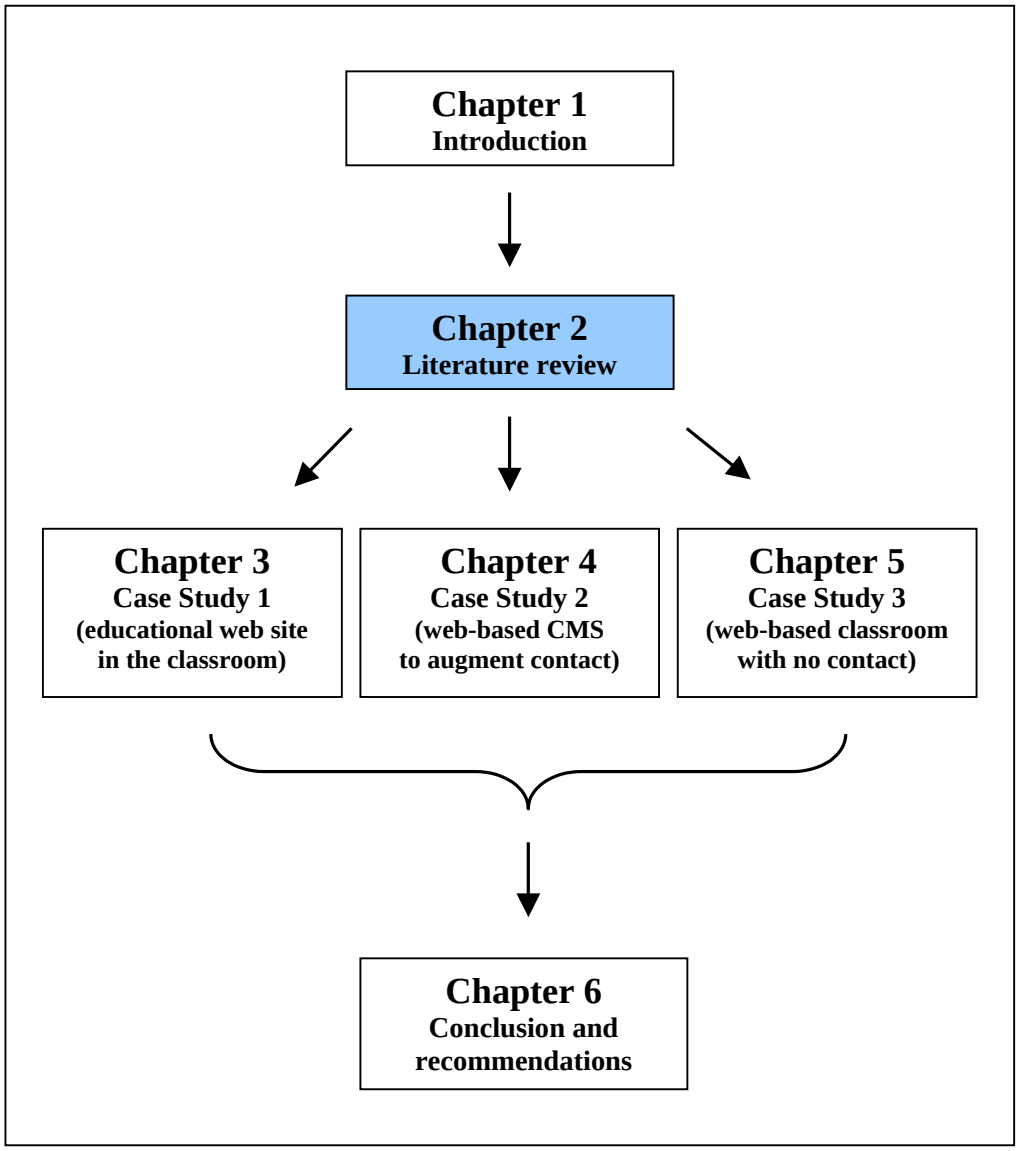
Chapter 2

Literature review



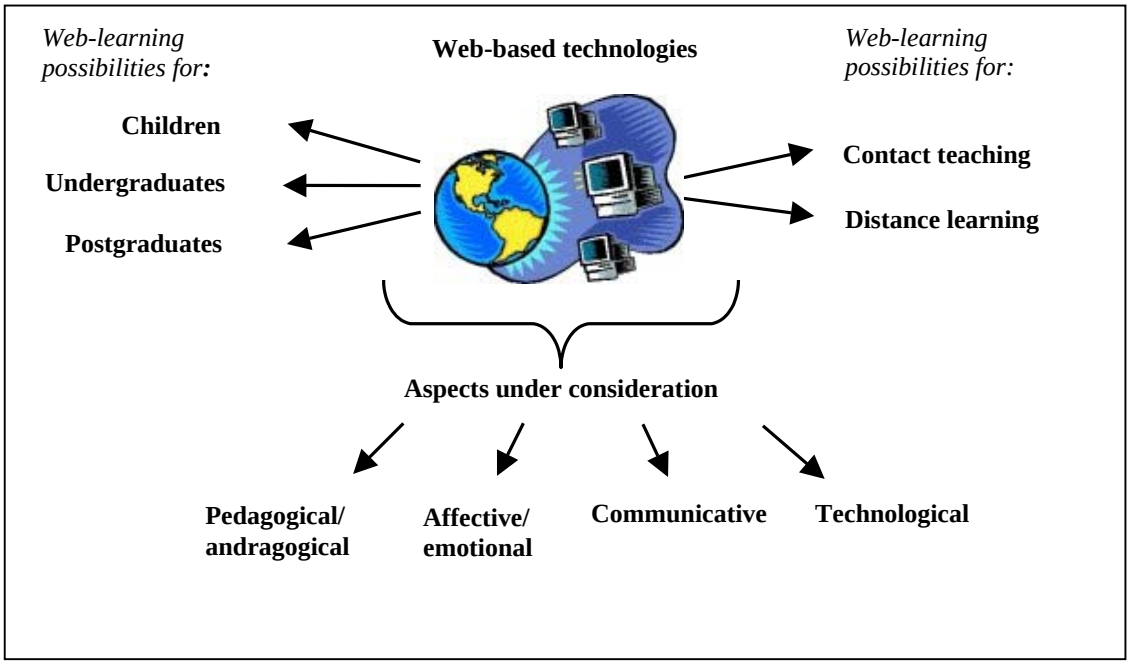
2.1 Introduction

Following the previous chapter which provided a framework for the study, this chapter reviews relevant literature covering the research questions in Chapter 1, Table 1.1. The following points are discussed in this chapter:

- Aspects to consider when using web-based technologies.
- The distinguishing characteristics of learners of different age groups, and the differences and similarities between these age groups in the context of web-based technologies.
- Learning possibilities for children, undergraduates and postgraduates in the context of web-based technologies.
- Web-learning possibilities for contact teaching and distance learning.

These points are discussed in turn in the sections that follow, and are illustrated diagrammatically in Figure 2.1.

Figure 2.1 Application of web-based technologies for different age groups and types of teaching



2.2 Aspects to consider when using web-based technologies

> *Nothing before has captured the imagination and interest of educators simultaneously around the globe more than the World Wide Web* (Owston, 1997).

A wide range of technological options are currently available to educators and instructors (Huang, 2000). Web-based instruction (WBI) has been widely applied in both contact teaching and distance learning (Huang, 2000; Harmon and Jones, 1999; Trentin, 1999; Liaw and Huang, 2000), and there is a current rush in academia toward implementing it (Harmon and Jones, 1999). However, the rush to conduct education and training on the Web is at best ill-devised, and at worst will fail to deliver the magic everyone expects (Harmon and Jones, 1999). Harmon and Jones (1999) argue that the Web will be of great value for education in the near and distant future, if used appropriately.

Richie and Hoffman (1997) define web-based instruction (WBI) as "a hypermedia-based instructional program which utilises the attributes and resources of the Web to create a meaningful learning environment wherein learning is supported and fostered". According to Sherry and Wilson (1997), a WBI learning environment should include many resources, support collaboration, implement web-based activities as part of the learning framework, and support both novices and experts. A WBI environment is also able to provide a wealth of information to learners that is not readily available in textbooks or in lectures (Daugherty and Funke, 1998).

Harmon and Jones (1999) present five levels of web use. Table 2.1 presents these levels and gives a description of what each entails. These levels are commonly used in schools, colleges and universities, and in corporate training. Each case study in this dissertation investigates the use of a different level of web use, as indicated in italics in Table 2.1. In Case Study 1, the Web was used as a **supplement** to traditional contact teaching, while Case Study 2 considered **communal** use of the Web. In Case Study 3, the level of web use was **immersive**, i.e. the course was run entirely on the Web.

Table 2.1 Five levels of web use in education

Level of web use		Description
1.	Informational	▪ Provides stable information to the learner. ▪ Administrative in nature ▪ Consists of the instructor placing items such as the syllabus, course schedules and contact information on the Web for learners to review. ▪ Requires little or no daily maintenance, and takes up minimal space and bandwidth.
2.	Supplemental ***Case Study 1 (educational web site)***	▪ Provides course content information for the learner, functioning as an addendum to the core content. ▪ Main part of educational experience is provided in a classroom setting. ▪ Instructor places course notes on the Web. This should be done after class, otherwise class attendance will drop. ▪ Requires more technical know-how by the instructor, daily or weekly maintenance, and low to moderate space and bandwidth.
3.	Essential	▪ Requires the instructor to have HTML skills, and information literacy skills along with ample course development time. ▪ Learner obtains most, if not all, of the course content information on the Web. ▪ Classes still meet face-to-face, but learners are expected to use the web-based course materials extensively. ▪ Requires learners to take a more proactive approach to ensure their own learning.
4.	Communal ***Case Study 2 (web-based CMS)***	▪ Classes meet both face-to-face and online. ▪ Learners generate course content themselves. ▪ Requires the use of other online tools, such as chat rooms, bulletin boards, e-mail, and video. ▪ Requires both instructor and learners to have good HTML skills as well as effective technology skills in general. ▪ Online group collaboration tools are not as user-friendly and "bug-free" as one might hope and novice technology users might not be able to get past the frustrations of imperfect tools to get to meaningful interaction about the course content.
5.	Immersive ***Case Study 3 (web-based classroom)***	▪ All of the course content and interactions occur online. ▪ This level should be seen as a sophisticated, constructivist virtual learning community. ▪ Comprised of learner-centred, constructivist pedagogies. ▪ Instructor and learners must have a high level of technical expertise and sophisticated learning strategies.

(summarised from Harmon and Jones, 1999)

Various aspects play an important role in different web-based technologies. These aspects need to be considered as they influence the effectiveness of learning or the degree to which learning is supported. These aspects are pedagogical/andragogical, affective/emotional, communicative, and technological aspects, and are discussed in turn in the sections that follow.

2.2.1 Pedagogical/andragogical aspects

Pedagogical/andragogical aspects emphasise how learning domains are to be represented, and affordances provided to support learning (Hannafin *et al*, 1997).

In this section the following are discussed:

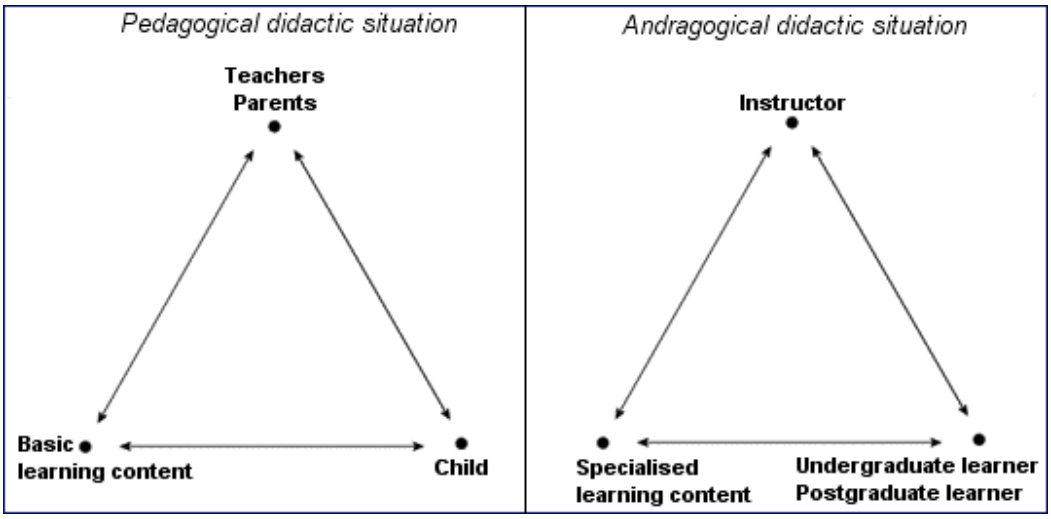
- Pedagogical and andragogical didactic situations;
- objectivist and constructivst epistemology; and
- collaborative learning.

2.2.1.1 Pedagogical and andragogical didactic situations

The term "andragogy" is used to distinguish the teaching and learning of adults from "pedagogy", the teaching and learning of children. "Andragogical" in this study includes both undergraduate and postgraduate learners.

Fraser (*et al*, 1993) presents two didactic situations, namely: the pedagogical didactic situation and the andragogical didactic situation. They define a didactic situation as a coherent set of circumstances in which people find themselves at a particular time, in which he/she is in a specific relationship with other people or objects (aspects of reality) and which demand or suggest particular activities. Figure 2.2 gives a schematic representation of these two situations (Fraser *et al*, 1993).

Figure 2.2 Pedagogical and andragogical didactic situations (adapted from Fraser *et al*, 1993)



In the **pedagogical didactic situation**, teachers and parents teach basic learning content to immature children in order to lead them to adulthood, while in the **andragogical didactic situation**, instructors function as tutors who teach and guide students, apprentices and other adult persons, by means of specialised learning content, to become more mature (Fraser *et al*, 1993).

2.2.1.2 Objectivist and constructivist epistemology

The application of technology to teaching and learning has undergone a paradigm shift in terms of the learning strategies which should be embedded in web-based instruction. This paradigm shift has been the move from an objectivist epistemology to a constructivist epistemology (Sims, 1998) – the former and the latter are two of the main approaches, or epistemologies of learning.

According to objectivist epistmemology, knowledge has an objective and separate existence, the attributes, relationships and structure of which can be known (Cronin, 1997). As a knowledge expert, the instructor (and/or appropriately designed content in the case of web-based instruction) embodies an accurate representation of this structure. Teaching involves presenting knowledge and modelling its structure in such a way that it can be accurately acquired and reproduced, while learning involves the accurate acquisition and replication of

this external knowledge (Cronin, 1997; Jonassen *et al*, 1995). The instructor is therefore the transmitter of knowledge and the learner is a receiver (Jonassen *et al*, 1995).

According to Miller and Miller (1999), the fundamental goal of the objectivist epistemology is the accurate transmission and reception of knowledge. This epistemology not only drives strategies which determine the communication between learner and content, but also drives communication between instructor and learners, and among learners. Communication is therefore a means (i.e. strategy) to an end (acquisition of knowledge).

In contrast to objectivist epistemology, the constructivist epistemology reflects a position that knowledge is not independent of the learner, but is internally constructed by the learner as a way of attaching meaning to experiences (Cronin, 1997; Jonassen *et al*, 1995). It is a specific strategy of instruction that facilitates cognitive learning, in contrast to didactic, authoritarian teaching as evidenced in the objectivist epistemology, and is a learner-centred, rather than an instructor-centred approach.

According to Jonassen (*et al*, 1995), learning involves the interpretation of experiences and therefore the knowledge constructed by each learner is unique. Constructivist aspects include real-world situated learning, anchored instruction, discovery-learning, integrated testing, and transfer (i.e. applying known skills to new tasks) (de Villiers, 1999; Miller and Miller, 1999). The active learner participation required in constructivist models can lead to long-term results and real-world performance. Web-based teaching and training facilitate learner initiative, knowledge construction and real-world exposure via browsing (de Villiers, 1999).

A dominant characteristic of constructivist learning is collaboration among learners. In contrast to objectivist instructional theories, constructivist theories posit that it is through communication with others that learners construct meaning from their experiences (Miller and Miller, 1999). The importance of social negotiation in the learning process makes communication critical, hence the need for constructivist instructional environments to be designed and implemented with social negotiation in mind.

Constructivism is increasingly attractive in the public learning system, with its critical need to motivate and engage diverse learners. Constructivists object to pre-specified objectives

and criterion-referenced testing, preferring contextualised learning experiences where learners explore and set their own goals (Dick, 1996). Table 2.2 sets out some key terms associated with constructivism (Dick, 1991; Duffy and Jonassen, 1991; Merrill, 1991), together with corresponding descriptions.

Table 2.2 Terms associated with constructivism

Key terms	Description
Active participation	Learning is an active experience.
Situated/anchored instruction	Learning is anchored in contexts which stimulate apprenticeship learning.
Real-world applications	Problem-solving situations are practical and represent the real-world.
Transfer	Learners transfer skills to other problem-solving situations.
Integrated testing	Testing is integrated into the task, i.e. less emphasis on formal testing and scoring.
Collaborative learning	Emphasis on teamwork (collaboration) to promote multiple perspectives.

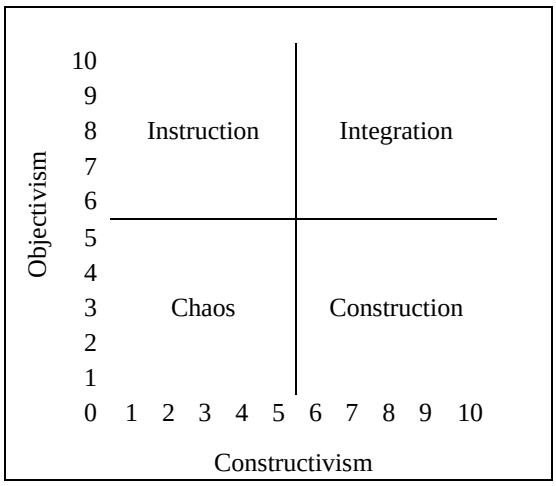
To facilitate a deeper understanding of constructivism, the constructivist epistemology is compared to the objectivist epistemology. Table 2.3 shows certain differences between these two approaches, based on the works of the following authors: Duffy and Jonassen, 1991; Jonassen *et al*, 1995; Runes, 1962:217; and Tam, 2000.

Table 2.3 Differences in learning between the objectivist and constructivist epistemology

Objectivist epistemology	Constructivist epistemology
▪ Knowledge and truth exist outside the mind of the individual and are therefore objective.	▪ Knowledge and truth are constructed by individuals and do not exist outside the human mind.
▪ Learning is viewed as the acquisition and accumulation of a finite set of skills and facts.	▪ Learning is a change in meaning constructed from experience.
▪ Learning is objective.	▪ Learning is personal and relevant to the learner.
▪ Mainly concerned with the object to be known/learned.	▪ Emphasises personal construction of knowledge.

Educational software, course management systems (CMSs), and web sites usually fall into one of these approaches, however, they can and do sometimes overlap. Cronjé (2000c) proposed that the two approaches can be seen as complementary rather than opposing. He proposes that the two can be juxtaposed with each other at 90° instead of at 180° on a continuum. Figure 2.3 depicts these two approaches, with four quadrants that emerge between the two epistemologies.

Figure 2.3 Four quadrants of teaching and learning



Each of the four quadrants represents a particular kind of teaching or learning, as indicated in the following descriptions:

- The *chaos* quadrant is the domain of serendipitous and incidental learning;
- *Instruction* is the domain of programmed learning, tutorials, lectures, and drill-and-practice;
- *Construction* corresponds closely to what is traditionally written about constructivism, constructionism and cognitivism; and
- *Integration* is the combination, under appropriate conditions, of instruction and construction. It is typically the domain of the instructional designer, and learning in this quadrant depends on a goal analysis to determine the learning outcome (Cronjé, 2000c). The designer would then select both objectivist/instructionist and constructivist/cognitive learning events to achieve the desired outcome (Cronjé, 2000c).

2.2.1.3 Collaborative learning

Collaborative learning is strongly associated with constructivism. This section examines collaborative learning in more detail, discussing its features and giving guidelines for its use.

Hiltz (1995) defines collaborative learning as a learning process that emphasises group or co-operative efforts among faculty and learners, and stresses active participation and interaction on the part of both learners and instructors. Knowledge is viewed as a social construct, and therefore the educational process is facilitated by social interaction in an environment that facilitates peer interaction, evaluation and collaboration.

In collaborative learning, the instructor and learners adopt certain roles, and certain features characterise the learning process. Features of collaborative learning, given in Table 2.4, are based on the works of Clarke, 1998; Cronjé, 1999; Hiltz, 1995; Johnson and Johnson, 1999; Jonassen and Reeves, 1996; Kafai and Resnick, 1996; Tam, 2000; and Watson and Rossett, 1999.

Table 2.4 Features of collaborative learning

Role	Description of role
Role of the learner	▪ Assess, sequence and derive meaning from information. ▪ Construct and generate their own knowledge. ▪ Collaborate with other learners. ▪ Act as planner, manager, guide, facilitator and participant.
Role of the instructor/ teacher	▪ Act as mentor and guide. ▪ Encourage learners to work together to build a common body of knowledge, and accomplish shared goals. ▪ Structure learning opportunities (act as planner, manager, guide, facilitator and participant). ▪ Serve as a resource. ▪ Create and maintain a collaborative problem-solving environment. ▪ Assure assessment.
Characteristics of the learning process.	▪ Encourage and accept learner autonomy and initiative. ▪ Use a wide variety of materials, including raw data, primary sources and interactive materials, and encourage learners to use them. ▪ Inquire about learners' understandings of concepts before sharing his/her own understanding of those concepts. ▪ Encourage learners to engage in dialogue with other learners and with the instructor. ▪ Engage learners in experiences that show contradictions to initial understandings and then encourage discussion. ▪ Provide time for learners to construct relationships and create metaphors. ▪ Assess learners' understanding through application and performance of open-structured tasks.

Johnson and Johnson (1999) identify five prerequisites for effective collaborative learning, namely: positive interdependence, individual accountability, a mutual goal, face-to-face promotive interaction and social skills. These prerequisites are discussed in turn.

- *Positive interdependence* relates to the perception that we are linked with others in such a way that we cannot succeed unless they do.
- *Individual accountability* exists when the performance of each individual learner is assessed and the results returned to the group and the individual. The purpose of collaborative learning groups is to make each member a stronger individual.
- *A mutual goal* exists when group members discuss how well they are achieving their goals and maintaining effective working relationships.
- *Face-to-face promotive interaction* is when individuals promote each other's success by helping, assisting, supporting, encouraging and praising each other's efforts to achieve.
- *Social skills* are the interpersonal and small group skills (that need to be taught to learners), which contribute to the success of a collaborative effort.

According to Trentin (1999), learning to collaborate is a prime educational goal as well as an indispensable prerequisite when the aim is to co-develop something. However, this scenario becomes more intricate when learners live away from their educational institution and have to engage in a collaborative exercise.

2.2.2 Affective/emotional aspects

> *What has received relatively little attention by instructional technologists and designers is the development of instruction that incorporates affective goals, objectives, and strategies into educational programs and practices* (Martin and Briggs, 1986:11).

The Virtual Campus of the University of Pretoria states that an engaged learner is a motivated learner, and that it is generally agreed that motivation can make more of a difference between success and failure than any other factor (Virtual Campus, 1998a). According to Fleming and Levie (1993), variation, curiosity, relevance, challenge and control are general intrinsic motivational principles. Malone (1981) states that one of the powers of interactive electronic instruction is the capability to engage by providing rapid, compelling interaction and feedback to the learner.

Malone (1981) emphasises the importance of designing instruction using metaphors with which learners are familiar. Malone (1981) identifies four aspects that foster intrinsic motivation, namely:

- Create **challenge**;
- hand **control** over to learners;
- encourage **curiosity**; and
- meet the **fantasy** needs of individuals.

Web-based technologies should also be designed with creativity embedded, adhering to the Keller ARCS motivational model (Keller and Kopp, 1987), which strives to:

- Gain the **attention** of learners;
- demonstrate **relevance**;
- instil **confidence**; and
- provide **satisfaction**.

Emotional responses are not all positive, however. The combination of technologies designed to motivate learners, and the way humans communicate on the Internet, can result in certain emotional responses which may not be expressed in traditional face-to-face contact. Holland (1996) mentions that "talking on the Internet, people regress …. people regress, expressing love and aggression to a degree that they never would face-to-face". Holland (1996) states that there are three symptoms of this regression, namely:

- Flaming;
- sexual harassment; and
- generosity.

The first and most common symptom is flaming. King (1995) states that flame wars often erupt among strangers, that is, newcomers to Internet discussion groups, and new members of a particular group are often the source of, or the target of, inflammatory messages. He states that people who have never seen or heard each other take the anonymity of cyberspace as an excuse to be rude in ways that one does not see in real life. They are more blunt and uninhibited than they would be in traditional face-to-face contact (King, 1995).

A second symptom of regression on the Internet is sexual harassment. This occurs when crude invitations are made to people about whom one knows no more than their online signature (these may well be "gender-benders" that hide the sex of the speaker).

The third symptom of regression, which may not necessarily be considered a regression at all – is the extraordinary generosity one sees on the Internet. Features of online communication are openness, a sense of sharing and mostly tolerance. Total strangers may devote extensive time to helping one by, for example, sharing information.

2.2.3 Communicative aspects

In web-based courses, as in any learning environment, instructional interactions include "interactions that take place between learners and the content they are trying to master" (Moore, in: Wagner, 1997:21). Instructional strategies used to sequence the delivery of course content as well as the strategies used to present content are communication tools that determine the manner in which the learner interacts with the content. The pedagogical/andragogical design "communicates" information that shapes learners' experiences, including expectations about the purpose of learning, depth of reflection and understanding, level of participation, degree of learner control and perceptions of the instructor's role (Miller and Miller, 1999).

Therefore, communication in web-based instruction involves more than just interactions between the instructor and learners via communication methods such as e-mail and conferencing. Furthermore, Miller and Miller (1999) believe that communication occurs through instructional design features that shape the learner's interaction with content. This definition of web-based communication (learner-content interaction) highlights the connection between pedagogy and communication.

Web-based instruction provides two categories of interactivity: instructional/content interactivity and social interactivity (Liaw and Huang, 2000). These categories are elaborated upon in Table 2.5, and discussed in more detail in Sections 2.2.3.1 and 2.2.3.2.

Table 2.5 Content and social interactivity

Type of interactivity	Description
Instructional/ content interactivity	▪ Content interactivity may be stimulated through immediate feedback, questioning, control of pacing, sequencing, and other interactive controls. ▪ Allows individuals to explore abundant and diverse bits of information in their own ways. ▪ Non-linear content interaction leads learners to reflect more on their own knowledge construction. In this way, content interactivity approaches the constructivist epistemology.
Social interactivity	▪ Social interactivity can be provided by e-mail, voice mail discussion lists, newsgroups, chat rooms, bulletin boards, online conferences, or any other two-way communication media that are integrated into web-based instruction. ▪ Provides enormous potential for social and interpersonal interaction. ▪ Learners and instructors or learners and learners can engage in side-by-side and online questioning, answering, discussion, debate, or negotiation without face-to-face communication. ▪ Tends to have elements of mutuality, flexibility, and bi-directionality that are not as frequently found in purely instructional interaction. ▪ Social and interpersonal interaction are able to directly foster content and instructional interaction.

(summarised from Liaw and Huang, 2000)

From the above it is evident that interactivity in instruction takes on a complex meaning. To sum up, good instruction refers to thoughtful interface design and sufficient feedback, as well as active learning, in which the learner acts on the information to transform it into new, personal meaning. In a constructivist sense, the learner co-constructs meaning by exploring an environment, solving a problem, or applying information to a new situation that he/she helps to define (Campbell, 1999).

2.2.3.1 Instructional/content interactivity

Based on the literature, this section gives instructional design principles for web-learning. Liaw and Huang (2000) define instructional design as the systematic design of teaching and learning environments. Hannafin and Peck (1988) emphasise instructional design principles based on cognitive learning theory: instructional media should support orientation and recall of prior knowledge; and both intellectual skills and learning strategies should be fostered. Cognitive science relates to the reasoning and thinking processes used by learners as they acquire knowledge and skills. Perception and learning are viewed as reorganisation of the brain's knowledge structures, as learners construct meaning by integrating new with existing knowledge, using mental schemata to facilitate comprehension and to aid recall (Inhelder and Piaget, 1958). It is important to include instructional and cognitive features in learning materials, over and above the actual subject matter, to help learners actively plan their study experience.

It is thus imperative that sound principles of instructional design be applied when developing web-based technologies, and that certain guidelines be adhered to. Course material should be designed on the Web in such a way that it adheres to the principles of instructional design as synthesised by Cronjé (1997), but with contributions from other authors:

- Learners **construct** knowledge based on their experience/s, which they then convert into knowledge and skills (Campbell, 1999). Learning is thus an **active process**.
- Interpretation is **personal**, i.e. learners interpret the same material differently, based on their personal knowledge and experiences (Liaw and Huang, 2000:43).
- Learning is **collaborative**, i.e. it is enhanced by **multiple perspectives**.
- Knowledge is based on **real life** experiences, thus learning should be situated in real life (Myers, 1999:51).
- **Integrated testing** and **continuous assessment** are preferable to formal criterion-based testing.

The type of task, the goal of the instruction, and the characteristics/needs of learners also need to be considered (Myers, 1999). Gagne (1965 in: Anand, 1998) sees learning as a form of information processing that is progressive or sequential and builds upon previous knowledge. His research deals with the foundations of effective instruction and has greatly contributed to the field of instructional technology, especially regarding the design of

instruction. According to Gagne the following steps should be considered when designing instruction:

1. Gaining and maintaining attention of learners.
2. Informing learner of objectives.
3. Reminding learners of prior knowledge.
4. Presenting new material clearly and distinctively.
5. Providing guidance for learning.
6. Eliciting performance.
7. Providing feedback on performance.
8. Assessing performance.
9. Enhancing retention and transfer.

Instructional designers should strive to implement web-based instruction with a high quality of interactivity (Liaw and Huang, 2000). However, in literature there is no single accepted definition of interactivity. Each author describes it in his or her own way. According to Campbell (1999), an interactive program provides varying levels of interactivity, ranging from simple point-and-click interaction through to sophisticated search techniques and the analysis, manipulation and application of information in new and authentic contexts. Gilbert and Moore (1998) define interactivity as two-way communication among two or more people within a learning context, for the purpose of either task/instructional competition or social relationship building.

In this regard, the notions of individualised, adaptive and remedial communication are also implied. These characteristics can all be applied in educational programs/web sites. With regard to web sites, forms/Common Gateway Interface (CGI), Java, Javascript, quicktime virtual reality and Shockwave all provide opportunities for flexible design of educational systems.

Borsook and Higginbotham-Wheat (1991) and Cronjé (1996) identify a series of interactivity components which make computer technology interactive, and benefit the learner. These components include:

- Immediacy of response;
- non-sequential access of information;
- adaptability;
- feedback;
- options (that the receiver of instruction is able to select);
- bi-directional communication; and
- grain-size (this refers to the length of a presentation sequence before input is required - the larger the grain size, the lower the interactivity).

However, there are further elements relevant to the success of interactivity, namely:

- The extent to which design has been applied to the application;
- the embodiment of instructional features that promote active learning; and
- engagement and control.

These three elements are discussed in turn.

(a) The extent to which design has been applied to the application

Jonassen (1985:7) believes that only through rigorous instructional design will interactions be effective. He emphasises that "interactivity enables learners to adjust the instruction to conform to their needs and capabilities ... the learner becomes an active participant, rather than passive observer, making significant decisions and encountering their consequences".

(b) Embodiment of instructional features that promote active learning

According to Fenrich (1997 in: Sims, 1998) interaction implies active learner participation in the learning process, and failure to build interactivity into programs reduces learning and retention. Examples of conditions that highlight the nature of interacting with technology are: questions that require thinking, active participation in a simulation or an educational game, providing feedback, building on current knowledge and experience, learner control of pace and sequence, learners' comments and annotations, and learner modifications to the computer program.

This approach is further extended by the possibility for interactive applications to include a risk factor: "can the user lose something or have something unpleasant happen to them? When there is no risk of consequences for the learner ... the mind runs idle" (Allen in: Sims, 1998).

(c) Engagement and control

Engagement refers to the extent to which the learner works with the content, while control involves determining the options available for accessing and navigating through the content structure (Sims, 1998). Csikszentmihalyi's (1990) Flow Theory of Optimal Experience is based on learners becoming very engaged and absorbed by certain activities, and is defined as:

> *…. the state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will do it even at great cost, for the sheer sake of doing it* (Csikszentmihalyi, 1990).

This motivating "flow" can be achieved if web-based technologies are designed in such a way that they are goal-oriented, grab the attention of learners, offer challenges and hand control over to learners (Clarke, 1998).

2.2.3.2 Social interactivity

Communicative interaction between individuals lies at the heart of most approaches to teaching in educational settings (Hewson and Hughes, 1998). It has been discovered that both the "constructivist approach to the design of learning and research on learners approaches to learning, emphasise that active engagement with content and opportunities to interact with teachers and peers are essential elements for deep learning" (Hewson and Hughes, 1998:329).

One way to foster collaborative learning is to use Computer-Mediated Communication (CMC). This section defines CMC, and gives its benefits and limitations for learning.

(a) What CMC is

Wolz (1997 in: Edwards and Clear, 2001) defines CMC as "any form of interpersonal communication that uses some form of computer technology to transmit, store, annotate, or present information created by one or more participants". He states that CMC can help to achieve fundamental educational objectives such as:

- Focus on active learning;
- place the responsibility for learning with learners; and
- encourage peer review and teamwork.

(b) Benefits of CMC for learning

When learners have opportunities to interact with other learners and instructors, this facilitates knowledge building and promotes knowledge sharing (Liaw and Huang, 2000). Much of learning inevitably takes place within a social context, and the process includes the mutual construction of understanding (Bruner, 1971). Group communication offers the opportunity for learners to:

- Gain the motivational support of fellow learners and instructors;
- develop critical judgement, and participate in problem-solving; and
- often has the potential for other incidental learning.

CMC holds considerable benefits for adult learners . Further benefits are shown in Table 2.6, according to Lewis *et al* (1995); Hiltz and Wellman (1997); Chism (1998); and Karayan and Crowe (1997).

Table 2.6 Benefits of CMC for learning

Category	Benefit
Communication	▪ Learners are given the opportunity to refine their communication skills, and think critically and creatively. ▪ CMC enhances the exchange of academic discourse and is a good sounding board for ideas and excellent for networking purposes.
Sense of anonymity	▪ Learners share larger quantities of information than in a traditional classroom, due to the sense of anonymity that prevails.
Greater flexibility	▪ Independent of time ▪ Learners' disabilities, such as an inability to hear, see or move – need not be a limitation in electronic communication.

Access	▪ Learners from impoverished backgrounds can be given access to rich learning environments and form part of stimulating communities of learners via low-cost Internet and web tools.

Owing to the success of discussion lists, real time chat and bulletin boards, it is evident that users feel a need to interact and share thoughts (Dieberger and Hook, 1999). Dieberger and Hook (1999) believe that learners enjoy social interaction on the Web and therefore in the near future it is likely that many more socially enabled systems will appear on the Web.

(c) Limitations of CMC for learning

However, despite the efficiency of Internet resources such as discussion lists, real time chat and bulletin boards to deliver messages, the delivery of messages, in itself, is not sufficient to ensure learning (Hewson and Hughes, 1998). Hiltz and Wellman (1997) report certain limitations of CMC with regard to web-based classrooms. These limitations are given in Table 2.7.

Table 2.7 Limitations of CMC for learning

Category	Limitation
Social-emotional	▪ Limited by lack of visual and social cues and presence. ▪ Good for communicating information, opinion and suggestions, but less suited to communicating agreement or disagreement. ▪ Normless behaviour can result unless there is a clear identification and monitoring of acceptable rules and conventions.
Procrastination	The flexibility of asynchronity may result in procrastination when learners are too busy to log on regularly, which can result in falling behind with regard to deadlines.
Non-participation	Some learners may take on the role of a "lurker", simply observing, learning from the others, but not giving their own input.
Management	Large groups with high levels of interactivity can trigger information overload unless communication tools provide adequate management of information.
Access	It may be argued that CMC in the 21ST century will benefit mainly the technological "haves" rather than the "have-nots". That is, opportunities for the world's population are, and are likely to remain severely limited for some time (Lewis *et al*, 1995).

(summarised from Hiltz and Wellman, 1997)

Due to CMC being limited by a lack of visual and social cues and presence, many of the linguistic and extra-linguistic features of face-to-face communication are removed (Hewson and Hughes, 1998). For this reason, it is the researcher's opinion that, in general, web-based classrooms should not replace face-to-face communication but function as a "web support", so that the end result is indeed a flexible learning system. However, where geographical

barriers cannot be overcome, or where it is an instructor's specific objective that a course runs in this way, exceptions should be made.

2.2.4 Technological aspects

In this section technological aspects relating to the following are discussed:

- Benefits and limitations of web-based material;
- types of CMC; and
- technological benefits and limitations of CMC.

2.2.4.1 Benefits and limitations of web-based material

Table 2.8 presents the technological benefits and limitations associated with web-based material.

Table 2.8 Benefits and limitations of web-based material

Benefits	Limitations
▪ The *cross-platform distribution* of the Web means that 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; Starr, 1997).	▪ Every web browser *interprets HTML tags a little differently*. Developers should test the implementation of these features in different web browsers (Lynch and Horton, 1997).
▪ *Hypertext* on the Web facilitates the linking of information within documents. Links to information external to the document can also be incorporated, to extend the depth and breadth of information.	▪ Searching and browsing through hypertext is often *overwhelming* (Cronjé, 1997).
▪ Graphical browsers render possible the *delivery of multimedia* on the Web. Audio, video, and animation can be delivered to many users with a once off cost and no decline in quality with repeated use (Starr, 1997).	▪ *Limited bandwidth* slows the access time of multimedia products (Wulf, 1996).
▪ The Web provides easy access and fast, convenient delivery of material across distances. ▪ *True interactivity* goes beyond static web pages and page linking, and creates interactive pages with information exchange between the user and the server (Starr, 1997).	▪ Web servers may not be robust enough to handle heavy traffic. ▪ Not everyone has *access to the Web* (Cronjé, 1997). Dellit (in Bundy, 2000) holds the viewpoint that "the dominant paradigm of the Web is the marketplace and … capitalism thrives on inequality". The Web is therefore by definition a vehicle of inequality. ▪ Access problems can occur due to unstable technology. For example, networks can be unstable.

The infrastructure of an organisation must be considered when making a decision to use web-based instruction (WBI). WBI may not be a viable option in the case of limited

bandwidth, access problems, web servers that are not robust enough to handle heavy traffic, or if problems cannot be resolved quickly.

Before implementing WBI, it is essential that the following should be in place:

- A support infrastructure to help instructors get their material online;
- appropriate technical support to ensure that technology failures do not impact adversely on the success of the class; and
- appropriate hardware and software support for instructors to work with the online environment.

2.2.4.2 Types of CMC

CMC technology allows numerous learners to communicate at a distance, and can be used either synchronously or asynchronously. The former facilitates real-time communication, while the latter relates to the transmission and receiving of messages at different times, i.e. a time gap exists between messages sent and responses received. Asynchronous communication is normally text-based and includes e-mail, discussion lists, and bulletin boards. Synchronous technology includes text-based real-time chat, and audio and video conferencing. Learners can communicate simultaneously using these technologies, but only a small number can effectively converse at one time. Otherwise discussions become confusing and fragmented (Edwards and Clear, 2001).

However, this study focuses on asynchronous web-based technologies. Table 2.9 gives the main technologies incorporated in asynchronous communication with their descriptions, as given by Clarke (1998).

Table 2.9 Technologies incorporated in asynchronous communication (adapted from Clarke, 1998)

CMC Technology	Description
E-mail	For one-to-one text message communication and attaching files for use in other application software.
Discussion list	Uses list-processing software and distributes e-mail to all subscribed users on a list. A moderator is optional. Useful for one-to-many communication.
Bulletin board	For posting comments and accessing information and databases.
Newsgroups	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.

Chism (1998) and Cronjé (1997) recommend linking CMC to events that occur in a web-based classroom. Of the various CMC technologies, discussion lists and bulletin boards have been the most widely used in tertiary education (Holden and Wellman, 1993). The purpose of a discussion list/bulletin board is to establish online communities that have common goals and interests, and also to serve as a forum where learners can offer each other support, encouragement, feedback and new ideas.

Nagel (1994) has discovered that every discussion list/bulletin board goes through the same cycle, beginning with a few initial postings, going on to achieve major growth, and ending in stagnation. Learners who subscribe to a discussion list receive all messages in the order they are posted, and electronic conversation therefore tends to be random and disjointed. A bulletin board, in contrast, allows for a more orderly kind of electronic conversation because learners can choose what topics to read and respond to (Wulf, 1996). Table 2.10 depicts the differences between a discussion list and a bulletin board, both providing useful applications for learning.

Table 2.10 Differences between a discussion list and bulletin board

Discussion list	Bulletin board
Learners typically communicate by sending and receiving e-mail through a traditional e-mail program, e.g. Outlook Express.	Learners communicate by posting comments and questions directly to a server, from where the bulletin board is run.
E-mail comes directly to learners, arriving in their "inbox", i.e. "push" mail.	Learners must go to the host server to read the postings/fetch their messages, i.e. "pull" mail.
Messages are random and disjointed.	Messages are structured in order and can be viewed chronologically or by thread.
Dynamic, in that learners can structure and manage their e-mail program in the way they choose. Unnecessary messages can be deleted.	Static, in that messages remain intact and cannot be deleted.

2.2.4.3 Technological benefits and limitations of CMC

A summary of the technological benefits and limitations of CMC is given in Table 2.11 (Cronjé, 1997; McMahon, 1997; Winiecki, 1999), with guidelines for design. The table refers specifically to three categories, namely: CMC in general, discussion lists/bulletin boards and real time chat.

Table 2.11 Technological benefits and limitations of CMC, and its design implications

Type	Benefits of CMC	Limitations of CMC	Design implications
General	Quick delivery	Possible misinterpretation	Use emoticons
	▪ Reliable delivery ▪ Accurate (digital) transfer	▪ Unstable technology, i.e. - networks can be unstable; and - possible time delays ▪ Lack of non-verbal cues	The remote network and host network must be stable before the course begins.
	Inexpensive	▪ High initial cost ▪ Maintenance, upgrade and training costs	Problems likely to decrease in future as bandwidth and connectivity improve and costs come down.
	Availability	Limited accessibility	Develop information kiosks
	Disputes broaden learners' horizons and develop character and interpersonal skills.	Disputes and disruptions may result in hurt individuals.	▪ Foster an open and interdependent exchange (Winiecki, 1999). ▪ Use "netiquette" guidelines to guide behaviour. ▪ Create a policy for handling disputes and disruptions (McLellan, 1999).
	Competent individuals feel comfortable with the technology	Individuals with inadequate skills battle to use the tools to facilitate learning	Teach technology skills where necessary.
Discussion list/bulletin board	▪ Easy to store, forward, save and sort, in the case of discussion lists ▪ Permanently available in the case of bulletin boards	Can generate co-ordination problems, e.g. information overload. Learners may feel overwhelmed by the quantity of information.	Maintain strict discipline in terms of subject headings and message threading.
Real time chat	Fun way of communicating	Emotionally frustrating for learners who cannot access the chat room or who cannot type quickly.	Plan practice sessions
	Almost immediate	Message overlap	▪ Let learners take turns to communicate. ▪ Plan practice sessions.
	Learners free to be themselves, due to the informal nature of the medium	"Chats" are not necessarily saved permanently.	Summary of chat can be sent on the discussion list/bulletin board, to confirm discussion.

2.3 Distinguishing characteristics of learners of different age groups, and the differences and similarities between these age groups in the context of web-based technologies

In line with Outcomes-Based Education (OBE) – a learner-centred approach – the following should be considered in the development and implementation of web-based technologies:

- Different learning styles and rates of learning (Virtual Campus, 1998a); and
- the importance of the existing knowledge of learners.

Hannafin and Peck (1988:48) assert that "learning may be more efficient when the instruction is adapted to the needs and profiles of individual learners". The characteristics of each group of learners under investigation in this study will now be discussed, examining what the literature suggests regarding each group, i.e. children, undergraduates and postgraduates/adult learners. In Chapter 6, the researcher will assess each group's experience of the web-based technology they used, and how it matched/did not match their characteristics.

The various age groups have been classified into distinct categories, namely: the Millennial Generation, Generation X (Xers), and Baby Boomers, for children, undergraduates and postgraduate learners respectively. Table 2.12 lists the different groups along with their generations.

Table 2.12 Groups of learners and their generations

Group of learners	Generation	Period of birth
Postgraduates	Baby Boomers	Between 1941 and 1960 (Laidlaw, 1998)
Undergraduates	Generation X (Xers)	Between 1961 and 1981 (Lankard, 1995)
Children	Millennial Generation	Since the early 1980s (Zoba, 1997)
Children	Net Generation	Between 1977 and 1997. The Net Generation primarily includes the Millennial Generation, and some of the Xers (those born after 1975) (Miller, 2001).

Xers are the children of the so-called "Baby Boomers". This name was given due to the fact that more babies were born during the years 1941 to 1960 (directly after World War II) than during any previous generation (Laidlaw, 1998). They are the single largest demographic group (Judd, 2000). The sheer size of this group led to increased competition for jobs and made upward mobility difficult. Baby Boomers generally believe that hard work and long

service will yield rewards (Judd, 2000). Xers were the latch-key children in an increasingly dangerous world, during a time when society was becoming more and more atomised (Abood, 1997). Literature states that many of the parents of Xers (the Baby Boomers) are now divorced, both go to work, and were more permissive than parents of previous generations. Consequently, the Baby Boomers developed their attitudes, values, and characteristics as a direct result of having to cope with the world they were living in (Laidlaw, 1998).

Society has attached a negative connotation to Generation X. In the early 1990s, Generation X achieved notoriety as a media label designed to pigeon-hole American youth into the stereotypical image of the disaffected slacker. They were classified as “baby-busters”, “slackers”, “twenty-something”, the “generation without a conscience”, the “lost generation”, the “13th generation”, the “me generation”, but most commonly and most enigmatically as “Generation X” (Slattery, 1996).

On the positive side, they are independent thinkers who make their own decisions - using their own values, norms and standards, instead of conforming to convention. Xers are able to face problems on their own and have confidence in their ability to fend for themselves. They grew up with computers and tend to be highly techno-savvy and entrepreneurial. Xers watched as the Boomers were downsized and overtaken by technology trends and believe that the “corporation as parent” is history (Judd, 2000). They tend to be loyal to the project they are attached to, and are concerned about building their individual skills (Judd, 2000).

The Millennial Generation, like the Xers, are used to facing problems on the own, since both parents work outside the home. The latter has made them dependent on their peers. They reach out to people and have a strong desire to be connected and to collaborate with others (Miller, 2001). The Net Generation have been influenced by intensive Internet usage. They are active and participate, in that they inquire, discuss, argue, play, shop, critique, investigate, ridicule, fantasise, seek and inform (Tapscott, 1999). The Millennial Generation encompasses most of the Net Generation, and hence will be discussed under the Millennial Generation.

2.3.1 Characteristics of children as learners

According to du Plooy (*et al*, 1982) each child needs security and safety. The child looks to the future with expectation and from the beginning tries to discern and capture meaning in the world. A fundamental characteristic of children is also the **need to communicate**, and to step out of themselves to **explore and discover** and to become the somebody they want to be. In this respect the teacher needs to provide every child with a fair chance to explore authentically by bringing the world into the four walls of the classroom (du Plooy *et al*, 1982). The Web has the advantage of doing just this, in that it opens up the world to the child, provides a base from which the child can explore, and also exposes a child to the real world and to virtual learning.

Piaget concluded that intellectual development is the result of the interaction of hereditary and environmental factors (Ginn, 1995). As children develop and interact with the world around them, knowledge is invented and reinvented. Piaget believed that a child's thinking and learning involve the active participation of the learner. He asserted that for a child to know and construct knowledge of the world, the child must act on objects and it is action which provides knowledge of those objects, i.e. the mind organises reality and acts upon it. His approach to learning is a readiness approach, which emphasises that children cannot learn something until maturation gives them certain prerequisites. He espoused active discovery-learning environments in schools, believing that children need to explore, to manipulate, to experiment, to question and to seek answers for themselves. Activity is thus essential for children (Ginn, 1995). Piaget's theory of intellectual development is in line with current thinking and Outcomes-Based Education - a method of teaching where the learner is the most important consideration and learning happens through activities (Pretorius, 2000).

According to Miller (2001), as a result of a society that is constantly undergoing change, young people in the Millennial Generation have taken on the following characteristics:

- Prefer to work with their *peers* or groups than with adults;
- need to *reach* people of their own age;
- need *quick responses* to activities;
- are creative thinkers able to *customise* things to their needs;
- need to *explore and do* things; and
- are *achievement-oriented*.

Judd (2000) describes the Millenial Generation as energetic - needing continual stimulation and challenge. They are comfortable juggling many things at once and will move on quickly if they get bored or dissatisfied (Judd, 2000). Tapscott (1999) comments that these children argue and debate, and are easily vocal on any information they encounter with a click of a mouse. They rely on their own point of view, test it, and alter it if appropriate (Tapscott, 1999). They are the first generation to grow up surrounded by digital media.

2.3.2 Characteristics of undergraduate learners

An undergraduate is usually a post-school youth, late adolescent or early adult who has left the pedagogic didactic environment of his family home and school, to continue his/her studies as a learner in the company of other adults to receive training for a career.

Laidlaw (1998) has compiled a profile of a typical Generation X learner, having four main characteristics, namely: independent and self-reliant, technoliterate, expectation of instant gratification and self-building. A description of these characteristics is given in Table 2.13.

Table 2.13 Characteristics of Generation X

Characteristics	Description
Independent and self-reliant	▪ I like to do things my way, build my own meaning. ▪ Give me the information, skills and tools, and let me get on with it. ▪ Tell my why I need to learn something and what I will get out of it. ▪ I need to know how I am doing.
Technoliterate	▪ I am not afraid of technology. ▪ I can cope with multiple sources of information at once. ▪ Visuals appeal to me more than text. ▪ I have five senses, and like to use them all.
Expectation of instant gratification	▪ I need to be involved, to do it myself. ▪ Give it to me straight and to the point. ▪ If something does not interest me I will move on. ▪ I am used to being entertained.
Self-building	▪ I know I need to build my own security by constantly learning new skills. ▪ Things are constantly changing so I need to keep abreast. ▪ I can take responsibility for my own learning process. ▪ I believe breadth of experience is just as important as depth.

(summarised from Laidlaw, 1998)

A further characteristic of Generation X is that they are able to work co-operatively with other young people (Brown, 1997). They are therefore more comfortable with the "collaborative approach" (Haskell, 1996). Problem-solving is a social activity and consequently this form of learning is social activity (Miller, 2001).

Miller (2001) characterises Generation X as independent problem-solvers, self-starters, responsive, focused, ambitious, fearless and technologically literate.

2.3.3 Characteristics of postgraduate learners

Cronjé (*et al*, 2000a) analysed Ference and Vockell's (1994:25) list of adult learning needs and set them out in table format, provided as Table 2.14.

Table 2.14 Characteristics of adult learners (Cronjé, 2000a)

Characteristics	Description
Active learner	Willing to participate in the learning process. Given the opportunity and the proper incentives, they often prefer to be active rather than passive learners.
Experience based	Bring a wide variety of prior educational and life experiences to a new learning situation.
Expert	More self-reliant. Adult learners operating as independent individuals tend to want to accomplish things for themselves. Inclined to draw and rely on their own personal experience and knowledge to seek answers to questions and to solve problems.
Hands-on	Faced with important matters in everyday life. As a result, the adult learner tends to focus attention on real-world situations.
Task-centred	More active in performing tasks directed toward reaching a goal or solving a problem.
Problem-Centred	Focus on dealing with problems they encounter in their particular life situation.
Solution-driven	Operate in the real world, focus on real-life problems and often actively seek out solutions to their problems.
Value-driven	*Need to know* why they should learn something before undertaking to learn it. Given the rationale for learning something, they will often invest considerable energy in investigating the increased benefits gained from the learning experience and the consequences of not learning it.
Skill-seeking	Actively seek out the attainment of new and improved skills in order to better meet and solve real-life problems.
Self-directing	Perceive themselves to be independent and responsible for their own actions and have a need to be directly involved in planning and directing their learning activities.
Motivation (External)	Often externally motivated by such factors as better jobs, increased promotional opportunities and higher salaries.
Motivation (Internal)	Often internally motivated by such factors as self-esteem, recognition, confidence, career satisfaction and the overall quality of life.

(a) Similarities between the groups

From examining the characteristics of each group of learners, it appears that children and undergraduates also take on some of the typical characteristics of adult learners.
These three groups of learners hold certain common characteristics. They are:

- Active learners;
- self-directed;
- skill-seeking;
- need guidance; and
- internally or externally motivated.

Taking the characteristics of Generation X as described by Laidlaw (1998), it would seem that Generation X (undergraduate learners), and Baby Boomers (postgraduate learners) also share some characteristics, namely, they are:

- Hands-on;
- task-centred;
- value-driven;
- skill-seeking; and
- internally or externally motivated.

(b) Differences between the groups

The term "andragogy" is used to distinguish the teaching and learning of adults (including undergraduates) from "pedagogy", the teaching and learning of children (Noren, 1997). Hence, in literature the descriptor "andragogic" is used to refer to adults, and "pedagogic" to refer to children.

Andragogy became an integral part of the language of adult education through the efforts of Malcolm Knowles. Knowles felt that the learning of adults is so different to the learning of children that it required its own descriptor (Noren, 1997). Andragogy embraces a number of concepts, including several mentioned in Table 2.14:

- Adults want to know why they need to learn something before they begin learning it.
- Adults see themselves as self-sufficient and responsible for their own learning.
- Adults have a wealth of experiences which they bring to the learning environment.
- Adults are ready to learn when they have a need to learn.

- Adults are problem-centred in their learning.
- Adults' motivation for learning comes from more internal than external factors (Knowles, 1989).

Andragogy provides designers and lecturers/teachers with a framework from which to approach their work. The differences between the three groups of learners, taking into account the concepts embracing andragogy, are given in Table 2.15.

Table 2.15 Differences between the different groups of learners

Category	Children	Undergraduates	Postgraduates
Background	▪ Come to school with limited experience. ▪ Get taught basic learning content (Fraser *et al*, 1993). ▪ Eager to learn ▪ Eager for the experience of new things and large dimensions (Hajre-Chapman, 2001)	▪ Build further experience from past learning. ▪ Get taught specialised learning content (Fraser *et al*, 1993).	▪ Get taught specialised learning content. ▪ Have a wealth of experiences which they bring to the learning environment. ▪ Concerned with integrating new knowledge and skills into previously acquired knowledge and skills (Noren, 1997).
View on learning	▪ Perspective on learning is long term, i.e. what they are learning now may not be used for a long time (Noren, 1997).	▪ Training for a career ▪ Task-centred, i.e. want to know the task/project they must do and when it must be completed by.	▪ Expect to put what they are learning into practice soon if not immediately, i.e. they are goal-oriented (Noren, 1997).
Motivation	▪ Motivation for learning is external. They go to school because they have to (Noren, 1997).	▪ Motivation for learning can be both internal and external.	▪ Motivation for learning is usually internal, but can also be external. ▪ Participate in educational programs because they want to (Noren, 1997).
Technology	▪ Well accustomed to technology	▪ Well accustomed to technology	▪ Often not well accustomed to technology

Of particular interest in Table 2.15 is learners' view on learning. While children are eager to learn new things, undergraduates and postgraduates seem to be more concerned about the value particular tasks hold, and postgraduates are especially concerned about applying what they have learnt to their life situation.

2.4 Learning possibilities for children, undergraduates and postgraduates in the context of web-based technologies

The Web provides a process that facilitates learning and a metaphor that might help to re-think learning as a more active and engaging process. The engagement of learners in learning and the consequent development of learning as a life-long commitment must be a key objective for the future (Kennedy, 1999).

The Web holds the following advantages as given by Kennedy (1999):

- It is open, accessible and full of potential.
- It facilitates access to information retrieval but leaves individuals free to decide what is important.
- It facilitates communication across national and cultural barriers.
- It provides the conditions under which learning can take place, but does not construct learning in any particular way.

Kennedy (1999) asserts that these advantages need to be the characteristics of pedagogy/andragogy in the new century if learners are to be engaged in learning, and if they are to become committed to lifelong learning.

2.4.1 Children

Kennedy (1999) believes that the Web can and will play a central role as a learning tool in the future, as young people adapt to it easily and schools may be the only social sites where equal access can be guaranteed. Possibilities of web-learning for children include the following:

- Children can search for information, rather than simply look at it. This forces them to develop **thinking and investigative skills**, as they have to become the critics and judge whether resources on the Web are of good quality or not (Tapscott, 1999).
- Interactions can be facilitated by using small discussion groups. Classes could go offline for brief discussions of particular issues and then go online to discuss their findings with a larger group (Flottemesch, 2000).
- Children can communicate with one another and argue and debate issues (Ginn, 1995). This forces them to exercise not only their **critical thinking**, but also their **judgement**. In this regard, they are likely to become a generation of critical thinkers, because they have the tools to question, challenge and disagree at their disposal. According to Tapscott (1999), this results in Millennial Generation children questioning the implicit value contained in information.
- Children can use the Web not only to learn, but to **learn practical skills**, by constructing learning products with an HTML editor, and to engage in peer teaching as they construct their projects with other children. In this way children communicate their understanding of the subject to those around them. They also become **active participants** instead of passive "sponges", and the teacher takes on the role of facilitator as he/she guides them in their creations (Ginn, 1995).
- Children can learn the **social skills** required for effective interaction in the knowledge-based society, as they experience electronic peer relationships, teamwork, criticism, fun online, friendships across geographical boundaries and communicate their ideas (Tapscott, 1999).

Web-based technologies correspond well to Piagetian thought (see section 2.3.1), which postulates that a child's thinking and learning involve the active participation of the learner. It is the teacher's role to assess the child's current cognitive levels, and his/her strengths and weaknesses. Piaget saw teachers as facilitators of knowledge – whose role was to guide and stimulate the children. Teachers can do the latter by presenting children with web-based

technologies that are appropriate for various situations and occasions in which they can discover new learning (Ginn, 1995).

2.4.2 Undergraduates and postgraduates

A wide range of technological options are currently available for undergraduate and postgraduate learners (Huang, 2000). The possibilities of web-based technologies are similar for both groups, hence their joint discussion. Table 2.16 presents commonly used technologies that both can use in web-based instruction. The term "learner" is used in this section to refer to undergraduate and postgraduate learners.

Table 2.16 Web-based technologies and their application for undergraduates and postgraduates

Web-based technologies	Application
E-mail	▪ E-mail can be used for learners and instructors to work one-on-one. ▪ It can facilitate learning activities by gaining feedback from the instructor or other learners. ▪ Learners can also communicate via voice, rather than the text form of e-mail.
Online discussion groups: ▪ Discussion lists ▪ Newsgroups ▪ Bulletin board ▪ Real time chat	▪ Learners can interact widely with other members of a learning community about topics that interest them and can simultaneously be in control of their own learning. ▪ Online discussion groups incorporate discussion lists, newsgroups and bulletin boards.
	▪ Instructors can use a **discussion list** to establish an online community that has common goals and interests, and serve as a means where learners can offer each other support, encouragement, feedback and new ideas. ▪ The learner can construct personal meaning by engaging in dialogue and reflection.
	▪ **Newsgroups** can be used when active participation of learners is required. ▪ Newsgroups are similar to discussion lists, but are kept in the conference, and not sent to individual user addresses.
	▪ Learners and instructors can use **bulletin boards** for posting comments and accessing information and databases.
	▪ **Real time chat** can be used when learners and instructors wish to discuss something, or make a joint decision. ▪ It can be used to establish a sense of immediacy.
Online resources	▪ Learners can use an online search to conduct research or collect relevant information to assist their learning.
CD-ROM	▪ Instructors can place Web-based material on a CD-ROM and distribute it to learners. ▪ Learners do not have to dial-up to a service provider.
Web-based CMSs	▪ Web-based CMSs can be used to support enriched interactive educational communication on the Web, and offer enhanced support to teachers and learners.
Asynchronous communication	▪ Learners can access the discussion at different times from each other via discussion lists, bulletin boards, or newsgroups. ▪ Learners have more time to reflect on their own ideas and can think critically, seeing that they control the pacing of instruction. ▪ Learners have the opportunity to refine their communication skills, including "process" skills such as communication, critical thinking and creative thinking.
Synchronous communication	▪ Learners can interact with each other at the same time, without having to be in the same place. ▪ Synchronous communication plays the role of a thinking device for the collaborative construction of knowledge and enhances learners' higher-order thinking skills and creative abilities.
World Wide Web (Web)	▪ Learners can use the Web to decide on their own route of inquiry, and work at their own pace. ▪ Learners can search actively and freely to solve problems or to construct their own knowledge.
Web sites	▪ Lecturers can use web sites to display course material. ▪ Learners can present data and findings on their own web page.

(summarised from Huang, 2000)

2.4.3 Learner characteristics and design implications

Table 2.17 summarises the most prevalent characteristics of each group of learners, with design implications based on their characteristics. The table is categorised according to the various aspects considered in this study.

Table 2.17 Characteristics of children, undergraduates and postgraduates and design implications

Aspect	Group of learners	Characteristics/needs	Design implication based on learners' characteristics
Pedagogical	Children	▪ Able to customise things to their needs. ▪ Need physical activity during the learning process.	Must do things, that is, be actively involved in the learning process.
	Undergraduates	Like to do things their own way, and build their own meaning	Need to find/create their own learning content.
	Postgraduates	Independent	Need to find/create their own learning content, surrounding a particular life situation they encounter.
Affective/ emotional	Children	Motivated when using technology	Need material in visual format, with a high level of interactivity.
	Undergraduates	Need content matter which has relevance for a career.	Learning material must hold long-term career value.
	Postgraduates	Work under pressure; have no time to waste.	Need rapid access to learning material, resources and utilities.
Communicative	Children	Peers interact, communicate and support one another.	Divide learners in groups from where they can interact, communicate and support one another.
	Undergraduates		
	Postgraduates	Active learners, problem-centred and solution-driven	
Technological	Children	Need *quick responses* to activities.	Build high level of interactivity.
	Undergraduates	Not afraid of technology, and can cope with multiple sources of information at once.	Allow learners to share their experiences of technology.
	Postgraduates	Technophobia prevalent	Provide support for learners, should any technological difficulties arise.

2.5 Web-learning possibilities for contact teaching and distance learning

In this section the web-learning possibilities for both contact teaching and distance learning are discussed.

Traditional contact teaching can benefit from levels one, two, and three of Harmon and Jones's levels of web use, while distance learning requires the interactivity found in levels four and five (Harmon and Jones, 1999) - see Table 2.1.

2.5.1 Contact teaching

Children and learners need a variety of instructional methods in order to learn. Web-based technologies are one such method that can be used as an extension for learning. Marsh (2000a) suggests assigning part of the instruction to the Web and computer-based lessons, thus enabling learners to engage in more interactive instruction. Ginn (1995) suggests that web sites for real learning, not just drill and recitation be developed, so that learners are able to move back and forth between programs, the Internet and more traditional learning resources. Such work can be done independently, creatively and at the learners' own pace (Kennedy, 1999).

It is Nilakanta's (2001) view that one can no longer only teach the "traditional" way – the advent of technology in schools has brought this into sharper focus. The learner is no longer dependent solely on the teacher for information since he/she can get it with the help of technology. Learners therefore require guidance to develop the skills (cognitive and metacognitive) that will help them gather, analyse, synthesize and share knowledge.

Caudron (1997:22) suggests that learning experiences should be "meaningful, memorable, and fun", especially for the Millenial Generation, who are energetic, and need continual stimulation and challenge (Judd, 2000), and for Generation X who are used to being entertained, and who want to know why they must learn something before taking the time to learn it (Caudron, 1997). Caudron (1997) urges educators to "as much as possible use all the senses, role play, and simulation learning … don't expect Xers to perform without practice". He also recommends capturing learners' attention by focusing on the outcomes more than the

techniques, on what they are going to be able to do, not what they need to know. Abood (1997) agrees with the latter, stating the need to focus on tangible end-results, not processes.

2.5.2 Distance learning

The purpose of distance learning is to serve learners who are not likely to attend traditional classroom instruction because they are either time-bound due to work or travel schedules, or location-bound due to geographic or family responsibilities (Galusha, 1997; Edwards and Clear, 2001). They therefore enrol in distance learning courses for their convenience.

Porter and Lane (2000) define distance learning as a process that connects learners with remote resources. It provides educational access to learners not enrolled in educational institutions and can augment the learning opportunities of current learners. It offers unique learning benefits to learners not otherwise served. The implementation of distance learning is a process that uses available resources and will evolve to incorporate emerging technologies (Porter and Lane, 2000), such as various discussion software. These tools are being used to enhance communication and overcome the isolation of distance (Flottemesch, 2000). According to Flottemesch (2000), simply having the ability to access information is inadequate: "information must be shared, critically analysed, and applied in order to become knowledge" (Garrison, 1990). According to Kruh and Murphy (1990, in: Flottemesch, 2000):

> *Quality distance education is dependent upon the interaction and participation of the learner, similarly as in traditional face-to-face instruction. It is essential that the distance educator purposefully designs this ingredient into the instructional program.*

Flottemesch (2000) gives general strategies which can be implemented at the beginning, during and at the end of the distance learning course, to improve interactivity between learners.

Beginning of the course: Initially, interaction can be fostered by having learners introduce themselves to other class members at other sites, and learn their names and their particular interests in the course. The instructor could encourage learners to use the discussion software available, and set times when they will reply to learners' correspondence.

During the course: In order for learners to feel an integral part of the classroom, techniques for improving learner-learner interaction should be in place. These techniques could include:

- Instructing learners to provide information across distances in relatively short exchanges. This can add greater attention to what is being communicated.
- Incorporating group presentations into course assignments and/or projects. Group projects require learners to interact with their peers/group members. This reduces the social isolation associated with the use of technology.
- Asking learners questions to promote interaction. Questions should be open-ended, challenging and interpretational in order to maximise learner interaction.
- Facilitating interactions with CMC.

After the course: Learners could assess how they have worked with others.

In a discussion on Adult Education on ITFORUM (a discussion list for Instructional Technologists), Marsh (2000a) comments that he had more communication/contact with his learners than he would have in traditional instruction. Clarke (1999) makes the same claim, stating that "web-based, computer-mediated communication methodology has value as a distance learning tool because it CAN facilitate more person to person interaction and collaboration than correspondence courses and more than in some face-to-face courses". She also asserts that in her experience, a fully online course provided the opportunity for regular and supportive, collaborative interaction with peers and the instructor.

A challenge for those designing web-based instruction or using it, is to consider seriously which presentation method will best enhance the information and work to facilitate interactivity among learners and academic staff (Liaw and Huang, 2000). Misuse of interactivity, synchronity and technology can lead to loss of the learner's attention, boredom, information overload and frustration (Berge, 1999).

2.6 Summary

The review of current literature in this chapter indicated the roles different aspects play in web-based technologies. The character traits of each age group were discussed, and their differences and similarities given. An application of where web-learning can be used for each age group was given, as well as the possibilities for web-based learning in contact teaching and distance learning.

Teachers can use web sites as a supplement to traditional contact teaching, in addition to certain communication tools, e.g. e-mail, bulletin boards, etc. CMC can play a major role in meeting the needs of undergraduates and postgraduates (adult learners), as it can facilitate a high level of collaboration and interactivity between learners, as well as between learners and their instructor/teacher.

This chapter has given a review of literature relevant to the research questions and has served the purpose of contextualising the research. In the following three chapters the case studies are discussed, the first being the evaluation of an educational mathematics web site, followed by an investigation of a web-based CMS, and finally, a report on a web-based classroom.