the sound element within the simulation effective.

The DMLE 5 point scale responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.100) indicate that 100% (7) of the respondents considered the look of the material to be effective, 14% (1) considered the sound and picture elements of the video clips effective, and 29% (2) considered the sound element within the simulation effective.

The DMLE open responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.101) indicate that only a small minority 14% (1) of this group of respondents highlighted the elements of graphics, or multi-media, as important. It may be considered however that the value of such elements reflects in the ratings given by this group to exercises, feedback and interactivity.

The DMLE open responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.101) indicate that the video material used was not considered to add interest by 86% (4), but was considered to have added interest by 29% (2) and aided learning by 43% (3) of the respondents. The use of multi-media was considered important by 71% (5) of the respondents. Simulations were considered to have aided learning by 71% (5) and to have added interest by 57% (4) of the respondents. Graphics were considered to have aided learning by 57% (4) of the respondents. The use of colour was identified as important by 29% (2) of the respondents as was variety in style of presentation. The visual display used was considered to have aided learning by 14% (1) of the respondents.

The DMLE open responses Semester 1 2000 to 2001 (see Appendix 2.3, Table 2.3.101) indicate that simulations are considered to aid learning by 29% (2)of the respondents, visual display by 41% (13), and video by 31% (10) in aiding their learning. The results indicate that the on screen visual display was considered by 22% (7) of the respondents to have positively affected interest levels, video material by 22% (7) simulations by 6% (2) and graphics by 3% (1) of the respondents.

The video material was not considered to have added interest value by 9% (3) of the respondents and the use of colour, multimedia, and variety of presentational style were each considered important by 3% (1) of the respondents.

The HBS open responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.102) indicate that a games element was considered effective by 18% (3) of the respondents, interactivity by 6% (1) and simulations by 6% (1) of the respondents.

The Woolwich MNE open responses to questionnaire one (see Appendix 2.3, Table 2.3.103) indicate that graphics were considered to aid learning by 40% (2) and simulations by 40% (2) of the respondents. The demonstrations were considered valuable by 20% (1) and the visual display was considered to aid learning by 40% (2) of respondents.

The Woolwich MNE open responses to questionnaire two (see Appendix 2.3, Table 2.3.103) indicate that graphics were considered to aid learning by 100% (2) and simulations by 100% (2) of the respondents. The demonstrations were considered valuable by 50% (1) and the visual display was considered to aid learning by 50% (1) of respondents.

The Woolwich MNE open responses to questionnaire three (see Appendix 2.3, Table 2.3.103) indicate that graphics were considered to aid learning by 80% (4), exercises by 80% (4) and simulations by 80% (4) of the respondents. The demonstrations were considered valuable by 40% (2) and interactivity was specifically valued by 20% (1) of respondents.

4.6.4.7 Comparison With Other Modes

The following sections offer a detailed presentation of the responses obtained regarding comparison with other modes.

The SEI 5 point scale responses at midpoint (see Appendix 2.3, Table 2.3.104) indicate that 80% (32) of the respondents considered the material to be more motivating than some lectures they had experienced, 40% (16) considered it more motivating than most lectures they had experienced, and 8% (3) of the respondents considered it more motivating than the best lectures they had experienced.

The SEI 5 point scale responses at exit (see Appendix 2.3, Table 2.3.104) indicate that 78% (36) of respondents considered the material to be more motivating than some lectures they had experienced, 43% (20) considered it more motivating than most lectures they had experienced, and 7% (3) of the respondents considered it more motivating than the best lectures they had experienced.

The SEI open responses at entrance (see Appendix 2.3, Table 2.3.105) indicate that the computer-based material was considered to be better than a lecture by 7% (33), or a book by 4% (18) of the respondents, with 1% considering the computer-based material not to be better than a lecture 1% (7), or a book 1% (3) . It was highlighted by 1% (4) of the respondents that they would not want all classes to be computer-based.

The SEI open responses at midpoint (see Appendix 2.3, Table 2.3.105) indicate that the computer-based material was considered to be better than a lecture by 29% (55), or a book by 26% (49), or a case study by 9% (17) of the respondents, with a directly expressed preference over either by 10% (20) of the respondents. The results indicate that 7% (14) of the respondents would have taken the class had it been non computer-based. The computer-based material was considered not to be better than a lecture by 5% (10), or a book by 6% (11), or a case study by 7% (13) of the respondents. It was highlighted by 1% (1) of the respondents that lectures varied with lecturers.

The SEI open responses at exit (see Appendix 2.3, Table 2.3.105) indicate that the computer-based material is considered to be better than a lecture by 22% (36), or a book by 8% (13), with a directly expressed preference over either by 19% (32) of the respondents. It was highlighted by 14% (23) of the respondents that they would have taken the class even had it not been computer-based, with 3% (5) considering that the computer was not better than a book and 1% (2) considering that the computer was not better than a lecture.

The SEI interview responses (see Appendix 2.3, Table 2.3.106) indicate that the computer-based material is considered to be better than a book by 61%, better than a lecture by 56%, with a directly expressed preference over either by 8% of respondents. The feedback also indicates that 30% of interviewees consider lectures vary depending on the lecturer, while 15% comment that they would not want all their classes to be computer-based.

SEI Comparisons With Other Modes: Qualitative Analysis of Responses Obtained in Interviews

It was highlighted by some interviewees that there was potential distraction due to peer presence in lectures (see Appendix 3 A3.35, SEI 21), and that lectures were considered to depend on the speed and clarity of the lecturer (see Appendix 3 A3.35, SEI 4). It was considered that the lecturer's tone of voice, use of humour and display of enthusiasm counted, with some concluding that this might relate to the lecturer's personality (see Appendix 3 A3.35, SEI 5). Some compared older lecturers, with younger lecturers, concluding that the younger lecturers were more dynamic and added "entertainment value" which influenced the way the class came across for students (see Appendix 3 A3.35, SEI 20).

Others commented that it was difficult to say what made a good lecture. It was considered this might relate to the structure of the lecture, offering good introduction, information and summary and that the lecturer could see whether learners were following or not. The point was made that some lecturers may have well structured material but no contact with their audience. The way the lecturer said things was considered to be important, with body language and facial expression coming into play. Entertaining anecdotes were considered to offer breaks for learners. Jumping from one issue to another was considered to reflect a bad lecturer. The central point emphasised was that the learner got lost in bad lectures (see Appendix 3 A3.35, SEI 40). The further point was made that just as learners may become lost in lectures, they might also become lost when using computer based material (see Appendix 3 A3.35, SEI 40).

Some commented that lectures were dull where the lecturer just talks for the whole hour, but that the same applies where learners are required to read for the full hour, adding that a good lecture is interactive by asking you questions (see Appendix 3 A3.35, SEI 37). Others commented that a good lecturer is well prepared, builds on key points, uses good overheads, appreciates that the material may be easy for him but not for others, knows how to explain things and emphasises what he is saying, while speaking at a suitable pace, taking into account that learners are trying to write notes (see Appendix 3 A3.35, SEI 41).

That lectures depended on the lecturer and their ability to put the material across was clearly a view held by interviewees (see Appendix 3 A3.35, SEI 43, SEI 46, SEI 45), making the point that the lecturer must take account of the student perspective and keep the material interesting for the audience, which was considered to be greatly affected by the method of presentation used (see Appendix 3 A3.35, SEI 45).

Some commented that a poor lecturer was long winded which would lead to learners losing attention, while a good lecturer was clear and concise, concluding that a poor lecturer is worse than straight text and that interactive elements make the material better than a lecture (see Appendix 3 A3.35, SEI 54, SEI 56).

Even where the subject itself was motivating, the presentation in lectures was commented on by some as sending them to sleep (see Appendix 3 A3.35, SEI 25). Some commented that lectures were dull because they were difficult to follow (see Appendix 3 A3.35, SEI 32) and they would rather have the computer-based material.

Others considered the computer-based material was more personal than lectures, in that it offered the individual student direct feedback and was always there if they wanted to access the material (see Appendix 3 A3.35, SEI 22, SEI 36), but there was a potential problem raised, in that the learner may not take note of the important points therein (see Appendix 3 A3.35, SEI 28).

The responses indicate that being able to work in their own time and at their own pace, and having the material constantly available was perceived by learners to be important (see Appendix 3 A3.35, SEI 13), and this was highlighted by some as making the computer-based material better than lectures (see Appendix 3 A3.35, SEI 7)

The responses indicate that typing is perceived by some learners to be more thought provoking than writing notes, or reading from a book, and that even scrolling windows and telling the computer what to do is perceived as keeping them "active", with some perception that novelty might be an important element and that if all classes were computer-based they'd probably learn to type and switch off (see Appendix 3 A3.35, SEI 5).

Having a book was considered by some to make it easier to go back through the material, rather than having to go back to the computer lab, as the book was portable, though they also commented that it was easier to take in the computer-based material as the text was broken up into smaller sections (see Appendix 3 A3.35, SEI 46) and it did not seem as big a task as reading a book, concluding that it was easier to concentrate on the computer-based material than a book or lecture (see Appendix 3 A3.35, SEI 40). Some commented that the cross referencing made the computer-based material more interactive than a book (see Appendix 3 A3.35, SEI 57). Others commented that they were used to reading books and their eyes did not get so tired with books, therefore they preferred books to the computer-based material (see Appendix 3 A3.35, SEI 42).

The use of pictures and opening and closing of windows was cited by some as making the computer-based material better than a book. The comment being that books were regarded as background information, with nothing to look forward to but text, and nothing to do but turn pages (see Appendix 3 A3.35, SEI 37). Some commented that the conversational style, with the light humour element helped to make the material about right for the course (see Appendix 3 A3.35, SEI 54). Having to click and move through the computer-based material constituted activity for some interviewees, which they considered led to them reading more intensely than they would have done from a book (see Appendix 3 A3.35, SEI 50). Some considered the "thunderbolt prompts", or exercises, to make the material better than a book, as they tended to skim through books but could not do that with the exercises, as they were concerned they might miss important material, therefore they learned more (see Appendix 3 A3.35, SEI 59).

Some considered the ease of finding information made the computer-based material better than a book (see Appendix 3 A3.35, SEI 41, SEI 6). The computer-based material was considered by some to be better than a book as it made use of colours and graphics which made it less boring (see Appendix 3 A3.35, SEI 22). The interactive exercises were considered by some to make the computer-based material better than a book (see Appendix 3 A3.35, SEI 17). Others considered the “interactivity” made the computer-based material entertaining, which made it more exciting than a book (see Appendix 3 A3.35, SEI 24, SEI 45).

It was considered by some that more dedication was required with a book, as it could easily be put down, whereas the computer-based material made them sit down and do it, commenting that they preferred the computer-based material (see Appendix 3 A3.35, SEI 32), with others commenting that with books they'd be more likely to leave the work until an assignment was due (see Appendix 3 A3.35, SEI 7). Others considered that the computer-based material offered more variety of presentation than a book, including use of fonts and images, which made it less boring than a book (see Appendix 3 A3.35, SEI 25).

The SHS 5 point scale responses at exit (see Appendix 2.3, Table 2.3.107) indicate that 68% (23) of respondents considered the material to be more motivating than some lectures they had experienced, 32% (11) considered it more motivating than most lectures they had experienced, and 15% (5) considered it more motivating than the best lectures they had experienced.

The SHS open responses at entrance (see Appendix 2.3, Table 2.3.108) indicate that the use of computers was considered to be better than using a book by 14% (11) of the respondents, with 9% (7) expressing the view that using the computer-based material was not better than using a book. The use of computers was considered not to be better than “practical labs” by 6% (5) of the respondents.

The SHS open responses at midpoint (see Appendix 2.3, Table 2.3.108) indicate that the use of computers was considered by 69% (35) of the respondents to be better than using a book, and by 18% (9) not to be better than using a book. The use of computers was considered by 61% (31) to be better than a lecture and 10% (5) not to be better, than a lecture option. The use of computers was considered by 33% (17) to be better than class based case studies, and not better, than class based case studies by 24% (12).

The SHS open responses at exit (see Appendix 2.3, Table 2.3.108) indicate that the use of computers was considered to be better than using a book by 82% (28) of the respondents, with 47% (16) considering it to be better than a lecture, 3% (1) considering it not to be better than “practical labs”, and 50% (17) considering it better than class based case studies.

The DMLE 5 point scale responses Semester 1 1998 to 1999 (see Appendix 2.3, Table 2.3.109) indicate that 86% (6) of respondents considered the material to be more motivating than some lectures they had experienced, 86% (6) considered it more motivating than most lectures they had experienced, and 43% (3) considered it more motivating than the best lectures they had experienced.

The DMLE 5 point scale responses Semester 1 1999 to 2000 (see Appendix 2.3, Table 2.3.110) indicate that 100% (7) of respondents considered the material to be more motivating than some lectures they had experienced, 71% (5) considered it more motivating than most lectures they had experienced, and 29% (2) considered it more motivating than the best lectures they had experienced.

4.7 Statistical Analyses of SEI and SHS Results Obtained in Controlled Investigations

4.7.1 SEI Full Version Exercise v Web-based Text Version of Exercise

The following sections offer a detailed presentation of the responses obtained regarding the controlled investigation.

Given that there were many views expressed regarding the various elements within the computer-based materials being studied, it was considered that clear evidence should be gathered concerning any difference in value the respondents might hold when using computer-based material which consisted of on-screen text, as compared to the same material presented using other media in addition to text.

Given the restrictions of the circumstances concerned, it was decided to have volunteers use selected sub-sets of the material, from which they were currently learning, to offer feedback which allowed comparison to be made of the impact of the mode of presentation.

Where a clear preference was revealed this would indicate that one approach would be better received by learners than the other. This would offer a clearer picture of the relevance of comments made regarding the materials generally and would further inform the judgements required to draw conclusions from the feedback obtained overall.

4.7.2 SEI Full Version Exercise v Web-based Text Version of Exercise

4.7.2.1 Assumptions

The assumptions were that the use of a subset of the material, which the students concerned were using as part of their course work, would offer a level of insight, which could be generalised to the rest of the material concerned. It was also assumed that the responses offered on the Likert scale questionnaire would offer a genuine indication of the students' views.

The samples were convenience, to the extent that only those who attended and agreed to participate were included in the data collection exercise. This however is common in research involving case studies and my perspective would be that the responses obtained are representative of the populations they represent within the case study.

The study was counterbalanced to control for any order effects influencing the results obtained and statistical checks were carried out to investigate whether order effects had impacted on the results obtained.

4.7.2.2 Hypothesis

There was no directional hypothesis generated with regard to possible order effects in this part of the research. It was accepted that a "learning effect" as a result of order of presentation might have influenced the results obtained, therefore the results obtained were subjected to statistical testing which would reveal the likelihood of such. Given that the hypothesis was open to the potential effect being in either direction, the significance value was treated as "two tailed".

The hypothesis regarding the mode of presentation was that there would be a difference in the results obtained for the on screen text version and the on-screen exercise version of the material in relation to the statements on the questionnaire (i.e. subjects would be more engaged etc).

4.7.2.3 Methodology

This investigation made use of a sub-set of the material from the SEI Z1.104/6 Class. The material consisted of an on-screen exercise, which permitted the user to "interview" an entrepreneur, and a Web Page showing the same content in a text-based format.

The students were informed that this investigation was being carried out for the purpose of PhD research and that they were requested to take part on a voluntary basis by following the instructions provided and completing the associated questionnaire.

The instruction sheets and questionnaires were coded as A, or B. This related to the counterbalancing of the order in which the students accessed the two versions of the material (see Table 4.5). Those using the A version of the questionnaire looked firstly at the on-screen exercise version of the material, then at the on-screen text version. Those with the B version of the questionnaire looked firstly at the on-screen text version of the material, then at the on-screen exercise version.

Table 4.6: SEI Frequency Table: Showing Numbers of Respondents Using Each Version of Questionnaire

Questionnaire Version	Frequency	Percent	Valid Percent	Cumulative Percent
A: Full Exercise Version Followed By Web-based Text Version	34	52.3	52.3	52.3
B: Web-based Text Version Followed By Full Exercise Version	31	47.7	47.7	100.0
Total	65	100.0	100.0	

The investigation was carried out with minimal tutor involvement, in that assistance was given where requested, regarding accessing the Website, or clarifying areas of uncertainty. The focus of this investigation was to gather feedback which might be analysed quantitatively and permit a comparison to be made of the two modes of presentation.

The questionnaire was designed in a way which permitted it to be used irrespective of the particular computer-based material involved, which gave rise to an "na" category to accommodate responses to statements which were considered not to be applicable to specific software. The questionnaire analysis was conducted using SPSS software and the results were tested for order effects and for individual item responses relative to condition of presentation (i.e. the responses given to the item in on-screen exercise mode were paired with the responses given to the same item in on-screen text mode).

4.7.2.4 Approach Taken to Statistical Analysis

The raw scores from the questionnaire were entered in SPSS, with scores for full version entered first, followed by scores for text only version. (SPSS Items a1 to a64 referring to the Full Exercise Version and Items b1 to b64 referring to the Web-based Text Version of the material).

Totals were calculated for each student, within each condition (i.e. sum of all scores on all questionnaire items) for each category. This gave a Total score for each student for the Full Exercise Version, and for each student for the Text Only Version of the computer-based material.

Mean scores were then calculated for each student for each category (i.e. mean of the sum of scores on all questionnaire items within each condition). This gave a mean score within each condition for each student (i.e. mean score for full version and mean score for text only version).

Items 43, 44, 45, 47, 53 and 55 reverse scored in order to allow high score to indicate positive rating of the material.

4.7.2.5 SEI Results of Test Conducted For Order Effects (Non - Parametric)

The difference between the individual student's mean scores for each condition was calculated and referred to as their "Y" scores. The Y scores were calculated by subtracting Mean b (Individual Student's Mean Score For Items On Web Based Text Version Of Material) from Mean a (Individual Student's Mean Score For Items On Full Exercise Version Of Material). This gave a total of 65 "Y scores".

A 2 Sample (Independent Samples) Mann-Whitney U Test was run on Y scores ("Y" scores calculated by Mean a – Mean b) for students who used Questionnaire Version "A" (A: full exercise version of material followed by text version of material), compared to those who used Version "B" (B: text version of material followed by full exercise version of material).

A significant difference in the Y Scores obtained for Questionnaire Version "A" compared to Questionnaire Version "B" would have indicated that any effect observed might be due to the order in which the material concerned was rated by the respondents.

The result obtained from the Mann-Whitney Test, applied to the "Y scores" concerned indicates a significance level of 0.052 (see Table 4.7). The results of the Mann-Whitney Test indicate that there was no significant difference due to the order in which the versions of the computer-based material were addressed by respondents. Therefore it was appropriate to test for any significant differences in responses, likely to be due to the differences in condition (i.e. whether full version, or text only).

Table 4.7: SEI Table Showing Results of 2 Sample Mann-Whitney Test run on Y scores

Questionnaire Version (64 Items)	N	Mean Rank	Sum of Ranks
A: Full Exercise Version Followed By Web-based Text Version	34	37.35	1270.00
B: Web-based Text Version Followed By Full Exercise Version	31	28.23	875.00
Total	65		

Test Statistics[a]

	YSCORE64
Mann-Whitney U	379.000
Wilcoxon W	875.000
Z	-1.944
Asymp. Sig. (2-tailed)	.052

a. Grouping Variable: Questionnaire Version

4.7.2.6 SEI Results of Test Conducted For Condition Effects

Having established that there were no significant order effects, a Wilcoxon Test was run on the mean scores obtained by each of the questionnaire items under each condition (A: exercise version on screen, B: text version on screen). The result of the Wilcoxon Signed Ranks Test (see Table 4.7) indicates that statistically significant differences exist between the means concerned.

Table 4.8: SEI Results of Wilcoxon Signed Ranks Test

(Condition A: Full Exercise Version, Condition B: Web-based Text Version)

Wilcoxon Ranks

(Questionnaire Items = 64)		N	Mean Rank	Sum of Ranks
Mean B: Web-based Text Version - Mean A: Full Exercise Version	Negative Ranks	56a	35.71	1999.50
	Positive Ranks	8b	10.06	80.50
	Ties	1c		
	Total	65		

a Mean B < Mean A

b Mean B > Mean A

c Mean A = Mean B

Wilcoxon Test Statistics

	Mean B: Web-based Text Version - Mean A: Full Exercise Version
Z	-6.417a
Asymp. Sig. (2-tailed)	0.000

a Based on positive ranks

b Wilcoxon Signed Ranks Test

The result showed a statistically significant difference in mean scores. Given that the results of the Mann-Whitney Test indicated that there was no statistically significant order effect, the significant difference in mean scores could be taken to relate to the difference in presentation of the material.

In order to identify which of the questionnaire items were showing significant differences in responses obtained, the scores for the questionnaire items were treated as paired data and a Wilcoxon Signed Ranks Test was used to analyse the "paired data" by item on each of the 64 items on the questionnaire (e.g. scores for item a11 paired with scores for item b11, for all respondents)

The results obtained from this analysis (see Appendix 3.31) were then used as a basis for evaluating the effect of on-screen presentation, where computer-based material for learning is concerned.

Statistically Significant Results by Questionnaire Item for SEI Case Study 1 Controlled Investigation (Full Version Exercise v Web-based Text Version of Exercise)

The following statements showed statistically significant differences at the 5% level (Wilcoxon Signed Ranks Test (2 tailed), N=64) across the experimental conditions (see also Appendix 3, Table 3.31):

- The computer-based "on-screen text" / "on-screen exercise" version of this material offered me a challenge
- I got the chance, within the computer-based "on-screen text" / "on-screen exercise" version of this material, to apply my learning to solving problems or taking decisions
- I found the tasks set in the computer-based "on-screen text" / "on-screen exercise" version of this material interesting
- The computer-based "on-screen text" / "on-screen exercise" version of this material inspired me to think about the material I had previously covered
- The computer-based feedback from the "on-screen text" / "on-screen exercise" version of this material helped me check that I was really learning
- The computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to demonstrate my competency at the activity concerned
- The computer-based "on-screen text" / "on-screen exercise" version of this material made me curious to see the outcomes from my decisions
- The computer-based "on-screen text" / "on-screen exercise" version of this material, which allowed me to feel as though I was really there in the scenario
- The computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to choose which element of this computer-based material I looked at next
- I had to think carefully before deciding what to look at next in this computer-based "on-screen text" / "on-screen exercise" version of this material
- I could use this computer-based "on-screen text" / "on-screen exercise" version of this material to check how the experts would do things
- I could control the pace at which I worked through this computer-based "on-screen text" / "on-screen exercise" version of this material
- I could choose my own pathway through this computer-based "on-screen text" / "on-screen exercise" version of this material

- There was an element of humour in this computer-based "on-screen text" / "on-screen exercise" version of this material
- The humour element in this computer-based "on-screen text" / "on-screen exercise" version of this material increased my sense of engagement
- The game element in this computer-based "on-screen text" / "on-screen exercise" version of this material increased my level of engagement
- The context of this computer-based "on-screen text" / "on-screen exercise" version of this material was realistic in that it reflected real life situations
- The context of this computer-based "on-screen text" / "on-screen exercise" version of this material was meaningful for me (I found I could relate to it)
- I find this computer-based "on-screen text" / "on-screen exercise" version of this material makes the situations and examples used realistic
- Text in this computer-based "on-screen text" / "on-screen exercise" version of this material was easy to read on screen
- This computer-based "on-screen text" / "on-screen exercise" version of this material made me want to keep on working beyond the time I had intended
- Information was easy to find throughout this computer-based "on-screen text" / "on-screen exercise" version of this material
- The screen display for this computer-based "on-screen text" / "on-screen exercise" version of this material was not cluttered
- I found the colours used in displaying this computer-based "on-screen text" / "on-screen exercise" version of this material were appropriate
- The interface for this computer-based "on-screen text" / "on-screen exercise" version of this material was easy to use
- I felt as though I was actively learning from this computer-based "on-screen text" / "on-screen exercise" version of this material
- The interface helped me to spot my errors when using this computer-based "on-screen text" / "on-screen exercise" version of this material
- The interface helped me to reason about what caused my errors when using this computer-based "on-screen text" / "on-screen exercise" version of this material
- This computer-based "on-screen text" / "on-screen exercise" version of this material helped me to correct any errors I made

- This computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to make use of what I already knew
- This computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to learn by thinking and reasoning
- This computer-based "on-screen text" / "on-screen exercise" version of this material encouraged me to improvise when trying to solve problems or take decisions
- When using this computer-based "on-screen text" / "on-screen exercise" version of this material I had to identify problems then solve them
- I had to sort out relevant from irrelevant when trying to solve problems or take decisions using this computer-based "on-screen text" / "on-screen exercise" version of this material
- This computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to explore from a number of perspectives
- This computer-based "on-screen text" / "on-screen exercise" version of this material maintained the complexity of the real world
- This computer-based "on-screen text" / "on-screen exercise" version of this material encouraged me to reflect on a range of learning when attempting to solve problems
- Assessment was integrated within this computer-based "on-screen text" / "on-screen exercise" version of this material
- This computer-based "on-screen text" / "on-screen exercise" version of this material offered the opportunity for me to defend my views / opinions developed
- My understanding of the issues has changed having worked through this computer-based "on-screen text" / "on-screen exercise" version of this material
- This computer-based "on-screen text" / "on-screen exercise" version of this material contained too much on-screen text
- I find myself wanting to read this computer-based "on-screen text" / "on-screen exercise" version of this material from a print out, rather than on-screen
- I would have been better off reading a book than using this computer-based "on-screen text" / "on-screen exercise" version of this material
- I worked through all the elements of this computer-based "on-screen text" / "on-screen exercise" version of this material
- I was unsure what I should do when using the interactive elements of this computer-

based "on-screen text" / "on-screen exercise" version of this material (ie the instructions were not clear)

- The interactive elements in this computer-based "on-screen text" / "on-screen exercise" version of this material helped my understanding
- The look of the screen displays in this computer-based "on-screen text" / "on-screen exercise" version of this material helped motivate me
- The presentation of this computer-based "on-screen text" / "on-screen exercise" version of this material is better than other computer-based material I've used
- The presentation of this computer-based "on-screen text" / "on-screen exercise" version of this material is as good as other computer-based material I've used
- The presentation of this computer-based "on-screen text" / "on-screen exercise" version of this material is not as good as other computer-based material I've used
- The on-screen feedback provided helps me check I'm learning from this computer-based "on-screen text" / "on-screen exercise" version of this material
- I found this computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to practice doing the things I needed to do
- I found this computer-based "on-screen text" / "on-screen exercise" version of this material engaging to the point where I kept trying to solve the problems or make the decisions
- I found the on-screen feedback in this computer-based "on-screen text" / "on-screen exercise" version of this material made me actively think about my decisions

In drawing conclusions from the results obtained we may conclude, with confidence beyond the 0.05 level, that the differences in ratings obtained for all items, other than those discussed below, were differences in the ratings given by the users of the computer-based materials which may be attributed to the conditions concerned (i.e. presentation format) rather than being attributable to chance.

There were 10 items for which no significant difference was found (see Appendix 3.32):

The first item relates to the issue of getting lost when navigating through the computer-based material. The fact that similar responses were obtained for this item is likely to reflect the brief nature of the subset of material used, in that there was possibly insufficient material for this issue to arise. This might be further addressed by re-running such an investigation with the complete package, which would not have been possible within the circumstances of this research.

The second item relates to the retrieval capability had the learner become lost. As with the first item, it is likely that the subset of material used was insufficient for this issue to arise. Again this might be addressed by using the complete package for this element of the investigation.

The third item relates to the learner's view being influenced by prior experience of computer-based material. This merely indicates that the views expressed have been influenced to the same extent, irrespective of the condition in which the presentation took place. It is not clear from this result alone whether there has been influence of prior experience or not, merely that any influence relating to such appears not to differ significantly in relation to the condition of presentation.

The fourth item relates to the learner's awareness of "valid" learning. The result obtained does not by itself indicate whether uncertainty exists in the mind of the learner, but merely that there is no significant difference in their uncertainty between the two conditions of presentation.

The fifth, sixth, seventh and eighth items refer to sound and video, which was missing from both conditions of presentation, therefore it might be expected that no significant difference in response would be obtained. These items were retained within the questionnaire in order that identical questionnaires might be used across case study groups.

Items nine and ten relate to the influence of "high quality images" on understanding and engagement. It is likely that the images used in the on-screen exercise version in the SEI case study were regarded as "low quality", given that the image was merely a grey background within which text based options were made available for students.

It is therefore important that we consider these results more fully by relating them to other elements of data and relating all of the data concerned back to the reality of the materials and situations within which the data was gathered. This permits a greater level of insight to be gained and helps protect against the danger of misinterpreting the significance of any "lack of significance".

4.7.3 SHS Full Version Exercise v Web-based Text Version of Exercise

4.7.3.1 Assumptions

The assumptions were the same for the SHS Case Study as the SEI Case Study. The samples were convenience, as were the samples in the SEI Case Study. The study was counterbalanced in the same way as the SEI Case Study.

4.7.3.2 Hypothesis

As with the SEI Case Study, there was no directional hypothesis generated with regard to possible order effects in this part of the research, and the significance value obtained was treated as "two tailed".

The hypothesis regarding the mode of presentation was also as that for the SEI Case Study, that there would be a difference in the results obtained for the on screen text version and the on-screen exercise version of the material in relation to the statements on the questionnaire.

4.7.3.3 Methodology

This investigation made use of a sub-set of the material from the Food & Beverage Management Course. The material consisted of an on-screen exercise, which permitted the user to "observe" an interaction between waiter and diner, and a Web Page showing the same content in a text-based format.

As with the SEI Case Study, the students were informed that this investigation was being carried out for the purpose of PhD research and that they were requested to take part on a voluntary basis by following the instructions provided and completing the associated questionnaire.

Also as with the SEI Case Study, the instruction sheets and questionnaires were coded as A, or B. This related to the counterbalancing of the order in which the students accessed the two versions of the material. Those using the A version of the questionnaire looked firstly at the on-screen exercise version of the material, then at the on-screen text version. Those with the B version of the questionnaire looked firstly at the on-screen text version of the material, then at the on-screen exercise version (see Table 4.9).

Table 4.9: SHS Table Showing Numbers of Respondents Using Each Version of Questionnaire

Questionnaire Version	Frequency	Percent	Valid Percent	Cumulative Percent
A: Full Exercise Version Followed By Web-based Text Version	39	53.4	53.4	53.4
B: Web-based Text Version Followed By Full Exercise Version	34	46.6	46.6	100.0
Total	73	100.0	100.0	

As with the SEI Case Study, the investigation was carried out with minimal tutor involvement, in that assistance was given where requested, regarding accessing the Website, or clarifying areas of uncertainty. The focus of this investigation was to gather feedback which might be analysed quantitatively and permit a comparison to be made of the two modes of presentation.

Again as with the SEI Case Study, the questionnaire was designed in a way which permitted it to be used irrespective of the particular computer-based material involved, which gave rise to an "na" category to accommodate responses to statements which were considered not to be applicable to specific software. The questionnaire analysis was conducted using SPSS software and the results were tested for order effects and for individual item responses relative to condition of presentation (i.e. the responses given to the item in on-screen exercise mode were paired with the responses given to the same item in on-screen text mode).

SHS Full Version Exercise v Web-based Text Version of Exercise

4.7.3.4 Approach Taken to Statistical Analysis

As with the SEI Case Study, the raw scores from the questionnaire were entered in SPSS, with scores for full version entered first, followed by scores for text only version. (SPSS Items a1 to a64 referring to the Full Exercise Version and Items b1 to b64 referring to the Web-based Text Version of the material)

Also as with the SEI Case Study, totals were calculated for each student, within each condition (i.e. sum of all scores on all questionnaire items) for each category. This gave a Total score for each student for the Full Exercise Version, and for each student for the Text Only Version of the computer-based material.

Mean scores were then calculated for each student for each category (i.e. mean of the sum of scores on all questionnaire items within each condition). This gave a mean score within each condition for each student (i.e. mean score for full version and mean score for text only version).

Items 43, 44, 45, 47, 53 and 55 reverse scored in order to allow high score to indicate positive rating of the material.

The difference between the individual student's mean scores for each condition was calculated and referred to as their "Y" scores. The Y scores were calculated by subtracting Mean b (Individual Student's Mean Score For Items On Web Based Text Version Of Material) from Mean a (Individual Student's Mean Score For Items On Full Exercise Version Of Material). This gave a total of 73 "Y scores".

A 2 Sample (Independent Samples) Mann-Whitney U Test was run on Y scores for students who used Questionnaire Version "A" (A: full exercise version of material followed by text version of material), compared to those who used Version "B" (B: text version of material followed by full exercise version of material).

A significant difference in the Y Scores obtained for Questionnaire Version "A" compared to Questionnaire Version "B" would have indicated that any effect observed might be due to the order in which the material concerned was rated by the respondents.

Table 4.10: SHS Table Showing Results of 2 Mann-Whitney Test run on Y scores

Questionnaire Version (64 Items)	N	Mean Rank	Sum of Ranks
A: Full Exercise Version Followed By Web-based Text Version	39	34.59	1349.00
B: Web-based Text Version Followed By Full Exercise Version	34	39.76	1352.00
Total	73		

Test Statistics[a]

	YSCORE64
Mann-Whitney U	569.000
Wilcoxon W	1349.000
Z	-1.040
Asymp. Sig. (2-tailed)	.298

a. Grouping Variable: Questionnaire Version

The result obtained from the Mann-Whitney U Test, applied to the "Y scores" concerned indicates a significance level of 0.298 (see Table 4.10). The results of the Mann-Whitney Test indicate that there was no significant difference due to the order in which the versions of the computer-based material were addressed by respondents. Therefore it was appropriate to test for any significant differences in responses, likely to be due to the differences in condition (i.e. whether full exercise version, or text only).

SHS: Results of Non Parametric Test Conducted For Condition Effects

Having established that there were no significant order effects, a Wilcoxon Test was run on the mean scores obtained by each of the questionnaire items under each condition (A: exercise version on screen, B: text version on screen). The result of the Wilcoxon Signed Ranks Test indicates that statistically significant differences exist between the means concerned (see Table 4.11).

Table 4.11: SHS Table Showing Results of Wilcoxon Signed Ranks Test

(Condition A: Full Exercise Version, Condition B: Web-based Text Version)

Wilcoxon Ranks

(Questionnaire Items = 64)		N	Mean Rank	Sum of Ranks
Mean B: Web-based Text Version - Mean A: Full Exercise Version	Negative Ranks	69a	38.41	2650.50
	Positive Ranks	4b	12.63	50.50
	Ties	0c		
	Total	73		

a Mean B < Mean A

b Mean B > Mean A

a Mean A = Mean B

Wilcoxon Test Statistics

	Mean B: Web-based Text Version - Mean A: Full Exercise Version
Z	-7.147a
Asymp. Sig. (2-tailed)	0.000

a Based on positive ranks

b Wilcoxon Signed Ranks Test

The result showed a statistically significant difference in mean scores. Given that the results of the Mann-Whitney Test indicated that there was no statistically significant order effect, the significant difference in mean scores could be taken to relate to the difference in presentation of the material.

In order to identify which of the questionnaire items were showing significant differences in responses obtained, the scores for the questionnaire items were treated as paired data and a Wilcoxon Signed Ranks Test was used to analyse the "paired data" by item on each of the 64 items on the questionnaire (e.g. scores for item a11 paired with scores for item b11, for all respondents)

The results obtained from this analysis (see Appendix A4.2) were then used as a basis for evaluating the effect of on-screen presentation, where computer-based material for learning is concerned.

Statistically Significant Results by Questionnaire Item for SHS Case Study 2 Controlled Investigation (Full Version Exercise v Web-based Text Version of Exercise)

The following statements showed statistically significant differences at the 5% level (Wilcoxon Signed Ranks Test (2 tailed), N=64) across the experimental conditions (see also Appendix 4, Table 4.2):

- The computer-based "on-screen text" / "on-screen exercise" version of this material offered me a challenge
- I got the chance, within the computer-based "on-screen text" / "on-screen exercise"version of this material, to apply my learning to solving problems or taking decisions
- I found the tasks set in the computer-based "on-screen text" / "on-screen exercise" version of this material interesting
- The computer-based "on-screen text" / "on-screen exercise" version of this material inspired me to think about the material I had previously covered
- The computer-based feedback from the "on-screen text" / "on-screen exercise" version of this material helped me check that I was really learning
- The computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to demonstrate my competency at the activity concerned
- The computer-based "on-screen text" / "on-screen exercise" version of this material made me curious to see the outcomes from my decisions
- The computer-based "on-screen text" / "on-screen exercise" version of this material, which allowed me to feel as though I was really there in the scenario
- The computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to choose which element of this computer-based material I looked at next
- I could use this computer-based "on-screen text" / "on-screen exercise" version of this material to check how the experts would do things
- I could choose my own pathway through this computer-based "on-screen text" / "on-screen exercise" version of this material
- There was an element of humour in this computer-based "on-screen text" / "on-screen exercise" version of this material

- The humour element in this computer-based "on-screen text" / "on-screen exercise" version of this material increased my sense of engagement
- The game element in this computer-based "on-screen text" / "on-screen exercise" version of this material increased my level of engagement
- The context of this computer-based "on-screen text" / "on-screen exercise" version of this material was realistic in that it reflected real life situations
- The context of this computer-based "on-screen text" / "on-screen exercise" version of this material was meaningful for me (I found I could relate to it)
- I find this computer-based "on-screen text" / "on-screen exercise" version of this material makes the situations and examples used realistic
- Text in this computer-based "on-screen text" / "on-screen exercise" version of this material was easy to read on screen
- This computer-based "on-screen text" / "on-screen exercise" version of this material made me want to keep on working beyond the time I had intended
- Information was easy to find throughout this computer-based "on-screen text" / "on-screen exercise" version of this material
- The screen display for this computer-based "on-screen text" / "on-screen exercise" version of this material was not cluttered
- I found the colours used in displaying this computer-based "on-screen text" / "on-screen exercise" version of this material were appropriate
- The interface for this computer-based "on-screen text" / "on-screen exercise" version of this material was easy to use
- I felt as though I was actively learning from this computer-based "on-screen text" / "on-screen exercise" version of this material
- The interface helped me to spot my errors when using this computer-based "on-screen text" / "on-screen exercise" version of this material
- The interface helped me to reason about what caused my errors when using this computer-based "on-screen text" / "on-screen exercise" version of this material
- This computer-based "on-screen text" / "on-screen exercise" version of this material helped me to correct any errors I made
- This computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to make use of what I already knew

- This computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to learn by thinking and reasoning
- This computer-based "on-screen text" / "on-screen exercise" version of this material encouraged me to improvise when trying to solve problems or take decisions
- When using this computer-based "on-screen text" / "on-screen exercise" version of this material I had to identify problems then solve them
- I had to sort out relevant from irrelevant when trying to solve problems or take decisions using this computer-based "on-screen text" / "on-screen exercise" version of this material
- This computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to explore from a number of perspectives
- This computer-based "on-screen text" / "on-screen exercise" version of this material maintained the complexity of the real world
- This computer-based "on-screen text" / "on-screen exercise" version of this material encouraged me to reflect on a range of learning when attempting to solve problems
- Assessment was integrated within this computer-based "on-screen text" / "on-screen exercise" version of this material
- This computer-based "on-screen text" / "on-screen exercise" version of this material offered the opportunity for me to defend my views / opinions developed
- My understanding of the issues has changed having worked through this computer-based "on-screen text" / "on-screen exercise" version of this material
- This computer-based "on-screen text" / "on-screen exercise" version of this material contained too much on-screen text
- I find myself wanting to read this computer-based "on-screen text" / "on-screen exercise" version of this material from a print out, rather than on-screen
- I would have been better off reading a book than using this computer-based "on-screen text" / "on-screen exercise" version of this material
- I worked through all the elements of this computer-based "on-screen text" / "on-screen exercise" version of this material
- I was unsure what I should do when using the interactive elements of this computer-based "on-screen text" / "on-screen exercise" version of this material (ie the instructions were not clear)

- The interactive elements in this computer-based "on-screen text" / "on-screen exercise" version of this material helped my understanding
- The look of the screen displays in this computer-based "on-screen text" / "on-screen exercise" version of this material helped motivate me
- The presentation of this computer-based "on-screen text" / "on-screen exercise" version of this material is better than other computer-based material I've used
- The presentation of this computer-based "on-screen text" / "on-screen exercise" version of this material is as good as other computer-based material I've used
- The presentation of this computer-based "on-screen text" / "on-screen exercise" version of this material is not as good as other computer-based material I've used
- The on-screen feedback provided helps me check I'm learning from this computer-based "on-screen text" / "on-screen exercise" version of this material
- I'm not sure whether I'm learning what I should from this computer-based "on-screen text" / "on-screen exercise" version of this material
- I found this computer-based "on-screen text" / "on-screen exercise" version of this material allowed me to practice doing the things I needed to do
- I found this computer-based "on-screen text" / "on-screen exercise" version of this material engaging to the point where I kept trying to solve the problems or make the decisions
- I found the on-screen feedback in this computer-based "on-screen text" / "on-screen exercise" version of this material made me actively think about my decisions
- Having video clips increased my engagement with this computer-based "on-screen text" / "on-screen exercise" version of this material
- Having high quality images helped my understanding of this computer-based "on-screen text" / "on-screen exercise" version of this material
- Having high quality images increased my engagement with this computer-based "on-screen text" / "on-screen exercise" version of this material

There were 8 items for which no significant difference was found (see Appendix A4.3):

The first item relates to the issue of choosing what to look at next within the exercise material. Given that the scenario concerned had to be viewed sequentially this would not have been a subject requiring careful thought prior to continuing with the exercise in this case.

The second item relates to the learner having personal control over the pace at which they progressed though the exercise. The exercise in this case was largely controlled by the speed of the video clip concerned, while the text version would be influenced directly by the learner's speed of reading. The learners could not particularly influence the pace of working through the video clip, but it might be considered that they could have adjusted their speed of reading. This however might have required skimming and may have been considered by the respondents not to have been an option for the exercise concerned.

The third item, as with the first item with no significant difference in the SEI Case Study, relates to the issue of getting lost when navigating through the computer-based material. The fact that similar responses were obtained for this item is likely to reflect the brief nature of the subset of material used, in that there was possibly insufficient material for this issue to arise. This might be further addressed by re-running such an investigation with the complete package, which would not have been possible within the circumstances of this research.

The fourth item, as with the second item with no significant difference in the SEI Case Study, relates to the retrieval capability had the learner become lost. As with the third item, it is likely that the subset of material used was insufficient for this issue to arise. Again this might be addressed by using the complete package for this element of the investigation.

The fifth item, as with the third item with no significant difference in the SEI Case Study, relates to the learner's view being influenced by prior experience of computer-based material. This merely indicates that the views expressed have been influenced to the same extent, irrespective of the condition in which the presentation took place. It is not clear from this result alone whether there has been influence of prior experience or not, merely that any influence relating to such, appears not to differ significantly in relation to the condition of presentation.

The sixth and seventh items refer to the use of voice over material aiding the learner's understanding of, or engagement with, the exercise. The results might have been expected to be more favourable to the voice over element. However it may be that the respondents consider the content of the voice over material to be stating what they might consider obvious, therefore not adding any more than text material stating the obvious.

The eighth item refers to the use of character voices in the exercise material aiding the learner's engagement with the exercise. The results might have been expected to be more favourable to the character voices element. However it may be that the respondents consider their engagement level is determined by factors other than the voices, such as the relevance of the material. This would be the same for the multi-media and the text based versions of the exercise. This of course is likely to relate to the approach taken to learning.

4.8 Statistical Analyses of Questionnaire Results Obtained in SEI Case Study

The intention underlying the use of questionnaires was to enable data to be gathered from large numbers of learners at a number of points over the semester. It was considered that this would enable some further understanding to be gained of the impact of using the material and any changes in perception, on the part of the learner, over time. It was also considered that some further understanding might be gained regarding any shifts in perception between the cohorts over time, spanning the range of semesters covered.

The initial questionnaires were restricted due to circumstantial factors and contained items considered to be of dual use, meaning of use to the "department" and also of use for this research. The questionnaires were further developed on an on-going basis, becoming more focussed on issues of particular interest for this research. The advantages of this approach were considered to be the flexibility it offered for emergent factors to be addressed and further understanding of such to be gained. However the trade off was that the level of standardisation possible within the questionnaires was reduced.

It had been initially assumed that the learners who elected to respond to the questionnaires would respond to all batches issued within the semester concerned. This was based on the premise that all students would attend the scheduled lab sessions. In reality this did not happen.

The impact of such attendance variability has resulted in greatly reduced numbers of respondents for whom comparisons over time may be appropriately made.

The dual impact of the organic nature of questionnaire design employed and the variability in respondents over time has limited the numbers of responses which may be appropriately compared. Comparisons over time may only be made where the respondents have completed the required sequence of questionnaires and where the items within the questionnaires concerned are the same in each of the questionnaires.

The dual impact of these issues has been such that comparisons of overall responses at the level of response frequencies has been possible for all entrance, midpoint, and exit batches over all semesters, but any further statistical analysis has been more restricted.

4.8.1 Investigation of Patterns over Time: Changes in "Population" and "Individual" Perception of Computer-Based Material over Time

It was considered that changes in the expressed perception of the computer-based material over time would be reflected in differences in the responses obtained from the sample, and from individuals within the samples, investigated in the entrance, midpoint and exit questionnaires.

It was considered that the use of the computer-based material itself would be likely to impact on the expressed perceptions of the material concerned. It was considered that this would be reflected in the ratings given by those sampled regarding the material at the entrance, midpoint and exit sampling stages.

It was also considered that experience with computer-based materials generally might be reflected in the responses given.

In attempting to identify changes in the general perception over time it was considered that the responses obtained from unrelated respondents at each of the sample points would provide evidence of any impact on the sample, and therefore the root population, of using the materials over time.

This was tested using the Kruskal Wallis H Test, on unrelated subjects.

In attempting to identify changes in the individual's perception over time it was considered that the responses obtained from related respondents at each of the sample points would provide evidence of any impact on the individuals, of using the materials over time.

It was considered that where the use of the material impacted the sample of respondents in a particular way, this would be reflected in a change of expressed perception of the material over time, in a particular direction. It was anticipated that their expressed views would be more favourable regarding specific elements within the material where the impact had been highly positive and less favourable where the impact had been highly negative. This was tested using the McNemar Test, on related subjects.

4.8.2 Response Patterns as Reflected in Correlations of "Individual" Perceptions

It was considered that there might be patterns found in the responses obtained, which might help clarify the importance for learners, of given elements, or combinations of elements, within the computer-based material.

It was considered that there might be correlations between views expressed in relation to given elements by the respondents sampled.

It was also considered that the responses obtained regarding the computer-based material might be correlated to the individual's preferred approach to learning, or their learning style.

While any correlations found would not in themselves indicate causality, it was considered that these might be used as indicators of areas which might be further explored using the open responses obtained in questionnaires and interviews. Correlation was tested using Kendall's Tau, on related subjects.

4.8.3 Investigation of Differences in Responses

Kruskal-Wallis H

The Kruskal-Wallis H Test was used to test whether several independent samples were from the same population by comparing three batches of data gathered by variable (item). The Kruskal-Wallis test was selected as an appropriate test to check whether there was a significant difference in the medians of the populations (batches) sampled. This was used to test whether any of the batches of data had a higher median than another and for the purposes of this research was considered to enable a conclusion to be drawn as to whether the impact on the learner of using the computer based material could be considered to have increased, or decreased over time. Tests for differences in response between batches were also conducted using the Kruskal-Wallis Test (see Table 4.12).

Table 4.12: Kruskal-Wallis H Test Summary Table

Questionnaire Items	**Test Used**	**Batches Used**	**Result of Test**
Learner confidence	Kruskal-Wallis	Entrance v Midpoint v Exit across semesters	Significant Differences were found for all units with the exception of units 5 (Market Research and Sources) and 7 (Finance Issues)
Content appropriateness	Kruskal-Wallis	Entrance v Midpoint v Exit across semesters	No Significant Differences
Preferred Environment	Kruskal-Wallis	Entrance v Midpoint v Exit across semesters	No Significant Differences
Ratings of elements	Kruskal-Wallis	Midpoint v Exit across semesters	No Significant Differences
Responses to viewpoint statements	Kruskal-Wallis	Midpoint v Exit semester 1 & 2 1999 to 2000	Significant Differences 1 – learning summaries increased depth of thought 2- prefer more face to face contact with class tutor

The results of the Kruskal-Wallis test indicate that the responses regarding preferred environment, and ratings of elements, may be considered to be from the same population, which is also the case with regard to the viewpoint statements (with the exception of two items).

4.8.4 Investigation of Changes in Responses over Time

The McNemar test

The McNemar test was selected as an appropriate test to check whether the level of "mind changing" in a particular direction, or directional shifts in viewpoints, expressed by learners, was greater than that which might have been expected by chance. This was considered to enable a conclusion to be drawn regarding the impact of using the material on the viewpoints expressed. Tests for differences in response over time were conducted with respect to the items in the table below. These were conducted using the responses from the same respondents (related) only, at entrance, midpoint, and exit (see Table 4.13).

Table 4.13: McNemar Test Summary Table

Questionnaire Items	Test Used	Batches Used	Result of Test
Preferred Environment	**McNemar Test**	**Entrance v Midpoint v Exit across semesters**	
		Entrance Q14 v Midpoint Q15	No Significant Differences
		Midpoint Q15 v Exit Q16	No Significant Differences
		Entrance Q14 v Exit Q16	No Significant Differences
		Entrance Q17 v Exit Q19	No Significant Differences
Ratings of Elements	**McNemar Test**	**Midpoint v Exit across semesters**	
		Midpoint Q6 v Exit Q7	No Significant Differences
		Midpoint Q9 v Exit Q10	No Significant Differences
		Midpoint Q12 v Exit Q13	No Significant Differences
		Midpoint Q15 v Exit Q16	No Significant Differences
Responses to Viewpoint Statements	**McNemar Test**	**Midpoint v Exit across semesters**	
		Midpoint Q15 v Exit Q16	No Significant Differences

The results indicate that the viewpoint held by the respondents has not shifted in a particular direction between the midpoint and exit point questionnaires. This would suggest that the use of this material has not had sufficient impact on the respondents to cause their views to change in a particular direction.

4.8.5 Investigation of Correlation in Responses

Kendall's tau-b

The more common test for correlation may be considered to be Spearman's rho, but Kendall's tau was considered to offer a more generally applicable test and therefore to be more suitable in this instance. Kendall's tau-b was considered more appropriate as it placed few requirements on the nature of the population from which the data had been gathered, given that it estimates the probability that two observations are concordant or discordant

The responses at entrance, midpoint and exit were tested for correlation using Kendall's Tau. Tests were conducted using the responses from the same respondents (related) only (see Table 4.13).

Correlation Results: Kendall's Tau

Table 4.14: Batches Used in Correlation Calculations

Questionnaire Items: Preferred Environment
Batches Used : Entrance v Midpoint v Exit across semesters
Entrance Q14 Only (Sem 1 1999-2000)
Midpoint Q15 Only (Sem 1 1999-2000)
Entrance Q14 v Midpoint Q15 (Sem 1 1999-2000)
Midpoint Q15 v Exit Q16 (Sem 1 1999-2000)
Entrance Q14 v Exit Q16 (Sem 1 1999-2000)
Entrance Q17 Only (Sem 2 1999-2000)
Entrance Q17 v Exit Q19 (Sem 2 1999-2000)

(Note: Q refers to Questionnaire Number)

Questionnaire Items: Ratings of Elements
Batches Used: Midpoint v Exit across semesters
Midpoint Q6 Only (Sem 2 1997-1998)
Exit Q7 Only (Sem 2 1997-1998)
Midpoint Q6 v Exit Q7 (Sem 2 1997-1998)
Midpoint Q9 Only (Sem 1 1998-1999)
Exit Q10 Only (Sem 1 1998-1999)
Midpoint Q9 v Exit Q10 (Sem 1 1998-1999)
Midpoint Q12 Only (Sem 2 1998-1999)
Exit Q13 Only (Sem 2 1998-1999)
Midpoint Q12 v Exit Q13 (Sem 2 1998-1999)
Midpoint Q15 Only (Sem 1 1999-2000)
Exit Q16 Only (Sem 1 1999-2000)
Midpoint Q15 v Exit Q16 (Sem 1 1999-2000)

(Note. Q refers to Questionnaire Number)

Questionnaire Items: Ratings of Viewpoint Statements
Batches Used
Midpoint Q15 Only (Sem 1 1999-2000)
Exit Q16 Only (Sem 1 1999-2000)
Midpoint Q15 v Exit Q16 (Sem 1 1999-2000)

(Note Q refers to Questionnaire Number)

Questionnaire Items: Approaches to Learning (ASSIST) Correlations Q15 v Midpoint Q15 Significant Correlations
Batches Used
Midpoint Q15 Only (Sem 1 1999-2000)

(Note: Q refers to Questionnaire Number)

The results indicate that a number of responses to questionnaire items are correlated with the responses given to other questionnaire items. The results indicate the direction of the correlation, which enables a conclusion to be drawn regarding the potential relationship between the items, as perceived by the respondents. This enables an overview to be gained of the possible relationships between the elements within the computer-based material and their perceived impact on the learner using the material. This enables a focussed interrogation of the open responses obtained, thereby offering the possibility of determining underlying reasons for the perceptions regarding the items for which correlations were identified.

The significant correlations found are presented below by order of topic addressed (see also Appendix 3.29).

Preferred Environment

Significant negative correlations were found between ratings of

- electronic book and game approach (Q14 (0.047), Q15 (0.047))

Significant positive correlations were found between ratings of

- simulated environment and combination environment (Q14 (0.002), Q15 (0.002))
- game approach and simulated environment (Q17 (0.044))
- simulated environment and simulated environment (Q14 v Q16 (0.025))

The significant correlations obtained indicate that:

In the Semester 1 1999 to 2000 cohort:

Those who rated:

- simulated environment highly at entrance also rated a combination environment highly at entrance
- game approach highly at entrance also rated the electronic book approach lowly at entrance
- simulated environment highly at the entrance point also rated a simulated environment highly at the exit point.
- game approach highly at mid-point also rated the electronic book approach lowly at mid-point
- simulated environment highly at exit also rated a combination environment highly at exit

In the Semester 2 1999 to 2000 cohort:

Those who rated:

- simulated environment highly at entrance also rated a game approach highly at entrance

Elements

Main Text Windows

Significant positive correlations were found between the ratings of

- main text windows at midpoint and exit (Q9 v Q10 (0.007), Q12 v Q13 (0.036))

Main Text Windows and Navigation

Significant positive correlations were found between the ratings of

- main text windows, the "navigation feet" Q7 (0.046), Q15 (0.031) and buttons (, Q12 (0.036))

Main Text Windows and On-Screen Interactive Exercises

Significant positive correlations were found between the ratings of the main text windows and

- interactive exercises ratings (Q12 (0.046))

- text used in the on-screen exercises ratings (Q12 (0.019))
- difficulty of exercises ratings (Q13 (0.046))

Significant negative correlations were found between the ratings of the main text windows and

- tasks specified ratings (Q16 (0.042))

The significant correlations obtained indicate that:

In the Semester 2 1997 to 1998 cohort:

Those who rated:

- text windows highly at exit also rated the navigation feet highly at exit.

In the Semester 1 1998 to 1999 cohort:

Those who rated:

- text windows highly at midpoint also rated text windows highly at the exit

In the Semester 2 1998 to 1999 cohort:

Those who rated:

- text windows highly at midpoint also rated the buttons, exercises, and text used in exercises, highly at midpoint.
- text windows highly at midpoint also rated text windows highly at the exit
- text windows highly at midpoint also rated the text windows highly at exit.
- text windows highly at exit also rated the difficulty level of the exercises highly at exit

In the Semester 1 1999 to 2000 cohort:

Those who rated:

- text windows highly at midpoint also rated the navigation feet highly at the midpoint.
- text windows highly at exit also rated the tasks specified in the exercises lowly at exit

Navigation / Usability

Hypertext Links

Significant positive correlations were found between the ratings of

- hypertext links at midpoint and the hypertext links at exit (Q9 v Q10 (0.019), Q12 v Q13 (0.042))
- hypertext links and the colours used in exercises (Q9 (0.006)

Hypertext Links and Text in Exercises

Significant positive correlations were found between the ratings of

- hypertext links and the text used in exercises (Q9 (0.005)

Hypertext Links and Button Links

Significant positive correlations were found between the ratings of

- hypertext links, button links and navigation feet (Q12 (0.012), Q13 (0.018), Q13 (0.001))

Hypertext Links and Maps

Significant positive correlations were found between the ratings of

- hypertext links and main map (Q13 (0.012), (Q16 (0.033))
- hypertext links and structure map (Q13 (0.001)

Hypertext Links and Exercises

Significant positive correlations were found between the ratings of

- interactive exercises at midpoint and the hypertext links at midpoint (Q15 (0.049))
- notepad exercises at midpoint and the hypertext links at midpoint (Q15 (0.022))

Navigation "Feet" / Button Links and Maps

Significant positive correlations were found between the ratings of

- navigation feet at midpoint and the navigation feet at exit (Q6 v Q7 (0.028), Q9 v Q10 (0.017))
- links at midpoint and the button links at exit (Q9 v Q10 (0.026))

- navigation feet and the structure map (Q13 (0.001))
- navigation feet and hypertext links (Q13 (0.018))
- navigation feet and button links (Q13 (0.009))
- navigation feet and the structure map (Q9 (0.034))
- button links and the main map (Q10 (0.040))
- button links and structure map (Q13 (0.005))
- button links and the text used in exercises (Q10 (0.043), Q12 (0.010))
- "feet" buttons (Q13 (0.034)) and the text used in exercises

Navigation "Feet" / Buttons, Exercises, Graphics and Colour

Significant positive correlations were found between the ratings of

- graphics used and the navigation feet (Q6 (0.009), Q10 (0.004))
- button links and the graphics used in exercises (Q12 (0.025), Q13 (0.016))
- colours used in the interactive exercises and the navigation feet ratings (Q6 (0.024), Q10 (0.002))
- button links and the colours used (Q10 (0.044), Q12 (0.032), Q13 (0.003))

Navigation "Feet" / Buttons and Exercises

Significant positive correlations were found between the ratings of

- interactive exercises and the navigation feet (Q9 (0.015))
- interactive exercises and the button links (Q10 (0.006))
- Café Poirot exercise and the button links (Q10 (0.043))
- business plan evaluation and the button links (Q9 (0.039))
- navigation feet and the relevance of exercises (Q9 (0.038), Q10 ((0.036), Q13 (0.002))
- button links and the scenarios used in exercises (Q9 (0.028)
- button links and tasks specified (Q13 (0.043))
- notepad exercises and button links (Q13 (0.005))
- business plan evaluation and the navigation feet (Q16 (0.025)
- button links and the feedback given in exercises (Q10 (0.040), Q9 (0.019))

Navigation Maps

Significant positive correlations were found between the ratings of

- main map at midpoint and the main map at exit (Q9 v Q10 (0.002), Q12 v Q13 (0.023))
- main map and the structure map (Q12 (0.008), Q13 (0.003), Q15 (0.007), Q16 (0.047))
- main map and the text used in exercises Q15 (0.043)
- structure map and the text used in exercises (Q12 (0.036), (Q15 (0.043))
- structure map and the interactive exercises (Q9 (0.025))
- business plan evaluation and the structure map (Q9 (0.029), Q12 (0.012))
- Café Poirot exercise and the structure map (Q12 (0.019))
- notepad exercises and the main map (Q13 (0.010)
- notepad exercises and the structure map (Q13 (0.007),
- main map and the scenarios used in exercises (Q15 (0.034)
- structure map and the scenarios used in exercises (Q9 (0.013), Q15 (0.034))
- structure map and tasks specified in exercises (Q13 (0.030)
- structure map and the relevance of exercises to module ratings (Q9 (0.006), Q13 (0.046))
- main map and the difficulty of exercises (Q16 (0.030)
- main map and the feedback given in exercises (Q16 (0.044))
- learning summaries and the structure map (Q12 (0.018)

Significant negative correlations were found between the ratings of

- main map and the learning summaries (Q6 (0.045)

Navigation Maps, Colour, Graphics and Exercises

Significant positive correlations were found between the ratings of

- structure map and colours used in exercises (Q13 (0.012))
- main map and the graphics used (Q9 (0.047)
- structure map and interactive exercises (Q6 (0.027))

Navigation Sub Windows: "History and Glossary"

Navigation "Feet" / Buttons and Sub Menu Windows

Significant positive correlations were found between the ratings of

- glossary window and button links (Q13 (0.043))
- history window and button links (Q13 (0.035))

Significant positive correlations were found between the ratings of

- history window and the glossary window (Q9 (0.008), (Q10 (0.039), Q12 (0.048), Q15 (0.034))
- history window at midpoint and the history window at exit (Q12 v Q13 (0.021))

Significant negative correlations were found between the ratings of

- the glossary window at midpoint and the glossary window at exit (Q6 v Q7 (0.027))

Navigation Sub Windows and Button Links

Significant positive correlations were found between the ratings of

- button links and the glossary window (Q9 (0.026), Q12 (0.017))

Navigation Sub Windows and Maps

Significant positive correlations were found between the ratings of

- the glossary window and the main map (Q16 (0.018))

Navigation Sub Windows and Graphics

Significant positive correlations were found between the ratings of

- the glossary window and the graphics used in exercises (Q9 (0.032)

Navigation Sub Windows and Colours

Significant positive correlations were found between the ratings of

- the glossary window and the colours used (Q12 (0.047))

Navigation Sub Windows and Exercises

Significant positive correlations were found between the ratings of

- the Café Poirot exercise and the history window (Q10 (0.006))
- the interactive exercises and the history window (Q15 (0.031)),
- the history window and the difficulty of exercises (Q15 (0.032))
- the ratings of the interactive exercises and the glossary window (Q15 (0.040))
- the glossary window and the scenarios used in exercises (Q12 (0.012)
- the ratings of the notepad exercises and the glossary window (Q13 (0.027))
- the learning summaries and the glossary window (Q16 (0.046))

Significant negative correlations were found between the ratings of

- business plan evaluation and the history window (Q7 (0.049)

Navigation Sub Windows and Difficulty of Exercises

Significant positive correlations were found between the ratings of

- the glossary window and the difficulty of exercises (Q16 (0.032)

Navigation Sub Windows and Feedback

Significant positive correlations were found between the ratings of

- the glossary window and the feedback given (Q12 (0.009)
- the history window and the feedback given in exercises (Q16 (0.046))

The significant correlations obtained indicate that:

In the Semester 2 97/98 cohort:

Those who rated:

- navigation feet highly at midpoint also rated the graphics and colours used in exercises highly at midpoint
- structure map highly at midpoint also rated the exercises highly at midpoint
- main map lowly at midpoint also rated the learning summaries highly at midpoint
- history sub-window lowly at midpoint also rated the business plan evaluation exercise highly at midpoint

- glossary sub-window lowly at midpoint also rated the glossary sub-window highly at exit
- navigation feet highly at midpoint also rated the navigation feet highly at exit.

In the Semester 1 98/99 cohort:

Those who rated:

- hypertext links highly at midpoint also rated the colours and the text used in exercises highly at midpoint
- navigation feet highly at midpoint also rated the structure map, the exercises and the relevance of the exercises highly at midpoint.
- button links highly at midpoint also rated the main map, the business plan evaluation, the scenarios used in exercises and the feedback given in exercises highly at midpoint
- main map highly at midpoint also rated the graphics used in the exercises highly at midpoint
- glossary sub-window highly at midpoint also rated the history window, button links and the graphics used in exercises highly at midpoint
- structure map highly at midpoint also rated the exercises, the scenarios used in the exercises, the relevance of the exercises and the business plan evaluation exercise highly at midpoint
- hypertext links, navigation feet, button links and main map highly at midpoint also rated them highly at exit
- navigation feet highly at exit also rated the colours and graphics used in the exercises highly at exit
- button links highly at exit also rated the exercises, the colours used in the exercises, the feedback given in the exercises, the relevance of the exercises and the Café Poirot problem solving exercise highly at exit
- glossary sub-window highly at exit also rated the history sub-window highly at exit
- history sub-window highly at exit also rated the Café Poirot problem solving exercise highly at exit

In the Semester 2 98/99 cohort:

Those who rated:

- hypertext links highly at midpoint also rated the button links highly at midpoint
- button links highly at midpoint also rated the text, graphics and colours used in exercises highly at midpoint
- structure map highly at midpoint also rated the main map, text used in exercises, business plan evaluation exercise, Café Poirot problem solving exercise and learning summaries highly at midpoint
- glossary sub-window highly at midpoint also rated the history sub-window, button links, colours used in exercises, scenarios used in exercises and feedback given in exercises highly at midpoint
- hypertext links highly at midpoint also rated the hypertext links highly at exit
- history sub-window highly at midpoint also rated the history sub-window highly at exit
- hypertext links highly at exit also rated the button links, navigation feet, main map and structure map highly at exit
- button links highly at exit also rated the structure map, notepad exercises, colours used and tasks specified in exercises highly at exit
- navigation feet highly at exit also rated the hypertext links, button links, structure map, text used in exercises and relevance of exercises highly at exit
- main map highly at exit also rated the notepad exercises highly at exit
- structure map highly at exit also rated the main map, notepad exercises, tasks specified in exercises, relevance of exercises and colours used in exercises highly at exit
- glossary sub-window highly at exit also rated the notepad exercises highly at exit.

In the Semester 1 99/00 cohort:

Those who rated:

- hypertext links highly at midpoint also rated the exercises and notepad exercises highly at midpoint
- main map highly at midpoint also rated the scenarios used in exercises and text used in exercises highly at midpoint
- structure map highly at midpoint also rated the main map, text used in exercises and scenarios used in exercises highly at midpoint

- history sub-window highly at midpoint also rated the glossary sub-window, the exercises and the difficulty level of the exercises highly at midpoint
- glossary sub-window highly at midpoint also rated the exercises highly at midpoint
- hypertext links highly at exit also rated the main map highly at exit
- navigation feet highly at exit also rated the business plan evaluation highly at exit
- main map highly at exit also rated the feedback given in exercises and the difficulty level of exercises highly at exit
- structure map highly at exit also rated the main map highly at exit
- glossary sub-window highly at exit also rated the main map, the learning summaries and the difficulty of the exercises highly at exit
- history sub-window highly at exit also rated the feedback given in the exercises highly at exit.

Exercises

Significant positive correlations were found between the ratings of

- the interactive exercises and the Café Poirot exercise (Q6 (0.034), Q13 (0.044))
- the interactive exercises and the business plan evaluation (Q9 (0.014)
- the ratings of the interactive exercises at midpoint and the interactive exercises at exit (Q6 v Q7 (0.016))
- the learning summaries at midpoint and the learning summaries at exit (Q6 v Q7 (0.014), Q9 v Q10 (0.004)),
- the notepad exercises at midpoint and the notepad exercises at exit (Q12 v Q13 (0.038))
- the interactive exercises at midpoint and the interactive exercises at exit (Q9 v Q10 (0.027), Q12 v Q13 (0.000))
- the business plan evaluation at midpoint and the business plan evaluation at exit (Q12 v Q13 (0.022)),
- the Café Poirot exercise and the business plan evaluation (Q16 (0.01)

Significant negative correlations were found between the ratings of

- the notepad exercises and the Café Poirot exercise (Q10 (0.023)

Exercises and Visual Element (look) of Windows

Significant positive correlations were found between the ratings of

- the visual element (look) of windows and the learning summaries (Q15 (0.036))
- the visual element (look) of windows and the scenarios used in exercises (Q15 (0.034))
- the visual element (look) of windows and the Café Poirot exercise (Q16 (0.030))

Exercises and Text

Significant positive correlations were found between the ratings of

- the interactive exercises and the text used in exercises (Q9 (0.012)
- Café Poirot Exercise and the text used in exercises (Q9 (0.048), Q16 (0.030))
- business plan evaluation and the text used in exercises (Q9 (0.035), Q12 (0.030) , Q16 (0.030))
- scenarios used in exercises and the text used in exercises (Q9 (0.006), Q10 (0.005), Q12 (0.047), Q15 (0.020))
- text used in exercises and the tasks specified in exercises (Q9 (0.003), Q12 (0.014))
- text used in exercises and the feedback given in exercises (Q9 (0.007), Q10 (0.012), Q12 (0.004))
- text used in exercises and the difficulty of exercises (Q9 (0.021))
- the notepad exercises and the text used in exercises (Q12 (0.007), Q13 (0.048))

Exercises and Tasks

Significant positive correlations were found between the ratings of

- the interactive exercises and the tasks specified in the exercises (Q7 (0.049), Q13 (0.036)
- the tasks specified and the notepad exercises (Q6 (0.046)
- the ratings of the scenarios used in exercises and the tasks specified in exercises (Q12 (0.007)
- the tasks specified in exercises and relevance of exercises (Q7 (0.045), Q10 (0.013)

Exercises and Scenarios

Significant positive correlations were found between the ratings of

- the scenarios used in exercises at midpoint and the scenarios used at exit (Q6 v Q7

(0.045), Q12 v Q13 (0.006)),

- the interactive exercises and the scenarios used (Q7 (0.049), Q9 (0.001)
- the Café Poirot Exercise and the scenarios used in exercises (Q9 (0.008)
- business plan evaluation and the scenarios used in exercises (Q9 (0.010)
- the notepad exercises and the scenarios used (Q12 (0.037))
- the scenarios used in exercises and the tasks specified in exercises (Q9 (0.010)
- the scenarios used in exercises and the relevance of exercises (Q9 (0.015), Q10 (0.017)
- the scenarios used in exercises and the difficulty of exercises (Q10 (0.044)

Exercises and Relevance

Significant positive correlations were found between the ratings of

- relevance in exercises at midpoint and relevance in exercises at exit (Q6 v Q7 (0.014)
- the interactive exercises and relevance (Q7 (0.016), Q13 (0.002)
- Café Poirot exercise and relevance of exercises (Q13 (0.033))
- the relevance of exercises and the tasks specified in exercises (Q6 (0.027),
- the relevance of exercises and the difficulty of exercises (Q10 (0.031))
- relevance of exercises and the scenarios used (Q13 (0.033)
- feedback given and relevance (Q13 (0.012))

Exercises and Difficulty

Significant positive correlations were found between the ratings of

- the difficulty of exercises at midpoint and the difficulty of exercises at exit (Q9 v Q10 (0.013), Q6 v Q7 (0.020)),
- the interactive exercises and the difficulty of exercises (Q10 (0.046)),
- the difficulty of exercises and the notepad exercises (Q6 (0.01), Q7 (0.034)
- tasks specified in exercises and the difficulty of exercises (Q9 (0.010)),
- difficulty of exercises and the feedback given in exercises (Q6 (0.012))

Significant negative correlations were found between the ratings of

- the notepad exercises and the difficulty of exercises ratings (Q9 (0.039)

Exercises and Feedback

Significant positive correlations were found between the ratings of

- the feedback given in exercises and the difficulty of exercises ratings (Q10 (0.048))
- business plan evaluation and the feedback given in exercises (Q9 (0.014))
- the scenarios used in exercises and the feedback given in exercises (Q9 (0.031), Q12 (0.039)),
- the tasks specified in exercises and the feedback given in exercises (Q9 (0.008), Q12 (0.003)),
- the feedback given in exercises and the relevance of exercises (Q9 (0.006))
- the Café Poirot exercise and the feedback given in exercises (Q10 (0.036)

Exercises and Use of Colour

Significant positive correlations were found between the ratings of

- the colours used in exercises at midpoint and the colours used in exercises at exit (Q12 v Q13 (0.004)
- the colours used in exercises and the graphics used in exercises (Q6 (0.036), (Q7 (0.01), (Q9 (0.001) , (Q10 (0.002), (Q12 (0.000)
- the notepad exercises and the colours used in exercises (Q12 (0.005), (Q13 (0.007)
- the colours used in exercises and the text used in exercises (Q12 (0.034)
- the colours used in exercises and the scenarios used in exercises (Q10 (0.017), (Q12 (0.000),
- the colours used in exercises and the relevance of exercises (Q10 (0.007)
- the colours used in exercises and the tasks specified in exercises (Q12 (0.041)

Exercises and Use of Graphics

Significant positive correlations were found between the ratings of

- the graphics used in exercises at midpoint and the graphics used in exercises at exit (Q12 v Q13 (0.005)
- the graphics used in exercises and the difficulty of exercises (Q15 (0.020)
- notepad exercises and the graphics used (Q12 (0.011), (Q13 (0.013)
- graphics used in exercises and the scenarios used in exercises (Q12 (0.000), (Q15 (0.045)

- the graphics used in exercises and the tasks specified in exercises (Q12 (0.042)
- the graphics used in exercises and the business plan evaluation exercise (Q16 (0.033)
- the graphics used in exercises and the Café Poirot exercise (Q16 (0.033)

The significant correlations indicate that:

In the Semester 2 97/98 cohort:

Those who rated:

- exercises highly at midpoint also rated the Café Poirot problem solving exercise highly at midpoint
- relevance of exercises highly at midpoint also rated the tasks specified in exercises highly at midpoint
- difficulty of exercises highly at midpoint also rated the feedback given in exercises and Notepad Exercises highly at midpoint
- tasks specified in exercises highly at midpoint also rated the Notepad exercises highly at midpoint
- graphics in exercises highly at midpoint also rated the colours used in exercises highly at midpoint
- exercises highly at midpoint also rated the exercises highly at exit
- relevance of exercises highly at midpoint also rated the relevance of exercises highly at exit
- scenarios used in exercises highly at midpoint also rated the scenarios used in exercises highly at exit
- difficulty of exercises highly at midpoint also rated the difficulty of exercises highly at exit
- learning summaries highly at midpoint also rated the learning summaries highly at exit
- exercises highly at exit also rated the scenarios used, tasks specified and relevance in exercises highly at exit
- relevance of exercises highly at exit also rated the tasks specified in exercises highly at exit

In the Semester 1 98/99 cohort:

Those who rated:

- exercises highly at midpoint also rated the scenarios used in exercises, text used in exercises and the business plan evaluation exercise highly at midpoint
- relevance of exercises highly at midpoint also rated feedback given, scenarios used in exercises highly at midpoint
- scenarios used in exercises highly at midpoint also rated the tasks specified , feedback given, text in exercises, business plan evaluation exercise and the Café Poirot problem solving exercise highly at midpoint
- difficulty level of exercises highly at midpoint also rated the tasks specified, the Notepad exercises and the text in exercises highly at midpoint but the Notepad exercises lowly at midpoint
- feedback given in exercises highly at midpoint also rated the business plan evaluation exercise and text in exercises highly at midpoint
- tasks specified in exercises highly at midpoint also rated the feedback given , text in exercises highly at midpoint
- Café Poirot problem solving exercise highly at midpoint also rated the text in exercises highly at midpoint
- business plan evaluation exercise highly at midpoint also rated the text in exercises highly at midpoint
- exercises highly at midpoint also rated the exercises highly at exit
- difficulty level of exercises highly at midpoint also rated the difficulty level of exercises highly at exit
- learning summaries highly at midpoint also rated the learning summaries highly at exit
- Notepad exercises lowly at midpoint also rated the Café Poirot problem solving exercise highly at exit
- exercises highly at exit also rated the difficulty level of exercises highly at exit
- Relevance of exercises highly at exit also rated the Scenarios used, tasks specified, colours used and the difficulty level of exercises highly at exit
- Scenarios used in exercises highly at exit also rated the difficulty level of exercises, colours used and the text used in exercises highly at exit

- feedback given in exercises highly at exit also rated the difficulty level, text used and the Café Poirot problem solving exercise highly at exit

In the Semester 2 98/99 cohort:

Those who rated:

- scenarios used in exercises highly at midpoint also rated the tasks specified, graphics used , colours used, text used and the Notepad exercises highly at midpoint
- feedback given in exercises highly at midpoint also rated the text used in exercises highly at midpoint
- tasks specified in exercises highly at midpoint also rated the feedback given, graphics, colours and text used in exercises highly at midpoint
- colours used in exercises highly at midpoint also rated the text used and the Notepad exercises highly at midpoint
- Notepad exercises highly at midpoint also rated the text used in exercises highly at midpoint
- business plan evaluation exercise highly at midpoint also rated the text used in exercises highly at midpoint
- exercises highly at midpoint also rated the exercises highly at exit
- scenarios used in exercises highly at midpoint also rated the scenarios used in exercises highly at exit
- colours used in exercises highly at midpoint also rated the colours used in exercises highly at exit
- graphics used in exercises highly at midpoint also rated the graphics used in exercises highly at exit
- Notepad exercises highly at midpoint also rated the Notepad exercises highly at exit
- business plan evaluation exercise highly at midpoint also rated the business plan evaluation exercise highly at exit
- exercises highly at exit also rated the relevance of exercises highly at exit
- relevance of exercises highly at exit also rated the scenarios used, feedback given and the Café Poirot problem solving exercise highly at exit
- Notepad exercises highly at exit also rated the text used in exercises highly at exit

In the Semester 1 99/00 cohort:

Those who rated:

- The visual elements of the windows highly at midpoint also rated the scenarios used in the exercises and the learning summaries highly at midpoint
- The visual elements of the windows highly at exit also rated the Café Poirot problem solving exercise highly at exit
- scenarios used in the exercises highly at midpoint also rated the graphics used, text used in the exercises highly at midpoint
- difficulty level of the exercises highly at midpoint also rated the graphics used in the exercises highly at midpoint
- Café Poirot problem solving exercise at exit also rated the graphics used and text used in exercises and the business plan evaluation exercise highly at exit
- business plan evaluation exercise at exit also rated the text used in exercises highly at exit

Viewpoint Statement Correlations

Visual Presentation

Significant positive correlations were found between the ratings of

- "I found the visual elements (look) of the windows motivating" and "The interactive exercises helped me to understand the material" (Q15 (0.045), Q16 (0.012))
- "I found the visual elements (look) of the windows motivating" and "I worked through all elements of the material " (Q16 (0.036)
- "I found the visual elements (look) of the windows motivating" and "I revisited material when I found other things related to it" (Q16 (0.030)

Exercises

Significant positive correlations were found between the ratings of

- "The interactive exercises helped me to understand the material" and "The interactive exercises helped me to understand the material" Q15 v 16 (0.032)
- "The interactive exercises helped me to understand the material " and "The on-screen feedback given for the interactive exercises helps me check I'm learning" (Q16 (0.015)

Significant negative correlations were found between the ratings of

- "I found the visual elements (look) of the windows motivating" and "The learning summaries increased my depth of thought" (Q15 (0.022)
- "The interactive exercises were not essential so I focused on other material" and "The notepad exercises increased my depth of thought" (Q15 (0.035)
- "The interactive exercises were not essential so I focused on other material" and "The on-screen feedback given for the interactive exercises helps me check I'm learning" (Q16 (0.006)
- "The on-screen feedback given for the interactive exercises helps me check I'm learning" and "I feel quite isolated when working with this computer based material" (Q16 (0.026)

Approach

Significant negative correlations were found between the ratings of

- "I revisited material when I found other things related to it" and "I'm not sure whether I'm learning what I should from this computer based material" (Q15 (0.034)

Significant positive correlations were found between the ratings of

- "Strategic Approach Adjusted" and "I found the visual elements (look) of the windows motivating" (Q15 (0.016)
- "Strategic Approach Adjusted" and "Tasks specified in self contained exercises" (Q15 (0.020)
- "Strategic Approach Adjusted" and "Deep Approach" (Q15 (0.001)

Significant negative correlations were found between the ratings of

- "Strategic Approach Adjusted" and "I would have been better reading a book" (Q15 (0.050)
- "Strategic Approach Adjusted" and "This material contained too much text" (Q15 (0.024)
- "Strategic Approach Adjusted" and "I would find more tutor input helpful" (Q15 (0.048)

Surface / Apathetic

Significant positive correlations were found between the ratings of

- "Surface Apathetic Approach" and "This material contained too much text" (Q15 (0.022)

Significant negative correlations were found between the ratings of

- "Surface Apathetic Approach" and "Interactive Exercises" (Q15 (0.048)
- "Surface Apathetic Approach" and "Feedback given in self contained exercises" (Q15 (0.042)

Assist Deep

Significant positive correlations were found between the ratings of

- "Deep Approach" and "Visual Elements (Look) of Interactive Exercises" (Q15 (0.032)
- "Deep Approach" and "Interactive Exercises" (Q15 (0.016)
- "Deep Approach" and "The interactive exercises helped me to understand the material" (Q15 (0.024)
- "Deep Approach" and "The on-screen feedback given for the interactive exercises helps me check I'm learning" (Q15 (0.006)
- "Deep Approach" and "This material is more motivating than some lectures I've experienced" (Q15 (0.029)
- "Deep Approach" and "This material is more motivating than most lectures I've experienced" (Q15 (0.006)

Significant negative correlations were found between the ratings of

- Deep Approach" and "The interactive exercises were not essential, so I focused on other material" (Q15 (0.000)

Comparison with Lecture

Significant positive correlations were found between the ratings of

- "My view of this material has been influenced by other multi-media material I've used" and "This material is more motivating than most lectures I've experienced" (Q16 (0.034)

- "This material is more motivating than most lectures I've experienced" and "I would find more tutor input helpful" (Q16 (0.042)
- "This material is more motivating than the best lectures I've experienced" and "This material is more motivating than the best lectures I've experienced" (Q15 v 16 (0.031)

Significant negative correlations were found between the ratings of

- "This material is more motivating than the best lectures I've experienced" and "I find myself wanting to read this material from a print out rather than on screen" (Q15 (0.012)

Influence of Previous Experience of Multi-Media

Significant positive correlations were found between the ratings of

- "My view of this material has been influenced by other multi-media material I've used" and "I would find more tutor input helpful" (Q16 (0.034)

Significant negative correlations were found between the ratings of

- "My view of this material has been influenced by other multi-media material I've used" and "The time flexibility is more important to me than the quality of the presentation" (Q15 (0.045)
- "The presentation of this multi-media material is as good as others I've experienced" and "The learning summaries increased my depth of thought" (Q15 (0.046)

Too much text

Significant positive correlations were found between the ratings of

- "I find myself wanting to read this material from a print out rather than on screen" and "I skimmed the material, rather than read it all, in order to save time" (Q16 (0.033)

Significant negative correlations were found between the ratings of

- "This material contained too much text" and "I revisited material when I found other things related to it" (Q15 (0.046)

Human / Tutor Contact

Significant positive correlations were found between the ratings of

- "I find email communication useful for maintaining contact with the class tutor" and "The presentation of this multi-media material is as good as others I've experienced" (Q15 (0.032)
- "I find email communication useful for maintaining contact with the class tutor" and "I find email communication useful for maintaining contact with the class tutor" (Q15 v 16 (0.034)
- "I would prefer to have more face to face contact with the class tutor" and "I skimmed the material, rather than read it all, in order to save time" (Q15 (0.034)
- "I would prefer to have more face to face contact with the class tutor" and "I'm not sure whether I'm learning what I should from this computer based material" (Q15 (0.020)
- "I would find more tutor input helpful" and "The notepad exercises increased my depth of thought" (Q15 (0.040)

Significant negative correlations were found between the ratings of

- "I would find more tutor input helpful" and "I found the visual elements (look) of the windows motivating" (Q16 (0.050)
- "I would prefer to have more face to face contact with the class tutor" and "I revisited material when I found other things related to it" (Q15 (0.016)

The significant correlations obtained indicate that:

In the Semester 1 99/00 cohort:

Regarding "Visual Presentation", those who rated:

- "I found the visual elements (look) of the windows motivating" highly at midpoint also rated "The interactive exercises helped me to understand the material" highly at midpoint
- "I found the visual elements (look) of the windows motivating" highly at midpoint also rated "The learning summaries increased my depth of thought" lowly at midpoint
- "I found the visual elements (look) of the windows motivating" highly at exit also rated

"I worked through all elements of the material ", "The interactive exercises helped me to understand the material" and "I revisited material when I found other things related to it" highly at exit

Regarding Exercises, those who rated:

- "The interactive exercises were not essential so I focused on other material" highly at midpoint also rated "The notepad exercises increased my depth of thought" lowly at midpoint
- "The interactive exercises were not essential so I focused on other material" highly at exit also rated "The on-screen feedback given for the interactive exercises helps me check I'm learning" lowly at exit
- "The interactive exercises helped me to understand the material" highly at midpoint also rated "The interactive exercises helped me to understand the material" and "The on-screen feedback given for the interactive exercises helps me check I'm learning" highly at exit
- "The on-screen feedback given for the interactive exercises helps me check I'm learning" highly at exit also rated "I feel quite isolated when working with this computer based material" lowly at exit

Regarding "Approach of Learner", those who rated:

- "I revisited material when I found other things related to it" highly at midpoint also rated "I'm not sure whether I'm learning what I should from this computer based material" lowly at midpoint

"Deep Approach"

- "Deep Approach" highly at midpoint also rated "Visual Elements (Look) of Interactive Exercises" , "Interactive Exercises", "The interactive exercises helped me to understand the material", "The on-screen feedback given for the interactive exercises helps me check I'm learning", "This material is more motivating than some lectures I've experienced", "This material is more motivating than most lectures I've experienced" highly at midpoint
- "Deep Approach" highly at midpoint also rated "The interactive exercises were not

essential, so I focused on other material" lowly at midpoint

- "Deep Approach" highly at midpoint also rated "Strategic Approach Adjusted" highly at midpoint

"Strategic Approach"

- "Strategic Approach" highly at midpoint also rated "I found the visual elements (look) of the windows motivating", "Tasks specified in self contained exercises", "This material contained too much text" highly at midpoint
- "Strategic Approach" highly at midpoint also rated exercises , feedback given in exercises, "I would have been better reading a book", "I would find more tutor input helpful" lowly at midpoint

"Surface / Apathetic Approach"

- "Surface Apathetic Approach" highly at midpoint also rated "This material contained too much text" highly at midpoint
- "Surface Apathetic Approach" highly at midpoint also rated "Interactive Exercises" and "Feedback given in self contained exercises" lowly at midpoint

Regarding Comparison with Lecture, those who rated:

- "This material is more motivating than the best lectures I've experienced" highly at midpoint also rated "I find myself wanting to read this material from a print out rather than on screen" lowly at midpoint
- "This material is more motivating than the best lectures I've experienced" highly at midpoint also rated "This material is more motivating than the best lectures I've experienced" highly at exit
- "This material is more motivating than most lectures I've experienced" highly at exit also rated "My view of this material has been influenced by other multi-media material I've used" highly at exit
- "This material is more motivating than most lectures I've experienced" highly at exit also rated "I would find more tutor input helpful" highly at exit

Regarding Influence of Previous Experience of Multi-Media, those who rated:

- "My view of this material has been influenced by other multi-media material I've used" highly at midpoint also rated "The time flexibility is more important to me than the quality of the presentation" lowly at midpoint
- "The presentation of this multi-media material is as good as others I've experienced" highly at midpoint also rated "The learning summaries increased my depth of thought" lowly at midpoint
- "My view of this material has been influenced by other multi-media material I've used" highly at exit also rated "I would find more tutor input helpful" highly at exit

Regarding Perceptions of Too much text, those who rated:

- "This material contained too much text" highly at midpoint also rated "I revisited material when I found other things related to it" lowly at midpoint
- "I find myself wanting to read this material from a print out rather than on screen" highly at exit also rated "I skimmed the material, rather than read it all, in order to save time" highly at exit

Regarding Human / Tutor Contact, those who rated:

- "The presentation of this multi-media material is as good as others I've experienced" highly at midpoint also rated "I find email communication useful for maintaining contact with the class tutor" highly at midpoint
- "I skimmed the material, rather than read it all, in order to save time" highly at midpoint also rated "I would prefer to have more face to face contact with the class tutor" highly at midpoint
- "I'm not sure whether I'm learning what I should from this computer based material" highly at midpoint also rated "I would prefer to have more face to face contact with the class tutor" highly at midpoint
- "The notepad exercises increased my depth of thought" highly at midpoint also rated "I would find more tutor input helpful" highly at midpoint
- "I revisited material when I found other things related to it" highly at midpoint also rated "I would prefer to have more face to face contact with the class tutor" highly at midpoint

- "I find email communication useful for maintaining contact with the class tutor" highly at midpoint also rated "I find email communication useful for maintaining contact with the class tutor" highly at exit
- "I found the visual elements (look) of the windows motivating" highly at exit also rated "I would find more tutor input helpful" lowly at exit

4.9 Summary of Findings from the Empirical Research

The following sections within Chapter 4 offer summary findings from the results obtained in this research. These findings are then related to the previously discussed literature in Chapter 5 of this thesis.

4.9.1 Findings from SEI Pilot Study (Semester 2 1996 – 1997)

The SEI results (see Appendix 2, Table 2.1.1) suggest that the initial session offered particular value for learners. It was considered to be likely, that as the material was new to the students concerned the input was useful at that point. The lower rating for the second session was considered likely to reflect the fact that this session essentially consisted as support as and when requested, and in some cases this was not required.

The self-study sessions were considered by the majority of respondents to be more than, or highly effective. It was therefore considered that, whatever comments were made criticising component parts or elements of the material, the results supported the overall conclusion that users could and did learn by using the CBL material in its current format.

The fact that the self study sessions were more highly rated than personal notes, reference books, or speaking with friends suggested that the material was perceived to be better than books in some respect and that, while direct human interaction may be considered effective, there were ways in which this CBL material was considered to be more effective by the learners concerned.

It was considered that when attempting to draw conclusions as to why this may be so, it was important to consider a range of variables outwith the immediate CBL environment. The variables concerned were considered to range from timetable commitments to individual circumstances of the learners.

4.9.2 Findings from SHS Pilot Study (Semester 2 1998 – 1999)

The SHS results show (see Appendix 2.2, Table 2.2.1) that a combination environment was the most favoured option and an electronic book environment was least favoured. The Directories of Tea, Coffee and Light Beverages and the Wine List were considered to be well presented, informative and interesting (see Appendix 2.2, Table 2.2.2). The central value for respondents was highlighted as relating to working laboratories and the restaurant. Being confident enough to explain / recommend options to customers is highlighted as important for respondents.

A minority of respondents adopted a skimming approach and a large minority revisited sections where they found other things related to such (see Appendix 2.2, Table 2.2.3).

A large minority of respondents considered additional input from the class tutor would be desirable, with some indicating they would prefer this in face to face mode and some perceiving themselves isolated when using the CBL material (see Appendix 2.2, Table 2.2.4).

The results suggest (see Appendix 2.2, Table 2.2.5) that there is a value in the expert video clips which is not related to increasing the depth of thought in the learner. This may relate to motivation level, entertainment value or some other aspect, which makes the video clips effective for learners. The Cailein Gillespie video offers content, which directly relates to the practical work of the students concerned. The opportunity to hear the pronunciation of foreign titles for menu items is particularly valuable for the students and there is an element of this within the video clip. Another factor, which may influence the views of the users here, is that the image concerned is that of a known member of staff. The production videos are less directly related to the practical work required of the students. To this end they may be regarded as nice to know rather than need to know which may lower their level of perceived relevance, which may reflect assessment having an impact in relation to motivation. Another factor here may be that while the Cailein Gillespie video clip is different for each menu item the production videos are the same for all in their category. The results relating to the interactive table setting exercise indicate limited perceived value in the exercise as it is currently presented.

The results show (see Appendix 2.2, Table 2.2.6) that the look of the windows was considered motivating by approximately one third of respondents, while a similar proportion considered this not to be so. A majority of respondents considered the presentation of the material was as good as or better than other materials experienced. Time flexibility was highlighted as more important than presentation by approximately one quarter of the respondents. Previous experience with other multi-media material was considered by approximately one quarter of the respondents to have influenced their viewpoint regarding this material.

The results (see Appendix 2.2, Table 2.2.7) suggest that the material concerned offered considerable functional value for the majority of the students concerned. The lower ratings for the hand tool and arrow pointer indicate that there may be an issue of usability, or that there may be a relevance issue involved. The results suggest that the use of a pull down menu approach to navigation was considered to be highly effective. This system of navigation is fairly common to users of both Mac and PC, therefore the environment may be taken to have some level of comfort for users. Given that the respondents had not used all of the Mediabase material at the stage of responding, it may be that this result is slightly weighted in favour of the menu approach. The results suggest that the use of a clickable screen area is similar in effectiveness to the use of a pull down menu option.

The results show (see Appendix 2.2, Table 2.2.8) that a small minority of respondents considered there was insufficient text content in the material, while a smaller minority considered there was too much. Reading from the paper-based metablock was considered preferable to reading from screen by approximately one quarter of the respondents. The results relating to reading from the Metablock (see Appendix 2.2, Tables 2.2.9 and 2.2.11), or books, suggests that factors other than the reading aspect alone were influencing the respondents. These may have included flexibility of access and the reduced level of eye strain on reading text from a paper base where the task was simply one of reading text. This may also reflect a balanced judgement which indicates that the CBL material offers benefits such as ease of information retrieval, photorealistic images which directly relate to assessed material and audio output which directly relates to assessed material.

The results indicate (see Appendix 2.2, Table 2.2.10) that usability problems were experienced with some of the interactive material, where approximately one third of respondents claimed to be uncertain of what they had to do with the interactive maps.

The results indicate (see Appendix 2.2, Table 2.2.11) that a large majority of respondents considered the material to be more motivating than lectures, but none of the respondents considered the material to be more motivating than the best lectures they had experienced. Approximately one quarter of respondents considered that they would have preferred to read from a printed format rather than from screen text. The results indicate that despite this the CBL material offered a value which was considered by respondents to outweigh that of a book.

4.10 Findings from the Main Case Studies

4.10.1 Learner "Overhead" Issues

The following sections offer a summary of findings from the responses obtained regarding issues relating to learner overhead.

4.10.1.1 Computer Literacy

The SEI and SHS open responses obtained at exit to the class (see Appendix 2.3, Tables 2.3.1 and 2.3.2) permit the conclusion to be drawn that the learners concerned were not complete novices with computers to the level where they were uncomfortable with the use of such. This enabled the responses given to the questionnaires to be considered as reflecting an opinion of the material in use, rather than a generic difficulty with the use of computers.

4.10.1.2 Content Appropriateness

The results suggest that the material largely meets the needs of the diverse group of users regarding the level of content appropriateness (see Appendix 2.3, Tables 2.3.3, 2.3.4 and 2.3.5). The interview responses also support this conclusion. The level of content appropriateness may therefore be regarded as sufficient to support the conclusion that any comments made regarding the effectiveness of the CBL material are unlikely to be heavily biased due to the impact of inappropriate content material.

The expressed views regarding content appropriateness are similar at midpoint and exit, with the exceptions of "team building" which is perceived as too basic beyond the midpoint, "getting into business" which was initially perceived to be too detailed becoming perceived as too basic, finance issues which was initially perceived as too basic then became more balanced in expressed views, and survival strategies which was perceived as too basic by the exit point. Of the earlier units Market Research & Sources was considered by respondents to be least appropriate in content. The lower ratings for the later units reflect the fact that many students tackled the material in serial order therefore presented nil responses for the later units.

Where there has been a decrease in the appropriateness rating between midpoint and exit, this may indicate some violation of expectancy between the midpoint and exit stages. This may relate to levels of repetition within the material, or perceived levels of interactivity.

4.10.1.3 Confidence Levels

Comparison of SEI entrance ratings to exit ratings indicates that the perceived confidence levels have increased (ranging from 37% to 62%) following the use of the material (see Appendix 2.3, Tables 2.3.6 and 2.3.7).

Where ratings have decreased at the midpoint stage this might indicate that the material was perceived as difficult to understand at that point, or that some of the initial confidence had been revealed to be misplaced. Where no change in ratings has taken place, as with funding, this might be taken to indicate that perceived levels of confidence have been reinforced by the material covered.

Perceived confidence levels have therefore been shown to be sufficiently high that the responses obtained in the research are likely to reflect the learner's view of their use of the material, rather than any issues relating to lack of confidence with the content of the material. This conclusion is also supported by the open responses obtained in relation to respondents' confidence levels (see Appendix 2.3, Table 2.3.8).

4.10.1.4 Approaches to Learning and Learning Styles

The SEI results show (see Appendix 2.3, Table 2.3.9) that a majority of learners worked through all the elements contained in the module. A majority of the learners concerned revisited material initially covered, though a skimming approach was adopted by a small minority. The skimming approach is less prevalent at the exit point, which may indicate that such an approach was found to be less than effective overall.

The results obtained from questionnaires and interviews suggest that where the visual presentation is perceived to be motivating, learners are more likely to work through the material, revisit material, and engage in an approach which is deeper than surface level.

The SHS results (see Appendix 2.3, Table 2.3.10) show that a minority of learners worked through all the elements of the material. A majority of the learners concerned revisited material initially covered and a majority adopted a skimming approach.

The DMLE results show (see Appendix 2.3, Tables 2.3.11 and 2.3.12) that a majority of learners worked through all the elements of the material. A minority of the learners concerned adopted a skimming approach, and revisited material initially covered.

This may reflect a strategic approach to learning which seeks to identify the material on which to focus in detail. There may be some relationship between the level of text involved, or the level of violation of expectancy, and the extent to which a skimming approach was adopted, though such an approach may simply reflect a surface approach to learning. The relatively low level of skimming and the reduction in the use of skimming between midpoint and exit may reflect the need to cover all of the material contained within the SEI module in order to complete the class, as the entire set of material is core to the class.

In the SHS Case this may relate to the volume of material involved in the Mediabase and may also reflect the reference use made of such. The need for specific information relating to particular elements at any given time may have influenced the skimming approach, in that learners may have skimmed in order to find the specifics they required at the time. The Mediabase contains some material which is related to, but not core to, the class concerned.

In the DMLE Case this may relate to the volume of material involved in the software and may also reflect the timescale within which it had to be covered. The competitive element involved in attempting to make profit within the simulation may have influenced the skimming approach, in that learners may have skimmed in order to find the specifics they required at the time. The

DMLE material includes content which is related to, but not core to, the simulation concerned.

The main point for the purposes of this research would be that learners require the capability to use the software in this range of ways, as they see fit.

ASSIST and LSI Results

The SEI results show (see Appendix 2.3, Table 2.3.13 and 2.3.14) that the vast majority of the students take an approach to learning which is surface-apathetic and that the vast majority of the students concerned are motivated towards the style of information transmission.

The SEI interview responses support the conclusion that a range of approaches were employed in the use of the material and that variations in motivation and desired outcome are likely to impact on the preferred approach to the material. This suggests that a range of approaches should be accommodated within CBL material, with clear implications for instructional design and interface design.

The results obtained from questionnaires and interviews suggest that where the display is perceived as motivating and the tasks specified in exercises are perceived as effective, learners are likely to adopt a strategic approach to their own learning. The results also suggest that where the material is perceived to offer more than a book, not to contain too much text and not to require more tutor input, learners are likely to adopt a strategic approach to their own learning and that those adopting a strategic approach are taking a deep approach to learning with the material they choose to select as strategically important for them.

The results obtained from questionnaires and interviews suggests that where the material is perceived to contain too much text, learners are likely to adopt a surface approach to their own learning and that where the interactive exercises are perceived as effective and to offer effective feedback, learners are less likely to adopt a surface approach to their own learning.

The results obtained from questionnaires and interviews suggest that where the display is perceived as motivating learners and interactive exercises are included which are perceived as helping them to understand the material, learners are likely to take a deep approach to learning.

The results also suggest that those who perceived the feedback from interactive exercises as helpful in checking their learning were adopting a deep approach to their learning, that those who perceived the interactive exercises as less than essential were not adopting a deep approach to their learning and that where the computer-based material is perceived to be more motivating than lectures the learners are likely to adopt a deep approach to learning.

The SHS results show (see Appendix 2.3, Table 2.3.16 and 2.3.17) that the majority of the respondents from the Scottish Hotel School take an approach to learning which is deep and a large minority adopt a strategic approach. A large majority prefer an information transmission type of course and teaching and a minority prefer supported understanding. There appears to be some contradiction in the SHS Case between the approach to learning and the preferred type of teaching, in that transmitting information relates more to a surface approach.

The results support the conclusion that information transfer is a centrally important element for learners in Higher Education and that an information transfer approach may be required in addition to other modes where deep learning is to be nurtured. If the learners have a perceived need or want for such a delivery mode then it may constitute a type of hygiene factor without which the deeper aspects of supporting understanding would not be perceived by learners as effective.

The results suggest the possibility that the students may have become assessment driven within the education system and rely on information transfer modes in order to pass exams or assessments. This may account in part for low ratings on exploratory, or problem solving, elements, which are designed for deeper learning and do not therefore focus on information retrieval. An assessment driven approach may also account for the relatively high value attributed to textual information, despite the rating of such material as boring and the associated difficulties of screen based text such as eye strain.

The MNE results indicate that the majority of learners in this group adopted a deep approach to their learning and expressed a preference for supporting understanding (see Appendix 2.3, Table 2.3.20). This suggests that a straight transfer of information would not meet the needs or wants of these learners and that a more complex means of conveying the required information would be required. This might be taken as a reflection on the way in which the students within the "real world" or "business world" are assessed, or effectively rewarded for their efforts, and the most efficient means by which the information required for such assessment might be accessed from the student perspective.

The SEI, SHS, DMLE and MNE results regarding learning style (LSI) would suggest that the majority of learners had a preference for visual learning (see Appendix 2.3, Tables 2.3.14, 2.3.15, 2.3.18, 2.3.19 and 2.3.21). This would suggest that elements within the CBL material which were visual in style would be perceived as more effective for these learners. This might be taken to suggest that graphics, animations and videos would be particularly valuable within the material.

4.10.1.5 Human Contact and Tutor Related Issues

This section offers a summary of findings based on the results obtained from the investigation of perceived impact on human contact and tutor related issues.

The SEI and SHS results show (see Appendix 2.3, Tables 2.3.22 and 2.3.26) that there was a degree of isolation experienced on the part of a minority of respondents. The SEI, SHS, DMLE and MNE results show that human contact was perceived to be important by a minority of respondents (see Appendix 2.3, Tables 2.3.23, 2.3.24, 2.3.25, 2.3.29 and 2.3.30). The value of dialogue and guest speakers is clearly an area of importance to learners (see Appendix 2.3, Table 2.3.25) and the results suggest that the CBL material does not as yet provide this in a way which matches or betters the direct contact with real people. This suggests that there are elements in the learning and teaching process which benefit from face to face provision in some way which the CBL material did not deliver. In the DMLE Case the results are likely to reflect the level of human contact already in use as the students were working in groups with the class tutor present. The results may indicate that human contact is taken for granted when present yet highlighted as important where it does not exist, therefore suggesting it might be a hygiene factor.

The SEI, SHS and DMLE results show (see Appendix 2.3, Tables 2.3.31, 2.3.32, 2.3.33, 2.3.34 and 2.3.35) that increased levels of tutor input would potentially offer benefits for a large minority of the learners using the CBL material, and that this would be preferred in a face to face mode. The increase in the SEI percentages concerned between midpoint and exit suggests the possibility that the longer learners are exposed to CBL materials the more they are likely to perceive value in face to face contact and tutor input. However it may also be considered that this reflects the later material being more difficult, or that the tutor input was too early.

The SEI interview feedback suggests that direct tutor input offers some benefit for learners which the current CBL material does not provide, even when enhanced using email as a means of communication. One of the aspects highlighted as important was that learners could both see and hear the other party.

The results obtained from questionnaires and interviews suggest that where the visual elements of the computer-based material are perceived to be motivating, learners are less likely to perceive a need for face to face contact with, or more input from, a class tutor. The results also suggest that where the presentation of the material is perceived to be as good as others experienced, electronic contact with the tutor is more likely to suffice, that the perceived value of electronic contact with the tutor was consistent over time and that those adopting a strategic approach to learning did not desire additional tutor input. The results suggest that where there is a perceived need to save time, tutor input is preferable to skimming text based material and where self monitoring of learning is uncertain direct tutor contact is preferred. The results suggest there is perceived value in additional tutor input when dealing with problem solving or reflective exercises and that this should be face to face. The results also suggest that where learners are engaged to the level of revisiting material they are less likely to perceive a need for face to face contact with a class tutor.

4.10.1.6 Learner Management Issues

This section offers a summary of findings based on the results obtained from the investigation of perceived impact on learner management issues.

The SEI results show (see Appendix 2.3, Tables 2.3.36 and 2.3.37) that respondents valued having a level of personal control over the time, pace, place and approach to learning they employ when using CBL materials. The CBL aspect is perceived as beneficial for learners, but the restricted access to some extent undermining such advantages (see Appendix 2.3, Table 2.3.37). Therefore, while these figures are noteworthy as they stand, it is plausible that had access been less restricted the ratings on these aspects would quite possibly have been even higher. The low level of response, 5% (9) at exit, regarding route flexibility might be taken to suggest that most respondents adopted a sequential, or serialist, approach to the material. This must to some extent be tempered by considering that many of the learners concerned may have adopted a holistic approach, which was non-sequential, but used the opportunity offered within the open responses to raise other issues, which for them were more important to express. This feedback must therefore be considered alongside the other sources of results concerning route flexibility.

The SEI interview feedback shows that while the flexibility offered by the learners being allowed to manage their own learning is perceived as a particularly valuable aspect of CBL material, it is acknowledged that this requires levels of self-management beyond that of more traditional modes of learning.

While the actual numbers in the case are very small, the MNE results (see Appendix 2.3, Table 2.3.39) support the conclusion that the issue of self management is important where CBL material is extensively used. The results show that this applies to those in full-time employment, for whom the learning is part of staff development work.

The DMLE and HBS results (see Appendix 2.3, Table 2.3.38) suggest that the issue of self management is perceived as less important where CBL material is not extensively used. In the DMLE and HBS Cases the CBL material plays a relatively small, though important, part in the overall class, running for only one of twelve sessions, while in the SEI and SHS Cases the CBL material is a major component of the class concerned and runs throughout the class. There is also the issue of questionnaire design and exposure to be accounted for, in that the DMLE and HBS respondents had to respond only on one occasion to a questionnaire requesting open responses to 14 questions, while those in the SEI and SHS classes had multiple opportunities to respond to questionnaires.

4.10.2 Findings Regarding Learner Perceptions of CBL Material

4.10.2.1 Perceived Impact on Learning / Understanding (Cognitive)

This section offers a summary of findings based on the results obtained from the investigation of perceived impact on learning / understanding (cognitive).

The SEI results show (see Appendix 2.3, Table 2.3.40) that undertaking the work required to produce learning summaries was considered by approximately half of the respondents to increase their depth of thought. The notepad exercises were also considered to increase the learners' depth of thought, but for a minority of respondents. This may be a reflection of the numbers who chose to complete the notepad exercises, but no record of completion was available therefore the number concerned is unknown.

The SEI results show (see Appendix 2.3, Tables 2.3.41 and 2.3.42) that the exercises were considered to have aided learning / understanding for many respondents and that this is more pronounced at the midpoint stage. This might suggest that the deeper level of learning offered by the exercises is perceived as more valuable at the midpoint stage than at the exit, or may simply be a reflection on the variations in the exercises concerned. The SEI interview responses confirm the role of the exercises in facilitating deeper learning. The exercises were considered to have clarified issues raised in the material and aided learners' understanding of the material, with some commenting that the exercises ensured that they were learning rather than skimming the material. Some interviewees commented that the "quizzes" increased their recall of the material.

The SEI results show (see Appendix 2.3, Table 2.3.43 and 2.3.44) that the respondents considered the use of CBL material helpful for gaining learning / understanding, but that the hypertext links are not as highly valued by the respondents as other aspects of the CBL material.

The SEI results suggest that undertaking work which requires knowledge of content and a reflective element, increases the learners' depth of thought. However the difference in ratings observed regarding the notepad exercises and the learning summaries might suggest that the work which is reflective, but not directly assessed is less likely to increase depth of thought. This might lead us to the conclusion that the assessment itself is playing a significant role here. This might in part account for the potential value attached by respondents to the possibility of having multiple choice tests within the material. There is a difficulty here however in that their responses relate to "checking" their learning as individuals, rather than having their learning assessed by this means.

The results obtained from questionnaires and interviews suggest that the feedback from interactive exercises helps learners understand the material, helps learners monitor their progress, and encourages a deep approach to learning. The results also suggest that where the exercises were perceived as offering feedback which helped check learning they were less likely to be considered non-essential, and where learners were engaged with the material to a level where they perceived an increase in their depth of thought and were motivated to revisit material, there was less likelihood of learners feeling isolated when using the material.

The MNE results indicate (see Appendix 2.3, Table 2.3.48) that information retrieval, coupled with feedback explanations of material, on demand, are expectations which should be met for the learning process to be best suited to the learners concerned. While exercises are considered to aid learning, problem solving is not quite as highly rated in provoking thought which might suggest a rehearsal, rather than thinking value in some exercises. The use of images rather than text, with demonstrations to inform learners would appear to be more helpful for learners.

The SEI, SHS and DMLE results suggest (see Appendix 2.3, Tables 2.3.40, 2.3.45, 2.3.46 and 2.3.47) that there was uncertainty experienced on the part of some respondents which may relate to the learners concerned finding it difficult to monitor their own learning. The results support the conclusion that the CBL materials did not present the content, highlight the focus of importance for the learner, and offer clear feedback on learner progress throughout the learning process to the level required by all respondents.

The SEI results show (see Appendix 2.3, Table 2.3.40) that a majority considered that multiple choice tests would be helpful for checking their learning, while the SHS results show (see Appendix 2.3, Table 2.3.45)) that a minority considered this to be so. The DMLE results show (see Appendix 2.3, Tables 2.3.46 and 2.3.47) a majority in one year but a minority in the next.

The results suggest that the tests are valuable for many respondents, but that their perceived value is likely to depend on the educational context. The SHS results may be considered to reflect the direct application element of the material for these students being more helpful than the multiple choice tests concerned, with such tests being of some help, but practice in context being of greater value.

4.10.2.2 Perceived Impact on Learning / Understanding (Affective)

This section offers a summary of findings based on the results obtained from the investigation of perceived impact on learning / understanding (affective).

The SEI, DMLE, HBS and MNE results show (see Appendix 2.3, Tables 2.3.49, 2.3.50, 2.3.52, 2.3.53 and 2.3.54) that the majority of respondents and interviewees considered relevance of the material, feedback and explanation of feedback as important. The MNE results (see Appendix 2.3, Table 2.3.54) suggest that for some the perception of relevance is likely to be related to assessment. The HBS results (see Appendix 2.3, Table 2.3.53) suggest the main elements of impact to be relevance and the use of a "game" element in the CBL material. This might be taken to imply interactivity and fun to have potential importance. This would also imply that the element of challenge was important for these respondents. The results relating to the use of real life examples might be seen as further evidence of the need for relevance as perceived by the interviewees. The results indicate that the use of fun / humour and interactivity are valued, as is variety in the content offered. This is likely to relate to the motivational side of the learning process, with fun, humour and interactivity providing a break from on-screen text as a basic input and further benefits when directly linked to the specific material to be learned. The level to which novelty value was considered to have an impact suggests that even with non-novice users there may be a "novelty effect" created by the use of computer platforms for delivering materials for learning. The results also suggest that where multimedia material is used there may be benefit in allowing learners to control the use of such, as expectations differ and that which is effective for some has a negative effect on others, as the results indicate with regard to the video material used in DMLE. The results suggest that the potential for motivating learners is negatively affected where too much text is used, or where eye strain / fatigue is experienced. The results suggest there may be a link between the experience of eye strain / fatigue and the use of too much text.

The SHS results show (see Appendix 2.3, Table 2.3.51) that aspects may become irritating over time of use. This may relate to the usability aspects such as navigation, or to content which remains the same over the time concerned. It is possible that these aspect exert a cumulative impact on learners which becomes more obvious to them as their use of the material allows any novelty effect to wear off, their demands on the material to increase and their need to achieve outcomes becomes more sharply focussed due to time constraints for work output.

The results show the central importance of relevance and assessment for respondents, which suggests that these are crucial elements in terms of motivating these learners. The issues of too much text being used, breaks in text being important, and variety being important, are raised, and may be considered as having an impact on the motivational side of the learning process.

The results support the conclusion that the CBL material presented has to be regarded as relevant by the learners, which is likely to relate to the objectives they have as their focus at the time the material concerned is in use. The results also suggest that having a "game" style of presentation is likely to motivate a proportion of learners, but may not be considered highly motivating by all learners at all times.

4.10.2.3 Expressed Preferences for CBL Environment Types

This section offers a summary of findings based on the results obtained from the investigation of expressed preferences for CBL environment types.

The SEI, SHS, DMLE and MNE results show (see Appendix 2.3, Tables 2.3.55, 2.3.56, 2.3.57 and 2.3.58) that a large majority of respondents expressed a preference, at the entrance point, midpoint and exit, for a combination of modes of presentation within the CBL material, rather than for individual metaphor styles, of which the electronic book was least rated of the options considered.

Given that this feedback was obtained prior to respondents using the class material to any degree, it would be reasonable to regard this as a reflection of the general preference / expectation level of the respondents. The similar results obtained at midpoint and exit, with respondents having used the class material to some degree, indicate that the material, which used a book metaphor, did not significantly alter the views expressed by respondents with regard to preferred CBL environment.

The results suggest that the prospect of reading text from a computer screen is less desirable for learners than the prospect of exploring more media-rich and interactive CBL environments. The results also suggest that learners who favour the game approach tend not to favour an electronic book environment. Those who favour a simulated environment would be likely to accept such as part of a combination environment and a game approach within a simulated environment would be likely to be considered acceptable.

4.10.2.4 Perceived Effectiveness of Elements Within The CBL Material

This section offers a summary of findings based on the results obtained regarding perceived effectiveness of elements within the material.

4.10.2.5 Effectiveness of Navigation Elements

The SEI responses (see Appendix 2.3, Tables 2.3.59, 2.3.60) suggest that hypertext links were not considered by respondents to be quite as effective as the structure map or the navigation feet. This suggests that more "graphic" forms of navigation are less confusing for users, as the structure map is a graphic representation of the material which may be accessed and the button is a graphic in that it offers an iconic representation which is associated with a directional navigation in this instance. The hypertext links do not offer any graphic representation which suggests navigational direction. The difference in ratings between the map graphics and those achieved by buttons within text windows or hypertext within text windows would suggest that both buttons and hypertext failed to offer users something which the map format of navigation managed to achieve. This may be related to the map format having provided a tangible frame of reference within which learners could orientate themselves, in relation to where they were currently, had travelled from, and wished to go next. The results indicate that use of hypertext links and buttons within windows resulted in the learners becoming "lost in hyperspace". The navigation feet, despite being arguably similar to buttons within the text windows, and essentially hyperlinks with a graphical veneer, were considered effective by a greater number of respondents.

The history window has to be sought out by users and then offers a sub-window within which the title of the windows viewed within the particular learning session may be viewed. The low rating is likely to reflect the easier options for navigation using elements which remain visible and active on screen, without requiring the user to call up a particular function, before navigating within the window it provides.

The SEI interview responses support the conclusion that hypertext adds direct and indirect value for users but that violation of expectancy and navigational confusion are problems which have not yet been fully addressed in CBL material. The results support the conclusion that even with today's learners, who may be regarded as "computer literate", it is essential to offer clear orientation for every mode of navigation within CBL material.

There is perceived value of both ease of use and relevance. The use of "navigation feet" buttons and hypertext links helped learners to access the text based material. Another way of phrasing this may be considered to be that the "navigation feet" buttons and hypertext enhanced the "ease of use" of the text windows.

The results suggest that ease of revisiting specific material when seeking information relating to reflective, problem solving and decision making exercises is perceived as important and the provision of specific navigational links to defined information is perceived as useful for learners when addressing reflective, problem solving and decision making exercises.

There is perceived value in ease of discretional navigation between interactive exercises and to information when addressing reflective, or problem solving and decision making, exercises and there is an expressed desire for material accessed to be perceived as relevant to the learners. There is perceived value in graphical representation of navigational options and provision of multiple navigational options, including hypertext, buttons and maps, for discretional navigation, within the computer based material. There is perceived value of positional information, to aid navigation through the material when seeking information.

There is perceived value in the inclusion of search facilities and direct access routes to specific material within the material. The results obtained from questionnaires and interviews indicate the perceived value of direct access routes to specific material including selective search when required. The results indicate that the perceived value of the history window remained consistent between midpoint and exit and perceptions of the glossary window changed between midpoint and exit.

The results suggest that the perceived value of the hypertext links, navigation feet, and of the button links remained relatively stable between midpoint and exit and that there was perceived value in the use of colours for highlighting elements presented on screen and navigational options within the material.

4.10.2.6 Effectiveness of Exercise / Simulation Elements

The SEI, SHS and DMLE responses (see Appendix 2.3, Tables 2.3.61, 2.3.62, 2.3.63, 2.3.65, 2.3.66, 2.3.68 and 2.3.69, 2.3.70, 2.3.71) show that the interactive exercises and simulations were considered effective by a majority of the respondents. The relevance of the exercises for the module and the scenarios used within the exercises achieved the highest ratings of the exercise elements. The exercises were considered by a majority of the learners concerned to have helped them understand the material presented. The exercises also offered the learners concerned a means of checking their own learning. The text used within the interactive exercises was considered effective by a majority of the respondents, which mirrored the ratings achieved by the main text windows. The tasks specified and the graphics used within the exercises were considered effective by more than half of the respondents, as were the colours used and feedback given within the exercises. The difficulty level of the exercises was considered effective by a large minority and the notepad exercises were considered effective by a smaller minority of the respondents. The results indicate that additional exercises, and more complex exercises, would be welcomed by a minority of respondents (see Appendix 3 for responses by batch).

A sizeable minority of the learners concerned chose to focus their attention away from the exercises, considering them as non-essential. This would suggest that for some learners, even material which is likely to enhance their level of understanding may be disregarded in order to focus on that which is specifically required for their needs as they perceive them to be at that point in time. This is likely to relate to the way in which assessment is perceived by the learners and the level of commitment they choose to make in relation to learning to pass assessment, rather than learning for deeper understanding in its own right.

The SEI interview responses show (see Appendix 2.3, Table 2.3.65) that the exercises added positively to the learning experience gained in their own right, offering learners benefits in terms of interest levels, practice opportunities, and self monitoring of learning achieved. The responses suggest that the exercises had provoked thought and aided learning and understanding, to a level which might be considered to be deeper than surface learning. The interview responses indicate that the exercises add an element of interest for the learners concerned. When this is considered in relation to text alone being boring we might reasonably conclude that one of the benefits of the exercises would be that they prevent the material being only text, or they provide breaks from or in the text content. This has already been highlighted as important with regard to the text element of the material. For a large minority the exercises were considered to offer an opportunity to apply, or put into practise the learning they had gained from the CBL material. A large minority considered the exercises added an element of fun or even enjoyment, with a larger minority expressing a desire for more exercises, and more complex exercises.

The SHS results (see Appendix 2.3, Table 2.3.66) suggest that the exercise elements in the material benefited a majority of respondents by having a motivational practical focus and offering opportunities for practice. The table setting exercise (see Appendix 2.3, Table 2.3.67) was considered by many of the learners concerned to have helped them to learn. The exercise also offered the learners concerned a means of checking their own learning.

It should be noted that there was an issue with the table setting exercise in that the completely correct solution is impossible to achieve. This has been caused by the level of specification within the programming used. This coupled with the fact that many of the students experienced table setting in the real environment prior to attempting the interactive exercise is likely to have impacted on the results obtained.

The use of exercises requiring thought and response on the part of the interviewees is identified as valuable for their learning. The value of having feedback on demand, and a level of explanation provided as feedback, within the CBL material, was clearly indicated in the results from the interviews. Feedback on demand was considered to be important by a large majority of interviewees, with a level of explanation being considered important by a smaller majority.

It may be argued that the provoking of thought is necessary in order to aid learning / understanding and therefore all who expressed the view that the exercises aided learning / understanding were implicitly expressing the view that the exercises provoked thought.

Respondents indicating that the exercises had provoked thought might be considered to reinforce that the exercises aided learning and understanding. This may also be regarded as offering some insight that the level of learning / understanding might be considered to be deeper than surface learning.

The value of the exercises in aiding learning / understanding is likely to relate to the interaction required by the learner in making judgments, reaching decisions and checking the outcome of such decisions by comparing their responses to the feedback offered by the exercises. This also is likely to account in part for the exercises adding interest.

The results indicate that, while content is regarded by these learners as particularly important for their purposes, the exercises offer something, which differs from text alone and is more effective for learning. A likely possibility here is that the level of interactivity affects the learning achieved. The DMLE and MNE results (see Appendix 2.3, Tables 2.3.69, 2.3.70, 2.3.71 and 2.3.72) suggest that the exercises and simulations added positively to the learning experience in their own right, offering feedback and additional benefits for learners in terms of a motivating challenge, and practice opportunities. The use of simulations appears to impact positively on motivation and learning for respondents. The importance of feedback on demand suggests that the exercises and simulations are important in providing a feedback loop to learners and this is made possible by the level of interactivity designed into the elements concerned. This may be argued to involve levels of physical, mental and emotional engagement.

The results support the conclusion that the exercises added positively to the learning experience gained in their own right, offering learners benefits in terms of interest levels, practice opportunities, and self monitoring of learning achieved. The exercises also offer indirect benefits by providing breaks in text material and exposing the learners to stimulating elements within their design, ranging from screen display used to the level of interactivity and complexity offered.

The results obtained from questionnaires and interviews indicate the perceived importance of the combination of "problem solving" and "reflective", or "decision making" exercises being set for learners. The results suggest the perceived value of optional exercises is less than those which are directly assessed.

There is perceived value in the visual element (look) of windows when addressing reflective, problem solving and decision making exercises and in the text conveying information within exercises.

There is perceived value in the use of colour and graphics in presenting reflective, or problem solving and decision making exercises The results obtained from questionnaires and interviews suggests the perceived value of the colours and graphics used, remained consistent for the learners, between midpoint and exit.

There is perceived value in undertaking "realistic" and "relevant" activity within the exercises and in situating relevant, reflective, problem solving and decision making activity within scenarios in the exercises.

The results obtained from questionnaires and interviews suggest the perceived importance of offering exercises at appropriate difficulty levels. The perceived appropriateness of the difficulty of exercises remained consistent for the learners, between midpoint and exit.

There is perceived value for the learners, in the provision of feedback relating to reflective, or problem solving and decision making exercises, and activities within such.
The results obtained from questionnaires and interviews suggest the perceived value of the interactive exercises, in aiding understanding, remained consistent over time.

4.10.2.7 "Usability" Related Responses

This section offers a summary of findings based on the results obtained regarding "usability" related responses.

The SEI, SHS, DMLE, HBS and MNE results (see Appendix 2.3, Table 2.3.73, 2,3,74, 2.3.75, 2.3.76, 2.3.77 and 2.3.78) indicate that ease of use was important to learners. For some eye strain or fatigue had been experienced, and for some hyperlinks were found to be confusing. The SEI and SHS results show that the ability to revisit information was perceived as important.

The results suggest that a range of factors affect the ease of use experienced. The results suggest that the issue of text on screen must be addressed carefully, given that where it is perceived by the user as being "too much" it is likely to have a negative impact on their learning experience. The screen display used may have a positive impact to the level where it aids learning.

The importance attached to the capability to revisit information easily may be related to issues of flexibility, of route and pace of study. This may, to some extent, be a reflection of the importance attached to information retrieval. This in turn may well relate to assessment as a motivator. The results suggest that even with material which makes significant use of multimedia and graphic user interfaces, ease of use is a complex issue when dealing with CBL.

It must be considered that some errors, on the part of the users, may have been perceived by them to be malfunctions in the CBL material, therefore not "literally" a malfunction in that sense. It may be argued however that this reflects poor "usability" design and that the potential for user error, perceived by them as "malfunction" should be "designed out" of the material. That the map facility was found helpful, while links were confusing might offer some hint as to the way in which improvements might be made.

The results support the conclusion that the usability dimension of the material concerned did not entirely meet the needs and wants of the respondents.

4.10.2.8 Perceived Impact of On-Screen Presentation

This section offers a summary of findings based on the results obtained from the investigation of the perceived impact of presentation elements.

The SEI results show (see Appendix 2.3, Table 2.3.79) that the presentation of the material was considered motivating for a large minority of respondents and for more than half of the respondents equalled the presentation they had experienced in other computer-based materials. The SHS and DMLE results show (see Appendix 2.3, Table 2.3.80, 2.3.83 and 2.3.84) that the presentation of the material was considered motivating for the majority of respondents and for many respondents equalled, or bettered, the presentation they had experienced in other computer-based materials.

The SEI results indicate that (see Appendix 2.3, Table 2.3.79), for almost one third of the respondents, quality of presentation is considered to be less important than time flexibility, while a similar percentage appear to hold the opposite view. This may to some extent explain respondents' expectations, regarding presentation and would suggest a three way split within the respondent group regarding the importance of presentation.

That apparently contradictory feedback has surfaced in this set of responses raises potential issues regarding the approach taken to completion of the questionnaires by some respondents, or in the design of the questionnaires themselves. However if we assume that the questionnaires were not interpreted differently by different respondents and that the responses obtained truly reflect the views held, then our conclusion may be that the responses are not actually contradictory, but that different learners perceive their needs and wants in different ways and that this has significant importance for the developers of CBL materials, should they aim to meet the needs of a diverse group of learners.

This may be taken as indicative of the level of expectation held by the learners concerned with regard to the mode of presentation to be experienced when using CBL materials. Given that we are dealing with an intelligent group of adult learners, who are under pressure to achieve results, it would not be outwith the realms of possibility that they might be assessment focused and pragmatic about how such results might best be achieved. Under such circumstances it would seem likely that presentation would be required to meet minimum needs for learners to achieve results, but exceeding such minimal requirements might be perceived by the learners as unnecessary.

The SEI interview responses indicate the importance of presentation, given that the presentation is seen before the content is addressed. The importance of the interface used looking up to date and the use of colour were also cited as important, with colour being perceived as less boring.

The results obtained from questionnaires and interviews suggest a relationship where those who considered the exercises helpful for understanding were not motivated by the general look of the windows presented by the material and those who considered the learning summaries increased their depth of thought were not motivated by the general look of the windows presented by the material.

The SHS results indicate (see Appendix 2.3, Table 2.3.80 and 2.3.81) that the visual display used, met the requirements of the majority of respondents and added an interest value in its own right for a minority of respondents. The results also suggest that for a minority there is a problem with eye strain / fatigue. The SHS and DMLE results also indicate (see Appendix 2.3, Table 2.3.82 and 2.3.85) that variety in style of presentation is important for a minority of respondents and that a majority of respondents value the use of colour within the material. The higher levels of response on exit suggest that the importance of such elements may become more obvious to learners over time.

4.10.2.9 Perceived Impact of On-Screen Text

The SEI, SHS, DMLE and MNE results (see Appendix 2.3, Table 2.3.86, 2.3.87, 2.3.88, 2.3.89, 2.3.90, 2.3.91, 2.3.92, 2.3.93 and 2.3.94) show that many respondents considered text alone to be boring within this CBL material, that there was too much text used and that simply displaying text on-screen is not particularly motivating for learners. The results suggest that text does have value to add, but that from the learner's perspective there is value providing breaks from text on-screen.

The SEI and SHS results also show (see Appendix 2.3, Table 2.3.88 and 2.3.99) that, having used the material over a period of time, very few learners considered they would have gained more by having a book, rather than computer-based presentation. This suggests that there is perceived additional benefit to the computer-based format.

The SHS results also indicate (see Appendix 2.3, Table 2.3.89) that a workbook using a question and answer format would have been considered helpful for learners. While this may relate to the use of text on screen it may also reflect a desire for practice towards assessment and / or "interactivity" with the material at the level of checking understanding.

The SEI interview responses show that text alone, or too much text becomes boring for learners therefore text on-screen is not particularly motivating for these learners. The use of text-based material is considered both valuable and desirable by a large minority of the interviewees, but the way in which it is presented is crucially important from the learner's perspective. Where long sections of text are used this can result in learners skimming the material and they are likely to lose interest in, or concentration on the material and that reading text from the screen results in learners experiencing fatigue and eye strain. Where reading is involved there is an expressed preference for printed material rather than screen text. There is also an expressed preference for a quiet atmosphere where reading has to be undertaken. The underlying reasons for the desire for printed material range from reducing eye strain and fatigue to ease of use. Some comment that having printed material would allow them to refer to such at a later date, while others express the desire to have copies that they may annotate, or read as they travel.

Interviewees expressed dislike of the pop-up windows as they could not be kept open on screen, which relates to the difficulty in taking notes on computer. This might suggest that such windows should not be used for text material which cannot be taken in fully at a glance. Some expressed a preference for full screen displays and larger windows, while others valued the staged display using reveals.

The food for thought coming out of this however would be that, where learners get the impression that they would gain as much , or more, from a hard copy of the material, it is likely that the material concerned is neither meeting their expectations nor making best possible use of the computer-based platform from which it is presented.

The results suggest that there are advantages and disadvantages in using text on screen, and the use of such should be very carefully considered. The central issue to be addressed might be the added value for the user of having text appear on-screen rather than in print. Where this is not sufficiently clear then the material is likely to result in the on-screen text having a negative impact on some users.

The results obtained from questionnaires and interviews suggest that where learners perceive they would prefer to read from a print out of the material they are more likely to skim the material. The results also suggest that where the material was perceived to have contained too much text learners were less likely to revisit material, less likely to work through all elements of the material, and less likely to adopt a strategic approach to learning.

The results suggest that the learners' perceptions of the value of text based material remained consistent between midpoint and exit. There is perceived value in the use of text as a means of conveying information and there are times when greater value is attached to information transfer in the form of main text windows than to problem solving and decision making in the form of exercises.

4.10.2.10 Perceived Impact of Graphics / Multimedia Presentation Elements

This section offers a summary of findings based on the results obtained from the investigation of the perceived impact of graphics / multimedia presentation elements.

The SEI, SHS, DMLE and MNE results (see Appendix 2.3, Tables 2.3.95, 2.3.96, 2.3.97, 2.3.98, 2.3.99, 2.3.100, 2.3.101, 2.3.103) show that the use of graphic material and multi-media material is considered by respondents to offer value in terms of their learning experiences when using CBL material.

The results indicate that the graphics impact on the learners' level of interest, with the element of colour highlighted as important and the use of fun / humour. That the graphics provide breaks in text material is highlighted as important.

The benefits offered may be directly related to the content of the material, or may be indirectly related, e.g. by offsetting negative effects on motivation levels, which might have been experienced had the graphic or multi-media element not been used.

The SEI interview responses indicate the value of having graphics used within the CBL material. These were considered to be generally of value by a majority of interviewees and to add interest and aid learning for a large minority of interviewees. A large minority considered the graphics added an element of fun or humour, provided breaks in the text material, and even aided learning in their own right. The use of colour in such graphics was identified as important by a large minority of interviewees.

The results obtained from questionnaires and interviews suggest that there continues to be a perceived value in having more tutor input, where the view held of the computer-based material is perceived to have been influenced by other multi-media material used. The results also suggest that time flexibility is perceived to be more important than presentation and learners are less likely to work through all elements of the material, where the view is not influenced by previous experience of other multi-media material. The results suggest that where the presentation is perceived not to be as good as other multi-media material experienced there is likely to be less likelihood of the material being perceived to increase depth of thought.

The SHS results (see Appendix 2.3, Table 2.3.98) suggest that multimedia material is recognised as having a value for the learner, with a large minority of respondents valuing the use of video material as they considered it to add interest or aid learning in its own right. The use of simulations was also suggested by the results to be valuable in adding interest, aiding learning and enabling the self monitoring of learning achieved. A small minority of respondents indicated the potential value of a simulated environment in aiding their motivation, with a similar minority expressing a desire for the use of virtual reality.

The DMLE results (see Appendix 2.3, Table 2.3.101) suggest that there is an issue concerning the extent to which the use of multimedia, in particular video material, actually contributes to the motivation level of the learners despite aiding learning. The results suggest that the use of multimedia materials and simulations can have a positive impact on learners, which might suggest that this is so unless there are particular faults or omissions with the material concerned. The results suggest the importance of colour and variety in the style of presentation. This is likely to relate to the levels of motivation experienced. The DMLE results suggest that there is particular value to be gained from the use of simulations, that the visual display is important for learning and motivation as is the use of video material. Given that the simulations and graphics were considered to have aided learning, to a greater extent than they impacted on motivation levels, we might conclude either that such levels of presentation were simply expected, or that they explained rather than inspired.

It is important to consider however that many of the elements highlighted by the respondents as aiding learning or adding interest could not be provided without the use of multi-media, and therefore even where there may be no demonstrable impact on motivation levels where multimedia is used within this material, we may have encountered a negative impact had such multimedia not been used.

The HBS and MNE results (see Appendix 2.3, Table 2.3.102 and 2.3.103) do not directly highlight the importance of multi-media, but might be considered to be reflected in the responses relating to games, interactivity and simulations as such elements could not be provided without the use of multi-media.

4.10.2.11 Comparison with Other Modes

This section offers a summary of findings based on the results obtained from the investigation of the comparison with other modes.

The SEI, SHS, DMLE results show that there was some aspect to the CBL material which made it more preferable (see Appendix 2.3, Table 2.3.105, 2.3.106 and 2.3.108,) or motivating (see Appendix 2.3, Table 2.3.104, 2.3.107 and 2.3.109) for many respondents, than many lectures had been considered to be. The results may at one level be taken as a positive comment on the use of a computer platform for learning material. However, this conclusion must be tempered with feedback relating to the lecture option in its own right and that the restrictions due to timetable constraints may influence the preference for the flexibility of access offered by the CBL material.

The SEI interview responses suggest that the perceived value of using CBL material may be influenced by the possibility that the alternative may not be dynamic, or entertaining. A centrally important issue for learners is that they should not get lost in the material and that where the CBL material offers them a level of control over their pace and route which permits them to avoid this, it offers advantages over lectures which are set at a level outwith their control. The CBL material was considered more personal than lectures, in that it offered the individual student direct feedback and was always there whenever they wanted to access the material. That lectures depended on the lecturer and their ability to put the material across was clearly a view held by interviewees. The importance of the lecturer taking account of the student perspective and being able to keep the material interesting for the audience was highlighted as important and this was considered to be greatly affected by the method of presentation used. This suggests that the method of presentation in CBL material should employ a method of presentation which takes account of the student perspective and keeps the material interesting for the learners.

Mixed views were expressed regarding comparison with a book. Some considered that a book made it easier to go back through the material, rather than having to go back to the computer lab, as the book was portable. However they also commented that it was easier to take in the CBL material as the text was broken up into smaller sections and it did not seem as big a task as reading a book, which made it easier to concentrate on the CBL material than a book or lecture. Some commented that they were used to reading books and their eyes did not get so tired with books, therefore they preferred books to the CBL material. The use of pictures and opening and closing of windows was cited by some as making the CBL material better than books, which were regarded as background information, with nothing to look forward to but text, and nothing to do but turn pages. Some commented that the conversational style of the CBL material, with the light humour element helped to make the material about right for the course. Others considered that the cross referencing made the CBL material more interactive than a book. Having to click and move through the CBL material constituted activity for some interviewees, which they considered led to them reading more intensely than they would have done from a book. Some considered the "thunderbolt prompts", or exercises, to make the material better than a book, as they tended to skim through books but could not do that with the exercises, as they were concerned they might miss important material, therefore they learned more. Some considered the ease of finding information made the CBL material better than a book. The CBL material was considered by some to be better than a book as it made use of fonts, colours and graphics, which made it less boring. Others considered the "interactivity" made the CBL material entertaining, which made it more exciting than a book. It was considered by some that more dedication was required with a book, as it could easily be put down, whereas the CBL material made them sit down and do it, which they preferred. Others commented that with books they'd be more likely to leave the work until an assignment was due (see Appendix A.3.35 SEI 58).

A general preference for the CBL material was indicated in the results from the interviews. The CBL material was considered preferable to a book by a large majority of interviewees, and to lectures by a slightly smaller majority. A minority of interviewees expressed the view that the CBL material was not better than a book and a small minority expressed the view that they would not wish all their classes to be computer-based.

The results suggest that interest levels are centrally important and that learners expect the presentation of material to be made interesting in some way, or at least not made less interesting by difficulties caused due to presentational style.

The results obtained from questionnaires and interviews suggest that the material was perceived to be more motivating than lectures by those who had experience of other multi-media and that there continues to be a perceived value in having more tutor input. The results also suggest that those who considered the material to be more motivating than lectures were less likely to regard the exercises as non-essential or desire to read the material from a print out, that the comparison with best lectures remained consistent over time and that those who perceived the material to be more motivating than lectures are more likely to adopt a deep approach to learning.

The SHS results suggest (see Appendix 2.3, Table 2.3.108,) that the use of a CBL approach is considered preferable by a majority of respondents, with a large minority of respondents valuing the use of CBL material more highly than reading a book, and a fairly large minority valuing it above lectures. The expressed views are less pronounced with regard to practical labs and case studies. This suggests that the "reality" aspect of the practical labs and case studies may be of particular significance for respondents.

4.11 Findings from Statistical Analyses of Controlled Investigation Results

This section offers a summary of findings based on the results obtained from the investigation of the controlled investigation. This investigation was undertaken in order to obtain feedback which would clarify whether a particular preference existed within the groups studied and if so in which direction the preference was held.

The results of the statistical tests on the SEI and SHS CBL material (see Appendix A3.31 and A4.2) support the conclusion that there are significant differences between the responses obtained for the on-screen exercise versions of the CBL material, and those obtained in relation to the on-screen text versions of the same exercises. We may conclude, with confidence beyond the 0.05 level, that the differences in ratings obtained, were differences in the ratings given by the users of the CBL materials which may be attributed to the conditions concerned (i.e. presentation format) rather than being attributable to chance.

The results suggest that the differences obtained reflect the influence of the on-screen presentation condition concerned. The results indicate that more positive ratings were obtained in relation to the on-screen exercise version of the material, with lower, more negative, ratings being obtained in relation to the on-screen text version of the material. The results support the conclusion that the multi-media presentation of the CBL material concerned offers greater value for learners than an on-screen text presentation of the same material.

4.12 Review of "Results" Chapter

This chapter has provided a summary of findings from the detailed results of the research conducted in this study.

The results have been presented within categories emerging from the literature reviewed and from the open responses obtained. The results regarding perceptions of the CBL material have been presented in relation to impact on learning within the cognitive and the affective domains. Expressed preferences regarding computer-based environments have been highlighted.

Responses have been categorised in relation to perceived usability and impact of presentation of the material. Results regarding the use of on-screen text and of graphics and multimedia material have been highlighted. The perceived comparisons with other modes of presentation have been highlighted and the expressed levels of preference for an on-screen text or multi-media presentation of materials have been presented.

The results obtained in the "Introduction to Entrepreneurship" case study have been analysed over time and the results regarding differences over time and correlation of responses have been presented.

This leads us to Chapter 5 in which the results discussed here are directly related to the literature previously discussed in Chapter 2, conclusions are drawn regarding CBL materials and suggestions are offered for those involved in the development and use of such materials.

Chapter 5: Conclusions

5.1 Overview of Conclusions Chapter

This chapter is intended to offer a synthesis of the findings of this research and related literature. Clarification will be offered regarding the value of this research relative to the gap identified in the existing body of knowledge, which this research addressed, and why this may be argued to be of value. The key findings of this research will be identified and the relevance of related findings which underpin these will be clarified. A range of elements and perspectives, considered centrally important in this research, will be highlighted and the importance of such elements within the sphere of computer-based learning will be clarified. Recommendations for the design of computer-based learning material will be made in the light of the research findings. This will clarify the complexity of the arena and the contribution offered by this research, in the quest to enhance the effectiveness of the learner's experience when using computer-based learning materials.

5.2 The Contribution of This Study

This study addresses fundamental issues relating to the design and use of CBL material. The design issues are addressed in a way which enables an overview of the issues to be understood and a range of factors influencing design to be taken into account when drawing conclusions.

The case studies used cover a wide range of respondents in terms of age, year of study and core degree subjects, and a variety of software representative of current developments in the CBL arena within the Higher Education sector and beyond. The range of coverage, in terms of aspects addressed in relation to design of CBL material, and the range of respondents and actual CBL material involved, differentiates the empirical research in this study from those which have focussed on single groups using subject-specific CBL material.

Other studies have highlighted the importance of integrating computer-based material with the class overall (Thornbury et al 1996). This study also addresses the important aspect of context in which the CBL materials are used, across a range of classes.

In attempting to draw conclusions regarding this highly complex arena, there is one particularly salutary point to bear in mind. It may be argued that this should be considered whenever attempting to clarify issues relating to the design of computer-based materials on levels of instructional design, interface design, or graphical design. The point is raised by Davison et al (1999) that the "paradox of expertise" is that "experts find it difficult to explain how they arrived at a conclusion because they have set aside and forgotten the rules of the early stages". The authors argue that teachers and students are at different stages in their development which has an effect on their approach to problem solving. Davison et al (1999) consider this to relate to the "novice to expert" model of learning.

As Davison et al (1999, P13) point out, the design of activities to promote deep learning should reflect the limited capacity of novices to undertake the activities of which the experts are capable. They conclude that by recognising such differences, between experts and novices, regarding learning styles, motivational needs, experience, and the tendency for teachers to adopt approaches which best suit their personal style, we may make best use of educational technology in attempting to cater for learners. This should constantly remind us of the potential "blindness" of "experts" to issues which are clearly seen by non-experts, which in turn highlights the value of the user / learner perspective.

The contribution of this study is that it highlights the importance of learner perspective in relation to perceived effectiveness of the design of CBL material and the inter-related nature of such with the context of use.

5.3 Learner "Overhead" Issues

The literature highlights the potential impact of "overhead" on the learner's experience (Boyle (1997), Cooper (1995), Neilsen (1995), Mandel (1997), Stoney and Wild (1998). This "overhead" may involve a range of issues from the level of content to the skill level required to navigate the interface and the learning curve involved in gaining such skills. It was important to establish whether overhead issues relating to content level were likely to be affecting the respondents to such an extent that their perception of the effectiveness of the design of the CBL material might be skewed by such.

5.3.1 "Computer Literacy" of Users

The results suggest that computer literacy, which has been identified as one of the key problems for the interface design used in CBL material (Richards, 1994), is not an issue for the students concerned in this research. The results show that the respondents within each of the case studies were beyond the complete novice level of "computer literacy". This does not contradict the findings of such as Anderson et al (1993), given that many of the students concerned in this research were beyond their first year and that the level of computer literacy confirmed was simply that they had previously used a computer and is in line with studies such as Thornbury et al (1996) which have found that the level of computing skills was not an issue . This was considered sufficient to permit the feedback provided to be interpreted as applying directly to the design of the software in use, rather than to underlying difficulties with using computer technology.

5.3.2 Content Appropriateness

The results obtained permit the conclusion to be drawn, that the level of content of the material used within each of the case studies may be regarded as appropriate and that any comments made regarding the effectiveness of the CBL material were not merely reflections of problems due to the impact of inappropriate content.

5.3.3 Learner Confidence

The research indicates also that perceived confidence levels are sufficiently high to permit the conclusion that the responses obtained in the research, to questions regarding the design of the material in use, are likely to reflect the learner's view of their use of the material, rather than any issues relating to difficulty with the content of the material. The responses in interviews indicate that previous experience, in relation to both the content of the material and use of computers, was perceived as helpful when using the CBL material.

While the findings regarding "Computer Literacy" of Users, Content Appropriateness, and Learner Confidence are not considered to be "key findings" of this research they do establish the student level of comfort with the medium and content, therefore provide support for the validity of the other responses obtained in relation to the design of the CBL material.

5.3.4 Approaches to Learning and Learning Styles

Diversity in Style and Approach

The key finding regarding approaches to learning and learning styles is the diversity of style and practice encountered, within individuals at different times, within cohorts following the same class and therefore using the same CBL materials, and between cohorts. The results highlight apparent contradictions / anomalies, for example:

- The predominant approach to learning may be deep at the same time as a preference is expressed for a delivery mode suited to surface learning

- Students may seek the option for problem solving with feedback and information transmission within the same CBL material

- In some cases the use of CBL increased the motivation for "deeper learning", to the level of "knowing" (counter to Grantham and Hunt's (1999) concern that CBL can induce a surface approach to learning)

The importance of learning style and approaches to learning is highlighted by such as Pask (1976) and Entwistle (1988). However, views on the variability in adopted approach to learning differ, from those who argue that individual students tend to be consistent in their approach, Entwistle (1988), Pask (1976) and Schmeck (1983), to others who highlight the importance of the interaction between the learning styles and the impact of situation-specific concerns Laurillard (1984) and Ramsden (1979). The results of this research support the view that learners differ in their preferred learning style, their approach to learning, and the way in which these are influenced by circumstances at particular points in time. This highlights the complexity of learning needs and points to the need to accommodate this variety within the CBL material, with associated implications for instructional design, interface design and on-screen presentation. Furthermore, the results support Draper (1997), who points out that the origins of concepts of learning may be considered as "pragmatic", and that in truth we have much to learn about the ingredients of successful teaching delivery.

The results of the ASSIST analysis show that the vast majority of the students taking the SEI "Introduction to Entrepreneurship" class adopted an approach to learning which was surface-apathetic and preferred an information transmission type of course and teaching. The results in the case of Scottish Hotel School, show that the majority of the students taking the class adopted an approach to learning which was deep, with a small minority adopting a surface-apathetic approach. However, the majority of these students also preferred an information transmission type of course and teaching. This suggests that the students concerned are biased towards information transfer as a mode whether they are taking a surface or deep approach to learning. This might be taken as a reflection on the way in which the students within the Higher Education sector are assessed, or effectively rewarded for their efforts, and the most efficient means by which the information required for such assessment might be accessed from the student perspective. This relates clearly to the points raised by Porrit (1997), who points out that some students are motivated to pass exams rather than to seek deeper learning

In contrast, the results for the MNE group indicate that the majority of learners in this group adopted a deep approach to their learning and expressed a preference for supporting understanding. This suggests that a straight transfer of information does not meet the needs or wants of these learners and that a more complex means of conveying the required information would be required. This may be a reflection on the way in which the students within the "real world" or "business world" are assessed, or effectively rewarded for their efforts (e.g. Woolwich Group: MNE test and related increase in salary from employer when achieved), and the most effective means by which the information required for such assessment might be accessed from the student perspective.

The results indicate that the majority of learners in Case Studies 1, 2 and 5 have a visual style (Cases 3 and 4 were not assessed for learning style). This would suggest that graphic, animation, or video presentation of material might be considered more effective than other modes for these learners.

Influences on approach

The results indicate that learners ranged in approaches relating to working through all the elements of the material, adopting a skimming approach, and revisiting material initially covered. This may suggest a level of strategic approach to learning being employed, which seeks to identify the material on which to focus in detail. There appears to be some relationship between the amount of text involved, or the level of violation of expectancy, and the extent to which a skimming approach was adopted by a minority of respondents, though such an approach may simply reflect a surface approach to learning. There also appears to be some relationship between the volume of material offered and the need to be selective, in relation to other pressures on the learners concerned.

The responses in interviews indicate that a range of variables impact on the approach taken to the CBL material. Some learners perceived their motivation for learning as intrinsic interest in the subject area rather than something which is heavily influenced by the presentation of the material. Others perceived that, with the CBL material they approached with a view to knowing, and some perceived that doing the work by choice was important, while others perceived that by being computer-based the material kept their attention because they had to do it.

The results suggest that there are both motivator and hygiene factors at work, in that the learners express an interest in learning, but also seek to pass assessments, avoid failure and avoid being "bored" where possible. This supports the points raised by Valley (1997) that the concept of "learning style" may encompass such attributes as emotional state and motivation, prior knowledge, intelligence, and self-concept. As Valley points out, it is important to keep in mind that each category represents a spectrum of possibilities rather than a polarized definition, and that these "habitual styles" may be considered to affect learners to the level where they benefit more from some experiences than from others. The results appear to offer a level of support for this interpretation in that elements within the material which are rated poorly by some respondents are rated highly by others. Given that the users are working within the same environmental constraints and are being held to account within the same assessment regime this would suggest that their "learning styles", or preferences, have resulted in the differences in perception of the material as expressed in the responses obtained.

Implications for design of materials

The results obtained offer some insight into ways in which information technology may be used to accommodate the learning preferences of students (Jones et al, 1997), in that they indicate a range of preferences and approaches, influenced by circumstance and motivation.

However, attempting to draw conclusions regarding how such "learning style" preferences might be addressed within the design of CBL material is further complicated when we enter the debate about whether the learner should be expected to adapt to the design of the CBL material, or vice versa. On the one hand Valley (1997) suggests that assisting learners to employ different learning strategies may be argued to be more appropriate than trying to accommodate the individual preference of the learner. This runs counter to the view of Pask (1975) who considers that we should match the student's "existing competence", or learning strategy. This also brings the issue of stakeholder perspective back into the frame regarding the design of CBL material. The results of this research suggest that the conclusion reached from the learner perspective would be that they should be empowered to approach the material in the way they choose, at the time they choose. This is significant taken in the context of the point raised by Pillay et al (1998) that matching of the instructional design, to the learner's preferred style may release "cognitive resources", thereby allowing learners to focus on linking the material being studied to their prior knowledge. This in turn relates to the view of Wild & Quinn (1998), that it is important for learners to consider the way in which items of knowledge relate, therefore deep approaches to learning should be encouraged, which may be argued to require an internal locus of control. The results appear to support, the point raised by Wild and Quinn (1998), that some learners may not be ready to handle such an approach. For such learners "effective learning" requires that they be allowed to approach the material in a more structured, directed way, which as a minimum requirement ensures successful "information transfer" for the learners concerned.

It may be argued that this variation in preferences might be addressed within the design by exploiting the multi-modal capability of hypermedia, Kim (2000), Shiratuddin et al (2000). That learner approach or style is important, and how best this might be addressed, is a complex issue, to which there is no single definitive answer, as highlighted by such as Gardner (1983) and Hughes (2000). Such viewpoints coupled with the results obtained in this research suggest that the provision of a range of options within the design of CBL material, at both instructional design and interface design levels, might best benefit the range of learners concerned.

5.3.5 Human Contact and Tutor Related Issues

Perceived Need for Face to Face Contact

The key finding regarding direct face to face contact is that the use of CBL material has not yet removed the need for direct contact between students and tutors. The results show that:

- There is perceived value for learners in having human contact with peers and tutors
- A number of learners desire tutor input in face to face mode.
- The desire for face to face tutor contact appears to become more pronounced over time.
- Guest speakers and dialogue are highlighted as valuable for learners
- An important aspect of direct contact is that learners can see and hear the other party.
- There are ways in which CBL material may be brought closer to face to face provision

This supports the point raised by Porrit (1997), that many students prefer face to face lectures and tutorials to computers, and the point raised by Richardson et al (2000), that interaction with the instructor may still be regarded as centrally important for the level of learning achieved by students.

Implications for Design of Materials

The results suggest that where computers are used for providing or maintaining contact with others there is value in the use of multimedia, as this permits the sound and vision elements to be used and therefore enables the learner to gain benefit from seeing and hearing the other party.

The results indicate that the use of such multimedia should go beyond the use of video clips and offer a level of interactivity. The results suggest that the two-way flow currently offered by email should be regarded as a base level, but that this should preferably be offered in multi-media mode.

The perceived need for human contact clearly remains an important issue when we consider the design of CBL material. The results indicate that there are still elements in the learning and teaching process which benefit from face to face provision in some way which the CBL material does not yet deliver.

While these results do not indicate that a majority of the respondents wish all learning to be delivered by computer, nor that a majority desire human contact, the fact that a large minority chose to comment on the importance of human contact within their open responses indicates that this is an important issue for learners.

The results suggest that the issue may be addressed by having class tutors present and facilitating group working where this is possible. Where this is not possible there is clearly a need to address the issue within the design of the CBL materials employed. The logistics of addressing such issues are clearly less than straightforward, with some learners commenting that face to face sessions should require forced attendance, while on the contrary, others desired non-compulsory sessions. This indicates a need for flexibility within the design in order to meet the learner preferences concerned.

This may also relate to the issues regarding degree of learner control enabled and the line between that and what Laurillard (1993) refers to as "dereliction of duty" on the part of the provider. This may also be related to the need for interactivity as highlighted by Somekh (1996), and dialogue between teachers and students, which would traditionally have been available in a face to face environment as highlighted by Brailsford et al (1997).

5.3.6 Learner Management Issues

Perceived Need for Flexibility

The key finding regarding direct learner management issues where CBL material is used is that flexibility in the use of CBL material is centrally important for learners. The results indicate that:

- Learners value personal control over the use of the material
- The use of central labs is considered less than adequate in meeting perceived flexibility

needs

- Home access is desired
- CBL is perceived as requiring greater levels of self management than traditional modes of learning and teaching, which has advantages and disadvantages for learners

The results suggest that the issue of self management is likely to become increasingly important where CBL material is more extensively used. This supports the points raised by Johnson et al (1997), that with an increasing range of student ability entering Higher Education, it is important to allow students to learn at a pace they consider comfortable for them, and the point raised by Brain et al (1999) that CBL can give students control over when and where they learn and the pace of their learning. This may be considered to support the constructivist perspective, as highlighted by Grabinger and Dunlap (1995) to the extent that there is value in the encouragement of learner responsibility for learning.

The responses obtained in interviews indicate that self-management of learning, using the CBL material, offered flexibility which learners valued for various reasons. This supports the findings of Thornbury et al (1996) which highlight the importance of the demands on and approach taken by students when using CBL material. While self-management of learning was considered generally as a benefit, it was also perceived to have some disadvantages in that learners may easily mismanage their study and be faced with a bottle-neck of work to be covered.

The responses indicate that learners encountered some difficulty when accessing computers within the central lab system. One of the central issues regarding the current facilities was perceived to be distraction, often due to noise levels. Some expressed a preference to access the material from home, while others expressed a desire for more acceptable facilities within the campus. The issue of home access was particularly highlighted regarding those who lived a distance from campus. Having to access the material from the central labs was perceived by some as an "inconvenience", which might indicate some expectation of "convenience" on the part of some Higher Education students, using CBL materials. This appears to relate to the expressed desire for printed material, in that printed material is accessible from any location of the respondent's choosing therefore offering greater flexibility than the labs. The responses indicate that self management of learning benefits from the provision of individual choice and self-monitoring opportunities. The provision of choice enables learners to navigate through the material in ways which they find appropriate for them, including personal approaches to "breaks", and thereby enables individuals to reduce the likelihood of boredom and fatigue, and increase the likelihood of a positive motivation when using the material.

Implications for Design of Materials

There is a clear requirement for flexibility of use to be designed into the material, with adequate provision to facilitate learner self-monitoring.

The advantages of self management require ease of use and ease of access issues to be addressed before learners may fully benefit from the level of flexibility offered by the CBL materials.

There are issues relating to learner motivation, which suggest that there are likely to be advantages in offering material which has been designed to be as engaging as possible for learners.

5.4 Learner Perceptions of Computer-based Material

5.4.1 Impact on Learning / Understanding (Cognitive)

Perceived Need for Information Transfer and Practice Opportunity

The key finding regarding the perceived impact on learning / understanding in the cognitive domain where CBL material is used is that there is a diversity of perceived needs and wants encountered, within individuals at different times, within cohorts following the same class and therefore using the same CBL materials, and between cohorts. At times these differences highlight apparent contradictions / anomalies, for example:

- While there is perceived value the provision of information in an information transfer mode, there is also perceived value in the provision of opportunities for practice at the level of rehearsal
- There is perceived value in the provision of opportunities for problem solving at the level of using the knowledge gained, but not at all stages in their use of the CBL material, which suggests learners are responding to a system of assessment which

inspires them to seek information transfer, when using CBL material.

- Learners appear to be less than confident in monitoring their own learning when using CBL material and desire explanatory feedback
- Synchronous interactivity in communication appears to offer greater potential benefits for learners than asynchronous and, although forced compliance may be considered by some experts to offer a means by which learners may be granted "structured" use of material, learners prefer to retain personal control over their use of CBL material.

The results suggest that it is important that the learners have their thought provoked, and that problem solving offers an effective way of achieving this for some learners. The results show that exercises are considered to aid learning, but problem solving is not quite as highly rated in provoking thought, which might suggest a rehearsal, rather than thinking value in some exercises. Simulations containing real life examples and featuring graphics and video material are shown to be helpful for learners. The use of exemplar material and the provision of multiple opportunities for practice are also considered to be valuable for some learners and the availability of explanatory feedback on demand is shown to be important. Undertaking work which requires knowledge of content and a reflective element is perceived to increase the learners' depth of thought. However the results suggest that the work which is reflective, but not directly assessed is less likely to increase depth of thought, which tends to suggest that the assessment itself plays a significant role here. The results indicate that there was uncertainty experienced, regarding learning achieved, on the part of some respondents, which suggests difficulty in self-monitoring of learning.

Implications for Design of Materials

The results indicate that there is a level of uncertainty perceived by the learners, which suggests that the materials failed to present the learning material to the level required by the learners concerned. This suggests that the focus of importance for the learner should be more clearly highlighted and clear feedback offered for learners regarding their progress.

The results indicate that the combination of text and multimedia material is helpful for learners and that the use of images either on their own, or in combination with text is helpful for learners.

Appropriate demonstrations involving animated or video material were perceived as helpful for learners, with the sound element considered less important in helping learner understanding.

The results reflect the perceived value of the use of "authentic" learning tasks, to ensure that learning is considered meaningful by the student, as highlighted by Boyle (1998), but appear not to support the view that discovery learning methods, involving the construction of understanding, emphasising learning how to learn and solve problems, is desired. Rather it appears to reflect a desire for learning factual information. This runs counter to the current perspective of constructivist educators which, as Boyle (1998) points out, highlights the importance of supporting problem solving and where possible collaborative learning. Where learners favour the information transfer approach to learning, but do not engage in problem solving using the knowledge gained we may be faced with that which Grabinger and Dunlap (1995) refer to as "inert knowledge", and the learning might from such a perspective be argued to be "passive learning" (Pilipenko and Komissarova, 1995). It may be argued that the use of "problem solving" engages learners "actively" and that "active learning" is preferable to "passive learning", which has clear implications for the design of CBL materials. Davies and Crowther (1995),consider that the active / passive issue may be addressed using multimedia by making progress dependent on the completion of required tasks and providing feedback to learners which enables them to assess their own progress and level of understanding. However the results suggest that the learners would not favour the forced compliance element, or the problem solving requirement. The results suggest that the learners concerned would be more likely to find such impositions "tedious", as Davies and Crowther concede is possible, where too many questions are asked of learners.

Those who favour the use of "intuitive" interface design, such as Cooper (1995), resist the use of forced compliance, regarding ease of use as paramount, while others such as Hughes (2000) argue that forced compliance is appropriate in ensuring that users do not commit errors of omission, regarding ease of use as unrealistic and some level of "training" for use as appropriate in order to use computer-based material. This debate overlaps into instructional design, in that forced compliance for learner progress would essentially conflict with the ease of use and "engagement" aspects. Forced compliance would also be an issue in relation to navigation and the level of structure imposed, or freedom given to navigate at will as highlighted by Somekh (1996). It may be argued that the prime purpose of CBL material is to engage learners as fully as possible in the learning process, therefore the concept of "flow" should not be interrupted for the learner (e.g. by tasks being imposed by the computer). The results suggest that the learners concerned would be more likely to find such impositions frustrating, given the expressed desire for feedback on demand, and the views expressed regarding the number of re-tries considered acceptable for on-screen exercises.

5.4.2 Impact on Learning / Motivation (Affective)

Perceived Need for Motivating CBL Material

The key finding regarding the perceived impact on learning / understanding in the affective domain, where CBL material is used, is that perceived objectives and levels of relevance for learners are centrally important for learner motivation levels. However the perceptions of these elements are shown to vary across learners both within and between cohorts, which raises issues for design of materials. The results indicate that:

- Learners are likely to be motivated by assessment, the use of relevant real life examples, perceived interactivity, level of challenge and by the use of fun / humour.
- A "game" style of presentation is likely to motivate a proportion of learners, but is not considered highly motivating by all learners at all times
- Learners are likely to be de-motivated by perceptions of boredom, violation of expectancy and too much text being used

As previously discussed, in order for learning to take place learners must engage with the CBL material at the level of sensory perception initially, then at the higher cognitive levels. In order to facilitate this, the material provided must cater for their expectations, needs and wants.

The results show that accessibility and time flexibility are major factors in the CBL material being perceived as motivating for many respondents. It is also clear from the results that learners value the text material, and even choose to access text material while simultaneously avoiding multi-media options. This suggests that other factors may be exerting an influence on the users and therefore suggests a need for user choice.

The results obtained in this research indicate that where CBL material is concerned, it is centrally important that the learners perceive the content and process, with which they are expected to engage, to be relevant for their purposes. The use of "real" examples was perceived to be important in establishing the material as relevant and appears to impact on the affective domain. The circumstances within which the material is used by learners and the level to which assessment features in the use of the material is also indicated by the responses to impact on perceived relevance. The results indicate that a level of self assessment was perceived as helpful in enabling self-monitoring of learning, thereby motivating learners by confirming learning achieved. This supports the points raised by Davies and Crowther (1995), who argue that motivation to learn may be based on the interaction between the individual's expectation of being able to complete a task and the value of the task for the individual concerned. They also point out that the possibility of elements acting as hygiene factors must be considered, the absence of which might be considered to demotivate. This is relevant in that while the inclusion of particular elements may not directly impact on the perceived value of the CBL, their omission may result in a lack of value being perceived.

The results suggest that assessment plays an important role in motivating learners using CBL materials in Higher Education, to the extent that material which is not assessed may not be utilised by some learners. The results suggest that undertaking work which requires knowledge of content and a reflective element, is perceived to increase the learners' depth of thought, but that work which is reflective and not directly assessed is less likely to increase depth of thought. Therefore we may conclude that assessment itself appears to be playing a significant role in the affective domain. The results indicating a preference for an information transmission delivery style, when considered alongside the results indicating the importance of assessment, suggest that perceived assessment needs must be satisfied before the higher order needs, which permit deep learning, emerge and the associated CBL elements are valued by learners.

The importance of assessment, as reflected in the results, might be considered from the humanist perspective highlighted by Maslow (1968), as "needs" on the part of the learners which they become motivated to satisfy, or a source of fear which may be avoided. In either case this may be considered as influential in the choices made regarding their use of CBL materials and the extent to which they value the elements contained therein. The results regarding assessment support the points raised by Issroff et al, (1997), that material not considered as directly related to passing the assessment may be regarded by learners as merely an extra.

The level to which novelty value was considered to have an impact suggests that even with non-novice users there may be a "novelty effect" created by the use of computer platforms for delivering materials for learning, which would clearly be lost were many classes to be computer-based. The results suggest that the use of a computer continues to have a motivational value for learners in that a level of interest is inspired by such, which for some goes to a level of enjoyment. The results suggest that perceived interactivity may influence the preference for the CBL material over a book.

The results relating to the use of fun / humour, interactivity and variety in the content offered, also relate to the motivational side of the learning process. Fun, humour and interactivity are perceived as providing a break from on-screen text as a basic input and offering further benefits in terms of perceived understanding gained when directly linked to the specific material to be learned.

The importance of variety in the contents of linked windows may be related to the notion that repetition beyond a certain level becomes boring, and that expectations may be violated when following a hyperlink leads to an unexpected outcome.

The results also suggest that feedback and explanation of the feedback is perceived as important, with potential impact on both perceived learning gained and motivation to continue using the material. The perceived need for variety and explanatory feedback may be considered in terms of the "spiral curriculum" concept as espoused by Bruner (1960), which suggests that learners should be introduced to concepts in a variety of different ways, over a period of time, and also to the point raised by Somekh (1996), that designers tend to rely on students using the software many times without variation, despite the risk of monotony.

The results support the points made by Badcock et al (1996) that pedagogical design is crucial, with relevant and visually stimulating material, coupled with the moderate use of humour increasing the likelihood of increased motivation and enjoyment for learners.

The results indicate that aspects of CBL material can become irritating, which suggests that for some learners perceptions of the usability aspects of the interface design may change over time. This relates to the point raised by Mandel (1997), that an interface design which is easy to learn in the short run may prove to be laborious to use in the longer term. It is possible that these aspects exert a cumulative impact on learners which becomes more obvious to them as their use of the material allows any novelty effect to wear off, their demands on the material increase and their need to achieve outcomes becomes more sharply focussed due to time constraints for work output. This also relates to Mandel's point regarding productivity focussed users for whom it may be argued that ease of learning and ease of use are likely to be priorities, with the subsequent importance of recognising how much frustration such users are likely to tolerate (Mandel 1997).

Implications for Design of Materials

The results indicate that where CBL materials are to be designed for learner motivation and engagement there are many layers involved and the design should incorporate motivational aspects from the outset. The results suggest that variations in learners will require variations within the motivational design options made available within the CBL material.

The results indicate that the CBL material should be perceived by the learners as relevant for them, which may be different to the relevance perceived by instructional and interface designers, or educators. This supports the case for team based iterative approaches to design where learner involvement is facilitated.

The results suggest that perceived relevance is likely to relate to the objectives learners have as their focus at the time the material concerned is in use, which may be those of the learners themselves or those imposed by providers (e.g. in relation to assessment). This suggests a need for learner choice and flexibility of design in relation to both content and presentation.

Where learner control over CBL material is provided, there is a clear need for ease of use and avoidance of "boredom", as perceived by the learners. The message for the design of CBL material being that learners should be exposed to material in a range of ways, rather than having to face repetition within CBL material, in order to reduce the risk of monotony and perceived boredom.

The results suggest that assessment which is compatible with the nature of the course concerned should be employed as a motivator and that the CBL material should offer a range of styles and levels, including feedback availability on learner demand, rather than when the designers of the CBL material have decided it should be made available.

The results indicate that learners clearly value text material, and even chose to access text material while simultaneously avoiding multi-media options, which suggests that other factors may be exerting an influence on the users. This suggests that in addition to any discovery based or problem solving provision, the CBL material should also be routinely accessible in an information transmission delivery style in order to meet the needs and wants of a range of learners, within a dynamic learning situation.

The results suggest that in order to maximise impact in the affective domain, the material should make use of real life examples to demonstrate relevance for learners and that these should be shown via multi-media where possible.

The results suggest that learner motivation can be negatively affected by mode of presentation and that there is a link between the experience of eye strain / fatigue and too much text being used. Aspects of CBL material are perceived to become irritating, which suggests that for some learners perceptions of the design may change over time. The results also indicate that where too much repetition of content occurs there is likely to be a negative effect on learner motivation, and may lead to a reduced likelihood of hypertext links being accessed. This supports such views as Mandel (1997) on the importance of the design matching the expectations and experiences of users and that the most appropriate medium should be used at the most appropriate time, offering the most appropriate information.

The results clearly indicate that the inclusion of an element of fun or humour was perceived to be of value by learners and was considered to have assisted learning, by enabling working with the material to be perceived as "less of a chore", without taking away from the serious message in the material. This suggests that the design should include both elements where appropriate.

The results suggest that the inclusion of a game element is perceived to add interactivity, challenge and fun, which is likely to inspire active learning for some, though not all learners. This might be related to the creation of "disequilibrium", between what learners thought they understood and the new material which reveals gaps in their understanding, leading to "active learning".

This research suggests that there may be benefit in allowing learners to control the use of multimedia material, by selecting for themselves the mode of presentation, the level of interactivity and the level of feedback. This would offer a means of meeting the needs and wants of a diverse range of learners, given that their expectations differ and that which is effective for some has a negative effect on others.

5.4.3 Effectiveness of Exercises and Related Issues

Perceived Benefits of Exercises

The key finding regarding the perceived effectiveness of exercises and related issues, where CBL material is used, is that perceived interactivity may offer benefits directly and indirectly by impacting on both the cognitive and affective aspects of learning. The exercises were regarded as the most interactive element of the material and it was generally considered that interactivity was an advantage, with more interactivity perceived as preferable to less. However the perceptions of these elements are shown to vary across learners both within and between cohorts, which raises issues of flexibility and choice regarding the design of materials.

The responses indicate that there were noticeably differing definitions of interactivity employed by the learners interviewed, with some perceiving the hypertext links as interactive, and others considering that the act of pointing and clicking provided a level of interaction, which in itself raises issues regarding the level of "interactivity" considered appropriate for CBL material. This research indicates several centrally important aspects for exercises.

- There is perceived value in the use of a combination of text, graphics and colour within exercises, however exercises are perceived to offer more than on-screen text, even where the exercises themselves are largely text based.

- The "problem solving" aspect and the related "decision making" aspect to exercises are perceived to be of particular value when combined
- Perceived interactivity offers benefits directly and indirectly by impacting on both the cognitive and affective aspects of learning when using CBL materials.
- There is perceived value in exercises containing "realistic" and "relevant" activities at "appropriate" levels of difficulty with explanatory feedback available on demand.
- The perceived value of optional exercises appears to be lower than those which are directly assessed.

The results clearly show that the use of exercises is considered effective, within the CBL material. Relevance of the exercises and the scenarios used within them is considered by learners to be of prime importance.

Exercises are clearly perceived to offer something which differs from and is more effective than text alone, for learning. The results indicate that the exercise elements benefited a majority of respondents by offering opportunities for practice and having a positive impact on learner motivation.

The results indicate that the exercises were considered to aid learning / understanding, provoke thought and add an element of interest for respondents by means of interaction required of the learner in making judgments, reaching decisions and checking the outcome of such decisions by comparing their responses to the feedback offered by the exercises, thereby helping learners monitor their own learning.

The results suggest that the level of interactivity involved is perceived to affect levels of physical, mental and emotional engagement and the perceived level of learning achieved.

Exercises are also perceived to offer affective benefits by exposing the learners to stimulating elements within their design, ranging from screen display used to the level of interactivity and complexity.

Despite the perceived value of the exercises some learners considered them as non-essential and chose to focus their attention elsewhere. This suggests that for some learners, even material which is likely to enhance their level of understanding may be disregarded, in order to focus on that which is perceived to be specifically required for their needs at that point in time. This may relate to the way in which assessment is perceived by the learners and the level of commitment they choose to make in relation to learning to pass assessment, rather than learning for deeper understanding in its own right.

The on-screen exercises were perceived as "games" by some interviewees, with some expressing a desire for problem solving games involving more complex scenarios including simulation. The game approach was generally considered advantageous, with the main advantage being that learners could observe the consequences of their decision making. Competitiveness was also perceived to be valuable for learning, with the possibility of competing against existing track records being cited as a preferred option for some.

Implications for Design of Materials

Perceived relevance of content, the nature of the tasks specified and the feedback given in the exercises is particularly important for learners and should be addressed within the design of the CBL material.

The opportunity for practice and motivational impact of exercises is highly valued by learners, which indicates the need to design for motivation when developing screen displays and interactive functionality.

The design should offer flexibility for learners to focus on that which is perceived to be specifically required for their needs at any given point in time, which would require the information contained within interactive exercises to be available within information transfer modes in the material. This suggests the requirement for a level of duplication or redundancy of content, in order to provide learner choice.

The design should take the learner experience more fully into account and offer learner choice regarding complexity of exercises undertaken.

The design should enable learners to choose the level of explanatory feedback desired in response to their attempts at interactive exercises, which should be available on demand and should enable learners to improve on previous performance by offering the opportunity for multiple attempts at exercises.

5.4.4 Expressed Preferences for Computer-based Environment Types

Expressed Preferences for CBL Environment

The key finding regarding the expressed preferences for computer-based environment type is that learners in Higher Education favour a combination of text and multi-media in CBL material.

The results suggest that while the learners are aware of the need for information, they clearly prefer to have more than a simple information transfer using on-screen text. This might be related to the facilitation of "active learning" and the potential value of "game" approaches as highlighted by such as Laurel (1991) and (Mandel 1997), and suggests a positive impact of graphics within such environments. This might also be related to users' initially being susceptible to the danger of the "WYKIWYL: what you know is what you like phenomenon" as pointed out by Mandel (1997), in that they express a desire for text based material but, given that their wants and needs regarding interface design are likely to be dynamic rather than static, they would come to prefer a more elaborate interface over time. That learners in Higher Education appear to desire an information transfer style of delivery, yet least favour on-screen text style of delivery and most favour a combination environment, may reflect their expectations of the institution and its mode of assessment, coupled with their expectations of multimedia capable computers. While such as Aedo and Catenazzi (1997) may argue that the use of a book metaphor offers a level of familiarity for learners and Carswell (1998) may consider that the "book interface" is low on overhead as it has become very familiar to us over generations, the results regarding the preferred type of CBL environment suggest that the prospect of reading text from a computer screen is less desirable for learners than the prospect of exploring more media-rich and interactive CBL environments. The results also suggest that the "book interface" is perceived as less motivating for learners, which may to some extent reflect the issue of style becoming dated as highlighted by Mandel (1997).

Implications for Design of Materials

The results support the conclusion that a simulated environment consisting of a game element coupled with optional access to text based material would be most likely to meet the diverse needs of learners.

The perception of the book interface clearly has potential implications for any further development work undertaken in relation to the CBL material concerned, and may be related to the view that learning may be "situated" by simulating real circumstances, or by offering an environment such as a "microworld", within which the resulting learning experience may be perceived as "authentic". This may be related to the argument that decisions made regarding metaphors in CBL material are likely to reflect the underlying philosophy employed by the designers of the material, rather than the perspective of the user group.

The important point here being that the learners express a desire for authenticity and realism which would suggest a microworld environment to be appropriate. This would suggest that such a design should be employed where the learner is considered of prime importance, as opposed to a text-based delivery mode, which may be argued to be more cost-effective by some stakeholders given that it is easier and therefore cheaper to produce.

5.4.5 Effectiveness of Navigation Elements and Related Issues

Perceived Needs Regarding Navigation

The key finding regarding the perceived effectiveness of navigation elements and related issues is that where a range of users are to be catered for using CBL material it is likely that the instructional and interface design will require a high level of complexity. Ease of use is highlighted as centrally important and this must be considered from the learner's perspective. Provision of specific and easily accessible additional information on demand is perceived as important. Ease of revisiting specific material and of having specific navigational links to defined and relevant information within the material when addressing exercises is highlighted as important. This research indicates that:

- User needs and wants regarding navigation are likely to be dynamic rather than fixed, and influenced by the learner's intrinsic characteristics and their interaction with the environment within which learning takes place.
- Navigation within CBL material is still a major issue for learners and that even with today's learners, who may be regarded as "computer literate", it is essential to offer clear orientation for every mode of navigation within CBL material.
- Where learners perceive malfunctions, they experience violation of expectancy, which has a negative impact on their motivation.

The results support the conclusion that the use of hypertext links is perceived to increase the ease of use of text based material and the use of colour is perceived to increase the ease of use of the hypertext links. However, hypertext links although perceived as effective in their own right, were not considered by respondents to be quite as effective as the more graphic forms of navigation, which suggests that more "graphic" forms of navigation are less confusing for users. This is exemplified in the case of the MENTOR structure map which offers a graphic representation of the material which may be accessed, and the "feet" button which is a graphic in that it offers an iconic representation which is associated with a directional navigation in this instance. The hypertext links do not offer any graphic representation which suggests navigational direction. The difference in ratings between the map graphics and those achieved by buttons within text windows or hypertext within text windows would suggest that both buttons and hypertext failed to offer users something which the map format of navigation managed to achieve. This may be related to the map format having provided a tangible frame of reference within which learners could orientate themselves, in relation to where they were currently, had travelled from, and wished to go next. The results indicate that use of hypertext links and buttons within windows resulted in the learners becoming "lost in hyperspace".

Despite the potential confusion when navigating using hypertext, responses in interviews indicate that hypertext links were perceived by some learners to have enabled them to maintain their train of thought and helped their understanding. The hypertext links were perceived to have highlighted and clarified connections between important elements of the material, enabling learners to quickly view related material. The hypertext links were also perceived to have added an element of interest, or entertainment value, and to have helped learners recall the material concerned. The hypertext links were also perceived to have helped break up the text element.

The results support the views expressed by Conklin (1987), that the use of hypertext incurs centrally important disadvantages of disorientation and cognitive overhead. There is an option of restricting the freedom of navigation offered to learners, which may be argued to be beneficial to less experienced learners, as highlighted by Aedo and Catenazzi (1997). However the responses obtained support the view highlighted by Johnson et al (1997) that one of the most valuable contributions made by the use of computer-based material, is that it enables learners to allocate time to the material in the way they find appropriate.

The results indicate that the debates about the value of text, graphics, animation, simulation and interactivity, as expressed by such as Cooper (1995), Nielsen (1995) and Hughes (2000) are still relevant regarding CBL materials currently in use within Higher Education.

Implications for Design of Materials

The results suggest that choice and variability, including learner control over navigation, the interface design in use and the use of multimedia within such, should be designed into CBL material.

The results suggest that, in order to facilitate ease of use for a range of users, multiple modes should be accommodated within the navigation design, including graphical options highlighting user location and that colour differentiation of hyperlink options should also be incorporated in the design.

The results suggest that the provision of graphic symbols for navigation and representations of location offers greater benefit for learners than non-graphic options such as hypertext and is likely to offer greater ease of use.

The issue of navigation through learning material may also be related to the concept of "narrative flow", which may be applied to the construction of a coherent narrative path and should be applied to both content and interface design as suggested by Hughes (2000). The important point being that good CBL material / environments should offer the learner the possibility of finding and being led through multiple paths. The results indicate that the current material could be improved by addressing the "narrative flow" in the design, as respondents were de-motivated by content which was perceived as repetitive therefore boring and interface navigation which became confusing.

5.4.6 "Usability" Related Issues

Perceived Needs Regarding Usability

That the CBL material should be easy to use may appear initially to be a fairly simple requirement, but this becomes rather complex when we reflect on the range of individuals being catered for within the university context and the individual differences in expectations concerning "ease of use". This also relates to issues concerning cognitive load and eye strain / fatigue, which must be addressed in order to meet the needs of all users, which clearly relates to "usability" of the material. This is clearly important as highlighted by such McAleese (1998) where the learners are considered as "customers".

The key finding regarding perceived "usability" is that ease of use is centrally important for learners and that a range of usability factors affect the ease of use experienced. This may be related to the learner centred approaches to software design as suggested by Soloway and Pryor (1996), which favour users being regarded as "active agents" within the design process as suggested by Bannon (1991), thereby enabling the learners concerned to influence the design by offering their input to the process. The results suggest that even with material which has a graphic user interface and makes use of multimedia, ease of use is a complex issue. The responses indicate that:

- The usability dimension of the CBL material studied does not entirely meet the needs and wants of the respondents.
- The results clearly indicate that ease of use is related to the way in which the learners might wish to use the material and the importance attached to the capability to revisit information easily indicates a need for flexibility regarding chosen route and pace of study, which may be influenced by the perceived importance of information retrieval,

The results clearly indicate that for students in Higher Education, the retrieval of relevant information is of great importance and CBL material is considered to offer a level of capability, which is valued by students seeking such access to information. This is likely to be influenced further by the "massification" of Higher Education, which will inevitably increase the range of learners, as highlighted by D'Andrea and David Gosling (2001), and therefore, it may be argued, the range of "learner expectations" regarding CBL material, and the range of knowledge and learning styles for which provision might be made using CBL material. It may be further argued that the results support the view that the use of Multimedia may be of particular value where a heterogeneous student population is involved as highlighted by Crosby and Stelovsky (1995).

Implications for Design of Materials

The results indicate that where on-screen text is perceived by the user as being "too much" it is likely to have a negative impact on learners with some likely to experience eye strain or fatigue, and that hyperlinks were found to be confusing for some learners. The implications for design are that the screen display used should have a positive impact to the level where it aids learning and that this is likely to require less use of on-screen text and greater use of graphical navigation aids within CBL material.

The results suggest that the design of the CBL material should eliminate any need for duplication of effort on the part of learners and that the design of the CBL material should enable direct access to any applications to be used in final presentation of work.

The results suggest that where the use of on-screen note-taking is to be encouraged, the need to re-position screen windows should be minimised, in order to avoid de-motivating learners to a level where they resort to hand-written notes and the use of pop-up windows should be under learner control, with an alternative provided for those choosing to use the computer facility for note-taking.

The results indicate that the option of a constant display on screen to indicate the learner's position would prove helpful for some learners and the facility for learners to re-start where they had previously left off should be offered as a basic facility within CBL material.

It must be considered that some errors, on the part of the users, may have been perceived by them to be malfunctions in the computer-based material, therefore not "literally" a malfunction in that sense. It may be argued however that this reflects poor "usability" design and that the potential for user error, perceived by them as "malfunction" should be "designed out" of the material.

5.4.7 Impact of Presentation Elements

Expressed Views on Presentation

The key finding regarding the perceived impact of presentation elements is that although there is clear evidence of a general preference for on-screen presentation which goes beyond the use of on-screen text, learners using CBL materials prioritise the benefits offered by the material in light of their perceived needs and wants at the time of use, which means some value time flexibility, while others value high quality presentation. The results indicate that:

- The presentation of the CBL material studied was generally considered motivating and as good as the presentation they had experienced in other computer-based materials, even where much of the material was text-based. This may be considered indicative of a fairly low level of expectation held by the learners concerned regarding CBL presentation.

- For almost one third of the respondents, quality of presentation is considered to be less important than time flexibility, while a similar percentage hold the opposite view.

The importance of design at the visual and graphic levels is highlighted by Mandel (1997), who comments that the design of the various elements on screen impacts users in combination with everything else on the screen. The results obtained in this research suggest that the combined impact should be taken to include the user priorities at the time of use, when dealing with CBL material for Higher Education.

The apparently contradictory feedback obtained in this research might be taken to suggest potential issues regarding the approach taken to completion of the questionnaires by some respondents, or to the design of the questionnaires themselves. However if we assume that the questionnaires were not interpreted significantly differently by different respondents and that the responses obtained truly reflect the views held, then our conclusion may be that the responses are not actually contradictory, but that different learners perceive their needs and wants in different ways.

The results indicate that the visual display used, met the requirements of the majority of respondents and added an interest value in its own right for a minority of respondents, but that for a minority there is a problem with eye strain / fatigue. The results suggest that variety in style of presentation adds value for a majority of respondents and that a majority of respondents value the use of colour within the material. The higher levels of response on exit, suggests that the importance of such elements may become more obvious to learners over time. The responses in interviews indicate that an expectation exists that the on-screen presentation, including the interface used, should look "up to date" and that the use of colour is perceived to make the on-screen presentation less "boring". The results indicate the importance of colour and variety in the style of presentation in relation to the levels of motivation experienced by learners.

Implications for Design of Materials

Given that we are dealing with an intelligent group of adult learners, who are under pressure to achieve results and may therefore be assessment focused and pragmatic about how desired results might best be achieved, it is clear that presentation of CBL material should meet minimum needs for learners to achieve results. We must also accept that exceeding such minimal requirements might be perceived by some learners as unnecessary. However given the range of perceptions involved and the assumed approach of making best possible use of available technologies to maximise cognitive and affective impact on learners, there is a strong case for aiming at best possible design specifications, with a basic mode option available for learners who choose to select such.

5.4.8 Impact of On-Screen Text

Perceived Needs Regarding On-Screen Text

The key finding regarding the perceived impact of on-screen text is that learners consider on-screen text has value but should not be over-used within CBL materials. While the use of computers continues to inspire levels of interest and enjoyment in learners, this may be undermined by over-use of on-screen text, which the results suggest increases the likelihood of eye strain and fatigue being experienced by learners when using CBL material. The difficulty here is that individuals vary in their perceptions of too much text therefore learner choice is a key issue.

The results support the conclusion that:

- The availability of text based material is important in order to meet the perceived information transfer wants and needs of learners
- The use of a combination of text based information transfer, colour in screen displays and on-screen exercises is important in order to meet the perceived wants and needs of learners.
- There is a danger of on-screen text being perceived by learners to be boring therefore failing to motivate, or even de-motivating learners.
- Where learners perceive text material to be over-used they are likely to desire a printed version of the text concerned.

The results suggest that where a preference for text is expressed by some learners, this may relate to other pressures within the learning environment as highlighted by Somekh (1996), which give rise to a perceived need for information transfer and that this may be perceived as appropriately delivered in a text format. The results support the view held by such as Harding et al (1997), that advances in software and hardware should not be considered likely to resolve the perceived problems regarding reading text from computer displays.

The results suggest that text does have value to add, but that from the learner's perspective there is additional value in providing breaks from text on-screen by utilising non-text components. Where on-screen text is perceived by learners to become monotonous, or fatiguing, there is a danger of learner motivation becoming negatively affected and learners may choose to restrict their use of the material.

The results indicate that, for some respondents, text on paper would be preferable to text on screen, partly in relation to such issues as eye strain/ fatigue but also in relation to restricted access. The results indicate learners perceive a hard copy would have permitted the material to be read at a time, and in a location, of the learner's choice.

The results support the points raised by Carswell (1998), that learners disliked being required to read text from computer screens and that well structured books were held in higher regard by some learners, than some CBL materials.

The food for thought coming out of this however would be that, where some learners get the impression that they would gain as much, or more, from a hard copy of the material, it is likely that the material concerned is neither meeting their expectations nor making best possible use of the computer-based platform from which it is presented.

The results also indicate that, having used the material over a period of time, very few learners considered they would have gained more by having a book rather than computer-based presentation. This clearly suggests that there is some additional benefit to the computer-based format.

Implications for Design of Materials

The results suggest that there are advantages and disadvantages in using text on screen, and the use of such should be very carefully considered. The central issue to be addressed is the added value for the user of having text appear on-screen rather than in print. Where this is not sufficiently clear then the material is likely to result in the on-screen text having a negative impact on some users.

The results support the point raised by Davies and Crowther (1995), that "page-turning" CAL and that which is little more than a "text-book plus flashing lights" is likely to be tedious and dull. The results also relate to the point raised by Herrington, Sparrow and Herrington (2000) that where large tracts of text are utilised it raises design issues, regarding the "activity" as "supplementing" the unit, rather than "being" the unit. This also relates to the point raised by Hughes (2000), that "expectancy" has to be managed, and to the point raised by Sniderman (2000) that interactivity may be regarded as involving more than guided clicking through branched instruction.

5.4.9 Impact of Graphics / Multimedia Elements

Expressed Views Regarding Graphics / Multimedia Material

The key finding regarding the perceived impact of graphics / multimedia elements is that the use of graphic material and the inclusion of colour are perceived as advantageous by learners, offering benefits directly and indirectly thereby impacting on both the cognitive and affective aspects of learning when using CBL materials. It is important to note that learners held differing views regarding their definitions of "multimedia". The results support the conclusions that:

- The benefits offered may be directly related to the content of the material, or may be indirectly related by offsetting negative effects on motivation levels, which might have been experienced had the graphic or multi-media element not been used.
- Graphics and video elements were perceived to aid learning and add interest in their own right, brighten the screen display, have a positive impact on learner attention and enable a level of respite from on-screen text material within the CBL material.
- Potentially demotivating effects incurred by using on-screen text material may be offset to some degree by the use of graphics.
- Graphics were perceived to impact on the learners' level of interest, with the elements of colour and the use of fun / humour highlighted by learners as important. The use of humour in the graphics was perceived as inspiring laughter, which was also perceived to act as a form of relief for learners.
- The use of simulations was perceived as adding interest, aiding learning and enabling the self monitoring of learning achieved.

Graphics were perceived as valuable by learners in motivating thought where they directly related to the material, or to inspire curiosity generally.

The responses in interviews indicate that some learners had expectations of "multimedia" which the CBL material did not meet, but the responses also revealed that the learners concerned held differing views regarding a definition of "multimedia". It was perceived that the use of multimedia materials has a positive impact on learner attention and understanding, adding an element of realism, and potentially reducing perceptions of isolation. The content of the multimedia material was perceived to be particularly important.

This supports the points raised by Davies and Crowther (1995), that multimedia features may be considered as "hygiene factors", and that the quality of the material, or content, is of prime importance. However the results suggest that the multimedia elements also add value in their own right as "motivators" for some learners. It may be argued that the meeting of learner expectations regarding multimedia elements, is more appropriate than the "managing" of expectations in order to have learners accept a lower level of presentation, from the learner perspective.

Implications for Design of Materials

The results suggest that there is particular value to be gained from the use of simulations and that the visual display is important for learning, as is the use of video material. However there are some conflicting views expressed regarding the extent to which the use of multimedia, in particular video material, actually contributes to the motivation level of the learners, despite being perceived to aid learning. Given that the simulations and graphics were considered to have aided learning, to a greater extent than they impacted on motivation levels, we might conclude either that such levels of presentation were simply expected, or that they explained rather than inspired. Again this highlights the importance of user choice within the design.

It is important to consider however that many of the elements highlighted by the respondents as aiding learning or adding interest could not be provided without the use of multi-media, and therefore even where there may be no demonstrable impact on motivation levels where multimedia is used within this material, we may have encountered a negative impact had such multimedia not been used. The importance of multi-media even where not directly highlighted, might be considered to be reflected in the responses relating to games, interactivity and simulations, all of which were perceived as valuable by learners.

5.4.10 Comparison With Other Modes

Expressed Preferences

The key finding regarding the perceived comparison with other modes is that learners expect computer-based material to offer some element which is different to that which may be obtained via other modalities. It is clear from the results obtained that flexibility is important for learners in relation to their personal timetables. The results also indicate that lectures are considered to be failing to meet the needs and wants of learners and CBL material is more favoured by many learners than all but the best lectures. A central point to emerge from the responses was that learners got lost in bad lectures and that just as they may become lost in lectures, they might also become lost when using CBL material.

The results support the conclusions that:

- Many learners value the use of CBL material more highly than reading a book or attending lectures.
- There is a perceived dissatisfaction with lectures, which has to some extent influenced the perceived preference for CBL material, as the alternative of a lecture is perceived not be dynamic, or entertaining.
- While there is a danger of too simplistic a conclusion being drawn when attempting such comparisons, however from these results alone it would appear that the use of CBL material is more motivating for many respondents than lectures.
- Accessibility offering time flexibility is a major factor in the CBL material being perceived to be more motivating, than lectures
- Availability of feedback was perceived to make CBL material more personal than lectures.

- There is still some value in the "point-and-click" level of "interactivity", as some learners perceived having to click through the CBL material as "activity", which they considered reduced the risk of their mind wandering as it might in a lecture.
- The use of "pictures" and opening and closing of windows was cited by some as making the CBL material better than a book. The comment was made that books were regarded as background information, with nothing to look forward to but text, and nothing to do but turn pages.
- Interactivity was perceived to make the CBL material better than a book or lecture, with some perceiving the "interactivity" as making the CBL material "entertaining", which made it more exciting than a book.
- Some concluded that it was easier to concentrate on the CBL material than a book or lecture. Some commented that the "cross referencing" made the CBL material more interactive than a book. Some perceived that ease of finding information made the CBL material better than a book and some that the CBL material was better than a book as it made use of colours and graphics.
- It was perceived by some that more dedication was required of them with a book, as it could easily be put down, whereas the CBL material made them sit down and do it. Some commented that they preferred the CBL material, with some adding that with books they'd be more likely to leave the work until an assignment was due.
- Others commented that they were used to reading books and their eyes did not get so tired with books, therefore they preferred books to the CBL material.
- Others considered that the CBL material offered more variety of presentation than a book, including use of fonts and images, which made it less boring than a book.

The expressed preference for CBL may at one level be taken as a positive comment on the use of a computer platform for learning material. However, this conclusion must be tempered with feedback relating to the lecture option in its own right and that the restrictions due to timetable constraints which influence the preference for the flexibility of access offered by the CBL material. This suggests on one level that lectures are below the level respondents would wish, and at another level that the CBL material offers something in a way which the respondents prefer.

This supports the points raised by Stanley and Eastcott (1999), that lectures are less than effective and that better use might be made of the time with students. It also supports the points raised by Cresswell (1998) that some areas of learning may be more appropriately addressed using CBL material.

Jones et al (1997), highlight the importance of educational software offering something which even the best of teachers cannot consistently offer, arguing that learning styles should be taken into account when developing courseware and identifying the capability of hypermedia to accommodate Pask's "holistic" learners, by allowing the material to be "grazed" at the discretion of the student.

The results suggest that the current level of learner expectations are being met by the CBL material to a level which is "acceptable" for the students concerned. The fairly low levels of expectation of "interactivity" expressed by learners and the apparent definitions of "interactivity" on which such expectations appear to be based do however suggest that there may be a need to reflect on the point raised by Mandel (1997), that "interaction techniques" should reflect the developments in technology, rather than having interaction of a type which may be considered to be based on "obsolete technology".

If we consider the student's views to be based on prior experience and we accept that the methods of assessment employed in Higher Education are also based on historical precedent, then it may be that we should offer interactivity of a higher level and assess the use of such in a more non-traditional way.

The results support the points raised by Carswell (1998), that learners expect that CBL material should offer clear benefits over books, such as improved access to information, a flexible structure and interactivity. The results also indicate that learners perceive "interactivity" in a range of ways.

This suggests that for some respondents the rudimentary measure of interactivity suggested by Laurel (1991), that they feel themselves to be participating in the ongoing action of the representation, may have been achieved using the exercises. This relates to the concept of "interactivity" being complex and to the point raised by Heath (1995) that the term "interactive" is used to describe most if not all multimedia packages and that the definition in use may be less than clear.

However if we simply conclude that the current expectations of students are being met we might conclude that the point made by Carswell (1998) that interactivity of a more sophisticated level is of less importance, is valid. There are clear implications of such conclusions for instructional and interface design.

Implications for Design of Materials

Flexibility of access is fundamentally important for CBL to be perceived by learners as preferable to a lecture mode of presentation and should be catered for within the design.

It is centrally important that learners should not get lost in the CBL material and that the CBL material should offer them a level of control over their pace and route which permits them to avoid this, in order to offer the learner advantages over lectures.

While there is some value in "point and click" interactivity, this should be regarded as a minimal level of provision in the design of CBL material. The fact that turning pages of a book of text is perceived as boring suggests that clicking through screens of on-screen text material would eventually elicit the same response. It is likely that there is a novelty factor which at present offsets this.

The design should seek to minimise eye-strain or fatigue for learners by employing a range of presentational options utilising a range of media and minimising the use of on-screen text. As a minimum requirement graphics or "pictures" should be incorporated in the CBL material in order to offer learners something to look forward to aside from text thereby making it less boring.

Interactivity at the level of exercises should be provided where possible as that level of interactivity is perceived by learners to make the CBL material entertaining and to encourage additional thought.

Feedback should be available to learners on demand in order to avoid the failings perceived of lectures.

5.4.11 Controlled Investigation

Expressed Preferences

The key finding regarding the preferences expressed in the controlled investigation is that there is a significant difference in learner preference for multi-media presentation rather than an on-screen text-based presentation of CBL material.

From the results of the statistical tests we may conclude that there are significant differences between the responses obtained for the on-screen exercise version of the CBL material and those obtained in relation to the on-screen text version of the same exercise. The results show that the differences obtained reflect the influence of the on-screen presentation concerned.

The results indicate that for all of the items concerned, more positive ratings were obtained in relation to the on-screen exercise version of the material, with lower, more negative, ratings being obtained in relation to the on-screen text version of the material. The results obtained in the controlled investigation indicate that there is a strong preference in favour of on-screen presentation which goes beyond the use of on-screen text. This allows us to conclude that the preferences indicated by the responses obtained in the range of questionnaires and interviews, are addressing a preference which is statistically significant for learners in Higher Education, and therefore important for developers of CBL material for such learners.

Implications for Design of Materials

The results obtained in the controlled investigation suggest that the design of CBL materials should ensure that the presentation offered goes beyond the use of text as a minimal requirement.

5.5 Overall Conclusions and Recommendations

5.5.1 Conclusions

This study was undertaken in a spirit of investigation. The inspiration for the study largely came from the author's experience in a wide sphere of educational provision and in the production and delivery of educational material using a computer-based method of delivery. This experience had given rise to many questions regarding views on education generally and the espoused approaches to teaching and learning, which were then re-kindled regarding the use of CBL.

This study sought to investigate whether the espoused theory was in line with the theory in use when it came to the design and use of CBL materials in Higher Education and beyond. The study centred on the espoused importance of the learner within the system and the extent to which those in education sought to meet the learner needs rather than other agendas. This study has approached the topic from the perspective of learner priority and has highlighted potentially conflicting issues or agendas where they have been found to exist.

This study has highlighted a wide range of views involved covering a range of aspects of education, including the cognitive and affective domains, all of which impact on the design of CBL material. This differentiates the study from others which investigate a single aspect of design.

This study has provided an up to date insight regarding the current provision of CBL material for students in Higher Education and beyond, clarifying the diverse nature of the learners for whom CBL provision is made and the implications of the diversity for the effective design of CBL materials. A wide range of CBL material and a wide range of learners have been studied, over a three year period, which differentiates this study from others which have focussed on single pieces of CBL material, and / or single groups of learners.

This study has highlighted the important interplay between stakeholders involved in design decisions and the potential impact on the design of CBL material has been discussed in relation to the meeting of learner needs and wants in the light of the diversity highlighted.

The potential conflict between designing for efficiency rather than effectiveness has been highlighted and the cognitive and affective impact of design elements has been highlighted from the learner perspective.

The study has revealed that while material currently designed and produced for CBL in Higher Education and beyond does enable students to successfully complete the classes concerned, it does not meet the perceived needs of all learners concerned at all times. While this is arguably an unattainable ideal, this research offers further insight into ways in which appropriate use of appropriate design might help bring our CBL provision considerably closer to meeting needs and wants of current learners in Higher Education and beyond.

The contribution of this study to the body of knowledge regarding the design and use of CBL materials in Higher Education and beyond is therefore essentially twofold.

First this study has highlighted the importance and diversity of learner perspective in relation to perceived effectiveness of the design of CBL material and the inter-related nature of such with the context of use in Higher Education and beyond.

Secondly this study has demonstrated that there is a need for important design issues to be further addressed even within currently produced materials and that this is likely to require underlying assumptions to be questioned more fully, if we are truly seeking a learner-centred approach to teaching and learning in Higher Education and beyond, using CBL materials.

The overall conclusion to be drawn from this study is that there is still some way to go if we wish to meet the needs and wants of the range of learners currently in Higher Education and beyond. There is a clear need to take greater care in addressing the wide range of design issues in order to meet both cognitive and affective needs and wants within CBL material.

This research supports a number of learner-focussed recommendations for the design and use of CBL material. It should be noted these recommendations are made from an educational perspective and do not attempt to address the logistical issues which would underpin such approaches. Some recommendations for addressing the design issues highlighted in this study have been offered in the following section.

5.5.2 Recommendations

Learners, as potential customers, should be taken into account from the design stage and should be included in the design team, in order to obtain direct feedback. This would address the issues of perceived objectives and therefore desired uses of the CBL material concerned.

Learner expectations of the CBL material should be assessed, met and / or managed and violation of expectancy should be avoided both in terms of instructional design and interface design.

Learners are likely to be de-motivated by repetition, which should be avoided by offering the material in a range of ways and by including indicators to identify previously viewed material, or offering some more elaborate method of guiding the user such as agent technology, or dynamic updating of hyperlinks to ensure that different material is inserted following each visit.

Interface design should be such that violation of expectancy is avoided for the learner. This may be done by offering clear locators and advance indicators of outcomes when options have to be selected by learners. Learners should be given personal control over the form that locators and advance indicators should take for their use of the material.

Given the strong preference found for on-screen presentation which goes beyond the use of on-screen text, developers of CBL material for learners in Higher Education should reduce their use of on-screen text by offering text material in a printed or printable format, and offering a form of on-screen presentation which goes beyond the use of on-screen text. Where a book metaphor is used to deliver text based material, there should be an option for learners to print the text if they prefer, and there should be other metaphors and delivery mode options within the material, such as the use of games and microworlds, to enable learner choice for those who prefer a problem solving or discovery based approach to learning.

Graphics, including colour images, should be included within CBL material, and these should offer images which reinforce the educational message being delivered where possible and act as breaks within other material such as text, in order to offer positive impact for learners in both cognitive and affective domains.

Hypertext offers useful navigation for learners and is clearly compatible with instructional design objectives, but must be very clearly signposted, ideally using graphic locators of some description, to ensure learners experience ease of use and avoid becoming lost in the CBL material or suffering increased cognitive load.

Narrative flow should be incorporated wherever possible in addition to hyperlinks and graphical indicators, in order to improve learner orientation within the CBL material, and this should be accomplished using the full range of media as exemplified by the film industry.

Real life examples should be used wherever possible in the CBL material.

Given that there is educational value in taking learners beyond the "what you know is what you like" level of interaction with CBL material, there should be a range of styles used and the learners should be offered control over which styles they use under which circumstances, with the retained option of setting some forced use of each style at some stage, specifically in order to extend the learner's repertoire.

Accessibility of the material should be maximised for learners and any restrictions in terms of time or place of use should be kept to the minimum required, to ensure any needs for synchronous interaction with others may be met.

The material should meet minimum instructional and interface design standards in the most basic format available, which might be argued to be "page turning CAL", offering "point and click interactivity" and this should increase on a sliding scale to the most complex format, which might be argued to be a highly interactive microworld utilising full multi-media capability.

Interactivity, using the widest definition of such, should be included within CBL material and this should offer a range of physical and mental exchanges between the learner and the CBL material. The level of "interactivity" should be variable by the learners concerned, ranging from simple "point and click" to engaging "artificial intelligence" and adaptive material where possible.

It is centrally important where interactivity is involved that feedback is provided on demand to avoid frustration. Explanations should be offered to avoid confusion and consequences of any learner decisions required within the CBL material should be made clear to learners.

It should be made possible for learners to choose a competitive element where they wish within the material, and where possible they should be offered the choice of competing against themselves by comparing previous attempts, or against others, including where appropriate some pre-programmed procedures within the material.

Exercises should be offered whereby the style and level of complexity may be chosen by the user to suit their needs and wants at the time of use. Feedback should be offered at multiple levels of complexity and a level of feedback should be offered immediately on learner demand, even where the learner has not entirely completed the exercise concerned. This would address the issue of learners monitoring their own learning progress using CBL materials.

Exercises should be developed in such a way that they provide the body of knowledge contained in a text-based equivalent within the material, and learners should be made aware that they may choose either method of learning the same material. This would address the issue of learner choice and the issue of exercise material being perceived as non-essential while text material is perceived as essential.

The range of exercises provided should enable learners to choose from simple to complex and from text based to multi-media. This would enable learners to take control of their own learning in terms of cognitive load and adjust such to suit their needs at the time of use.

Learners should be given control over the mode of presentation, in terms of instructional and interface design in use. The design elements should be adjustable to suit learner preferences in relation to their situation and priorities at the time of use.

The material at the highest level should seek to offer engagement to the level of entertainment as a vehicle by which deeper learning is achieved. By gaining and using a body of knowledge within a supportive CBL environment, learners should be enabled to engage as they would with a good book which has been made into a captivating movie production and interactive adventure game. Learners should be offered the freedom to choose the style of delivery and thereby increase the likelihood of their motivation being maintained. Clearly this requires intuitive simplicity at the user interface experience level, brought about by great complexity at the instructional and interface design level.

Where the decisions made by the designers of CBL material, reflect more pragmatic levels of provision, this should be acknowledged and appropriate steps taken to manage the learner expectations prior to and during their use of such materials. Where the interface design is such that the users must adapt to the material, rather than the material being adapted for the user, appropriate initial training in the use of the interface concerned should be offered in advance of users attempting to learn from the material.

Above all else perhaps, such decisions should be based on the perceptions and views of the users concerned rather than the perceptions and views of those involved in the design, development, production and use of the materials within the Higher Education environment.

Although it may be argued to be rather idealistic, the recommendation from this research would be that developers of CBL material for learners in Higher Education should utilise the computer-based arena to its full potential by offering full use of multimedia possibilities. This should be done within carefully considered instructional designs, via user variable interface designs which have usability at their core, in order to enable the learner to gather required information and to provide them with the opportunity to utilise the information to further construct their understanding and to solve problems using their increased understanding. This should be enabled within a learner sensitive CBL environment, which has been designed to meet the learner's perceived needs, for the range of users concerned.

Where the needs and wants of users are found to change or develop over time, the CBL material will require a high level of complexity, beyond that of any particular approach favoured by specific experts. Where it is not possible to provide the level of complexity required to meet the needs of the range of learners, this should be recognised and additional provision offered in other modalities to meet the needs of learners for whom the CBL provision falls short.

5.5.3 Reflections and Suggestions for Further Research

While this study has shown that there are still areas where we might better meet learners' needs and wants using CBL material, it has also highlighted the need for further investigation of the perceived needs and wants of current learners in Higher Education and Business regarding CBL.

The study was conducted within resource limitations which are often associated with PhD research, which affected the availability of respondents at the various sample points and therefore the numbers available for statistical analysis.

There is clearly a need for a longitudinal study to further consider the dynamic nature of the learner's situation and to investigate when any changes in perceived needs or wants, regarding CBL material, occur in relation to other factors in their learning environment.

There remains a need to further investigate what constitutes a "good teacher" and how such qualities might be developed within CBL materials to the level made possible by available technology.

The results obtained in this research support the conclusion that in order to truly offer the level of CBL material capable of meeting the needs and wants of learners as consumers, we must accept the need for greater attention being given to the design process and the levels of outcomes achieved by such. The results suggest that there is more to be gained for learners in both cognitive and affective terms by the McLaren F1 approach to quality of design, than by the Model T Ford efficiency of production approach.

5.6 Review of Conclusions Chapter

This chapter has provided a synthesis of the findings of this research and the related literature. The key findings of this research have been identified and the relevance of related findings which underpin these has been clarified. A range of elements and perspectives, considered centrally important in this research, have been highlighted and the importance of such elements within the sphere of computer-based learning has been clarified. Clarification has been provided regarding the value of this research relative to the gap identified in the existing body of knowledge, as addressed by this research, and why this may be argued to be of value. The contribution offered by this research, in the quest to enhance the effectiveness of the learner's experience when using CBL materials, has been clarified and recommendations for the design of CBL material have been made in the light of the research findings.

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