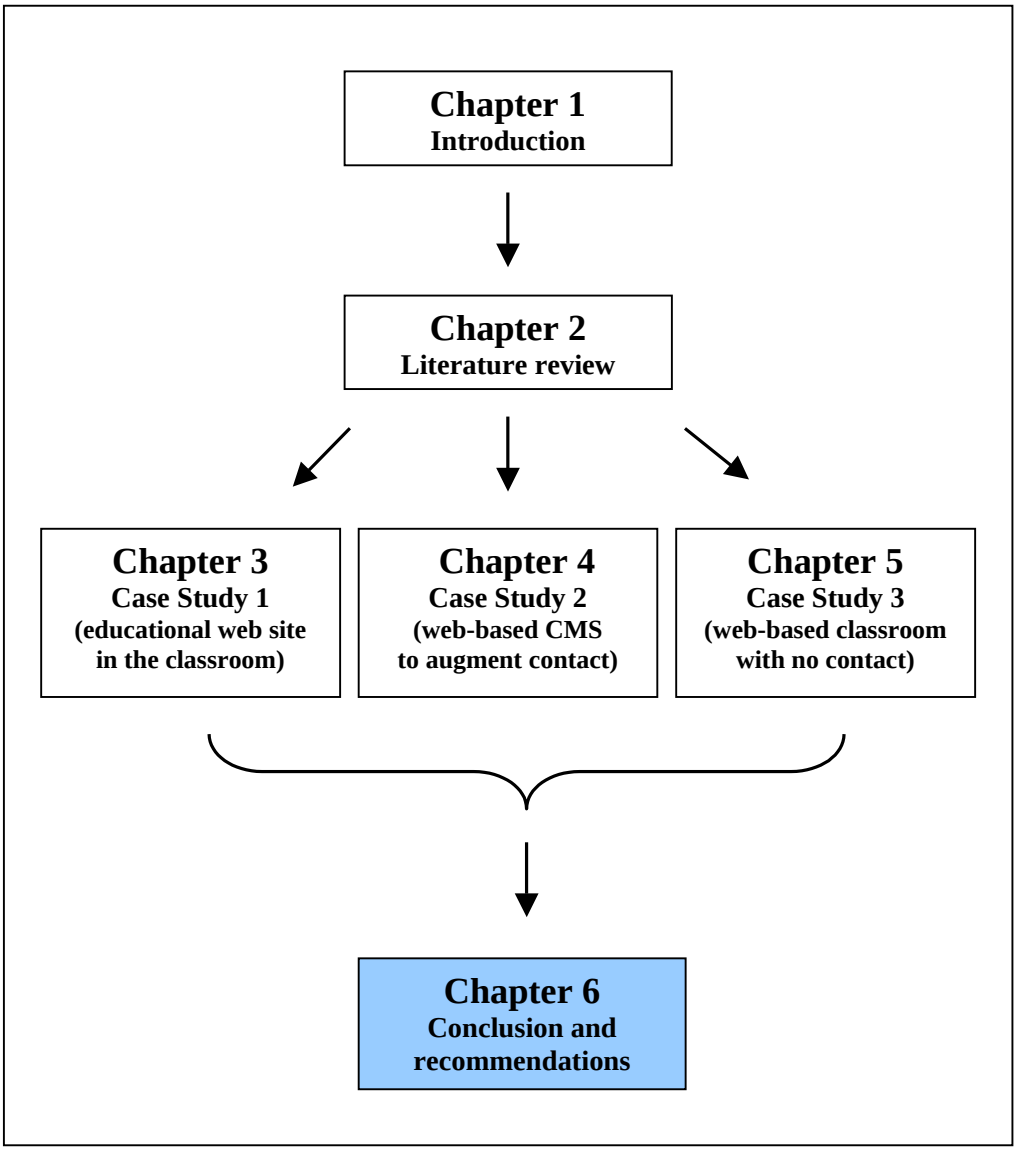
Chapter 6

Conclusions and recommendations



6.1 Introduction

In Chapter 1, Section 1.2, the problem was identified that numerous web-based technologies are currently available, yet there is no systematised structure stating which should be used for whom and how they should be used. This chapter seeks to provide such a structure and to obtain the best possible match between the characteristics of learners, web-based technologies, and teaching methods employed (i.e. contact and distance).

Chapters 3, 4 and 5 answer the subquestions relating to the three case studies. These questions covered aspects regarding the effectiveness of certain pedagogical/andragogical, affective/emotional, communicative and technological aspects. The goal of this chapter is to merge the results into one coherent whole, in an attempt to answer the major research questions (see Chapter 1, Table 1.1), conclude the study and propose recommendations for the way forward.

The chapter commences by answering each research question in turn.

6.2 What role do the aspects under investigation play in web-based technologies?

The researcher set out to answer the major research questions and assess whether or not there was a difference in the response of the different types of learners to the various aspects under investigation, namely:

- Pedagogical/andragogical;
- affective/emotional;
- communicative; and
- technological.

This section presents the findings of the research and is subdivided according to the different aspects of web-based technologies. Table 6.1 presents the target population used in each case study.

Table 6.1 Target population of learners in each case study

Case study	Target population	Generation
Case Study 1	Urban school and rural school	Millenial Generation
Case Study 2	Undergraduate Multimedia learners and postgraduate Engineering learners.	Generation X (undergraduates) and Baby Boomers (postgraduates)
Case Study 3	Formal learners and informal learners	Baby Boomers

Table 6.2 gives the principles derived from the results of the case studies in Chapters 3, 4 and 5. The principles have been placed under the different aspects under investigation in the study. The final column indicates the group of learners amongst whom the principle was found.

Table 6.2 Principles derived from the case studies

Aspect	Principle		Group
Pedagogical/ andragogical	*Children's responses to a site differ slightly, depending on their maturity level, computer and Internet skills, home language and prior knowledge.*		▪ Urban school and rural school
	Postgraduate learners take more responsibility for their learning and are more mature.		▪ Formal learners and informal learners ▪ Engineering learners
	Feedback is important to learners.		▪ All three groups of learners
	Collaborative learning can be effectively stimulated on the Internet, with no face-to-face interaction and contact time.		▪ Engineering learners ▪ Formal learners and informal learners
Affective/ emotional	Motivation	*A creative environment motivates learners.*	▪ Formal learners and informal learners
	Satisfaction	*The ways in which learners react to web-based material depends upon their background and expertise.*	▪ Urban school and rural school ▪ Multimedia learners and Engineering learners
	Frustration	*The more sophisticated and technologically advanced learners are, the more critical they become.*	▪ Urban school and rural school ▪ Multimedia learners and Engineering learners
	Conflict	*Conflict that is well managed can produce beneficial results.*	▪ Formal learners and informal learners
Communicative	Instructional/ content interactivity	*Children experience difficulty grasping all the aspects of a system that is not in their mother tongue.*	▪ Rural school
		"Techno-savvy" individuals expect sophisticated interfaces.	▪ All three groups of learners
	Social interactivity	*Undergraduate learners are reserved when it comes to communicating on a bulletin board.*	▪ Multimedia learners
		WebCT courses and fully online courses can provide the opportunity for regular, collaborative interaction with learners and the instructor.	▪ Formal learners and informal learners ▪ Engineering learners
Technological	*Time should be allocated for learners to master the technology.*		All three groups of learners
	Contingency plans are required by both instructors and learners to cope with technological failure.		All three groups of learners

These principles are elaborated on in turn, under their respective aspects, as indicated in Table 6.2.

6.2.1 Pedagogical/andragogical aspects

Principles surrounding pedagogical/andragogical aspects will now be discussed.

- **Children's responses to a site differ slightly, depending on their maturity level, computer and Internet skills, home language and prior knowledge.**

Both groups responded positively to the site and appreciated its value in their mathematical learning. However, *Plane Math* did not support the orientation and recall of prior knowledge for the rural school children, in that the site did not use objects they were familiar with. They also battled to understand some of the concepts, due to the material not being in their home language.

- **Postgraduate learners take more responsibility for their learning and are more mature.**

Ference and Vockell (1994) indicate that one of the needs of adult learners is to be independent and responsible for planning and directing their own learning activities. In this regard, both the formal and informal learners on the *RBO* course commented that this suited them. The formal learners were more committed to their studies than the informal learners who were doing the course in a continuing-education context. Although the formal learners experienced difficulty in complying with deadlines, they nevertheless persevered with the course and completed it, despite their initially low enthusiasm and their high anxiety levels during the course. The informal learners, on the other hand, withdrew early, or dropped out at a later stage, which is ironic considering their initially high enthusiasm and lack of anxiety.

The Engineering learners also took responsibility for their own learning. The results indicate that the Engineering learners were indeed task-centred and analytical, more value-driven and used *WebCT* to solve problems on hand.

- **Feedback is important to learners.**

With regard to the *WebCT* courses, the Engineering learners were generally satisfied with their feedback. They were, however, disappointed with two of their instructors who did not use the bulletin board at all.

The Multimedia learners were also not entirely satisfied with their feedback. Some of the learners had specific problems with the quality of feedback they received from their instructor, expressing concern that their instructor was over-reliant on technology and that his messages were vague.

Table 6.3 gives the feedback each group received and expected from their respective courses.

Table 6.3 Feedback each group received and expected

Group	Feedback received	Nature of feedback expected
Children	Children received system-generated feedback from the *Plane Math* site, as they progressed through the lessons.	In addition to feedback from the system, children appreciate the physical presence of a teacher.
Undergraduates	The *Multimedia* instructor provided e-mail feedback, which was constructivist in that he encouraged learners to think for themselves.	The undergraduate learners expected in-depth feedback and assessment.
Postgraduates	▪ The formal and informal *RBO* learners received minimal feedback via the discussion list. ▪ The Engineering learners doing the Maintenance Management course were content with the feedback they received via the bulletin board and e-mail.	▪ The formal learners expected regular feedback, as opposed to the informal learners who were content with less feedback. ▪ The novice learners on the *RBO* course expected more guidance and assistance, while those with advanced Internet knowledge took their own initiative, and proceeded with tasks without the guidance of an instructor. ▪ The Engineering learners expected regular feedback and were dissatisfied with some of their other instructors who did not use *WebCT* for its intended purpose.

- **Collaborative learning can be effectively stimulated on the Internet, with no face-to-face interaction and contact time.**

A dominant characteristic of constructivist learning is collaboration among learners. Both the courses run on *WebCT* and the *RBO* course were designed with social negotiation in mind. Collaborative learning was more effective among the postgraduate Engineering learners who were geographically dispersed and who had a greater need to collaborate, than for the undergraduate Multimedia learners who had traditional face-to-face instruction, four times a week. The Multimedia learners were unconvinced about *WebCT's* capacity to facilitate collaborative learning. The researcher believes this was a result of teaching inadequacies on the part of the instructor, who did not use *WebCT* to match learners' characteristics.

Both the formal and informal learners agreed that the *RBO* course, without face-to-face interaction and contact time, facilitated collaborative tasks, especially as compared with doing such tasks via conventional mail or telephone.

Although *Plane Math* (the educational web site) included collaborative group activities, these were not investigated due to time constraints. However, it is very likely that such activities would not only increase learner-learner interaction, but also take advantage of a medium that supports collaborative group work.

6.2.2 Affective/emotional aspects

The main findings are classified into four categories, namely:

- Motivation;
- satisfaction;
- frustration; and
- conflict

Under each category, the principles are elaborated upon on the basis of the results.

6.2.2.1 Motivation

- **A creative environment motivates learners.**

The use of a physical classroom as a metaphor in the *RBO* course, motivated learners effectively. The classroom metaphor also helped the learners to enter into the spirit of a physical classroom, and their personal contributions gave them a sense of ownership. Some learners even felt a sense of cohesiveness, as if they were part of the family. In contrast, *WebCT* did not employ a familiar metaphor.

6.2.2.2 Satisfaction

- **The ways in which learners react to web-based material depends upon their background and expertise.**

Learners were generally satisfied with *Plane Math* and the majority of learners in both groups were engaged by it. The basic elements of fun, discovery and self-motivated mastery were evident in the web site, and that value and the expectation of success, as suggested by Arnone and Small (1999), were present. However, the rural children enjoyed the web site more than the urban school children did, and found it an enjoyable, pleasant and novel way to learn, due to their lower exposure to technology. Both groups of children commented that some pages took too long to load, but otherwise they were satisfied.

The Multimedia learners, competent in the use of various technologies and media, found *WebCT* useful and credible, but not engaging and stimulating. They were neither challenged nor engaged by the learning experience. *WebCT*, therefore, did not match their characteristic of instant gratification. Some learners were satisfied, while others did not benefit or approve of the way the course was run.

On the other hand, the postgraduate Engineering learners who were less immersed in state-of-the-art technology, were more tolerant of *WebCT* than the undergraduate Multimedia learners, and they saw the task behind the problem. They were less demanding and critical than the Xers, more value-driven and intent on using *WebCT* to solve the problem on hand.

6.2.2.3 Frustration

- **The more sophisticated and technologically advanced learners are, the more critical they become.**

The children from the urban school were more critical than the children from the rural school, due to their wider exposure to the Internet, computer interfaces and learning resources in general. For the same reasons, they also expected far more from the site (e.g. increased interactivity) than the rural school children. The urban school learners found some lessons boring, that it was "a bit young", and that there was too much white on the screen.

The undergraduate Multimedia learners were aggressive learners, and expected things to happen quickly and immediately. Hence their considerable frustration with *WebCT*. Their main frustrations were due to teaching inadequacies, inadequate design, and technological problems and inadequate support.

Although the Engineering learners were less sophisticated technology users, they did not like the fact that two of their instructors did not use the bulletin board.

Learners also experienced frustration with technology. Each age group experienced frustration at the speed with which material appeared on their screen. This was more of a problem for the Engineering learners who accessed their *WebCT* course from home and required relevant information quickly. Instead, some learners felt that they wasted their time trying to access the relevant information from *WebCT*. Further problems experienced in *RBO* and the *WebCT* courses, were unstable and/or unreliable links.

6.2.2.4 Conflict

- **Conflict that is well managed can produce beneficial results.**

This was evident in the way the *RBO* instructor handled controversy/conflict that took place on the course discussion list. The instructor resolved/managed the conflict by placing the conflicting learners together in a collaborative learning group. They were instructed to build a web site dedicated to conflict and conflict management - the very topic that had given rise to their dispute. In this website they defined concepts associated with web-flaming and proposed strategies for handling it, addressing the topic by means of an appealing and

humorous metaphor. Due to this occurrence and the subsequent project on conflict, all the class were exposed to valuable issues of online collaboration.

6.2.3 Communicative aspects

In this section principles are given with relation to both instructional/content interactivity and social interactivity.

6.2.3.1 Instructional/content interactivity

- **Children experience difficulty in grasping all the aspects of a system that is not in their mother tongue.**

Although sound principles of ID were applied in *Plane Math*, the rural school children struggled to operate the system, possibly due to the material not being in their mother tongue, leading to difficulty in understanding it. They struggled to locate information on the screen quickly and easily, and to understand the system's feedback. They did not realise that they could decide for themselves what to do, and were unsure of the options.

In contrast, the children from the urban school, the more advantaged, well informed and computer literate group, had no problems in operating the system.

- **"Techno-savvy" individuals expect sophisticated interfaces.**

All in all, the undergraduate Multimedia learners were the most critical regarding the computer interfaces. They were typical "techno-savvy kids", expecting instant gratification due to their sophisticated knowledge of interfaces and principles of good design. To them *WebCT*'s interface was neither intuitive nor appropriate.

The Engineering learners, in contrast, felt that *WebCT* was user-friendly, although a few made negative comments about the design. In general they were less critical about the design of the web-based material than the Multimedia learners. Instead, they were concerned about functionality and doing their tasks successfully.

The *RBO* learners were also more concerned about functionality. Some learners found the design visually stimulating, while two of the informal learners did not appreciate the design.

There were also “techno-savvy” individuals among the children in the urban school. These children were more critical than those in the rural school, and found some lessons boring, that it was "a bit young", and that there was too much white on the screen. This is in line with Tapscott (1999) who believes that Millennial generation children question the implicit value contained in information.

Each group of learners comprised some technologically competent individuals who required sophisticated interfaces. Institutions should strive to match learners’ characteristics and develop sophisticated interfaces that also conform to sound principles of instructional design.

6.2.3.2 Social interactivity

Educational web sites can be enriched by offering social interactivity, especially with guidance from the instructor/teacher acting as a “virtual coach”.

The principles surrounding social interactivity will now be discussed.

- **Undergraduate learners are reserved when it comes to communicating on a bulletin board.**

The literature states that communicative features significantly enhance the exchange of academic discourse, serving as a sounding board for ideas and being useful for networking purposes. This, however, was not the case among the Multimedia learners. Only a third commented that the discussions facilitated collaborative learning, in contrast to the positive response from the Engineering learners, and the formal and informal learners on the *RBO* course.

It was interesting to note that undergraduates felt comfortable about asking certain questions, but not about initiating discussions or answering questions, as indicated in Chapter 4, Figure 4.6. In contrast, the postgraduate learners in the *RBO* course felt comfortable about using the discussion list for their collaborative tasks and to answer each other’s questions.

The findings showed that some learners were uncomfortable with discussion software. It is therefore essential that instructors give learners the necessary guidance and motivation for

successful performance. It must also be borne in mind that success does not necessarily equate to learners being fully engaged in discussion software.

- ***WebCT* courses and fully online course can provide the opportunity for regular, collaborative interaction with learners and the instructor.**

The success of collaborative interaction depends on both the instructor and learners. In the *RBO* course (a fully online course) the instructor set up a discussion list for his learners, but its success depended on the learners themselves, who used it for its intended purpose. That is, learners reflected and learnt from the contributions sent by peers. The informal learners in the *RBO* course were especially active and provided valuable interaction.

In contrast, collaborative interaction was low among the undergraduate Multimedia learners. The researcher believes this was due to both teaching inadequacies and reluctance on the part of the learners. At that stage the learners did not know a great deal about the topic, and secondly, were not comfortable with the new means of communication. The postgraduate Engineering learners, in contrast, had regular collaborative interaction with one another and the instructor, and were more tolerant of the new medium. They saw the task behind the problem and looked beyond the technological hitches.

6.2.4 Technological aspects

Principles surrounding technological aspects will now be discussed.

- **Time should be allocated for learners to master the technology.**

It is critical that time be allocated for learners to master the technology within their courses. This would familiarise learners with the technology and help them become accustomed to it prior to the course. Once learners are comfortable with the medium as such, they should participate confidently.

- **Contingency plans are required by both instructors and learners to cope with technological failure.**

It is crucial that instructors have a contingency plan as a backup in the event of technological failure. In traditional contact teaching, instructors have recourse to face-to-face communication, and learners can be given printouts of study materials. Emergency plans become harder to generate in distance learning environments, because one is unable to resort to direct communication. Instructors could, however, load their courses on two different servers, so if the one is down, the other could be used. They could also have course material placed on a CD-ROM, which learners could use offline, and at their own time and pace.

6.3 What are the distinguishing characteristics of learners of different age groups, and what are the differences and similarities between these age groups in the context of web-based technologies?

Tables 6.4 – 6.6 examine the characteristics of each group of learners against their experience of the web-based technology. This is with the purpose of assessing whether or not the different web-based technologies took into account the characteristics/needs of learners.

6.3.1 Children

Table 6.4 gives children's experience of *Plane Math*, under the different characteristics of Millennial Generation learners.

Table 6.4 The Millennial Generation learners' experience of *Plane Math*

Characteristics	Experience
Work with their *peers* or groups in preference to adults.	Children explored the web site with their peers, in a school context.
Need to *reach* people of their own age.	Children in the rural school were more excited about referring the web site to their friends than children from the urban school, due to the former group's lower exposure to the Internet.
Need *quick responses* to activities.	Children found the transitions between screens slow and to a certain extent this temporarily distracted their attention.
Are creative thinkers able to *customise* things to their needs.	Children could choose which lessons they wanted to work through. The computer customised the lesson based on learners' responses.
Need to *explore and do* things.	They found *Plane Math* fun and exciting, and enjoyed the learning experience. They could also choose which lesson they wanted to do.
Achievement orientated.	Self-motivated to assume learning responsibility. The children engaged in activities they found were meaningful.

Owing to the fact that children in the Millennial Generation have grown up with technology, it is the researcher's opinion that they will adapt to electronic communication more easily than Generation X learners, and certainly more easily than the Baby Boomers. They will also have the advantage of using technologies that have been tried and tested, in contrast to those who were the guinea pigs, that is, the undergraduates and postgraduates. When these learners reach tertiary education, they may accept the absence of face-to-face contact. Future research into this aspect would be interesting, as well as an investigation as to how children experience communication technologies such as bulletin boards and chat rooms, and the extent to which these technologies support their learning.

6.3.2 Undergraduate learners

Table 6.5 gives Multimedia learners' experience of *WebCT*, under the different characteristics of Generation X learners.

Table 6.5 Generation X learners' experience of *WebCT*

Characteristics	Experience
Independent and self-reliant	▪ Not all learners showed the characteristic of independence. Certain learners commented that *WebCT* is not a replacement for lectures and instructors, and required classes in which their work is explained and discussed.
Techno-literate	▪ Learners did not appreciate the over-reliance on technology and objected to the enforced use of certain communication technologies. ▪ They experienced numerous technological problems beyond their control.
Have an expectation of instant gratification.	▪ Learners were situationally self-motivated to assume learning responsibility in areas of their own interests, and not the instructor's. Some learners willingly gave up control and expended less effort in areas that did not interest them. ▪ Learners were not overly stimulated by the material. ▪ They experienced frustration when instructors did not update web sites when information changed, or left their sites incomplete.
Self-building	▪ They asked questions to complete projects.

The Multimedia learners (Xers) came across as self-confident, desiring to be independent and free, and to choose the direction of their own learning. This corresponds to one of their labels as described in literature, namely the "me generation" as Slattery (1996) suggests. However, educators can harness this negative image, by designing ways to harness their characteristics, e.g. engaging them in web-based material that appeals to them.

6.3.3 Postgraduate learners

Using Ference and Vockell's (1994) characteristics of adult learners, Table 6.6 lists adult learners' experience of both *RBO* and Maintenance Management.

Table 6.6 Postgraduate learners' experiences of *RBO* and the Maintenance Management course

Characteristics	Experience
Active learner	▪ In the *RBO* course, certain learners were actively involved in their collaborative tasks, and in the participation on the discussion list. The informal learners were especially active on the discussion list. ▪ Despite the high drop-out rate in the *RBO* course, learners had learned.
Experience-based	Learners conducted their projects and based them on prior experience.
Expert	Learners were experts in their fields, hence they could add value to the discussions that related to their fields.
Hands-on	Adults were like children in that they liked to be practical and do things. In *RBO*, learners were given hands-on tasks to do.
Task-centred and problem-centred	▪ Engineering learners were frustrated by the slow speed of screen transitions. ▪ In the *RBO* course, learners had to find things out for themselves, as they tackled real-life problems in context and presented solutions collaboratively.
Solution-driven	In the *RBO* course, learners took personal ownership of their tasks.
Value-driven	Some of the engineering learners were happy with the *WebCT* service.
Skill-seeking	▪ Postgraduates were seeking skills, in that they actively desired to attain new and improved skills in order to better meet and solve real-life problems. ▪ The formal learners in the *RBO* course were predominantly externally motivated, and were completing the masters degree in CIE for career benefits. The informal learners in contrast were internally motivated, having a high interest level in the course for its intrinsic value and desiring to learn new skills. ▪ Learners in both courses attached value to the communication features. Learning to use these features gave an added real-life skill.
Self-directing	▪ The course worked well for both groups of learners (formal and informal) in terms of being independent and responsible for planning and directing their own learning activities. ▪ The Engineering learners were self-motivated to assume learning responsibility.
Motivation (External)	The formal learners were motivated to do the course due to career opportunities. This contributed to their persistence when tempted to drop out.
Motivation (Internal)	The informal learners were doing the course primarily due to a high interest level. The Engineering learners were frustrated that two of their instructors did not communicate electronically at all.

Andragogy provides designers and instructors/teachers with a framework within which to approach their work. Table 6.7 shows the differences between the three groups of learners, taking into account the concepts embracing andragogy.

Table 6.7 Characteristics of learners of different age groups

Characteristics	Children	Undergraduates	Postgraduates
Active learners	Prefer to be active rather than passive learners.	Prefer to be active rather than passive, if material appeals to them.	Prefer to be active rather than passive learners, if material is relevant to their work situation.
Self-directed	It was easy for the children to take responsibility for their own learning, because *Plane Math* is not dependant on a teachers'/parents' presence.	▪ Were not fully self-directed, and would have liked more assistance. ▪ Focused on work they were doing, and on doing a thorough job.	▪ Both the Engineering learners and formal learners were self-directed, taking responsibility for their own learning, although the latter group did extend the deadlines. ▪ The majority of the informal learners did not take responsibility for their own learning. ▪ Learners in the *RBO* course were focused on dealing with problems they encounter in their particular life situation.
Skill-seeking	Web-based material must be relevant and engage attention (Keller's motivational model applies here).	Web-based material must be real-life oriented, in that they must be able to see its potential use.	Web-based material/course must be practically useful in the work situation.
Need guidance	Responded well to the feedback and branching in *Plane Math.*	Multimedia learners had high expectations in terms of feedback and assessment.	Formal learners had high expectations in terms of feedback and assessment. Informal learners had lower expectations in terms of feedback and assessment.
Internally or externally motivated.	They were internally motivated by *Plane Math's* web site.	Undergraduates' motivation for using *WebCT* was primarily external because they HAD to use *WebCT*, and their participation counted for marks.	High completion rate among the formal learners. Their motivation for learning was primarily external. High drop-out rate among the informal learners, who ironically, were internally motivated to do the course.
Technoliterate	▪ Urban school children were familiar with technology, in contrast to the rural children. ▪ Children are more forgiving when it comes to errors, such as slow download speed.	▪ Undergraduate learners were the least patient. ▪ Early adolescents are aggressive people.	▪ Engineering learners were angry when they were unable to access material – wasting their time. ▪ Engineering learners found *WebCT* too slow; as a result some resorted to e-mailing each other.

Interesting deductions can be made from Table 6.7, namely:

- Across the age groups, learners seek different skills with regard to web-based material, i.e. children want to see relevance, undergraduates want to see its potential use and postgraduates want to see its practical use, as applied to their specific work situation.
- With regard to technology, it was discovered that impatience increases up the age scale from children to postgraduates. In addition, if something does not work out well for them, they will use something which is more convenient to use, e.g. the Engineering learners resorting to conventional mail.
- Extrinsic motivation plays an important role with adults. For example, the formal learners completed the course due to being extrinsically motivated, in contrast to the informal learners who were essentially internally motivated, yet many of whom dropped out of the course.

6.4 What are the learning possibilities for children, undergraduates, and postgraduates in the context of web-based technologies?

Schools and universities need to implement web-based technologies that suit their budget. Complex and expensive Web-based technologies are not required to guarantee learning, as learning can even take place using simple and inexpensive technologies. It is not about the medium/technology that is used, but how one designs for it.

Possibilities and implications for instructional design and the promotion of learning are given for specific web-based technologies from the perspective of the different age groups, i.e. children, undergraduates and postgraduates. These are given in Tables 6.8 to Table 6.17. The web-learning possibilities and implications arise from the case studies, but some are extracted from the literature study. The implications for instructional design and promotion of learning should be useful to developers as they design and develop web-based technologies for future use.

The web-based possibilities and implications are not restricted to the specific age group under which they have been classified, and could well apply to others. The tables only serve as a guideline, based on the literature and the three case studies. Before any web-based technology is developed, it is essential that the target population is investigated to determine their specific characteristics/needs, so as to design relevant material.

Recommendations also depend on the epistemology one is using, i.e. how objectivist or constructivist the web-based technology is intended to be. Where web-learning possibilities are the same for two or more groups, these columns have been merged. This occurs frequently in the possibilities common to both undergraduate and postgraduates learners.

6.4.1 Educational web sites

Educational web sites and programs play a valuable role in improving and enhancing children's perceptions of learning, as indicated by the results of *Plane Math.*
From the positive response of the children from the two schools, it would seem that children easily accept educational web sites. It would therefore seem worthwhile to introduce such web sites/tutorials as a supportive tool in the appropriate educational curricula.

Table 6.8 shows the possibilities of educational web sites for different age groups, while Table 6.9 lists the implications educational web sites hold for instructional design and promotion of learning. Developers should address these as they design web pages for their target audience.

Table 6.8 Web-learning possibilities for educational web sites targeted at different age groups

Children	Undergraduates	Postgraduates
▪ Web sites can provide exploratory and discovery learning, allowing learners to participate in an active process (i.e. having control over its nature and direction), enabling them to develop their own feeling of autonomy and sense of values. ▪ Children, in searching for information, are forced to exercise not only their critical thinking, but also their judgement. ▪ Children can access information they need for class projects by surfing the web.	▪ Developers can incorporate Multimedia to simulate real life, and to provide different stimuli that present the same content. Graphics, text, sound, and video can be used to grasp learners' attention and stimulate them.	▪ Web sites can include multiple levels of materials with choice of links offered, and which learners can peruse in their own time and at their own pace. ▪ Web sites can incorporate problem-solving situations. ▪ Web sites can include "how to" reference guides, booklets and tutorials. ▪ Meaningful relationships can be formulated through the integrated use of sound, video, graphics, animation and text.

Table 6.9 Implications of educational web sites for instructional design and promotion of learning for different age groups

Aspects	Children	Undergraduates	Postgraduates
Pedagogical/ andragogical	▪ Children must participate actively in the learning process. ▪ Web activities should have relevance to real situations and provide integrated experiences. ▪ Clear aims and objectives should be provided, including information as to the target age group of each lesson. ▪ Instructions should be clear and outline the options offered.	▪ Learners should be engaged in problem-solving activities. ▪ Undergraduates should find/create their own learning content that holds potential value.	▪ Learners should be engaged in advanced problem-solving activities. ▪ Postgraduates need to find/create their own learning content, relating to a particular life situation they encounter.
Affective/ emotional	▪ Children need material in visual format, with a high level of interactivity. ▪ Sensitivity to learners' social and cultural background should be exercised. ▪ Motivational elements in web sites must be: engaging and stimulating; useful and credible; organised and easy-to-use; and satisfying and effective, i.e. both value and the expectation of success must occur within an educational web site.	▪ Learning material must hold long-term career value.	▪ Learners need content matter which has relevance for a career/particular life situation. ▪ Learners need fast access to learning material as they have no time to waste.
	▪ Sites should incorporate a high-level of interactivity and be exciting. ▪ Sites could be enriched by keeping abreast of current web developments.		
Communicative	▪ Learners can present what they learn by developing their own web sites. ▪ Divide learners into groups within which they can interact, communicate and support one another. Create an ethos of mutual support and community building.		
	▪ Give learners hypertext, adaptive and multiple access. Avoid step-by-step instruction.		▪ Engage learners in learning real world skills, through solving their own problems.
Technological	▪ Build high level of interactivity.	▪ Allow learners to share their experiences of technology.	
	▪ Provide support for learners in the event of technological difficulties. ▪ Reducing the size of graphics could increase transition speed between screens.		

Harbeck and Sherman (1999) give further instructional design implications for children:

- Children's web sites should be concrete; provide clear, simple navigation; have simple page design; and use large, obvious icons.
- Web sites should be exploratory, include multiple branching options, and provide predictable action.
- Web sites should be progressive and customised, in that design and content are adaptable to the age of the user.
- Web sites should provide active and enjoyable experiences to ensure a positive, affective response.

Children should also be afforded opportunities to apply what is learnt to "authentic" problem situations and so make their learning relevant and applicable to their lives (Chisholm, 2000).

The enthusiasm of the children, as indicated from the observation and questionnaire, indicates that educational web sites hold immense potential for children as a tool to support learning, as a supplement to traditional class time. Educational web sites should, however, be sensitive to learners' social and cultural background, as there was an obvious difference in the response of the rural school children to the use of unfamiliar objects in *Plane Math.*

6.4.2 Web-based CMSs

Many of the possibilities of web-based CMSs are the same for both undergraduate and postgraduate learners. Consequently, these two age groups have been combined, and referred to as tertiary learners. Children are not included in Tables 6.10 - 6.13, since technologies such as web-based CMSs and web-based classrooms are not as appropriate in tertiary environments, where a large number of learners study by means of distance learning. Furthermore, the children's application investigated was a web-based tutorial and practice environment, and not a web-based CMS/web-based classroom. Children also attend traditional classes and therefore do not need these technologies for direct teaching, although they can be used as a support, and to reinforce ideas.

Table 6.10 shows the possibilities of web-based CMSs for different age groups, while Table 6.11 lists the implications web-based CMSs hold for instructional design and the promotion of learning.

Table 6.10 Web-learning possibilities for web-based CMSs targeted at tertiary learners

Tertiary learners
▪ CMS can be used to support enriched interactive educational communication on the Web, and offer enhanced support to teachers and learners. ▪ CMS can be designed in the way the instructor or organisation chooses, and with the "look and feel" they specify. Instructors can choose a combination of features they would like to use, i.e. online study guide, discussion tools, presentations, quizzes, whiteboard, etc. ▪ Learners can conduct tests using the online quizzes instructors place on *WebCT*, eliminating time spent by instructors in marking written tests.

Table 6.11 Implications of web-based CMSs for instructional design and promotion of learning for tertiary learners

Aspects	Tertiary learners
Andragogical aspects	▪ Learners must receive regular feedback. ▪ Learners should report on their progress or attempts/successes/failures on the tasks given them, on a weekly basis. This may keep discussions more constructive, making the instructor more aware of where learners experience problems, and learners may find that they share the same difficulties. ▪ Make sure that the administrative technicalities are subordinate to the instructional aspects.
Affective/ emotional aspects	▪ Instruction should be designed for relevance and to match learners' interests. ▪ The interface should be re-designed and made more user-friendly. A metaphor that learners are familiar with should be employed. This metaphor should also draw upon their existing skill and knowledge. ▪ The basic elements of fun, discovery and self-motivated mastery should be present for learners. ▪ A questionnaire/s can be sent out to learners at certain times in the course. Instructors could ask learners to report on their progress, perceptions of the course and what they have learnt from the course up to that point. This could help focus the course.
Communicative aspects	▪ Instructors who have opted to use *WebCT,* should not only keep it current, but also use it and build in adequate scaffolding. For example, the instructor should frequently post messages to the bulletin board in the beginning of the course, to familiarise learners with this feature. As the course progresses, the interaction and scaffolding on the part of the instructor should decrease and interaction between learners should increase. ▪ Instructors should schedule inter-learner debates on controversial, but relevant, topics. Instructors should also interact enthusiastically on the bulletin board. ▪ The best model is to use a combination of face-to-face contact and electronic communication. Contact sessions should be held to promote a sense of unity and belonging in a group. ▪ Learners should not be forced to use any of *WebCT's* communication tools, but they should be so visually stimulating and put to such good use, that learners want to use them.
Technological aspects	▪ The host network and the remote network must be stable. ▪ Design for stability, by keeping the interactive features of the site working reliably. ▪ Basic network support should be provided to learners and instructors, and learners should be informed of changes made to systems that affect access, navigation or transfer procedures, e.g. when the classroom server is down.

6.4.3 Web-based classrooms

Various technologies can be incorporated as part of a web-based classroom.

Table 6.12 shows the possibilities of web-based classrooms for tertiary learners, while Table 6.13 lists the implications of web-based classrooms for instructional design and the promotion of learning. Many of the web-learning possibilities for web-based classrooms are the same for both undergraduate and postgraduates learners. Once again, these two age groups are combined, and referred to as tertiary learners. Children are not included in the table, because the investigation of learning by children did not relate to a web-based classroom.

Table 6.12 Web-learning possibilities for web-based classrooms targeted at tertiary learners

Tertiary learners
▪ Instructors can emphasise open-structured tasks that learners can "own" for themselves, and make applicable to their real-life tasks.
▪ Core syllabi and study objectives can be presented on a web site, and regular "classroom" discussions conducted via a discussion list and/or bulletin board.
▪ A free group service can be used to support collaborative learning, e.g. *Yahoo! Groups.*
▪ Learners can build and manage their own constructivist learning environments using the Web, in so doing taking responsibility for their own learning.
▪ Learners can jointly construct collaborative web knowledge sites, and in the process learn practical skills on how to build a site over a distance.

Table 6.13 Implications of web-based classrooms for instructional design and promotion of learning for tertiary learners

Aspects	Tertiary learners
Andragogical	▪ Monitor learners carefully, and give feedback regularly. ▪ Include many sub-deadlines and place pressure on learners to abide by them. ▪ Ask learners to report on their progress or attempts/successes/failures on the tasks given them, on a weekly basis. ▪ Let learners take initiative. ▪ Start the course with basic tasks, such as text and e-mail activities (e.g. virtual debates), to familiarise learners with the medium. ▪ Ask learners to report on their progress or attempts/successes/failures in the tasks given them, on a weekly basis. This may keep discussions more constructive, making the instructor more aware of where learners could be experiencing problems, and learners may find that they share the same difficulties. ▪ Specify clearly the pre-requisite knowledge and competencies for the course, so that prospective learners can then decide whether they have the pre-requisite knowledge for the course, or if not, whether they have the time to acquire this knowledge. ▪ Identify with various problems learners may encounter, especially if the technology is new to them and they are battling to master it.
Affective/ emotional	▪ Encourage learners to post introductions along with their fears and expectations for the course, at the outset of the course, or, when possible, create a homepage that others learners in the group can visit. ▪ Schedule inter-learner debates on controversial, but relevant topics. ▪ Strive to integrate the class at the outset of the course, through brief collaborative tasks. This would help learners get to know each other, and counter feelings of isolation. This applies specifically to distance learners. ▪ Set ground rules and protect the "weak" if confrontation/conflict arises. ▪ Give learners considerable choice and freedom concerning the direction of their tasks, and in how they can be implemented.
Communicative	▪ Base designs on sound principles of instruction design. ▪ Design material to be cognitively comprehensible, that is, consistent and predictable. ▪ Keep the web site dynamic to attract learners' attention. ▪ Establish clear norms and guidelines, at the outset of the course (Fisher, 2000) that learners agree to. These are then adhered to for the duration of the course.
Technological	▪ Ensure that the host and remote network are stable. ▪ Provide basic network support to learners from the university concerned, and inform learners of any changes made to any systems that affect access, navigation or transfer procedures, e.g. when the classroom server is down. ▪ Design web site to load quickly. Large graphics should not be used unnecessarily. ▪ Place sites demanding large bandwidth on CD-ROM's, which learners can use off-line in their own time and leisure. Video clips, material and articles can also be placed on a CD-ROM and used as a supplement to the Web.

6.4.4 Discussion lists/bulletin boards

Table 6.14 sets out the possibilities of discussion lists/bulletin boards for different age groups, while Table 6.15 gives the implications discussion lists/bulletin boards hold for instructional design and the promotion of learning. Where the web-learning possibilities of discussion lists/bulletin boards are the same for two or more groups, these columns have been merged, as evident in the possibilities shared by both undergraduate and postgraduates learners. Consequently these two age groups are combined, and referred to as "tertiary learners".

Discussion lists and bulletin boards are usually included as components in web-based CMSs and web-based classrooms, but for the purpose of in-depth examination, these have been split into two tables.

Table 6.14 Web-learning possibilities for discussion lists/bulletin boards targeted at different age groups

Children	Tertiary learners
▪ CMC allows the use of techniques such as collaborative group work, group discussions and brainstorming. ▪ Children can interact and exchange ideas through computer networks, regardless of whether they are on the same site or at distant sites. ▪ Children can give their own views.	▪ Discussion lists/bulletin boards can be set up to facilitate interaction and communication among the learners in the course, and between learners and their instructor. ▪ Learners can reflect on, discuss, and defend their knowledge/skill. ▪ Instructors can use discussion lists/bulletin boards to engage learners in solving problems. ▪ Learners can moderate discussions themselves, then summarise the results, and make them available to the rest of the class. Learners would experience the role of the lecturer in this way. This would hand control over to learners, and motivate them. ▪ A guest "speaker" who is an expert in the field, can be used to introduce content and answer learners' questions. ▪ The bulletin board can allow for threaded discussions and can be used as a backup for static information. ▪ Learners can use discussion list/bulletin board for collaborative tasks.

Table 6.15 Implications of discussion lists/bulletin boards for instructional design and promotion of learning for tertiary learners

<table>
<tr><th>Children</th><th>Undergraduates</th><th>Postgraduates</th></tr>
<tr><td rowspan="2">▪ Gently prompt and motivate learners to express their own views.
▪ Use as an extension to learning.
▪ Use in conjunction with traditional contact teaching.
▪ Encourage learners to subscribe to discussion groups on topics that interest them or on themes they doing in class.</td><td>▪ Should be used as an extension to learning, and not as only means.
▪ Should be reliable and learners given the choice whether to participate or not.
▪ Use correctly and in conjunction with teachers/instructors.</td><td>▪ Learners can share files for use in other application software, by attaching them to their e-mail message. In this regard, a group of learners can construct a web site without physically seeing each other.</td></tr>
<tr><td colspan="2">▪ Should capture learners' attention so that they want to contribute and intervene in the discussion.
▪ 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.
▪ Use "Netiquette" guidelines to guide behaviour.
▪ Create a policy for handling disputes and disruptions (McLellan, 1999).
▪ Discussions should be relevant to learners' careers.
▪ Group learners appropriately in the case of collaborative tasks.</td></tr>
<tr><td colspan="3">▪ Learners learn real world skills in realistic settings.</td></tr>
</table>

A combination of a bulletin board and a discussion list could be used, seeing that general notices can be posted on the former, and classroom discussions held on the latter. Instructors

can inform learners when they have placed new material on the bulletin board, so that learners know when to check it.

6.4.5 E-mail

Table 6.16 outlines the possibilities of e-mail for different age groups, while Table 6.17 gives the implications e-mail holds for instructional design and the promotion of learning.

Table 6.16 Web-learning possibilities for e-mail targeted at different age groups

Children	Undergraduates	Postgraduates
▪ Children can e-mail experts in the field. ▪ Children can use e-mail to communicate their ideas, stand up for what they think, and establish friendships across geographies.	▪ Undergraduate learners can communicate with experts in the field, offering learners the opportunity to become cognitive apprentices and develop their higher-order thinking skills in real world contexts.	▪ Collaborative problem-solving should be undertaken, providing learners with skills, expertise and knowledge. ▪ Adults can apply what they learn soon after learning it.
▪ Learners and instructors can work one-on-one. ▪ E-mail has great potential to shift the focus from instructor-centered teaching practices to a learner-centered environment. ▪ Learners can communicate real-life problems and request help from other learners. ▪ Instructors and/or learners can give feedback to each other, facilitating learning activities.		

Table 6.17 Implications of e-mail for instructional design and promotion of learning for different age groups

<table>
<tr><th>Children</th><th>Undergraduates</th><th>Postgraduates</th></tr>
<tr><td rowspan="2">▪ Present relevant problems, and direct the learners to experts for further information.
▪ Use emoticons, to indicate learners' emotions.</td><td>▪ Identify what attracts and retains the attention of learners.
▪ Evaluate learners' progress by asking them a question/s.</td><td>▪ Create a policy for handling disputes and disruptions (McLellan, 1999).
▪ Encourage learners to discuss real-life problems/opportunities they encounter in the workplace with regard to any aspect of the content they are learning.</td></tr>
<tr><td colspan="2">▪ Give learners frequent feedback.
▪ Encourage learners to share files, by attaching them to their e-mail messages, in the case of collaborative group tasks. In this way, two or more learners can construct a web site without physically seeing each other.</td></tr>
<tr><td colspan="3">▪ Foster an open and interdependent exchange (Winiecki, 1999).
▪ Encourage learners to create different folders for different topics and groups of people.</td></tr>
</table>

Tables 6.8 – 6.17 indicate that the Web serves various functions and offers a wide range of possibilities to teachers/instructors and learners. It provides a unique set of tools, and is a resource-rich technology for use in education. The Web allows learners to participate in an active process of handling and processing information, and constructing their own knowledge.

6.5 What are the web-learning possibilities for contact teaching and distance learning?

The Internet has become indispensable both in contact teaching and distance learning, especially the latter where the Web can connect learners who are geographically dispersed. This was particularly useful in the case of the Engineering learners and the learners who were part of the *RBO* course.

In this section, the web-learning possibilities for both contact teaching and distance learning will be discussed, as determined from this research.

6.5.1 Contact teaching

Traditional contact teaching can benefit from the first three levels of Harmon and Jones' five levels of Web use (see Chapter 2, Table 2.1), which generally include using the Web for:

- Making information available and for general announcements, and to communicate and publicise courses;
- placing course content on the Web; and
- for learners to complete course work and use for general searching.

WebCT and *RBO* went beyond these levels, making communal and immersive use of the Web, respectively.

Further web-learning possibilities for contact teaching are given in Table 6.18, with its implication for instructional design and the promotion of learning.

Table 6.18 Web-learning possibilities for contact teaching and its implication for instructional design and promotion of learning

Possibilities	Implication for instructional design and promotion of learning
▪ Educational web sites (web-based tutorial and practice environments) can be of value to learners and meet learners' expectation of success (Arnone and Small, 1999), if designed according to sound instructional design principles. ▪ Contact teaching can be supplemented by web-based CMSs to facilitate communication between and among learners, and offer enhanced support to teachers and learners through its various features, such as those on *WebCT*. ▪ Learners given a project can assimilate needed information by searching the Internet and other mediums, and then create their own web pages. ▪ The Internet can be used to gain essential skills, such as critical thinking, problem-solving, investigative, evaluative and writing skills. ▪ The Internet can be used for learners to contact professionals in the field. ▪ Learners can participate in forums with other learners, and in chat rooms.	▪ Web-based technologies should be designed in such a way that they are goal-oriented, grab the attention of learners, offer challenges and hand control over to the learner. ▪ As far as possible, instruction should be individualised and learners should have opportunities to communicate with one another, to argue and debate issues (Ginn, 1995). ▪ The basic elements of fun, discovery and self-motivated mastery should be present in the web site. ▪ Teachers should supply learners with the necessary guidance to gain skills that will enable them to gather, analyse, synthesize and share knowledge.

Based on the results, it is the researcher's opinion that web-based technologies should be used as an extension of learning. The use of the Web in schools should not replace school (face-to-face contact), but should be used as a support, and to reinforce ideas. The web should not replace the teacher. It is evident from examining the needs of children, as given in Chapter 2, Section 2.3.1, that children need supervision, support and the assurance that they are cared for.

6.5.2 Distance learning

In this section the principles derived from the case studies concerning the nature of distance learning are discussed.

- **Web-based CMSs and web-based classrooms are more valuable for learners who study from a distance than for learners who have traditional contact classes.**

This was indicated by the positive responses of the postgraduate Engineering learners regarding their experience of *WebCT* as an aid, and to the effect that the online discussion facilitated collaborative learning. The informal learners on the *RBO* course also attached more value to working collaboratively over a distance than did the formal learners who were accustomed to traditional contact teaching.

- **Learners would like a combination of face-to-face contact and electronic communication.**

Some learners felt isolated studying on the Web and would prefer a combination of both face-to-face contact and electronic communication. This was stressed by the undergraduate Multimedia learners time and time again, and by some of the novice learners on the *RBO* course. A combination of both would provide a good model for future courses, and will most likely become a common and widespread medium for continuing professional education.

Web-learning possibilities for distance learning are given in Table 6.19, with their implications for instructional design and the promotion of learning.

Table 6.19 Web-learning possibilities for distance learning and their implication for instructional design and promotion of learning

Possibilities	Implication for instructional design and the promotion of learning
▪ The Internet can be used to gain essential skills, such as critical thinking, problem-solving, investigative, evaluative and writing skills. ▪ Educational web sites are widely accessible. However, learners who do not have access are excluded. ▪ Web-based CMSs can be used to support enriched interactive educational communication on the Web, and offer enhanced support to teachers and learners. It can be easily managed, but can be very restricted. ▪ Web-based classrooms can consist of two components: the web site and the communication tools. The web site can include an online study guide, as well as learners' individual sites that they have built. The communication tools can be used to facilitate interaction and communication among learners. ▪ CMC can be used to facilitate collaborative learning.	▪ Instructors must keep material current. ▪ Instructors should stimulate discussion. ▪ Instructors need to give web-based CMSs/classrooms constant attention, to enable learners and lecturers to get the most out of it. ▪ Instructors should be enthusiastic about technology, and strive to foster a caring and supportive environment. ▪ Learners should be encouraged, rather than forced, to interact. If the system is reliable and stimulating, they will choose to use it.

It appears that the distinction between contact and distance is fading away, and that contact teaching and distance learning are converging. The communication tools available on the Web hold enormous potential to reduce the social isolation originally equated with distance learning. Increasingly, the Web is being used to support and enhance teaching processes, or in some instances, to present fully online courses catering specifically for distance learners. In the context of contact teaching, while the Web can be used as a source of course delivery (information transfer) and for communication, interaction and collaboration, instructors can use traditional class time to teach real learning content.

6.6 Gaps in this study

The results of this study leave some gaps. The latter relate to the response of the different groups of learners under investigation, and to the effectiveness of collaborative group activities that were not investigated in this dissertation.

6.6.1 Response of different groups

Due to the small sample sizes used in this study, further research is needed to clarify these results. Suggestions for future research include investigating in more detail, the reasons why learners responded the way they did.

Of particular interest is the unusual response of the Multimedia learners, known as the Xers, as to:

- The reason behind their attitude and their directness. Was this due to their instructor, the media used, life in general, or their age?
- Why were Multimedia learners more reserved in communicating on the bulletin board?

Of further interest are the reasons why learners discontinue web-based courses/classrooms. This is of particular interest because of the high drop-out rate among the informal *RBO* learners, who did the course in a continuing-education context.

6.6.2 Collaborative group activities

Suggestions for future research include investigating in depth the effectiveness of collaborative group activities among children. The collaborative activities in *Plane Math* were not investigated in a group of learners in this specific dissertation, and it would have been interesting to see how learners respond to these activities, and whether or not Miller (2001) is correct in saying that “The Millennial Generation reach out to people and have a strong desire to be connected and to collaborate with others”.

6.7 Challenges arising

The following challenges arise from the study and are grouped under the two kinds of teaching, namely contact teaching and distance learning.

6.7.1 Contact teaching

- Web-based material should be designed to adhere to both Malone's intrinsic motivators (Malone, 1981), and Keller ARCS model of Instructional Design (Keller and Kopp, 1987). This is essential considering that learners are becoming increasingly sophisticated and have high expectations of course material.
- Web-based learning environments should meet the characteristics of their specific target population/generation.

6.7.2 Distance learning

- Instructors should explore how one can create a cohesive supportive group of participants who do not communicate face-to-face in the case of web-based classrooms.
- Instructors should strive to take the "distance" out of distance learning, for their learners.

6.7.3 Contact teaching and distance learning

- Instructors should facilitate adequate and effective communication among learners, and between learners and the instructor.
- Instructors should keep interaction on discussion lists/bulletin boards useful, preventing learners from feeling frustrated by it. A further challenge is how to keep discussion lists/bulletin boards running, rather than dying out after the course is over.

6.8 Concluding remarks

This chapter has merged the results into one coherent whole, in an attempt to answer the major research questions and provide a systematic structure of web-learning possibilities for learners of different age groups, and for different types of teaching, namely contact teaching and distance learning. The findings are used to propose appropriate matches between the characteristics of learners, the web-based technologies used and the teaching methods employed (i.e. contact teaching and distance learning). Web-based technologies can, if designed correctly, accommodate individual learning differences and meet the characteristics of the age group they are targeting.

There are many unknowns, as educators/trainers move into this new and exciting territory, that poses stimulating opportunities, but also many challenges, especially the changing roles of both learners and instructors. Learners have to take responsibility for their own learning – through collaborating with others, and constructing and generating their own knowledge, while instructors have to change their role from "sage on stage" to that of being a mentor and guide, and structuring learning opportunities. A high level of interactivity can be fostered through CMC, where instructors and learners engage in dialogue, and learners themselves contribute to the pool of knowledge.

Teachers/instructors no longer have all the answers. The main focus needs to be on the educational aspects addressed in this study, including sound instructional design, taking into account the needs and characteristics of the age group the web-based technology is targeted at.

It is hoped that the possibilities suggested in this study will present designers with a greater understanding of the distinguishing characteristics of learners of different age groups and how their needs can be met using web-based technologies, and thus contribute to the development of instructional web courses that are successful in supporting learning.