Chapter 1

Introduction

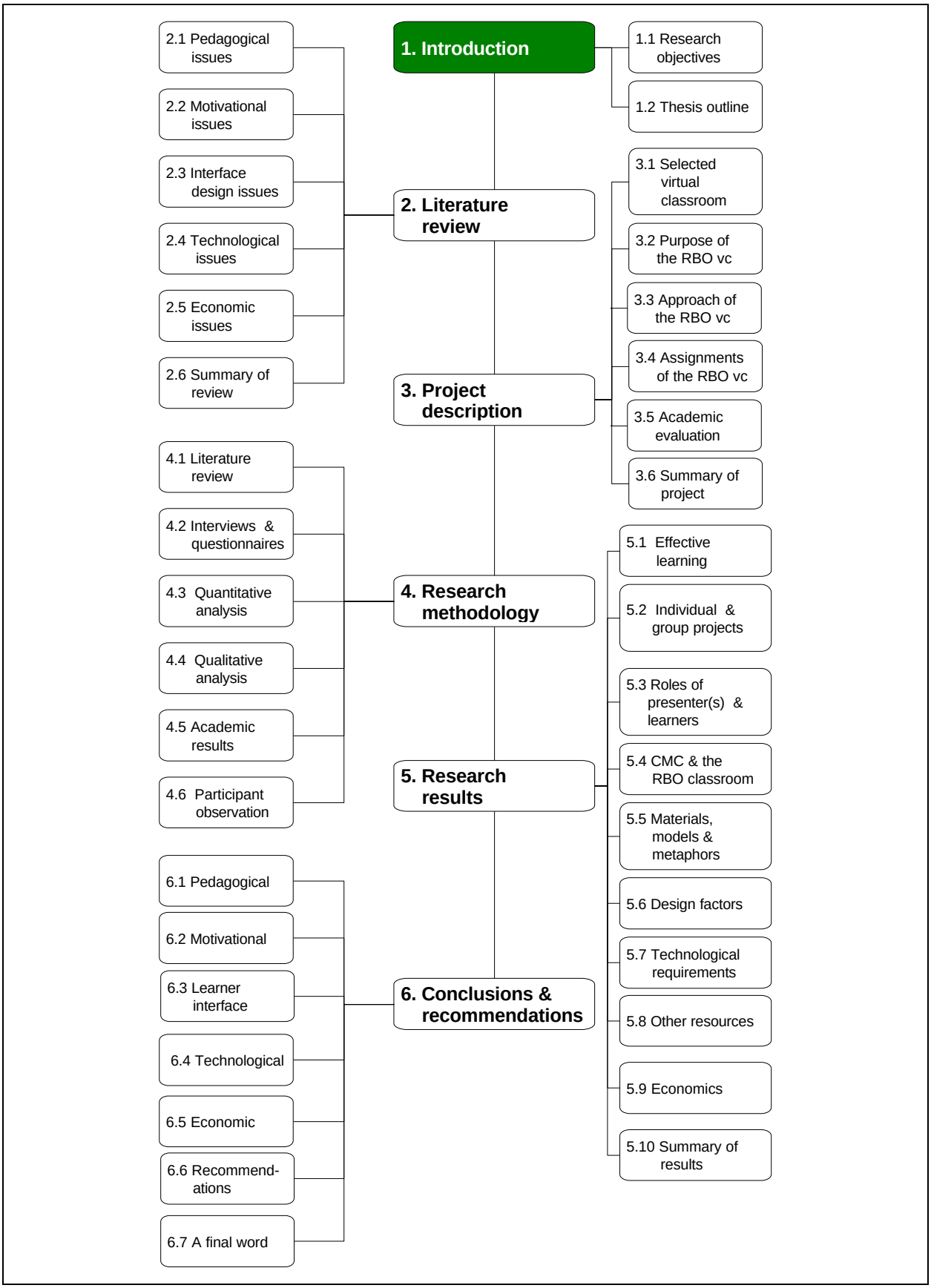
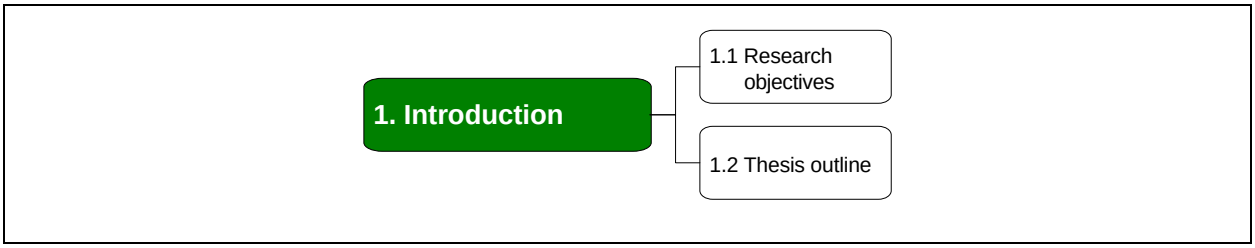


Figure 1.1 Outline of Chapter 1



This thesis reports on an investigation into the feasibility of the telematic teaching of adults i.e. the facilitation of learning with methods of delivery and interaction that employ any telecommunications media, including computer mediated technologies.

As advances in information technology move us further into a networked information environment, tertiary and adult education sectors need to adapt to deal with the rapid changes and uncertainty which typify the latter part of the 20th century.

Imminent technological advances include the possibility of merging voice, video and data traffic into a common digital infrastructure (Cause Current Issues Committee, 1997). In addition, increasing accessibility of wired and wireless connectivity is likely to become a reality when by the end of this decade, the planned Low Earth Orbiting Satellites clusters (LEOs) e.g. Iridium and Teledisc, are in place to facilitate global satellite links for telephones and computers (Tiffin and Rajasingham, 1995).

Even before the above-mentioned advances become a reality, the existing global connectivity of computer systems has provided and nurtured the phenomenon of the World Wide Web (Web or WWW). The Web is a large-scale system of computerised, interconnected hypermedia resources accessible from computers connected to it. Thus it can facilitate the delivery of information, including educational resources, to the desktop of these computers.

Occurring simultaneously with these technological developments are budget cuts in tertiary education in South Africa, as in other parts of the world. While globally there has been a downturn in the population of college age students, the demand for this level of education has increased as undereducated adults have filled the gap in their quest for life-long learning, or career related (re-) entry, advancement or change (Zastrocky, 1998). In South Africa universities are facing the challenge of a transformation model that involves increased access, massification and a changing student population with diverse educational backgrounds and levels of preparedness (Greaves, 1997). According to Greaves(1997), for universities to meet this challenge (as well as to survive the competition from extra-university institutions), they

need to become information-based institutions in which the processes of teaching, learning and research are re-engineered with the aid of information technology itself.

In line with the need for universities to explore means of harnessing technology for teaching and learning in cost effective ways, this study investigates the technology based delivery of a Master's level course module. The topic of the module was *Computer-assisted Education via the Internet*. This course had previously required students to travel to the University of Pretoria from their various home regions in South Africa for face-to-face interaction and contact time among learners, and between learners and the course lecturer. In 1997 the course was presented solely by means of a 'virtual classroom', defined here as a computer accessible, on-line learning environment attached to the World Wide Web which delivered material to adult students located at a distance from the course delivery centre.

To facilitate communication and interaction among course participants, including learners and course facilitator, the on-line course incorporated a dedicated electronic mail (email) mailing list which enabled distribution and delivery of messages to all those subscribed to it.

This course module provided the opportunity for learners to study a course that was:

- computer delivered, and
- accessible countrywide via Internet and email links.

The ability of the Web and email to deliver and distribute learning resources from a central location and to facilitate communication with learners in diverse locations, indicated that these methodologies have the potential to become useful content providers and delivery media for telematic teaching and learning.

1.1 Research objectives

The objective of the investigation undertaken and reported in this thesis was to answer a range of questions concerning telematically delivered courses in a South African learning context. The questions posed included those related to pedagogical, motivational, learner interface, technical and economic issues. An outline of the questions is presented in Table 1.1.

Table 1.1 Questions posed on Web-based telematically delivered courses

Topic of issue	Questions
Pedagogical	❑ To what extent can a Web and email delivered course without the provision of face-to-face interaction and contact time: ▪ adequately facilitate and enhance learning? ▪ meet the particular needs of adult learners? ▪ facilitate individual and collaborative projects? ▪ provide adequate and effective communication among learners and between learners and course presenter(s)? ❑ How does this course delivery method affect the roles of course presenter(s) and learners?
Motivational	❑ To what extent can a Web delivered course provide materials, models and metaphors to learners that elicit sufficient extrinsic and intrinsic motivation with respect to: ▪ challenge, ▪ curiosity, ▪ levels of learner control, ▪ fantasy, (Malone, 1981) ▪ achievement, ▪ relevance, ▪ confidence, ▪ satisfaction, and (Keller, 1983; cited in Duchastel, 1996) ▪ motivating 'flow'? (Csikszentmihalyi, 1990; cited in Rieber,1996)
Learner interface	❑ What design factors best facilitate learning via on-line Web-based material?
Technological	❑ What level of computer and telecommunication equipment is required for course delivery, access and communication?
Economic	❑ What other resources are required to set up, maintain and deliver such a course? ❑ What are the costs involved in terms of course material ▪ development, ▪ implementation, ▪ delivery, ▪ support, maintenance, monitoring, ▪ updating/upgrading, ▪ evaluation, and ▪ access? ❑ To what extent can this approach generate cost savings for presenters and learners?

1.2 Thesis outline

An outline of the remaining chapters of this thesis follows.

Chapter 2 offers a review of relevant literature on issues related to the Web-based, ‘virtual classrooms'; computer mediated communication as an interaction medium, and design and cost factors surrounding the implementation of Web-based learning.

Chapter 3 constitutes a description of the project, including an outline of a course presented via the Web and email. It discusses the following aspects:

- background and objectives,
- setting up and resources,
- participants,
- implementation,
- interaction and feedback, and
- evaluation.

The research methodology used in this investigation is discussed in Chapter 4. An elaboration of the matrix of research questions and methods in this chapter includes an analysis of academic results, on-line interviews and quantitative and qualitative analyses of course communications/interactions. The interview questionnaires, presented verbatim in the Appendices, are structured but informal, reflecting the nature of email communication which combines characteristics of both the spoken and the written word (Greller and Barnes, 1993)..

In Chapter 5 the research results and outcomes of the investigation are discussed.

Chapter 6 offers conclusions drawn from the results of the study and recommendations for future courses presented by means of similar methodologies.

Chapter 2

Literature review

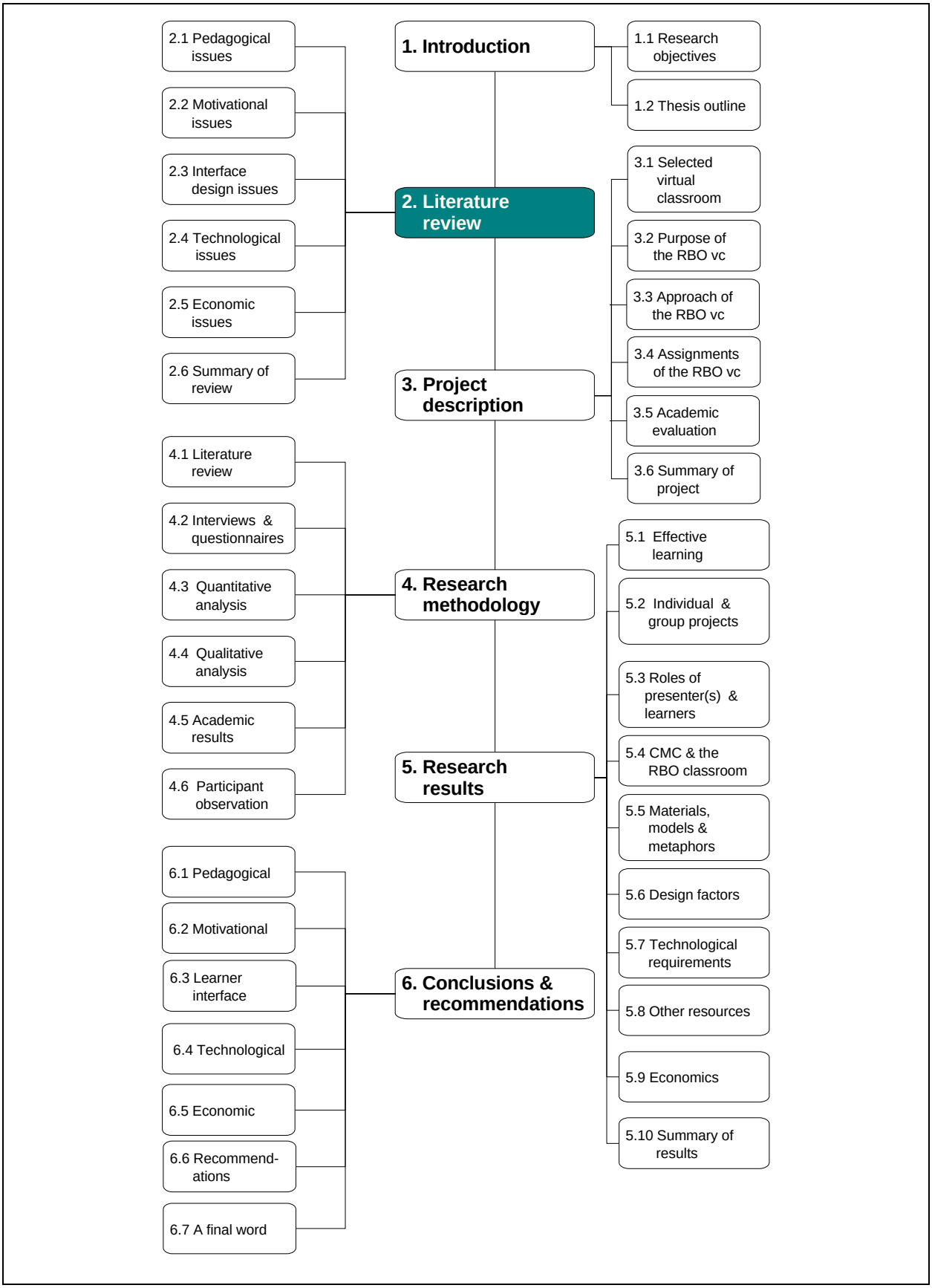
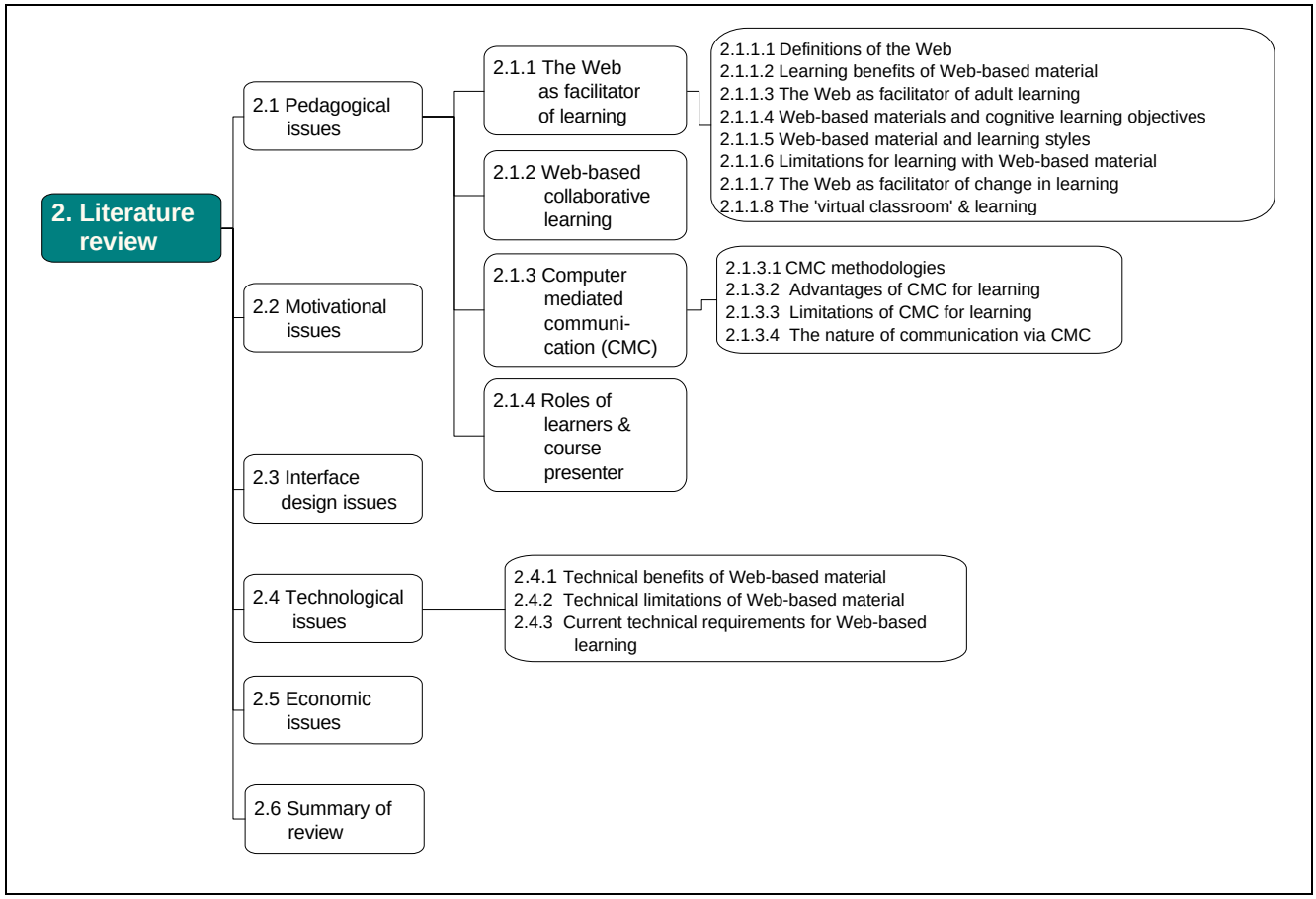


Figure 2.1 Outline of Chapter 2



A useful feature of the Web is that, compared to paper-based publications, it facilitates quick publication and distribution of information. As it is characterised by rapid change, Web-based resources, including on-line journals and articles, provide an expedient method of keeping up to date with its development.

To ensure that quality Web-based material informed this thesis, on-line material referred to included:

- selected university-based research reports and conference papers,
- recognised on-line journals,
- material that cross-referenced with the work of established professionals, and
- material for which the credentials of the writer were provided.

2.1 Pedagogical issues of Web-based learning

2.1.1 The Web as a facilitator of learning

2.1.1.1 Definitions of the Web

Definitions of the Web include the following collected by Rein, McCue and Slein (1997):

- the physical network of servers and gateways located around the world;
- the information contained in the distributed web of links and nodes;
- the technology, the Internet operating system, computing environment and tools, and
- the graphical interface with the Internet.

For the purposes of this study, the Web was viewed more broadly as a large-scale system of interconnected hypermedia resources accessible from any computer connected to it and which facilitates access to stored text, hypertext, images, sound and video for reference, perusal or downloading.

2.1.1.2 Learning benefits of Web-based material

As the Web is available 24 hours a day and deliverable to a desktop computer, it has the potential to support learning in one's own space, at one's own pace and in one's own (chosen) time (Harasim, 1996). This characteristic could open up life-long and distance learning opportunities to individuals and groups whose circumstances and time constraints may have denied them the opportunity to participate in learning in traditional time frames and venues. In addition, travel expenses can be eliminated by delivery of instruction electronically to learners connected to the Web (Muller, 1997).

A further way in which the Web may add value to existing learning scenarios is through the distribution of learning resources across international boundaries to provide access to information, ideas and perspectives from other cultures and beyond the local resources of library, instructor and textbook (Harasim, 1996). The Web could also contribute to bridging the gap between educational needs and the provision of educational resources, using digitised media to bring material to the learner that is otherwise inaccessible (Bacon, 1997).

If used quite simply to provide basic course content to contact students, Web delivery of material potentially frees up course lecturers/facilitators, enabling more focus on interaction with students. In addition, Web-based materials can be updated easily and quickly on the server allowing changes to be made available to connected learners without delay.

2.1.1.3 The Web as facilitator of adult learning

With respect to adult learners, Cross (1981; cited in Kearsley, 1997) includes in his theoretical framework of adult learning both personal characteristics such as aging, life phases and developmental stages as well as situational characteristics such as whether learning is part-time or full-time, compulsory or optional. Personal characteristics have a bearing on life-long learning as certain sensory-motor skills may deteriorate with aging e.g. hearing, eyesight and reaction time. Conversely, decision-making skills, reasoning and vocabulary tend to improve. Situational characteristics have a bearing on the self-directed, problem-centered nature of adult learning. Ideally adults need to be given as much choice and flexibility as possible regarding the nature, availability and organization of learning programs, including schedules, locations and procedures.

The nature of the Web facilitates provision of a variety of general learning program scenarios:

- consultation with expert,
- tutorials,
- access to relevant information, and
- group activity/learning partnerships.

Table 2.1 overleaf presents other aspects of adult learning needs, showing how various characteristics of the Web could be used to fulfill them.

2.1.1.4 Web-based material and cognitive learning objectives

Text material on the Web is in the form of hypertext or linked text. According to McManus (1996) and Ross (1993), this linked hypertext format may further facilitate learning by adding value to learning as follows:

- presentation of multiple perspectives,
- learner control,
- non-linear and multi-dimensional traversal of complex subject matter, and
- linking and making relational associations between subject components.

Table 2.1 Adult learning needs and the Web

Adult learning needs, (Ference and Vockell, 1994; Peterson, 1988; Rogers, 1989)	Use of Web to meet identified learning needs
Material to grab attention and stimulate busy, weary learners.	Graphics, sound , video and 'virtual' environments
Caters for diverse leaning styles.	Variety of text, graphics, sound, music and video used in individual or collaborative learning provides diversity.
Learner-centred.	Learners make selections from material and choose direction of navigation.
Guidance provided.	Electronic bookmarks, navigation aids, 'clickable' maps, indexes.
Life-centred, real and relevant information.	Graphics, video, sound, 'virtual' environments provide real data for realistic tasks.
Self-directed learning.	Multiple levels of material with choice of links offered.
Self-paced vs. unrealistic pressures that hinder learning.	Traversal and choices of levels of material in own time at own pace.
Independent learning.	Non-linear presentation of material provides optimal choice and independent control along the information superhighway.
Skills-seeking.	Multiple 'how to' tutorials on a wide range of topics
Feedback to assess performance and so that learning is not in a vacuum.	Feedback via multiple choice questionnaire (MCQ) forms plus email /listserv so that participants can learn from errors and each other in a safe environment (Ference and Vockell, 1994).
Life-long learning.	Myriad of categories of material available including on-line courses.
Higher level thinking.	Network and highway models of hypertext facilitate synthesis and evaluation, information overload requires judgment and discrimination.
Flexibility.	Limitless flexibility of order in which information can be accessed and how learners can construct own materials and learning environments (Kibby, 1996).
Constructivist learning.	Individual and collaborative construction of Web knowledge bases/sites.
Cognitive flexibility.	Complex learning environment with many alternative representations of the content and different examples from which to choose. Mastery of complex, ill-structured knowledge domains facilitates transfer (Spiro, 1991; cited in Kearsley, 1997; McManus, 1996).
Active and participatory vs. passive mode of learning	Selection and traversal of information, making connections and links. Social and cognitive engagement on-line (Harasim et al, 1995).
Importance of learner expectations and learning objectives.	Incorporates on-line guides with objectives and addresses other learning management issues.
Freedom from anxiety.	Access by means of user friendly graphic interface provided. Flattens the learning curve with supplementary 'how to' reference guides, booklets and tutorials, including email to affirm learner confidence so that learning is facilitated (Barron and Ivers, 1994).
Open climate (Petersen, 1988).	Establishes rapport, encourages openness. The netiquette conventions and tolerance on-line are important for adult learners.
Relevant learning.	Useful, applicable information provided that answers questions, solves problems and provides skills.
Hands-on learning.	Elicits performance, sets tasks regularly so that new knowledge is used in immediate and practical ways. Makes training closely resemble the real tasks expected in real life situations (Rogers, 1989).
Builds on existing experience to promote retention and transfer.	Presents material so that later information requires skills and knowledge learnt.

According to Ross (1993), models of hypertext format may also facilitate the realisation of learning objectives according to Bloom's (1956) six levels of the cognitive domain. Table 2.2

presents a synthesis of the views of Ross (1993) and Kemp (1985) on the link between hypertext and Bloom's taxonomy of cognition.

Table 2.2 Hypertext and Bloom's taxonomy of the cognitive domain

Bloom's taxonomy	Learner skills	Correlating hypertext models
Knowledge	Name, specify, state	Single frame design
Comprehension	Identify, explain, restate, translate	Linear
Application	Apply, solve, use	Jump Linear
Analysis	Analyse, compare, contrast	Tree
Synthesis	Design, develop, plan	Network
Evaluation	Assess, evaluate, judge, predict	Highway

(Ross, 1993; Kemp, 1985)

In the model presented in this table, the Web can be viewed as an example of the highway model of hypertext as it has multiple linked (parallel) networks. It corresponds to ***evaluation***, the highest level of cognition in Bloom's taxonomy. In addition, subsections of the Web could be viewed as representative of other models of hypertext in the table.

The ***analysis***, ***comparison*** and ***contrasting*** that accompany the learner's choice of a specific path or route through hypertext knowledge can be applied to learning from the Web, where a learner has the opportunity to select different paths and is exposed to different views of subject information at different Web sites.

Synthesis, which Ross relates to discovery, is required in careful browsing and selection of material. Thereafter ***evaluation*** is facilitated by the need for learners to make connections between the variety of perspectives and diverse information. In addition to the possibility of facilitating higher level cognition, Ross (1993, p.15) proposes that the "Merit of incidental learning and the depth of learning though web-like discovery has not yet fully evolved".

Spiro's Cognitive Flexibility Theory (Spiro et al, 1992: cited in McManus, 1996; Kearsley, 1997), posits that most knowledge domains are characterised by conceptual complexity and are ill-structured. As knowledge structures and processing skills are intertwined, mastery of complexity facilitates transfer. The complex, "spaghetti" like structure of the hypertext Web can facilitate this form of mastery.

The Cognitive Flexibility Theory also recommends that instruction:

- present multiple perspectives and diverse examples,
- support context dependent knowledge,
- emphasise knowledge construction not transmission, and
- that knowledge sources be highly connected and not compartmentalised (Kearsley, 1997).

The characteristic of the Web to facilitate the interlinking of multiple knowledge sources which are presented to learners together with opportunities to control and direct their traversal of these sources, suggests that the Web has the potential to enhance learning in complex domains.

In addition to being consumers and evaluators of information and knowledge provided by the Web, learners involved in the creation of their **own** hypertext knowledge bases require a high level of systemic thinking (Romizowski, 1996). With respect to knowledge construction, learners in general now have access to the same information as lecturers; however the Web may also facilitate access to channels and tools that allow learners to present their knowledge for public consumption. This may result in a democratisation of the learning process (Underwood & Karelse, 1996).

2.1.1.5 Web-based material and learning styles

The theory of Multiple Intelligences (Gardner, 1993; Dorricott, 1997) proposes at least seven learning styles:

- visualiser,
- verbaliser/linguist,
- questioner,
- mover,
- socialiser,
- individual, and
- musical/audio.

As the Web incorporates the diverse presentation of media including text, images, sound and video it is possible to use it to deliver material that meets the needs of learners with any or all of these learning styles.

Koehl (1997) recommends that instructional design should cater for more than the traditional learning styles. It should incorporate those learning styles not usually considered but now made possible through technology e.g. content linear, content non-linear, synchronous communicator, asynchronous communicator, lesson prescribed and lesson interactive styles. All of these, he argues, can be facilitated in carefully designed Web-based learning material.

2.1.1.6 Limitations for learning with Web-based material

Prerequisites for access to Web-based learning include the requirement that learners have regular access to computers and an Internet link and the pre-requisite training to use them (Gallow and Horton, 1994). If a learner has a sole location for computing and linking to the Internet, the advantage of being able to learn in one's own space falls away when that learner is away from that location.

In addition, given the vast quantity of information accessible via the Web, it is important to take heed of Laurillard's (1993), comment that learning is more than the aimless exploration or simple retrieval of information. Moreover the construction of learning is more than the recombining of associations between bits of information, and the mere quantity of references may not necessarily correlate with the quality of an analysis (Laurillard, 1993).

To counteract information and sensory overload and to assist users to discriminate between reliable and unreliable information on the Web, attention needs to be given to information literacy and development of critical evaluation of information (Underwood & Karelse, 1996). Proficiency in these areas is required over and above computer literacy.

While the Web provides considerable opportunities for learner control over paths taken to traverse information, this tends to be a one-way process. To ensure that the essential learning processes of personalised feedback and interaction occur, a course that makes exclusive use of the Web for learning needs to be supplemented by some form of computer-mediated communication (CMC), which provides this interaction and feedback.

The incorporation of electronic mail (email) communication or a dedicated email mailing list to supplement a Web course offers the means for both feedback and interaction. It may also

overcome logistical problems of learners geographically dispersed from one another and the trainer or instructor (Broholm & Aust, 1994).

In addition to the need for feedback and interactivity, courses designed to be presented via the Web, particularly if they replace or reduce contact time, should make sufficient provision for the handling of course and learning management issues. These include clarification of objectives and available resources; information on how to use technology; how much to expect to do at a time; where to get help, and how work will be assessed. These and other matters are usually clarified in personal discussions conducted in more traditional, face-to-face learning situations (Draper, 1997). Van Brakel (1996) suggests that comprehensive on-line study guides be designed to address these issues as a possible solution to this deficit.

Another incidental but important role of contact lecture time in the traditional learning paradigm is that of creating social cohesion in the class. To develop this social cohesion, team spirit and trust in exclusively 'virtual' learning spaces requires the designing in of specific methods. These include introductory exercises via email, special additional class mailing lists for asynchronous social communication, or synchronous electronic 'chat' spaces set up specifically for this purpose.

2.1.1.7 The World Wide Web as facilitator of change in learning

According to Tapscott, (1995; cited in Dorricot, 1997), through its potential roles in learning, the Web can facilitate the current shifts in emphasis evident in higher education and learning. These are presented in Table 2.3 overleaf

Rather than learning based on keeping and recalling information, Web-based information can facilitate the access and retrieval of information when it is required (Peraya, 1994). The use of the Web is also likely to result in increased student participation in the production of course materials which improve and expand through cumulative effort (Donohoe, 1997).

Quick publishing and wide, relatively inexpensive distribution via the Web can impact on the roles and relationships of teachers and students, transforming educational institutions from organisations which merely prepare learners for the world, to participative learning centres that contribute directly and without delay to social, vocational and professional tasks.

Table 2.3 Current shifts in higher education and learning

From	To
Physical classrooms	'Virtual classrooms'
Teacher focused	Learner focused
Presentation mode	Discovery mode
Standardised content	Individualised content
Information transmission	Information facilitation
Autonomous work	Team work
Fixed calendar	Flexible calendar
Centralised organisation	Decentralised organisation
Local population	Global population

2.1.1.8 The 'virtual classroom' and learning

Related to Web-based learning is the concept of the ‘virtual classroom'. A ‘virtual’ environment refers to one that is generated by a computer and used to simulate some aspect(s) of a physical environment.

The New Jersey Institute of Technology (NJIT) coined the name ‘Virtual Classroom’ to refer to its electronic information exchange system with specialised software that supported collaborative learning (Hiltz and Wellman, 1997).

‘Virtuality’ may also have the element of ‘negotiated reality’ (Turoff, 1997, p. 40), where the users of the computerised system negotiate an agreed upon reality. Thus a 'virtual classroom' can be viewed as an on-line learning environment to facilitate the accomplishment of learning goals as well as a community where members can exchange information, provide and receive support and develop a sense of belonging (Hiltz and Wellman, 1997).

NJIT’s first studies of the 'Virtual Classroom' were in 1986. Such classrooms varied from being exclusively on-line to those combined with face-to-face contact. According to Hiltz and Wellman (1997), the results of those and later studies supported the following hypotheses on ‘virtual’ learning:

- course mastery is equal or superior to that in traditional classrooms,
- higher subjective satisfaction was reported with respect to:

- access to lecturers,
- overall quality of learning experience, and

- there was a tendency to view the experience more as group learning than individual learning.

2.1.2 Web-based collaborative learning

Collaborative learning emphasises group or co-operative efforts of learning participants who actively interact and dialogue in order for new knowledge to emerge from the sharing of ideas and information (Turoff, 1995).

Oakley (1997) argues that collaborative work is often hampered by the difficulty of team members to get together outside of formal class time. Providing opportunities for Web-based material and asynchronous computer mediated communication (CMC) enables students to have more peer to peer and student to lecturer contact, as well as access to material developed by external experts. In addition, more and successful collaboration can result. The global interconnectivity, and richness and diversity of material on the Web can potentially facilitate a high level of collaboration that cuts across institutional and national boundaries (Harasim, 1996).

2.1.3 Computer mediated communication (CMC)

'Virtual' or on-line classrooms result in on-line communities with common goals and interests (Hiltz and Wellman, 1997). Increasingly, to facilitate communication and interaction among members of these on-line classrooms, some form of networked CMC is implemented.

2.1.3.1 CMC methodologies

Available CMC techniques can be divided broadly into those that are synchronous, which facilitate real-time communication, and those that are asynchronous, where the transmitting and receiving of messages takes place at different times. Table 2.4 overleaf presents a summary of the main CMC technologies.

In addition to these technologies, Integrated Services Digital Network (ISDN) is a technological infrastructure for high-speed delivery of courseware that incorporates voice, text and video for either synchronous or asynchronous use by learners.

Table 2.4 CMC methodologies

CMC methodology	CMC technology
Synchronous	❑ Computer video conferencing requiring computer video/sound capture card, specialist software (e.g. *CuSeeMe*), a large amount of bandwidth and fast network response (Evard, 1993). ❑ Internet Relay Chat (IRC). Usually real-time, interactive, text-only discussion system delivered via a networked computer chat server. ❑ Multi-User Dungeons/Domains (MUDs) and MUD Object-Oriented (MOOs). Traditionally used as gaming environments, they have the potential to set up virtual "places" to facilitate collaboration on (learning) projects (Evard, 1993; Harrison, 1997). ❑ Web-phones e.g. *Netmeeting* for sharing applications and files via an electronic white-board. ❑ Web delivered real time audio: requires specialist software and considerable bandwidth.
Asynchronous	❑ Email: for one-to-one text message communication and attaching of files for use in other application software. ❑ Email list (listserve): uses list-processing software and distributes email to all subscribed users on the list. Optional moderator. Useful for one-to-many communication. ❑ Bulleting Board Services (BBS): for posting comments and accessing information and databases. ❑ News groups: topic based and similar to bulletin boards, requiring a newsgroup server to temporarily store information that can be accessed by users. ❑ WWW broadcast: content delivery servers broadcast/'push' information over channels on the Internet. Accessed via special server software, e.g. *Pointcast*.

The choice of CMC technique according to Moore (1996) and Harrison (1997), depends on the purpose of the communication as well as the factors listed below:

- ❑ availability of appropriate hardware and software for students and instructors;
- ❑ availability of training and support in the use of the various technologies;
- ❑ availability and level of Internet connectivity and access for all participants;
- ❑ copyright and ownership issues for text, graphic, audio and video material, and
- ❑ cost of acquisition, support and use of appropriate technology.

Of the various CMC methods, (asynchronous) email has been the most widely used in higher education (Holden and Wedman, 1993).

2.1.3.2 Advantages of CMC for learning

According to Hiltz and Wellman, (1997 p.49), CMC has the following potential benefits:

- it facilitates more equality of participation than in face-to-face communication,
- its asynchronicity makes interaction more convenient,
- in the absence of 'turn-taking' participants can add interactions whenever they choose, and
- on-line communication is often 'more uninhibited, creative and blunt'.

Laurillard (1996) asserts that tutorials conducted via CMC result in a higher proportion of student time to tutor time compared with contributions in traditional face-to-face tutorials with ratios as high as 10:1. She attributes this to greater opportunities for individuals to contribute, as the asynchronous text-based medium means that the moment to contribute is extended. Students can return to the topic after they have given it thought and do not have to wait their turn as they do in face-to-face communication. Thus, they do more than merely attend the tutorial: they engage in more active learning.

Dede (1989) finds that the less socially adept and assertive learners could gain particular advantage by not having to compete with more confident learners in direct face-to-face class communication.

Research by Karayan and Crowe (1997) into the effects of electronic discussion groups in an educational setting indicate the following benefits:

- They cater for impulsive learners who want to comment on everything discussed and answer every question, in addition, having to write their responses could mean that they take time to think through their responses.
- They cater for reflective learners who require more time to process the issues and their responses.
- A sense of community which many students do not experience before in an academic setting, can be fostered.
- The skill of writing coherently around a topic can develop in a natural and non-threatening atmosphere.

Burgstahler (1997), from her experience with learners and tutors with disabilities, notes that even the inability to speak, hear, see or move need not be a limitation in electronic communication. A sense of anonymity seems to result in students sharing larger quantities of information than they do in traditional classrooms. Another advantage observed by Burgstahler included that learners have more access to the tutor and one another, as

electronic contact is not restricted to the limitations of scheduled class contact time. Provided that it is possible to access one's email while travelling, it is also possible for learning discussions and access to the tutor to continue even when the tutor is away, for example at a conference. This can make the planning of the teaching year more flexible.

In addition to the advantage of fast transmission rates and easy message storage, Levinson (1990) considers that asynchronous electronic communication's capacity to provide opportunity for reflection and revision of messages before sending them contributes to the production of a closer fit between ideas, intentions and their expression in writing.
Given the reported advantages of this asynchronous form of communication, Dede (1989) predicts that it could become the preferred method of instruction rather than a substitute to be used only when conventional strategies are not feasible.

2.1.3.3 Limitations of CMC for learning

A number of limitations of CMC reported by Hiltz and Wellman (1997) below concern field studies conducted in the early stages of CMC development with respect to classrooms:

- CMC generated co-ordination problems e.g. information overload,
- CMC is useful only for instrumental relationships rather than social supportive ones,
- CMC is limited by lack of visual and social cues and presence,
- CMC is good for communication of information, opinion and suggestions but
- CMC is less suited for communicating agreement or disagreement, and
- CMC is less effective for social-emotional tasks.

With reference to the last limitation, Hiltz and Wellman also report on more recent field research which suggests that links initially formed for instrumental purposes often broaden into those that are socially supportive, with relationships formed on-line being much like those off-line. These relationships may develop despite the members being dispersed geographically and communicating asynchronously rather than in 'real-time'; and having more heterogeneous social characteristics with respect to lifecycle stage, gender, ethnicity and socio-economic status.

Other potential disadvantages reported by Hiltz and Wellman (1997) include the following:

- the flexibility of asynchronicity may result in procrastination when students are too busy to log on regularly, which can result in falling behind with respect to deadlines;

- large groups with high levels of interactivity can trigger information overload

unless communication tools provide adequate management of the information, and

- normless behaviour can result unless there is clear identification and monitoring of acceptable rules and conventions.

2.1.3.4 The nature of communicating via CMC

While CMC may facilitate interaction similar to that which occurs in a face-to-face class e.g. contributing ideas and opinions, replying to and overhearing those of others, CMC uniquely combines the printed word (text) with verbal patterns of speech (Greller and Barnes, 1993). In addition, all communication is recorded and stored for later perusal and re-visiting. CMC also facilitates simultaneous conversation or 'threads' and provides the choice of replying to one person or a whole group.

Davis (1997) distinguishes the following three types of communication facilitated by CMC:

- impersonal, task-oriented, instrumental communication;
- interpersonal, social communication,
- hyper-interpersonal communication which enables individuals to self-present and edit.

While the first two operate similarly in face-to-face communication, hyper-interpersonal interactions provide a unique opportunity for individuals to be accepted and judged on the merit of their communication rather than on other visually identifiable characteristics.

Another reported phenomenon of CMC in research on student email communication indicates a predominance not of communication related to conceptual content, but of communication partly of a social nature and partly related to issues and questions around administration and course management (Draper, 1997). In face-to-face learning, students who are uncertain about or miss information concerning administration and course management may take up a considerable amount of the lecturer's time to obtain clarity one-on-one and one at a time. CMC provides a medium for one-shot communication, distributed to all students at once, to present and confirm course requirements.

Draper (1997) suggests that learning management is a crucial part of learning in which peer interaction plays an important role. Van Brakel (1996) also highlights the increasing importance of including issues of learning management in the self-directed model of learning. Both CMC and Web-based study and learning management guides can provide support for presenting and clarifying these issues.

2.1.4 Roles of learners and course presenters in Web-based learning

The exposure to growing databases provided by the Web and increased interaction among learners is likely to encourage the trend to more constructivist and collaborative work with learners, all contributing to a growing pool of knowledge (Donahoe, 1997). Earlier on, with the advent of computers in teaching and learning, Ryba and Anderson (1990) presented a strategic model for how a teacher's role would have to be adapted. They envisaged a number of essential roles including, planner, manager, guide, facilitator, model and participant. In Web-based learning the de-emphasis on information production and provision by the teacher implies that course presenters will increasingly take on these roles.

2.2 Motivational issues and Web-based learning

The novelty, diversity and richness of information found on the Web make it an interesting environment that caters easily for the first two factors in Keller's ARCS model of motivation, namely, attention and relevance (Duchastel, 1996). Keller's remaining factors of confidence and satisfaction can also be catered for by Web-based material, provided that careful instructional support supplements Web-based courses so that students do not get overwhelmed, lost or distracted in their search and exploration for relevant resources that fulfil their learning tasks.

In reference to Web-based learning, Malone (1981) extrapolates the motivational factors of curiosity, fantasy, control and challenge from games theory. Duchastel (1996) considers that the Web can more easily fulfill the first two factors. The remaining two are likely to be increasingly supported by Web-based learning experiences, as Web-based material becomes more interactive with the enhancement of Java and CGI (Common Gateway Interface) programming. The more recent advancements with dynamic hypertext mark-up language (DHTML) will also support the development of Web pages by providing more interactive choices and challenges to enhance the Web's potential for intrinsic motivation of learners.

In addition to the learning needs outlined in Table 2.1, adults have a particular need for satisfaction from learning that should contribute to their self-confidence (Peterson, 1988), as well as to their motivation for learning.

According to Rieber (1996), Csikszentmihalyi's Flow Theory of Optimal Experience may provide an important framework for adult motivation for learning. According to the theory, 'flow' occurs when adults become extremely engaged and absorbed by certain activities and spontaneously 'go with the flow' which is accompanied by a sense of satisfaction (Rieber, 1996).

Csikszentmihalyi asserts that learning activities are more likely to elicit flow if the individual is actively involved in a task and the following criteria are met:

- challenge is optimized;
- attention is completely absorbed;
- clear goals are embedded in the material;
- clear and consistent feedback is provided as to whether one is reaching the goals;
- absorption frees the individual, at least temporarily, from other worries and frustrations;
- the individual feels completely in control;
- all feelings of self-consciousness disappear, and
- time is transformed during the activity.

Given the absorption experienced by Web 'surfers', carefully structured Web delivered material that is goal-oriented and attention grabbing, and which offers challenges and learner control, has the potential to provide this motivating 'flow'.

2.3 Interface design issues and learning

Web-based material includes text, hypertext, images and other multimedia. Traditional text or print values linearity and sequentiality. The non-linear and interactive nature of hypertext make the differences between it and traditional forms of text "..so vast as to make hypertext a new medium for thought and expression" (Slatin, 1994; cited in Gibson, 1996, p.13).

The complexity of designing a hypertext learning site is compounded by the fact that the designer has no control over the following:

- how the reader arrives at the site,
- the order in which the reader navigates the site,
- the period of time the reader spends at the site or on any particular page,
- the pages the reader chooses to read, and
- the point at which the reader exits the site.

Furthermore, while traditional printed forms of information present a topic in a single, sequentially written article or book, hypertext Web-based material may present information spread across a number of disparate sites. Only attention to the URL (Uniform Resource Locator) at the top of the screen indicates to the user that s/he has moved away from the site where s/he started from (Gibson, 1996).

If Web-based learners are not to wander aimlessly from link to link and get lost in the process, effective design of Web sites has to:

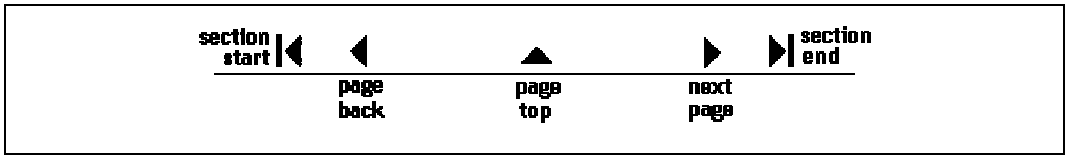
- orient readers and enhance their reading and access, and
- assist with navigation within and from the site (Stanton and Baber, 1994).

To increase coherence in the face of linked but often fragmented data, and to prevent reader disorientation and confusion, Ebersole (1997) recommends designing in cues/clues related to links. An example is browser software which usually colours and underlines text that is linked. The entire URL could be included as linked text to indicate a link *external* to the current material site. This could help distinguish between links within a current site and those external to the site before the readers find themselves in an unfamiliar environment.

Content maps and overview diagrams can also assist users in their traversal of a site. The familiar browser "Back" button is external to the Web site but this familiar convention, together with "Forward", "Top of page" buttons or pointers, can be included in page design to assist navigation and orientation.

An interface metaphor that was found to be commonly understood by South African students was the set of button pointers on the Video Cassette Recorder (Amory, 1994; cited in Murrell, 1998). An adapted and annotated example derived from this metaphor is presented in Figure 2.2.

Figure 2.2 Navigational metaphor



Achieving a consistent interface in virtual environments can result in the selection and application of a metaphor or theme. Metaphors draw on models to interpret the world and make related connections that may not be obvious (Viau, 1994). They are based on familiar concepts such as books and desktops which can help bring familiarity to new and potentially

confusing systems (Ebersole, 1997). Theoretically, the users then need to learn fewer rules as the rules that work are self-evident in the metaphor.

Metaphors can also foster intrinsic motivation in users particularly if the metaphor meets their fantasy needs, as Malone (1981) describes. However, care needs to be taken in the presentation of learning material to diverse groups so that selected metaphors are not only meaningful but also generalisable and acceptable according to the cultural and group norms of targeted groups and individuals (Murrell, 1998).

If the Web is to provide a rich educational environment rather than remain a mere repository of information, it requires deliberate, careful compilation of educational material and instructional and Web design. The situational and personal characteristics of potential learners as well as the situational conditions and constraints of educational settings, need to be taken into account.

2.4 Technological issues and Web-based learning

2.4.1 Technical benefits of Web-based material

Some of the technical benefits of Web-based material to provide learning are outlined below.

- As there is cross-platform compatibility, a single set of tools can be used to create and access Web materials for Windows, Macintosh, Unix and OS/2 computer users (Bacon, 1997).
- Web documents are authored by means of HyperText Markup Language (HTML). With a markup language, learning materials are quicker and simpler to prepare than material that requires a scripting or full programming language (Bacon, 1997). The expertise required to work in basic HTML is well within the capabilities of those with office automation software skills (e.g. MS-Office or Corel-Office) and without an excessively steep learning curve.
- HTML documents can be produced with available word-processing (text) editors (with or without special add-ons) or with specialised, including free- and shareware, dedicated HTML editors. Web browser software currently includes the functionality for limited HTML editing.
- HTML documents can be updated without the expense of re-printing revised versions, which occurs with paper copies.

- Web-based material can be developed without getting locked into expensive proprietary software.
- Web browsing software is freely available at no monetary cost.
- Web-based material can enhance text with colour, graphics, sound, animation and video.
- The hypertext format of Web-compatible material facilitates the linking of information within documents for easy searching. Links to information external to the documents can be incorporated to extend the depth and breadth of information.
- While the Web may not guarantee a paperless society, it provides the opportunity for users to make personalised selections of documents to save and print (Turoff, 1995).
- In addition to being a content provider, the Web is a global delivery medium that provides easy access and fast, convenient delivery of material across any distance (Muller, 1997). In South Africa this has particular significance for distance learning at a time when local postal services have decreased in speed and reliability, while costs have escalated.
- Most currently available computer based training (CBT) authoring systems have Web browser plug-in software so that CBT programs can be played through the browser.

2.4.2 Technical limitations of Web-based material

An evident limitation of the Web, particularly as a learning medium, is that it is not available to those who are not computer literate nor to those who have no access to the Web. Further, as the graphical interface of the Web requires some form of multimedia capacity, the computers required need good screen resolution and sufficient computer memory (RAM), all of which may add to the cost of access. While the cost of technology continues to decrease in relation to other commodities, this does not help those who still cannot afford it or who cannot afford the supporting infrastructure (Foks, 1995).

A limitation for Web-based delivery of training in many developing countries, including South Africa, is the lack of access to telephone and computer network services in economically disadvantaged areas. This limitation could lead to a scenario in which Web access further favours advantaged individuals and communities, while lack of access perpetuates the deficits experienced by the historically disadvantaged.

Cause for optimism, is the concept of ‘One person, one Internet connection’ presented by Jay Naidoo, South African Minister of Posts and Telecommunications, to the 1996 Information, Society and Development Conference attended by the Group of seven (G7), comprising leading industrial nations and representative from the developing world (Karras, 1996). While more modest than Gates’ (1995) long-term vision for the global community, it may indicate a commitment to a future infrastructure that could support the Web as a potential delivery and content provider for learning and education in South Africa.

A factor that could further increase the number of high-speed access points to the Web is emerging technology that enables users to access the Web via existing TV sets, cable and satellite links.

At this stage of the Web’s development, its next most serious limitation, after access issues, is related to its delivery method. Bandwidth refers to the amount of information that can be sent across a network in a given amount of time. At best the current delivery of large files that include high-resolution material such as graphics, sound and video along narrow electronic lines, proceeds at the pace of "a slowish CD-Rom" (Fluck, 1997).

With respect to this problem of limited bandwidth, new initiatives among higher education communities include *Internet II.* This will provide a high bandwidth network for quality of service among major research universities. While it is unlikely that *Internet II* will be made available for purposes of global learning in the short-term, in the middle to long term and with technology and satellite access likely to become more available and cost effective, the provision of bandwidth should improve in the future (Rudy, 1997).

Individuals and organisations with adequate computer and Internet access and moderate bandwidth rates still have a common problem: they are at the mercy of service providers and /or networking departments. Currently in South Africa, the larger service providers are buying out smaller private ones. Indications are that these larger service providers may have outgrown the nicety of being able to offer personal attention to individual clients and intensive handholding through the early stages of ‘getting connected’. However they provide 24 hour toll-free technical support and very fast and reliable links.

Local South African universities and other educational institutions that were previously connected via UNINET (University Information Network) may be forced to re-think their own connectivity. In at least two areas in South Africa the UNINET link can no longer cope with the demand for bandwidth, and universities in Cape Town and Durban have moved to renting the required bandwidth from service providers in the private sector.

In the tertiary education sector budget cuts and salaries that do not keep pace with those in the private sector are likely to result in increasing difficulty to attract sufficiently high calibre networking professionals to support the campus local area and wide area networks (LANs and WANs).

Other technical limitations of the Web are listed below:

- Different proprietary Web browser software packages do not always interpret HTML tags identically. In addition formal acceptance of new HTML standards lags behind their widespread use. The result is that Web material may display differently with different browsers or with certain features not fully compatible with all browsers (Lynch and Horton, 1997).
- Current HTML standards still limit the design of interactive HTML interfaces. The result is that much Web-based material is static with electronic page turning as the predominant interaction (Cronjé, 1996).
- Slight variation in screen resolutions that exists across computer platforms such as Macintosh vs. IBM compatible, results in variable displays. In addition, user choice of screen display resolution size may result in full screen display requiring horizontal or vertical scrolling (Lynch and Horton, 1997).
- Variable choice of number of screen colours can result in users not viewing the material as intended by the designer (Lynch and Horton, 1997).
- Web-based contents are named with reference to content location and not to the content or data object itself. This necessitates regular monitoring for broken links, expiry dates and outdated or updated content lest material has been moved, renamed or otherwise neglected (DeRose, 1996; Rein et al, 1997).
- Conversion of material to HTML from the original format may result in multiple formats of material requiring multiple updates and maintenance (Hall and Davis, 1996).

- The ease with which users may get lost in "hyperspace" necessitates bookmarks, location maps, indexes and a careful design paradigm with consistent screen and on-screen cues (Stanton & Baber, 1994).

2.4.3 Current technical requirements for Web-based learning

As the functionality of the Web and the hardware and software that facilitate access to it advances and improves on a daily basis, only a general idea is provided here of the current technical requirements for providing Web-based learning.

The minimum requirement to access Web-based learning and email is a computer that is linked to the Internet, either by means of a direct line (e.g. at a university) or through a modem attached to a telephone. A service provider through whom the connection is provided is also required,

Assuming that Java and DHTML enhancements possible on the Web are incorporated into Web-based material, the level of computer from which to access the material requires a 32 bit operating system e.g. Windows 95/98/NT. For material designed for the lowest common denominator of computer, machines that run Windows 3.1 would be adequate.

At least version 4 Web browser suites (Netscape Communicator and MS-Internet Explorer) are currently required to access most of the functionality and enhancements of the Web. These browsers now incorporate email and a newsreader, although earlier versions of the browsers can be used with a range of individual specialist software packages for email and news group reading.

Development of Web-based text material is possible with basic text editors. A range of specialist HTML editors are available from freeware and shareware packages: from the basic *AOLPress* through a range of inexpensive editors such as *HomeSite,* to the more sophisticated *wysiwyg* (what you see is what you get) editors such as *Macromedia's Dreamweaver* and *Microsoft's Front Page (*Lynch and Horton, 1997). Proprietary software to develop and manage Web-delivered learning material such as *Top Class, Lotus Notes* and *Oracle Learning Environment* is also available (Owusu-Sekyere, 1996).

2.5 Economic issues and Web-based learning

Over and above the initial and running costs of hardware, software and network infrastructure for the delivery of Web-based learning, there needs to be a commitment on the part of tertiary

institutions to invest in the training and support of course developers. As development and planning for development can take up to two years (Eastmond and Rohfeld, 1993), a long-term investment in support and maintenance is also required.

In a country where a large proportion of the population does not have access to computers or networks, consideration needs to be given to the sponsoring and development of (community) centres where access points can be provided (Owusu-Sekyere, 1996). Support and training for students is a further cost factor. Learners who access learning materials from home also have the burden of cost of equipment and connectivity to enable their participation in this learning methodology.

Once a course is developed the cost per student reduces as more students participate in the course. In addition, if the course is provided to distance students, there is a saving on travel and subsistence costs.

After introducing Web-based and asynchronous learning networks, a number of universities report considerable returns on their investment (Oakley, 1997; Brace, 1997), citing the following favourable factors:

- Better academic returns with improved test results and fewer drop-outs,
- increased faculty productivity and more effective use of time,
- actual cost savings on several courses, and
- gaining a competitive edge and regional recognition.

Ultimately, the sharing of resources across campuses within a region can reduce costs (Owusu-Sekyere, 1996; Fraser, 1997).

2.6 Summary of review

A review of current literature indicates that Web-based learning, together with CMC, has the potential to expose learners to a rich pool of real-world information, learning material and scenarios that are particularly motivating for adult learners with a range of learning styles. In addition, asynchronous communication facilitated by email can facilitate a high level of distance independent collaboration, with learners themselves contributing to the production of new knowledge.

The potential of CMC enhanced Web-based learning as a facilitator of effective learning is available only to groups and individuals who have access to the required technology and infrastructure. CMC methodologies may thus require a high initial investment which needs to be balanced against a range of possible favourable returns for students, faculty and institutions. Most important of all, as with other teaching and learning methodologies, the central focus needs to be on the educational underpinnings, including sound instructional design, that take account of the individual, group and situational contexts of learning.

The above factors were taken into account in the planning and implementation of the telematic teaching project that is outlined in the next chapter.