

Health care professionals learning online: A case study review of educational effectiveness

Volume I of II

University Department of Rural Health

University of Tasmania

Submitted in fulfilment of the requirements for the Degree of

Master of Medical Science

by

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Certificate of Workplace Training and Assessment

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December 2004

Abstract

The advent of the World Wide Web and Internet in the early 1990s has led to a major investment in information and communication technologies for educational purposes. The technology and growth of the Internet has been developing at an exponential rate, creating a situation where what constitutes effective educational practice has not been fully developed in the literature. Existing models of evaluation in the area are limited in scope or based on untested assumptions. These limitations are combined with a relative paucity of original research dedicated to explaining or predicting phenomena related to successful outcomes in Web-based learning, particularly from the perspective of the learners. This study addresses some of these gaps and the outcomes provide guidance for the future development of Web-based learning resources. It demonstrates the importance of sound instructional design and pedagogy and the results of the study point towards the overall effectiveness of the World Wide Web for learning.

The study used a naturalistic theory approach in conjunction with a multilevel evaluation to examine the impact of Web-based learning on over 300 health professionals enrolled with an Australasian Continuing Professional Education (CPE) provider, Med-E-Serv. The overall effectiveness of a number of the provider's courses was assessed in terms of learner satisfaction, cognitive achievement and self-reported application of knowledge gained from the course or behaviour change in professional practice. In addition, the impact of pedagogical and instructional design moderators (timing, pacing, feedback/interaction, problem-based learning [PBL] and learner autonomy) was assessed in terms of their impact on learner achievement and satisfaction.

The study found that health professionals expressed a high level of satisfaction (overall impressions, 98.1%) with the learning environment and a statistically significant improvement in cognitive achievement (Eta-square = 0.551). Self-reported application of course content into practice, or changes in professional practice (recorded as review, modify, change) was high (68.7%). Of the courses examined, 57% used a clinical assessment tool that 96.8% of respondents implemented into practice. This high percentage combined with Z_{obs} analysis (3.757) indicated that behaviour change was greater as a result of those courses that included a clinical learning tool.

The study revealed that pedagogical and instructional design moderators are inherently positively correlated to learner satisfaction. For example, the association between interaction, course feedback and learner satisfaction was positively correlated. Additionally, PBL was viewed as conducive to learning (94.95%), a finding supported by the pre-post course test scores. Learner autonomy in choosing the rate and pacing of course material and their relationship to satisfaction was significant (0.774, $p < 0.05$). These findings indicated that the instructional design and pedagogical characteristics of Med-E-Serv's courses examined in this study not only supported learning but also were highly regarded by the participating health professionals.

Acknowledgments

I would like to acknowledge the following people for their contribution to this study:


- Dr Lynn Robinson, Med-E-Serv Director, and Ms Beth Hendy, Med-E-Serv Educational Manager, whose combined understanding and encouragement allowed me to complete this study.
- The group of health care professionals who willingly embraced this new educational technology and my intrusions into their learning environment.
- Dr Peter Orpin for his key comments in the final stages, which resulted in a more refined document.
- Dr Quyn Le, my ICT consultant, for her valuable advice, assistance, encouragement and knowledge of ICT.
- Professor Judith Walker, my principal supervisor, for her unending support, advice and encouragement. Her belief in me and my ability to complete the study through some very difficult times has shown her to be a true friend, colleague and mentor.
- The numerous friends and colleagues who have provided support and advice at key times.
- Finally, my supportive family--my wife Jennifer and our sons Alistair and Connor--whose patience and frequent cuddles made this research possible. Without them sacrificing so much, this study would not have been possible.

Proofread for language, completeness and consistency by Margaret Falk Editorial Services in accordance with the *Australian Standards for Editing Practice* and policy developed by the Deans and Directors of Graduate Studies.

STATEMENT OF ORIGINAL AUTHORSHIP

The work contained in this thesis has not been previously submitted for a degree or diploma at any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due acknowledgement is made.

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CHAPTER ONE

INTRODUCTION

1.1 Overview

The impetus for this study arose from an educational consultancy to an organisation providing continuing professional education (CPE) to the health sector. It built upon the author's previous and current teaching and consultancy work that has and is addressing issues such as education in the information age, changing workforce skills, demands on telecommunications infrastructure and the need for all education sectors to be competitive in a world economy. The pedagogical emphasis of the study was on learning within a World Wide Web-based environment, and looking specifically at the World Wide Web (Web or WWW) as a tool for teaching and learning in the CPE environment for health care professionals (HCPs).

The purpose of the study was to explore how pedagogical and instructional design issues associated with a course delivering Web-based instruction for HCPs impacted on learner achievement and satisfaction. Design issues for Web-based instruction were selected because, if Fox and Mills (1997) assertion that Web-based education technologies may improve educational outcomes and support totally new educational systems is correct, this may radically change the way traditional education is delivered. This assertion needs to be validated. By reviewing a Web-based CPE course in terms of instructional design and learners' cognitive achievement and satisfaction, this study attempted to answer the pedagogical question: what is good Web-based educational design? It attempted to provide insight into how to design effective Web-based courses. This is particularly important given new computational media such as virtual reality, multimedia environments, and the opportunity to learn anywhere at any time. This necessitated understanding of the structure of the technology environment, its functional features, and the educational pedagogy that underpins it. In turn this raises challenging questions about design and human-computer interface concepts which will need addressing if the medium is to be conducive to learning. Various researchers claim that the growth and use of the Internet for educational purposes makes it necessary to understand the pedagogical strategies that can be used for online teaching and learning (Bonk, Kirkley, Hara, and Dennen, 2000; Koschmann, 1994).

The Internet has great potential to provide a unique environment for teaching and learning (Anderson, 1998) and indeed educators from all grades and subject areas are using the Internet to connect their classrooms to the Web (Flake, 1996). This is in part because the Web has become a major repository of educational resources. A growing number of online sites provide easy access to lesson plans, classroom activities, demonstrations, searchable databases, educational events, and continuing education tools and materials (for example, ERIC clearinghouse, Eisenhower clearinghouse, e-magine, EduArt and Med-E-Serv). This study is intended to serve as a foundation for future studies examining how Web-based instructional design impacts on participant learning within the educational domain of continuing professional education.

In this chapter, a description of and rationale for the study is provided. The study problem is defined and the purpose and significance of the study, the research objectives and questions, the methodology, and the assumptions underpinning the study are outlined. Throughout the study specific literature that relates to CPE, CME and online learning are referred to. Some of the references are dated, however, this is due to the narrow focus of the study, which has been under reported in the medical and educational literature.

1.2 The Study Problem

1.2.1 The growth of the World Wide Web

The rapid growth and proliferation of the Web as a teaching and learning resource is apparent upon examination of search engine findings for the terms *teacher resources*, *learning resources*, *education*, *training*, *continuing education*, *continuing professional education*, *continuing professional development* and *continuing medical education*, as indicated in Table 1.1. In addition, examination of WEB66 (2002)--the International School Website Registry, oldest and one of the most comprehensive databases of K–12 schools on the Web--indicated the growth of K-12 Websites from one site in 1993 to over fifteen thousand sites in February 1999. Similar growth could be expected within other education domains such as CPE. No similar registry could be found for the number of CPE sites. However, as indicated in Figure 1.1, the

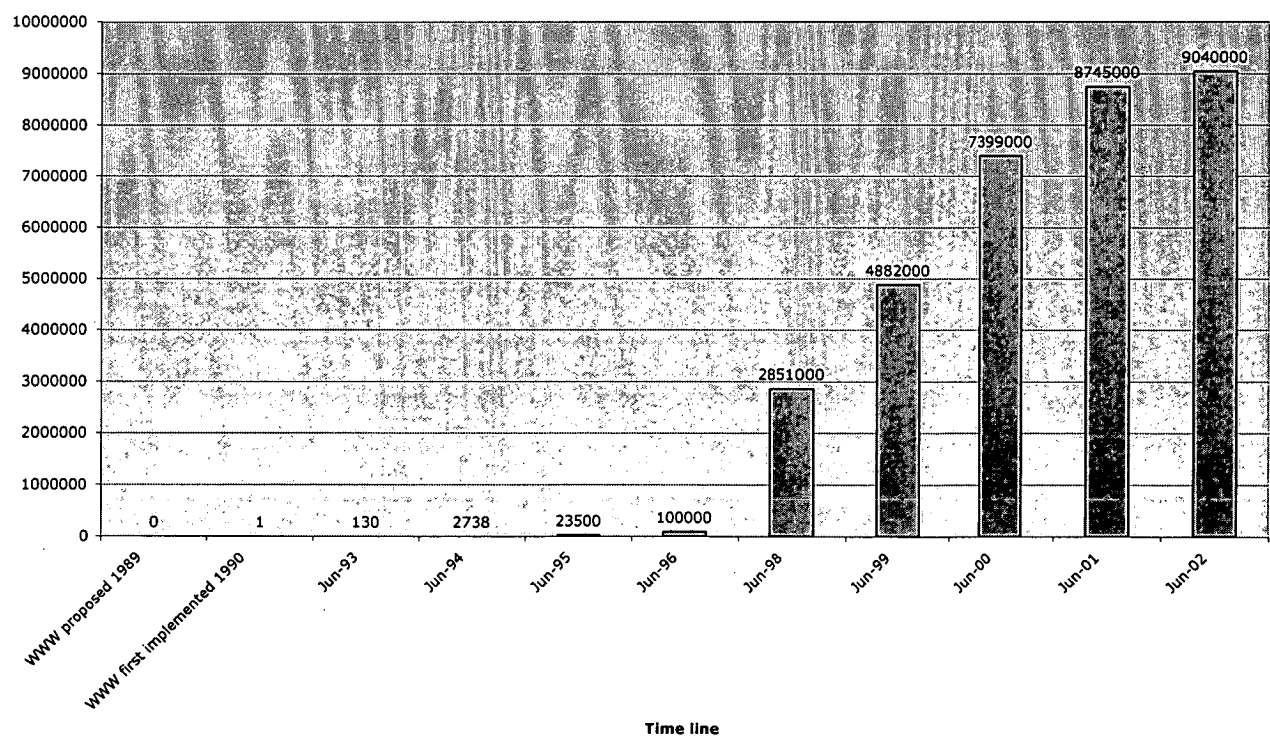
number of Websites¹ has grown dramatically from the initial site in 1993 to over 9 million in 2002.

Table 1.1 Search engine² findings for educational terms

Terminology	Number of sites
Teacher resources	676,000
Learning resources	1,140,000
Education	87,200,000
Training	60,700,000
Continuing education	2,850,000
Continuing professional education	112,000
Continuing professional development	207,000
Continuing medical education	421,000
Total	153,306,000

Source: Adapted from Yahoo.com search engine search 03/04/2004

Figure 1.1 WWW growth rate



Source: Adapted from Gray, 1995; O’Neil, Laviorie and Bennett, 2003.

¹ A Website is based on an Internet Provider (IP) address that delivers a unique http root page or home page (Gray, 1995).

² www.yahoo.com

The Web is being integrated into educational contexts in a number of different ways. Teachers and learners increasingly use the Web to conduct online inquiry-based projects and to gather content information on a particular subject (Wallace and Kupperman, 1997). The Web is also being integrated into the classroom as a tool for teaching (Shotsberger, 1996; Wright, 1998) and provides a new medium within which teachers and learners can publish their work (Friedland and Webb, 1996). In addition, teachers use the Web to gather lesson material, plans and activities for teaching and class use (Rakes, 1996). The Web provides both an opportunity and a platform for schools, universities and other bodies, such as Med-E-Serv, to deliver online courses (Collins, 1997a; Shotsberger, 1996; Smith and Taylor, 1995). Finally, interest is increasing in using the Web as a professional development environment for teachers and other professionals (Hammer and DiMauro, 1996; Slough and McGrew-Zoubi, 1996).

Research studies on the World Wide Web in education have focused primarily on the use of the Web within classrooms rather than on the Web-based resources themselves or on the use of those resources for learning (Owston, 1997; Windschitl, 1998). From a teacher's and educational researcher's point of view, Web-based resources and learning events must have practical value and be conducive to learning--that is they must provide for effective learning. At a National Association of Advisors for Computers in Education (NAACE) conference--a European educational conference for the implementation and development of technology in all areas of education, the British Minister for Learning Technologies, Willis asked: what constitutes effective and good practice in information communication technology (ICT)? (Willis, 2002). In order to commence addressing this question, this study looked at the instructional design characteristics of a course delivering online continuing professional education to determine the effectiveness of the course from instructional design, learner achievement and learner reaction points of view.

1.2.2 The changing face of education

In the past, the most important objective of education was the teaching of facts and skills. Today there is an intention among many educators to put as much emphasis on the actual process of acquiring knowledge as on the knowledge itself in essence, learning to learn. This educational approach helps learners to develop conceptual processes that enable them to become self-directed learners who are capable of learning new things and adapt to an increasingly dynamic, complex, and demanding workplace such as in the field of health care.

This model of education requires learners to develop independent learning skills that are centralised upon their motivation to learn (Steffin, 1983).

The education system is challenged both by the power of information technology (IT) and the need to use IT. ICT has the ability to be both a catalyst and a vehicle for implementing change and reform (Barker and Dickson, 1996). However, it needs to be remembered that ICT is used just like any other educational technology, as a means for information transfer. A study by Booth, Aiton, Bowser-Riley and Maber (1996) showed that Web-based materials that are not integrated into a structured framework have limited educational value. Web-based education, like class-based education, needs to be presented on a sound pedagogical footing.

If conventional didactic models of education in which the teacher is active and the learner is passive are used the application of ICT may only result in marginal improvement, if any, in the teaching and learning experience. Just providing educational bodies with ICT infrastructure, specifically computers and Internet access, will have little if any effect on learning, aspects not encompassed by Mulford's (2003) and Robertson, Webb and Fluck's (2003) recent investigation into ICT supported curriculums. Significant results will only occur if ICT is used in a learner-centred environment where both teachers and learners are aware of the pedagogical and informatic³ processes.

The area of informatics and pedagogy are full of jargon, confusion and variable structures. There are many models and frameworks in the literature relating to how technology can be introduced and used to improve the teaching and learning processes (e.g. Barker and Dickson, 1996; Duffy and Cunningham, 1996; Ramsden, 1992a, 1992b). Most relate to school-or university-based education. There have been very few studies concerning the vocational education or continuing professional education arena, and none of the studies or frameworks considered the effect of technology in terms of both informatics and pedagogy.

The methodological basis of this study is grounded in informatics, which is the "design orientated study of IT use with the intention to contribute to the development of both the use and the technology itself" (Dahlbom, 1996). This study is also grounded in pedagogical principles on how the teaching or learning environment affects learners' achievement and satisfaction. These principles include the need for the teaching methodology to incorporate

³ The connection of information science and technology

authentic learning and assessment tasks, the need to accommodate different learning styles, and the requirement for all learning tasks to build on and extend the learners' knowledge in the given teaching area.

1.2.3 Web-based distance education

Advances in ICT and new developments in learning theory provide opportunities to create new ways of designing and delivering education (Bonk, 2002; Khan, 2001). Web-based learning is one part of the recent integration of ICT into the delivery of education, particularly distance education. Distance education has been described as a planned learning event that occurs in a different place from the teaching (Moore and Kearsley, 1996). Due to the separateness of the learner from the instructor, the educational event requires special techniques in instructional design, communication efforts, and organisational arrangements.

Distance learning includes (a) synchronous communication, wherein the learner and instructor are present at the same time as the instruction, even though they may be physically separated in terms of place, and (b) asynchronous communication, wherein the learner and instructor are separated by both time and place (Phillips and Merisotis, 1999).

Distance education has been undergoing an evolutionary development process that has taken it from a historical model of print-based mail correspondence through to the current Internet-based approach. Computer-assisted instruction (CAI) was initially utilised as a supplemental tool to deliver classroom-based education but has now expanded into all parts of the educational sector (Rajendran, Tan, and Voon, 1990) including health and medical education.

In relation to medical education, it has been stated that medical professionals (Buckley, 1998) and educators (Reeves, 1999) often underestimate the value of research into the effectiveness of educational interventions. Difficulties assessing the effectiveness of continuing medical education (CME) relate to difficulties answering the questions: "what works, in what context, with what groups, and at what cost?" (Hutchinson, 1999). At the same time, traditional approaches to delivering medical education are being questioned through the demand for medical education to provide a broader vision of service that is more learner centred and based upon adult learning theories (Charlton, 2001; Headrick, Wilcock and Batalden, 1998; Richardson and Norris, 1997).

A review of randomised-controlled trials of continuing medical education concluded that CME experiences difficulties in its planning, delivery, effectiveness and efficacy (Davis, Thomson, Oxman, and Haynes, 1995). In essence, the overall value of this branch of postgraduate education is being questioned. This study examines the effectiveness of one branch of CME, namely Web-based CPE for health professionals.

The Internet joins a long list of educational tools that have been used for and have in themselves modified or enhanced the practice of teaching, including, but not limited to, the textbook, blackboard, radio, television, video and multimedia (LaRose, Gregg and Eastin, 1998).

The use of the Internet in distance education is opening up new and profitable ventures for institutions of higher education which may allow them to attract new and previously untapped markets of non-traditional learners or expand the courses being offered by the institution (Gubernick and Ebeling, 1997). This is the case with Med-E-Serv's CPE courses which deliver continuing professional education for health professionals, in particular general practitioners (GPs), through practitioner recognised and industry approved units and courses.

Some courses available on the Internet are delivered as a formal course with regular meeting times. Other courses follow a self-directed or learner centered approach, allowing learners to learn at a time and pace that is convenient to them. Within these courses, there is a wide range of disciplines and topics that cater for interest (informal education), professional education (development) through to formal qualifications at undergraduate and postgraduate levels. For the purposes of this study, formal industry recognised and accredited, continuing professional education courses were investigated.

A variety of applications are currently being used to deliver education on the Internet. These technologies include the use of the Web for online lecture notes, newsgroups for collaborative discussions and class announcements, e-mail correspondence between teachers and learners, and multimedia enhanced courses. However, with all of these media, the question that needs to be asked is how effective is the Internet in the delivery of education? In this study, a current example of an Internet-based health care professional CPE course is described and the components of the course that led to or detracted from learner achievement and satisfaction are analysed.

The use of the Web to deliver distance education is expanding, which is in turn testing new educational formats. However there are many critics who both underestimate and question the effectiveness of the Web to deliver worthwhile educational outcomes, particularly when the Web is compared to traditional face-to-face interactions. Many of these claims are unfounded, but not disproved. The use of computers as instructional tools is debatable, due in part to a lack of adequately controlled investigations to assess their effectiveness as an instructional modality (DeAmicis, 1997; Toth-Cohen, 1995). Several studies have been conducted to prove that computer-mediated education delivery is effective (Felix, 2002; Pipers and Wilson, 1996; Rajendran et al., 1990; Walsh and Bohn, 1990). There have been an equal number of studies that have found that in comparisons between computer-based and lecture-based models, learners have been more satisfied with the lecture-based model (Guy and Frisby, 1992; Kinney, Keskula and Perry, 1997). However, comparison of face-to-face education with technology-based education is not useful as it compares quite different media with different pedagogical implications. Like media should be compared to examine their pedagogical implications and effectiveness.

This study focused on the nature of interaction that is currently occurring in the learning context of Web-based continuing professional education, specifically within the context of an online accredited CPE programme for health care professionals in order to address issues of Web-based educational effectiveness and the moderators that influence this effectiveness.

1.3 Research Objectives and Supporting Questions

There is a lack of hard data about learner attitudes to Internet-based distance learning (Shea, Fredericksen, Pickett, Pelz, and Swan, 2000). This study was designed to provide such hard data to determine how learners who studied online felt about their course and to discover whether the most satisfied learners shared any characteristics, as well as identifying several moderators which influenced the effectiveness of the units studied. This generated a number of supporting questions that were refined and modified during the study. These are presented as Figure 1.2.

Figure 1.2 Research objectives and associated discovery questions

<p>Research objective 1: Quantify the overall effectiveness of the Web-based CPE course</p> <p>Research questions:</p> <ol style="list-style-type: none">1. Will learners enrolled in a Web-based CPE course have a positive reaction to the educational learning experience?2. Will learners enrolled in a Web-based CPE course acquire the knowledge disseminated through the educational experience?3. Do learners use the knowledge from the course in their work, that is, is the knowledge applied?
<p>Research objective 2: Assessing the influence of several factors (moderators) that are assumed to influence the effectiveness of the online learning event.</p> <p>Research questions:</p> <ol style="list-style-type: none">4. What are the successful and unsuccessful design influences and pedagogical techniques that enhance or distract from a positive learning experience in the Web-based CPE course?

1.4 The Study

1.4.1 Context

The study used a case study research methodology (Yin, 1994) combined with an adaptation of Kirkpatrick's (1998) multilevel evaluation of effectiveness framework to investigate the effectiveness of Web-based learning, for HCPs, within the context of several online CPE courses offered by a commercial CPE provider.

Numerous pedagogical developments and research findings in the field of continuing education state that learning can be more effective when:

1. learners are actively involved in the process of knowledge creation (Jonassen, Peck, and Wilson, 1999);
2. learning takes place in a realistic, role based context (Collins, 1997b); and
3. learners are supported to understand what they are learning (Vygotsky, 1978).

These findings are yet to be fully integrated into the field of CPE let alone into Web-based CPE for HCPs. Nonetheless, there are compelling reasons for Web-based teaching and learning

including the ease of information dissemination, interactivity, efficiency of access, opportunities for distance learning at the learner's convenience and opportunities to overcome didactic teaching practices.

According to the Society for Educational Technology in Dentistry (Jepson, 2002a), computer-aided learning (CAL) material has traditionally been developed using authoring packages which created little more than electronic textbooks, and the ability of the Web to support learning and interaction is still questionable. However, the Society recognised the potential that ICT may have in addressing practitioner skill shortages (Jepson, 2002b). Progress is being made in the scientific literature into the development and recognition of ICT or telematic⁴ support (technology supported environments) for specific educational needs. It is anticipated that this study will expand the knowledge of telematic-supported education (tele-learning⁵), or e-learning, by examining pedagogical and ICT support requirements for Web-based CPE. This last statement is particularly important as Shea et al. (2000) indicated that most research into computer based learning (CBL) has focused on the impact of individual technologies rather than the interaction of multiple technologies. However, this study focused on a number of media. In addition, Shea et al. (2000) stated that further weaknesses identified in the research literature related to a lack of a theoretical or conceptual framework. This study used a conceptual framework for understanding learner satisfaction and interaction within the Web-based courses.

Currently, educators are confronted with an increasing number of innovations in computer and information science and their associated by-products that present revolutionary ideas for creating teaching and learning environments. Such concepts as *Virtual learning*, *Virtual Universities*, *Virtual Communities*, and *e-learning* radically challenge notions of how teaching can be carried out and where learning can be achieved.

1.4.2 Case study selection

The choice of case studies was influenced by several factors. As the topic of this study was Web-based CPE for HCPs, the first selection criterion involved identification of courses offering Web-based CPE for HCPs to discover those effectiveness and interaction issues

⁴ Telematics is the use of communication technologies (Collis, 1997, p1)

⁵ Tele-learning is the making of connections among people and resources, via communication technologies, for learning related purposes (Collis, 1997, p1)

associated with Web-based CPE. The second criterion involved ascertaining how the course's instructional design and pedagogical factors (moderators) impacted on the learners' course achievement and overall satisfaction.

1.4.3 The educational provider

Med-E-Serv was established in 1994 to deliver electronically-based services to health professionals Australia-wide. The educational arm of Med-E-Serv, PriMeD, was launched in January 2002 and provides 150 hours of continuing professional education across 25 therapeutic areas and is accredited by the Royal Australian College of General Practitioners (RACGP) for its Quality Assurance and Continuing Professional Development (QA&CPD) program. As of January 2004 there were over 37,000 registered users, 8,000 of whom were Doctors, engaged with the online programs.

Med-E-Serv programme content is developed in conjunction with accreditation bodies, universities and the professionals themselves to ensure that its educational content is based upon evidenced-based practice principles, together with best practice evidence-based health care findings.

The backbone of the online learning courses is a purpose-made knowledge management system which provides not only a secure environment for its users but also allows the provider to tailor-make learning courses based upon the unique requirements of the learning material.

The educational courses also include a Personal Learning Journal which records progress through each educational experience and manages the recording of CPE (CME/CPD) points where these form part of the accreditation/assessment process.

Med-E-Serv has two branches in Australia, one in Sydney and the other in Brisbane, which together employ over 30 staff ranging from IT professionals through to administrative and content provider staff. The content provider staff includes representatives who are leading professionals in their fields and are chosen from both private and public practice, universities, peak research and professional organisations.

1.4.4 Research participants

For the purposes of this study, the term *learner* or *participants* refers to primary health care practitioners, including GPs, dentists, pharmacists, occupational therapists and nurses who were undertaking Web-based courses as a part of their CPE requirements, unless otherwise stipulated. The terms CME and CPE are often used interchangeably in the literature, however CPE will be the predominant term used as it forms the basis of lifelong professional education, whilst CME refers to specific medically-directed education. In addition, CPE was examined within the context of online or Web-based education, which is a branch of distance education (Carliner, 2002).

The participants recruited for this investigation were health care practitioners who were undertaking CPE courses through an Australasian e-learning provider. The participants were volunteers recruited over a period of 4 months, and as such, the sample size is one of convenience, totaling 313 individual participants.

1.4.5 Health professionals usage of ICT

Barnes (1998) identified the use of computers as a vital element required for the improvement of CME provision and this has, in part, been recognised by the Australian Government which, over a 3-year period, has injected more than \$15 million dollars into improving general practice access to and usage of computers (Kidd, 2002). Reasons for the use of ICT in general practice include but are not limited to better business practices (Richards, Bolton, Veale, and Quinlan, 2002), change in clinical practice and better patient outcomes (Johnston, Langton, Haynes, and Mathieu, 1994; Lock, 1996; Sullivan and Mitchell, 1995), and as in this study, obtaining access to CPE (Kidd, 2002; Richards et al., 2002).

An international survey of health professional's usage of the Internet (Mednet, 2001) analysed the results of 3030 online respondents. The results indicated that 56% were aged 40–60, with 54% from USA and 2.83% from Australia; the gender split was 49% male and 51% female. An overwhelming majority (83%) used the Internet for searching for medical literature. Limitations of this study were that the respondents' claims of professional status (family doctor, pharmacist, nurse, etc.) were not validated, nor their use of the Internet for CPE. However, the study does give an indication that health care professionals are using the Internet, which was supported by Barnes (1998) and Nielson (1998a, 1998b).

1.5 Protection of human participants

A standard ethics clearance for the study was authorised by the University of Tasmania Ethics Committee. Standard regulations for confidentiality and data collection procedures were required. In conjunction, the University of Tasmania's Research Ethics Committee authorised a plain English information sheet about the research's purpose, procedures and the requirements of participation for the self-volunteered participants. A statement of informed consent was to be by way of completion and submission of the appropriate survey tools.

1.6 Research Terminology

The understanding and use of terms associated with education and technology is often confusing and misleading. For this reason Chapter Two explores a brief history of the use of computers in education and current terminology associated with technology and education before an in-depth review of appropriate literature is presented. In addition, a glossary of terms is provided in Appendix 1.

1.7 Research Strategy

A case study research paradigm was adopted as the learning phenomena needed to be examined in a natural context using case study as its methodology. Miles and Huberman (1994a, p. 6, 1994b) contended that the main task of a case study is to explicate the way people in particular settings come to understand, account for, and take action and otherwise manage their day-to-day situations. The data collection methods included participation surveys, satisfaction surveys, and learning and application of knowledge surveys.

The theoretical standing was inductive, using a modified-grounded approach against extant literature on adult education, CPE, continuing medical education, technology-based education, and learning theory.

To further advance the study of the application of education in Web-based continuing professional education, the study was conducted using case study research strategies (Yin, 1994). The strengths and weaknesses of the case study approach are well reported in the literature (Cohen, Manion, and Morrison, 2000). Case studies can identify unique features that

might be imperative to understanding a case and the context in which the participants are being studied, whilst allowing flexibility to build upon unanticipated results. Whilst results may not be directly generalisable, case study research can provide valuable insights into other similar events (Cohen, 1998; Hiltz, 1998). For this interpretation to be generalisable it is necessary to give a detailed description of not only the telematic support options, but also of the broader educational settings in which the studies were conducted.

1.8 Research Methodology

The study used both qualitative and quantitative techniques to describe and analyse learners' attitudes towards Web-based instruction, from the perspective of effective instructional and pedagogical design. It also examined the interaction and instructional methods, strategies and activities associated with a Web-based CPE course. The research questions--methods, strategies and activities--were clustered into four major themes, three of which were centred on Kirkpatrick's multilevel assessment criteria: (Level I) learners' reactions to learning, (Level II) achievement, and (Level III) application into practice. The fourth area investigated instructional design and pedagogical influences on the other three themes. The underlying objective of the study was to examine whether CPE learners had a positive reaction to and acquired knowledge from the Web-based CPE learning experience, as well as demonstrating effective and efficient online pedagogical strategies.

All participants completed four surveys during the online course. The Level I data were analysed using descriptive frequencies and chi-square analysis; Level II data were analysed using independent paired t-testing and eta-squared analysis; and Level III data were analysed using descriptive statistics, Pearson product--moment correlation coefficient and Z_{obs} value. The effect of instructional design and pedagogical influences on participant learning, achievement and satisfaction was measured using descriptive statistics, chi-square analysis and Pearson product--moment correlation coefficient.

1.9 The Findings

Study findings supported the generalisation that the learners learnt, and applied that learning into practice. In addition, the case study learning environment (instructional design and pedagogical characteristics) was not only conducive to learning but also led to high learner satisfaction with the learning environment and learning context.

1.10 The Significance of the Study

In an era of rapidly changing technology, it is crucial to assess and evaluate the effectiveness of educational technology and learning (Bonk and Wisher, 2000; Carew, Chamberlain and Alster, 1997). When describing the effectiveness of Web-based CPE, the definition of effective must be carefully identified. Kirkpatrick (1998) described four different levels of assessment of effectiveness. Level I is described as the participant's reaction to the learning interaction, and is often measured using satisfaction surveys. Level II is the measurement of cognitive gains from the program, and is often measured using a post-test of knowledge. For comparative purposes, the pre-test and post-test design reveal changes that occurred as a result of the educational intervention. Level III assessment is designed to address whether or not cognitive learning has carried over into practical applications. This is difficult to measure in an educational environment (Davis, Thomson and Oxman, 1995; Richardson and Norris, 1997). Level IV effectiveness is of particular concern to the administrators of educational programs inasmuch as it describes the cost-effectiveness of the educational intervention--however this was not reported in this study due to the commercial nature of the examined material.

The significance of this study is that it will contribute to new educational models to guide the theoretical and empirical design and implementation of e-learning for CPE, particularly to HCPs. According to Hill, (2001) most telecommunications research has been presented at a theoretical and anecdotal level rather than at an empirical level. Several researchers (Elves, Ahmed, and Abrams, 1997; Mehta, Sinha, Kanwar, Inman, Albanese and Fahl, 1998; Rogers, Regehr, Yeh, and Howdieshell, 1998) have examined telecommunication use at the undergraduate medical level with mixed results, though computer supported learning (CSL) courses tended to reduce learning time and increase knowledge and skill level as compared to didactic lectures.

This study is supported by a large body of literature that asks how do we support online learning? (US Congress, 2002, Janicki and Liegle, 2001; Paulsen, 1995) and do learners actually learn online? (Bork, 1986; Janicki and Liegle, 2001). In addition, Neame, Brooke, Stitt and Rake (1999) suggested that medical education has remained largely isolated from the educative telematic changes that have occurred in most other corporate businesses, which also makes this study both timely and warranted. Richardson and Norris (1997) conveyed the message that health care professionals are interested and indeed are willing to pay for online CPE, which provides further impetus for the study.

It is implied that whatever the theoretical basis of CPE, its provision in North America, and presumably elsewhere, is not very effective in changing physicians' performance because the systems used are not effective in eliciting changes in physicians (Davis et al., 1995). Friedman (2000) argued that CPE has become stuck in time, space and content, by which he implied that CPE remains largely didactic and subject orientated. This contention is supported by others (COA, 1998) making an e-learning empirical study both timely and immensely practical.

Based upon this researcher's guiding principle that information is not learning (supported by Shank, 1998), this study aimed to produce the theoretical and practical outcomes outlined below:

1.10.1 Theoretical outcomes

1. Insights into current adult learning theories particularly as they relate to health professionals' generally and health professionals' learning through e-learning CPE specifically.
2. Contribution to theories on how, why and when health professionals learn in a virtual environment, in essence health professionals' learning strategies.

1.10.2 Practical outputs

1. Evaluation of whether or not an e-learning course can improve the educational performance of health professionals.
2. Needs assessment methods and tools that can be translated into e-learning courseware development for HCP CPE.

3. Contribution to the development of action steps or guidelines for CPE courseware development and specifically for Web-based HCP CPE courses.
4. Representative evaluation studies into e-learning-based CPE through the Web.
5. Validation and advancement of the understanding of outcome measures appropriate to Web-based HCP CPE.

1.11 Limitations of the Study

This study was restricted by certain conditions that were beyond the researcher's control. The voluntary and self-selected nature of the sampling potentially limited the results of the study. It is possible that the learners' reactions to Web-based learning were partially preconceived, dictating their enrolment in the Web-based course.

The study was also restricted with regard to the individual characteristics of the participants. The learners recruited for the investigation were all health professionals undertaking one of Med-E-Serv's 42 online courses for their continuing professional education requirements. The performance and reactions of these participants may not be reflective of every health care professional that undertakes a Web-based CPE course.

The instruments used to assess the dependent variables also limited the study. The tools utilised in this investigation to measure learner reaction (Level I) and learner achievement (Level II) were author-developed tools or author-provider modified tools, which were based on the moderators identified through the review of both the courses and the literature. It is possible that the reaction survey (Level I), the test of knowledge survey (Level II) and Level III application of knowledge into practice survey may have failed to "tap" the dependent variables in a comprehensive manner, or that other instruments, based on different design and theory, may provide a better measure of the reaction and achievement of the participants.

The study was restricted to those learners enrolled in one of Med-E-Serv's 42 CPE courses (see Appendix 2). Therefore, the results of this study may not be descriptive of other, similar populations.

The study was limited to a specific professional and academic population, health care professionals enrolled in Med-E-Serv's online courses. Therefore, the results may not be

generalised to other learners enrolling in Web-based courses for other online CPE courses or other online non-professional education courses.

In addition, the study was restricted to learners enrolled with a relatively large CPE provider with over 37,000 registered users. As a result, the findings from this study may not be generalisable to other Web-based courses with different user characteristics and learning requirements.

Further to the above limitations, the study used a modified Kirkpatrick's (1998) multilevel evaluation. In particular, the Level III evaluation of effectiveness was modified from Kirkpatrick's original intention of delivery some months after completion of the training. The reason for this is that the nature of Med-E-Serv's online courses required the users to study over a period of time, usually several weeks, during which time the participants put into practice or reject knowledge and training tools that were made available to them during their online CPE course. Therefore, these participants should have had ample time to reject or apply the CPE material into their work practices. Kirkpatrick (1998) claimed that the Level III analysis is the most difficult and time-consuming analytic process and that it requires a significant investment in time, finances and control on the part of the investigator. It is for this reason that the Medical Director of Med-E-Serv and their Educational Training Manager assisted the researcher in analysing the respondent's replies to the application of knowledge questions, to ensure that the responses were viewed both from an educational and clinical perspective.

1.12 Thesis Overview

The primary purpose of the study was to examine the reaction and learning of participants enrolled in a Web-based CPE course. The secondary purpose was to determine the instructional design and pedagogical characteristics of the course that had an impact on learner reaction and achievement.

In Chapter Two the current and historical aspects of technology, especially as it relates to education, are investigated. The chapter then provides a review and analysis of the supporting literature relevant to this topic. The characteristics of learning, ICT development and application to learning, for education in general and HCP CPE specifically, are reported.

Previous research findings concerning the characteristics of learning, characteristics of the ICT medium, and identification of ICT moderators that are assumed to affect learning are then reviewed. Research and literature that is relevant to the contexts and terms of adult learning, the constructs of adult learning, learning theories, and ICT and learning are also reviewed.

In Chapter Three, the methodology used in the study is outlined. A description of the case study setting and participants is provided to allow the reader to be grounded within the scope of the study. The chapter continues by outlining data gathering methods and the process and administration of the data collection. In the chapter the data analysis framework is explained and a time-line for the stages of the study is presented.

In Chapter Four, the results of the study are presented within the framework of the two learning objectives and four supporting research questions.

In Chapters Five and Six there is discussion of the findings of the study, bringing them together to form conclusions that concur with, refute or contribute to the literature on Web-based learning reviewed in Chapter Two. Chapter Six concludes with recommendations for further research.

References used in this study are listed at the end of this document. Appendices 1 to 10 present definitions, the ethics requirements for this study, survey tools, the content analysis, and samples of the open-ended questions from the survey tools and sample Web-based courses studied.

CHAPTER TWO

REVIEW OF THE LITERATURE

2.1 Overview

To gain a full understanding of Web-based education, a broad examination of the educational and scientific literature on the application of e-learning was undertaken. It focused on learner achievement, course satisfaction and application of course material into practice, or practice change as a result of the course, together with instructional and pedagogical design in order to identify potential questions for the study.

The review forms the basis for the investigation of Web-based CPE for HCPs, described in Chapter 3. The chapter is divided into six sections. Section 2.2 reviews literature on education and ICT technology. Section 2.3 reviews literature related to learning, CME, and CPE specifically as it relates to health care professionals. Section 2.4 reviews literature on evaluation methodology and its usage in ICT supported education. Section 2.5 presents literature examining the relationship of learners', particularly health care professionals', reactions and achievements through interaction with computer technology, including the Web. Section 2.6 identifies and explores literature on learner course achievement in ICT supported learning environments. Section 2.7 explores literature on the impact of instructional and pedagogical design moderators on learning and specifically on Web-based learning. This section also outlines the study's hypotheses as they emerge from the literature; especially the moderators identified in sections 2.5-2.7. The chapter concludes with a summary.

2.2 Education and ICT terminology

2.2.1 Defining terminology

The understanding and use of terms associated with technology-mediated education is often confusing and misleading. For this reason a glossary of terms is provided in Appendix 1 to support the study. Web-based education is a subset within the field of electronic education (e-education). Whilst many educational researchers and theorists (Gotschall, 2000; Hall, 1997; Karon, 2000; Schreiber and Berge, 1998; Urdan and Weggen, 2000; Zahm, 2000) have written about where e-learning fits within a hierarchical arrangement, none of the current definitions

and hierarchies appear to fully encompass the overlapping nature of e-learning, or take into consideration online learning's greatest potential to deliver *just-in-time* and *geographically where required* learning. This adaptability of online learning does not fit the existing category *distance education*. So a new definition of distance education is required that allows for both planned and unplanned experiences, autonomous and directed learning, together with the ability to be used anywhere at any time (geographically independent, asynchronous and synchronous). This new definition then permits e-learning to be a component or subset of not only classroom-based education but also of distance education. E-learning is the acquisition and/or use of knowledge distributed and facilitated by electronic media that incorporates synchronous and/or asynchronous access through geographically distributed locations and time. Online, computer-based, satellite distributed, and videoconferencing are but a few media examples of e-learning environments. Using this definition of distance education, online learning, an example of e-learning, was studied.

Teaching and learning is continually undergoing change due in part to pedagogical, economic, social and technological forces. Indeed, Urdan and Weggen (2000) revealed that rapid developments in technology have redefined the processes that underline the design, development and delivery of education. In this teaching and learning evolution, however, several terms have been attached to characterise the innovation and creation that has been occurring. These terms include e-learning, distributed learning, distance learning, online learning and Web-based learning.

Gotschall (2000) defined online education as an all-encompassing term that refers to all training and education done with a computer over a network, including an institution's Intranet, LAN (local area network), and the Internet. Schreiber and Berge (1998) purported that online learning is any technology-based learning that allows direct access of information, which supports Gotschall's definition. Further to this, Urdan and Weggen (2000) declared that online learning constitutes just one part of e-learning and includes learning via the Internet, Intranet and Extranet. Levels of sophistication of online learning vary. It can extend from a basic online learning programme that includes text and graphics of the course, exercises, testing, and record keeping, such as test scores, through to sophisticated online learning programmes. Sophistication includes animations, simulations, audio and video sequences, peer and expert discussion groups, online mentoring, links to materials on other Intranet or Websites, and communications with education records of development. This later scenario describes this

study's course environment.

Given the broad definition of online education, Hall (1997, 2000a, 2000b) defined Web-based education as instruction that is delivered over the Internet or Intranet with the material accessed through a Web-browser such as Netscape Navigator or Internet Explorer. Given the progression of definitions (Gotschall, 2000; Hall, 1997; Urdan and Weggen, 2000), Web-based education, online learning, e-learning, distributed learning, Internet -based learning and net-based learning all speak of each other and therefore, the terms online and Web-based will be used unless specifically stated.

2.2.2 Technology in education

One of the major reasons for using the Internet for flexible teaching and learning is that it provides access to courses for many learners who are unable to attend face-to-face sessions, for numerous reasons including work commitments and costs. It can also provide valuable interaction for learners studying at a distance by reducing their sense of isolation. Web-based education may be delivered in four distinct teaching and learning modes:

1. Informational, where course information such as course outlines and assignment descriptions are available on the Web;
2. Supplemental, where a part of a course is delivered on the Web. Generally this is reading materials with hyperlinks to supporting sources;
3. Dependent, in which most of the course material is available on the Web, and
4. Fully developed, where the entire course is delivered on the Web and face-to-face contact may not occur (Hall and LeCavalier, 2000a, Hall and Snider 2000b). This was the situation with this study's case study site.

2.2.2.1 Computer support for learning

Wittgenstein (1953), in his preface to his philosophical investigations, struggled with the notion of writing as a linear process, when it is derived from complex, non-linear thought processes. He described his thought process in terms of travelling "over a wide field of thought crisscrossed in every direction ... (much like a) long and involved journey" (p. ix). These descriptions are as relevant today, if not more so in a Web-based environment, as they were

half a century ago. Text is, as with thought, a continually shifting locus of a series of points, always interconnecting, never singular.

The advent of the World Wide Web and the Internet, together with advances in computer and software technology, allows Wittgenstein's interconnected texts--which Theodore Nelson (Nelson, 2002) termed hypertext, an extension of Vannevar Bush's 1954 suggestion for a non-linear, interconnected text system (Bush, 2002) to become an educational reality.

With the amount of information available on the Internet, there is a real danger of becoming 'lost in the mass of the inconsequential'. Internet users need to be able to decipher what is relevant and what is not. Even back in 1945, Bush envisioned the creation of a machine that could create a non-linear, interconnected text system that has the ability to act as a library to retrieve and sort information for user relevance. Bush termed this 'memex' (Ottawa University, 2002). Whilst the memex system was never built, it provides the impetus for the development of fast, associatively indexed retrieval systems, which are networked to other such systems (allowing for interconnectivity), which is the basis for the Web.

This interconnectivity is what is known as hypertext, which Landow (1994) described as "text composed of blocks of words (or images) linked electronically by multiple paths, chains, or trails in an open-ended, perpetually unfinished textuality described by the terms link, node, network, Web, or path--termed *lexia*" (p. 3). Given the changes in multimedia use within the Internet today, Landow's definition needs updating as it pertains not only to text (or images) but also to sound, animations, pictures or any other auditory, visual or tactile mediums that can be linked electronically by any of the previous *lexia*.

The fastest and best known of the hypertext systems in use today is the World Wide Web. The Web was developed by Tim Berners-Lee at the European Laboratory for Particle Physics, building on the research of Doug Englebart (inventor of the computer mouse) and Theodore Nelson (Berners-Lee, 1994). From initial research beginning in the 1980s, the Web has grown at a rapid rate from an initial site in 1990 through to an estimated 3 million Webpages⁶, in 1995 (Gray, 1995), to an estimated 9 million sites in 2002 (O'Neil et al., 2003). The Web is also replacing other Internet-based media such as Telnet and has incorporated other Internet-based

⁶ Webpages and Websites are not the same, as a site may have several Webpages or it may contain thousands (Gray 1995).

computer-mediated communication protocols such as e-mail, ftp sites, newsgroups and gopher sites. Consequently most electronic discourses will be filtered through the medium of hypertext, thus changing the way text is written, read, and used, for instance e-mail less structured and formal than written mail and short messaging services (SMS) use of alphanumeric characters to represent complex sentences and thoughts via the use of symbols such as 4CU--see you after 4. Thus, hypertext presents a medium in which learners can choose when and how they learn, by actively engaging in the learning process which may alter the tone or the comprehensive meaning of a particular lexia or node as well as their reaction and achievement within a Web-based learning environment.

The popularity of technology in education seems to have evolved in part from the urge to interact with other visual and auditory media, such as television and radio. Computers allow an interactivity that television does not, but despite the increasing ability to manipulate links and incorporate multimedia, the majority of Web-based material is still largely textual.

One of the drawbacks of electronic text as a medium is the difficulty in seeing what is on the screen as real text, and learners find that reading work is best done on a hard-copy printout. This may be partly due to the socialisation of print technology (words on paper) as the dominant medium for reading from childhood, and partly due to current technical constraints (small screen size, text clarity, flickering screens, etc.).

Certain technological enhancements, such as the ability to *bookmark* sites and within the text to allow for easier navigation in a large document, and the production of larger, higher-quality monitors, will help users to read online text. However, the need to read text on paper will probably remain a necessary part of the learning process for this is how most of us learnt to read both formally and through environmental/visual text (for example street signs and cereal boxes).

2.2.2.2 Web-based education

Khan (1997) defines Web-based instruction (WBI) as "...a hypermedia-based instructional programme, which utilises the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported" (Khan, 1997, p. 381). Alternatively, Relan and Gillami (1997) define WBI as "...the application of a repertoire

of cognitively orientated instructional strategies within a constructivist and collaborative learning environment, utilising the attributes and resources of the World Wide Web.”

WBI, also called Web-based training (WBT), is defined by Clark (2001, 1996) as “...individualised instruction delivered over the public or private computer networks and displayed by a Web browser. As such WBT is not downloaded but rather on-demand training that is stored in a server and accessed across a network.”

Though the above definitions are not identical, there is a common theme, which is that Web-based education takes advantage of the Internet and World Wide Web to deliver education, usually through browser software.

2.2.2.3 Web influences

With the growth in use of, and access, to both the personal computer and the Web, educators and learners are gaining unprecedented access to curricular resources. This will change the way Web-based materials are developed, conceptualised, and adapted to local contexts. Norman (1993) argued that even when technology is correctly predicted, it is rare that anyone truly understands its real impact. It is for this reason that the current study examined the instructional design and pedagogical Web characteristics that promote or detract from the learning process within one selected case study in order to produce recommendations for similar learning events.

Many Websites are modelled after familiar, well-established print materials such as reference and textbooks (Owston, 1997). This allows teachers and course developers to have relatively easy access to a large volume of resource materials within a familiar setting that often resembles an online textbook or library. However this researcher, like others (Habermann, Burton and Frender, 1998), argues that the full potential of the Web as an educational environment is not being fully utilised or realised. Further to this, Habermann et al. (1998) envisioned the Web supporting ‘an information arcology’, where users can interact with information and mould it according to their own needs; much in the way Bush envisaged the memax machine back in 1945. These researchers believe that we are in the early stages of the creation and diffusion of the Web as an educational tool.

This study serves as a foundation for future efforts to track the implementation, reinvention, and diffusion of Web-based education. Tracking the diffusion process will require new and innovative educational research approaches that are longitudinal in scope, and for this reason it is hoped that this study will form the basis of Med-E-Serv's documentation and research into their online CPE programme. Additionally, it is hoped that this research will contribute to the development of online education in general.

2.2.2.4 Defining design issues

Any learning event can be a complex amalgam of teaching methods, learning strategies, and assessment methods in the context of an instructional environment. The learning event is further complicated by the variety of products, educational outcomes, assignments, and personal motivation levels. A complete investigation into the quality and effectiveness of a learning event such as an online course is extremely difficult. This study focused on instructional and pedagogical methods used in an online continuing professional education course for medical education. Instructional methods involve relationships between materials/resources, instructors/electronic facilitators, and learners, whilst pedagogical methods refer to the teaching (instruction) processes used to design, deliver and evaluate the teaching and learning events. To facilitate this discussion, the author-derived term *e-pedagogy*⁷ will be used to describe the teaching and learning approaches of instructional design and pedagogical approaches undertaken in ICT environments.

According to Driscoll (2001) e-learning has traditionally focused on technology, but e-learning is much more than technology, it also concerns the human factors. Clark (2001) supports this humanistic approach by stating that training programmes need to evaluate which components of online learning produce effective results. Barron (2001) believed effectiveness could be measured by concentrating on determining which elements of a programme are effective and which are not.

Clark (2001) and Morrison, Ross and Kemp (2001) suggest that instructional methods need to be carefully chosen in order to address content and learning outcomes. Dick and Carey (1996) stated that instructional strategies should be based on current outcomes of learning research

⁷ e-pedagogy is an author-derived term to encompass the areas of instructional design and pedagogy. Therefore e-pedagogy is the educational application of instructional design for teaching and learning purposes. As such, e-pedagogy speaks of both instructional design and pedagogy.

combined with current knowledge of the learning process, all of which supports the content to be taught and the characteristics of the learners. Moore (1994) included teacher characteristics and the learning environment as factors that should influence the selection of instructional methods. Furthermore, some instructional methods in the online environment may capitalise on the strength of the computer technologies more than others. Consequently, the choice of instructional methods may affect the effectiveness and the quality of the course. Instructional methods for the purpose of this study were defined as “ways of helping someone to learn” (Reigeluth, 2002, 2001, 1995). The various specifications in the work of Dick and Carey (1996), Morrison (2001), Moore (1994) and Reigeluth (2002, 2001, 1995) have been encapsulated in the author-derived term e-pedagogy to describe ICT usage for teaching and learning.

Web-based education can be under-utilised if materials are simply ported (transferred) from one medium to another, for example, by transferring existing course material as is to Web-based, without considering the medium’s capabilities, such as graphics or communications (Parson, 1997). Using existing course material and ignoring technology feature possibilities, and so not restructuring the material to fit the features, can lead to learners learning less (Alexander, 1996). The area of instructional design is the systematic process of translating general principles of learning and instructional design theories into plans for instructional materials for learning, to ensure the quality of the instruction and hence of the teaching and learning experience (COE, 2003).

A component of instructional design theory is the notion of usability design. Usability issues in the design of Web-based education include:

1. Lack of interest in interface design, since course authoring systems allow the developer to cut and place text and graphics into pre-designed Webpage layouts, and so are expected to do the work of making a site attractive and easy for the user to interface with (Squires and Preece, 1996);
2. The need to replicate or improve on the best of face-to-face instruction by taking advantage of the Web’s capabilities (Welsh, 1997), and
3. Focus on the learners and their tasks rather than just on the content (Jones and Okey, 1995).

If the Web's educational potential is to be fulfilled then issues such as educational effectiveness and e-pedagogy need to be studied in order to produce e-learning theories and recommendations for courseware development. Two researchers sum up this argument more succinctly. Firstly, Boling and Sousa (1993) stated that: "if people cannot use what is being delivered to them, or if they will not use it because it fails to support them in crucial ways, the promise of technology is subverted before it can begin to be fulfilled... responsibility for learning outcomes can not afford to lose a measure of learner motivation to poor interface decisions, or to lack awareness ... that design issues must be addressed." This statement is further supported by Nichols (1995) who predicted that: "... the Web will likely soon become the most popular medium for the delivery of distance education type materials." On the basis, that these two statements are correct then additional research is required within this education domain, in terms of e-pedagogy and learning theory.

2.2.2.5 Benefits and limitations of Web-based education

Web delivery of education provides many benefits and limitations to both learners and the delivering teacher or organisation. The following benefits and limitations have been summarised from the literature reviewed:

Learner benefits:

- Flexibility to pursue education when and where required – this is usually referred to as *just-in-time* learning and *geographically independent* learning.
- Flexibility of synchronous or real-time learning and asynchronous or delayed learning.
- Ability to interact with peers and leaders in a variety of disciplines or locations.
- Reduction in or elimination of travel and accommodation costs often associated with distance learning.
- Flexibility for self-paced learning or structured learning dependent on the structure of the course.

Teacher or delivering organisation benefits:

- Lower costs in electronic publication of course material compared to printing the same material.
- Ability to re-use and re-engineer course material faster than with traditional print-based methods.

- Ability to automatically track learner access and progress to course material.
- Larger number of learners can be enrolled in a course.
- Potential source of new revenue or potential to revitalise under-subscribed traditional courses.
- Potential to offer courses not generally available by hiring in the instructor or joining another organisation to offer the course.
- Automation of learner evaluations with online interactive quizzes.

Learner limitations:

- Lack of direct human contact leading to reduced motivation.
- Internet communication methods such as e-mail and bulletin boards (listservs) may be awkward or intimidating for some learners.
- Cost of computer and technology access equipment, together with on-going access to Internet provider costs.
- Learners may have a lack of technical support to assist them with technology problems or software tools needed to do assignments.
- Vastness of the World Wide Web with the ability for learners to get lost amongst the millions of Webpages.

Teacher or organisation limitations:

- Relatively high setting-up costs and ongoing technical support costs.
- Requires finances and time to update staff in using the technology.
- May be no incentives for staff to use the new technologies.
- Unreliability of ICT equipment both hardware and software may cause problems in the delivery and maintenance of the course.
- Current authoring software limiting and restrictive and plug-ins or extensions to the authoring language poses restrictions on the types of Internet browsers that can be used to adequately and effectively view the course material
- Bandwidth limitations make some interactive or multimedia material slow or ineffective.
- Learners typically have varying computer equipment and software necessitating the development of material in both high and low bandwidth formats. This requires more time to develop and maintain the material. This may be overcome by CD-ROM and hybrid Internet-CD-ROM courses.

(Adapted from Aherne, Lamble and Davies, 2001; Alegre, 2002; Alexander, 1996; Althaus, 1997;

American Society of Training and Development [ASTD], 2000a, 2000b; Barron, 2001; BECTA, 2002; Bonk and Wisher, 2000; Clariana, 1997; Hall and Snider, 2000; Walker and Kelly, 2002; Zahm, 2000).

Hendy (1995) best summarised the above limitations when she wrote that the information superhighway can offer a new view of education and, faced with this remarkable array of ICT delivery, media, educators and learners face a challenge in choosing the most effective tool for the task. It is at this functional level that this research attempted to answer some fundamental questions as to what works in a Web-based course and how effective is it for learning. Based on Hutchinson's (1999) question "what works, in what context, with what groups?" Strother (2002) goes one step further with her belief that the obvious advantages of e-learning will not be available until systematic research is done to confirm that learners are actually acquiring and using the skills that are being taught online and that any research must be grounded in solid theoretical practices to assure that meaningful results are obtained.

2.3 Learning, CME and CPE

2.3.1 The contexts and terms of learning

The study focused on adult continuing professional education or learning that occurs during lifelong learning. Adults learn within institutions, outside institutions, in different settings, and under different circumstances across their lifetimes. In order to analyse the literature and understand independent self-directed learning/teaching, and CPE particularly, it was important to sketch the broader picture of the field. The work of researchers and theorists of adult teaching and learning from the United States of America, Canada, the United Kingdom and Australia from several decades were reviewed. The terms *formal learning*, *non-formal learning*, *independent learning*, *self-teaching*, *self-planned learning*, and *self-initiated learning*, *self-directed learning*, *continuing professional education*, *continuing medical education* and *informal learning* were examined.

2.3.1.1 Learning terms

Although there appear to be subtle differences between definitions of formal learning, formal learning is typified as compulsory; of considerable duration; organised around a curriculum; defined and assessed by either the institution, industry, discipline, or profession; consisting of

lessons which are directed by the professionally qualified teacher; and leading to an educational qualification (Armstrong and Davis, 1975; COA 1998; Charlton, 2001; Foley, 2000, 1995; Houle, 1996, 1992, 1983, 1980, 1961; Livingstone, 1999, 1998; Merriam and Caffaralla, 1991; Mocker and Spear, 1982).

Aspects and definitions of non-formal learning are similar, in that they agree that non-formal learning is characterised by the learner's choice of topic and the voluntary nature of participation, and that authorised providers or social institutions may conduct the courses. The differences between formal and non-formal learning appear to focus on the accreditation of the learning (Brookfield, 1983; Foley, 1995, 1983, 1981; Jarvis, 1999, 1987; Livingstone, 1999, Mocker and Spear, 1982).

The term independent learning may occur in a range of contexts, although generally it appears to be associated with an educational institution, where the teacher may or may not be present. Independence is related to the control the learner has over design and pace of the study, methodology and assessment of learning outcomes. However, sometimes the term referred to learning of an informal nature (Brookfield, 1983; Candy, 1991; Moore, 1985, 1973; Tough, 1971).

Definitions of self-directed learning refer to learners taking control of their own learning, or to a learning environment promoting self-directedness on the part of a learner, or to a philosophy of self-directedness in learning. Self-directed learning may occur inside and outside of institutionally-based learning programmes (Brookfield, 1983; Candy, 1991; Harris, 1989; Knowles, 1975, 1990; Marriam and Caffaralla, 1991; Mocker and Spear, 1982; Penland, 1981, 1979, Tough, 1971).

Tough's (1967, 1968, 1971) concepts of self-taught and self-planned learning related to a non-institutional environment. As with Brookfield's (1981) thoughts on independent learning, Tough first referred to self-planned learning as occurring in an informal learning environment. The concepts behind the use of the terms used by Tough, Brookfield, and Penland have contributed to an understanding of self-directed learning. However, their initial ideas of informal learning as occurring outside a formal institution remain, and will be addressed below.

Informal learning differs from formal learning that may occur in an institution, through the placement of the purpose of the learning in the hands of the learner. Livingstone (1999) agreed that informal learning may be contained in the general “social interactions and daily life” of Henze (1992) and Jarvis (1999, 1987), the “practical doings” of Armstrong and Davies (1975), and the “learning from experience” proposed by Foley (1995). However, his definition extends those presented here by declaring that a learning activity can be any activity involving a pursuit of understanding, knowledge, or skill. Livingstone claimed that informal learning might be more than the “unintended or incidental” learning contended by Marsick and Watkins (1990), Percy, Barnes, Gradin and Marcell (1988) or Foley (1995). Livingstone declared that for learning to be a significant encounter, it needed to be recognised and identified by the learner as such (1998b, p. 1).

2.3.1.2 Context of continuing professional education (CPE) and continuing medical education (CME)

Given the insights into learning forms, CPE may not fit precisely into any of the models. For most health professionals CPE is the longest part of their health education (Catto, 2001).

CPE is a requirement for health professionals. The General Medical Council (1997) stated that all responsible professionals should try to keep up with research within their discipline. Petersen (1999) stated that educational research has not figured widely in medical training until very recently. These aspects indicate that research into the effectiveness of medical CPE is required.

CPE for health professionals is defined as ‘any of the ways which doctors learn after formal completion of their training’ (Davis, 1998, Davis, Thomson, Freemantle, Wolf, Mazmanian and Taylor-Vaisey, 1999). This definition requires modification for this study so that the term ‘doctors’ is replaced by ‘health care professionals’. Hence, CPE is ‘any of the ways which health care professionals learn after formal completion of their training’. This definition is contrary to Grant and Stanton’s (1998) definition that CME is a process that is more teacher centred and didactic whilst CPE is more learner centred. However these terms are used interchangeably in the literature (Clearlan, 2001), and so the term CPE will be used unless otherwise stipulated. As accreditation and registration programmes become more widespread in the health professions, the effectiveness of CPE is coming under closer scrutiny by

governments, patients and the professions themselves (Grant and Freeman, 1999; Richardson, 1997).

The Internet has permitted the global distribution of medical education whilst at the same time creating opportunities for institutions to develop and extend existing material (Harris, Salasche and Harris, 2001; Richardson, 1997). An example is the partnership between the *British Medical Journal* and *Western Journal of Medicines* online school (Medschool.com, 2000). However Greenhalgh (2001) and Harris et al. (2001) stated that these online collaborative initiatives may overlook several important questions such as ‘what is the effectiveness?’, ‘will learners use it?’ and ‘what about economics?’

There are predictions that Web-based education will grow tremendously in adult and vocational educational settings (Imel, 1997; Phillips, 1998) and by association CPE should also grow. As Web-based courses proliferate, skills in searching, discovering, filtering, integrating, and disseminating knowledge become vital and understanding what constitutes effective design and assessment methodology becomes equally important.

2.3.2 Adult learning principles

The underlying philosophy of the case study course was the need to employ adult learning principles in the design, production, delivery and assessment of the CPE courses. This philosophy, coupled with the use of ICT, has led to what Moore (1991) called the ‘transactional theory of distance education’ in which ICT media affect the structure of course design, the type and nature of the dialogue between the learner and instructor, and the autonomy of the learner.

Knowles expanded on the work of Lindeman--one of the earliest writers on adult education (Jarvis, 1987)--by building on his humanistic/progressive education philosophies to formulate the concept of andragogy (Knowles, 1987, 1990). Knowles’ theory of andragogy emphasized that adults are self-directed and expect to take responsibility for their learning decisions; hence, the theory makes the following assumptions:

- Adults need to know why they need to learn something;
- Adults need to learn experimentally;

- Adults approach learning as problem-solving, and
- Adults learn best when the topic is of immediate value.

In practical terms, andragogy means that instruction for adult learners needs to focus on real-world problems and processes and less on content. Knowles (1987) identified several characteristics or conditions that are required for effective adult learning to occur. These conditions included:

- Where learners accept a share of responsibility for planning and operating the learning experiences and therefore are committed to the process;
- Where learners perceive the goals of the learning experience to be their own goals, and
- Where learners actively participate and by doing so sense progress towards their own learning goals.

In addition, Knowles (1987) proposed that adult learners need to learn from relating learning processes to their own experiences. Hence, his theory of andragogy incorporates constructivist processes as per Vygotsky's (1978) constructivist theory and problem based-learning (PBL) (Barrows, 1994) approaches. These theoretical associations were supported by the work of Jarvis (1997, 1999) who believed that adult learners take responsibility for their learning decisions. Closely associated with the work of Knowles (1987, 1990) was the work of Kolb (1984, 1985) and Honey-Mumford (1986). Both of these educationalists proposed that adults learn best when their individual learning styles and preferences are accommodated within the learning material (Honey-Mumford, 1986; Kolb, 1984, 1985).

Knowles' (1987) theory of andragogy was strongly influenced by the work of the educational psychologist Carl Rogers (1994), who believed that learning is facilitated when the learner participates completely in the learning process, which is primarily based upon direct experiences with practical, social, personal or research problems that are self-evaluated in terms of progress towards personal goals or success.

The work of Knowles (1987), Jarvis (1987, 1999), Honey-Mumford (1986), Kolb (1984, 1985), Rogers (1987, 1994), Barrows (2000) and Vygotsky (1978) emphasise the importance of learning to learn and to build upon previous learning experiences and knowledge. Despite these

works and the plethora of journals, books and research devoted to adult learning, there is as yet no universal understanding of adult learning (Brookfield, 1995) and this is particularly so in computer-based learning environments (Moore, 1991).

This section has highlighted the importance of adults choosing the time, place and pacing of their learning together with the importance of PBL and applying course content to practice. The different educational approaches for learning are highlighted in Figure 2.1. These factors will be further expanded in the following sections and refined to apply to the case study Website, as moderators for Research objective 2.

2.4 Evaluation of Web-based learning

2.4.1 Evaluation of e-learning

Evaluation of training and development programmes and interventions are the most critical issues facing training and education professionals today (Preskill, 1997). An American educational ICT company (ASTD, 2000a, 2000b) pointed out that current training evaluation techniques and processes can be expanded to include e-learning as a delivery method. Organisations use a variety of methodologies to evaluate training programmes. The methodology chosen should be driven by the purpose of the evaluation (Cohen et al., 2000). There can be multiple reasons to evaluate training programmes. Phillips (1996, 1997) outlined 10 broad purposes and uses of evaluation but the most relevant for the purposes of this study were:

- to determine the success in accomplishing programme objectives (in our case, did learners learn?);
- to determine if the programme was the appropriate solution for the specific need (in our case, to determine if the programme material was carried over into practice), and
- to identify the strengths and weaknesses in the process (in our case, the effectiveness of the e-pedagogy design processes used).

Author (date)	Conti (1991)	Caffarella (1994)	Jarvis (1996)	Cruckshank et al. (1995)	Kauchak & Eggen (1998)	Psychological postulate
Teacher stance	Teacher-centred	Teacher involvement	Teacher-centred	Teacher delivered	Teacher-centred	Behaviourist Pavlov, Watson, Skinner
Method	Lecturing Basic teaching method Instruction objectives Productive desk work	Presentation Lecture Demonstration Symposium	Didactic lecture Demonstration Controlled discussion Mentoring Tutorial	Presentation - show and tell Audio-visual Planned instruction Direct instruction	Prepared instruction Skills instruction Lecture discussion	
Purpose	To provide knowledge (p. 92).	To present a series of events, facts, concepts or principles (p. 189).	To provide information (p. 114). Transmit a selection of curriculum (p.107).	To inform an audience of certain facts, ideas, concepts, and explanation (p.166). To learn academic content (p.229).	To explain, model, and provide opportunities for practice with feedback (p. 266).	
Teacher & learner stance		Teacher & participant	Teacher & learner	Teacher & learner		Cognitive Ausubel, Bruner, Piaget Social Vygotsky Bandura
Method		Reflective practice Debate	Socratic questioning	Discussion Cooperative small group		
Purpose		To exchange ideas about a specific problem or issue (p. 189).	To identify solutions to problems, (p. 109).	To examine ideas and opinions, solve problems (p.174), improve communication skills (p.181). To encourage cooperative learning for common and individual good (p. 210).		
Learner stance	Learner-centred	Participant involvement	Learner-centered	Independent learner	Learner-centred	Humanistic Maslow, Knowles, Rogers Social Vygotsky Bandura
Method	Informal counselling Account for experiences Encourage dialogue & questions Problem solve for everyday living	Simulation, Critical incident Trial and error Group discussion Role play	Facilitated learning Questioning, Brainstorming Debate Group discussion	Doing something Discovery and curiosity Cognizance	Direct experience Cooperative learning Discussions Peer tutoring	
Purpose	To facilitate learning (p. 84)	To facilitate learning in a real setting (p. 190).	To facilitate learning (p. 122).	To facilitate and guide (p. 185). Practice and rehearsal of information (p. 192).	To foster social interaction (p.186). To promote authentic tasks (p.187). To construct meaning (p.185).	

Figure 2.1 Teacher and learner centered educational approaches

One of the most common training evaluation approaches is the Kirkpatrick model, which was first established in 1959. Kirkpatrick's model is a four-level process used to determine the effectiveness of training in order to improve future programmes and to eliminate programmes that are ineffective. In a study of training and human resource executives from *Business Weeks* 1000 companies, over 51% of respondents indicated that their organisation used the Kirkpatrick evaluation model (Hackett, 1997).

Kirkpatrick's (1998) model of training evaluation is based upon four assessment levels:

- Level I: Reaction is a measure of learners' reactions to the course;
- Level II: Learning is a measure of what they learned;
- Level III: Transfer is a measure of changes in their behaviour when they return to their working environment after the training programme, and
- Level IV: Results is a measure of the business outcomes that occur because they are doing their jobs differently.

For the purposes of this study, reaction criteria measure and report on the learners' feelings or impressions of the course. Learning criteria measure the amount the learners' learned during the course. Behaviour criteria measure changes in learner behaviour. Results criteria are more distal and outcomes can include increased productivity or improved morale, or as in this study's Level III criteria, application of knowledge or course material in practice.

Conceptually, the different evaluation criteria investigate and answer different questions about the effectiveness of the event. For example, satisfaction criteria are concerned with how much the learners enjoyed or appreciated an event. Therefore, it is reasonable to expect that training programmes' effectiveness will vary depending on the type of criteria used. Empirical evidence suggests that the relationship between different effectiveness criteria is low (Alliger, Tannenbaum, Bennett, Traver and Shortland, 1997; Arthur, Bennett, Stanush and McNelly, 1998).

The use of technology in education and training is transforming the way that individuals learn in today's life-long-learning model, from 'sperm to worm education' (Power, 2003). Bernstein and Auerbach (1999) indicated that in the training sector, technology training budgets in the

corporate setting have increased by 13% from 1998 to 1999, whilst during the same time Web-based training had increased at an accelerated pace, though the amount was not quantified. A survey of 500 training directors (News, 2001) showed that 60% preferred an e-learning initiative, 86% had a priority to convert face-to-face to online, 80% will set up or expand their knowledge-management programmes and 78% were developing or enhancing their electronic performance. These figures were pre-September 11, 2001 and may actually be accelerated by organisations cutting back on business travel and increasing their technology security and training post-September 11, 2001.

Previous studies of the effectiveness of computer-based education systems have shown mixed results. These results have ranged from no significant difference between classroom and computer-based education to high levels of satisfaction from learners (Hiltz, 1990; Rice-Lively, 1990; Wolcott, 1990). Experts, authors, educators and researchers (Thompson, 2000a, 2000b; Edwards and Fritz, 1997) are questioning the effectiveness of e-learning. According to Chute, Thompson and Hancock (1999), both scholarly research and practical experience have shown that distance learning is educationally effective, offers business value, and is in many cases more cost-effective than other approaches. However, the literature on computer-supported (mediated) learning is mixed and often inconclusive. Determining which sources of information are most relevant and important is essential for the validity of any assessment of programme efficiency or effectiveness. Overall, learner satisfaction, participation and interaction, feedback, curriculum delivery methods and curriculum design are important factors within traditional face-to-face education. These variables are frequently mentioned in the literature as being important to e-learning effectiveness. They form the basis of this review of the literature, and the subsequent formation of the research objectives and questions, especially the moderator hypotheses.

Whilst the reviewed literature suggests strong enthusiasm for evaluation, an American study (ASTD, 2000b) found that 67% of training directors interviewed do not measure the effectiveness of their Internet-based programmes at all. This last issue should raise concerns with educators regarding the effectiveness of the educational training programme.

2.5 Impact of computer technology on learners

2.5.1 Learner attitudes towards ICT

Learners' perceptions about the characteristics of instructional delivery media and their ability to learn using these media are key determinants in ensuring learner motivation and success in traditional classroom-based education (Coggins, 1988; Gee, 1990). These perceptions may also be equally important when implementing technology-based curriculum delivery.

Few empirical studies indicate an interaction between learning style and attitude towards computer technology. A study by Reiff and Powell (1992) indicated that some learners had a negative attitude towards computers whilst others had a positive or favourable experience. Eastmond (1995) found that some learners were interested made interested through the use of computer-assisted instruction whilst others were not supported by this finding.

Previous exposure to computer-mediated learning is one factor proposed by Eastmond (1995) as contributing to learner success. Others (Davis, Bagozzi, and Warshaw, 1989; Webster and Hackley, 1997; Zolton and Chapanis, 1982) support this view. Of particular note is Webster and Hackley's (1997) study that examined the effectiveness of technology-mediated distance learning and found a positive relationship between learners' attitudes toward technology and their learning outcomes. From the examined literature, it seems that being knowledgeable or competent about/with technologies and knowing how to use them is a vital key for computer-based learning outcomes. These findings were included in this study's Level I survey to relate learner course satisfaction with learner self-reported ICT competency.

2.5.2 Learner reactions

The literature is divided as to the overall benefits of technology to learner reactions. The majority of the literature suggests that the learning outcomes of those using technology at a distance and using technology in traditional face-to-face instruction, are similar. The most widely cited paper on technology-based learning is that of Thomas Russell (1999) which examined 355 sources dating back to 1928 and which generally found that attitudes and satisfaction of learners using distance learning were in the main positive.

Whilst this researcher believes that there is an impressive amount and array of writings that conclude that distance learning is viable and effective, Russell's paper had a relevant limitation. Russell reviewed distance learning over a 70-year period during which the concept of distance learning changed due to pedagogical changes and particularly due to evolving technology. For the purpose of this research, most of the literature reviewed was produced during the last decade. During this period, not only has technology grown at a rapid rate (for example, during the last four decades the speed and storage capacity of computers have doubled every 18–24 months) but cost, size, and power consumption have reduced at about the same rate. The Web has also expanded at an exceptional rate, and the bandwidth of computer networks has increased a thousand-fold in the last decade, whilst network traffic grows at a rate of 300–500% annually (Wulf, 1997).

Wentling, Waight, Strazzo, File, Fleur, and Kanfer (2000) believed that several factors make the Internet a highly desirable learning tool and supported this advancement in learning technology. Reasons for this desirability include:

1. internet access at home and work;
2. interactivity and media capability;
3. increasing bandwidth making better delivery platforms available;
4. high quality of authoring software, and
5. global technology standards fostering compatibility and usability of software.

2.5.3 Learner satisfaction

One of the most immediate and obvious measures of a programmes' effectiveness focuses on learner satisfaction, which Chute et al. (1999) term the quality of the individual learning experience. Learner satisfaction has implications for all aspects of a course, ranging from design and delivery through to assessment and reusability. As the Internet becomes more widely used in education (Wentling et al., 2000) the expectations and experiences of the learner need to be categorised and analysed. A number of researchers have examined the level of learner satisfaction with e-learning courses. An American study (ASTD, 2000a, 2000b) found that 67% of training directors interviewed do not measure the effectiveness of their Web-based programmes at all. In another study of training and human resource executives from *Business Weeks* top 1000 companies, over 51% of respondents indicated that their organisation evaluated

user satisfaction (Level I) (Hackett, 1997). What these two studies demonstrate is an inconsistency in processes/actions, identified within the literature in relation to evaluation, in that at least half, if not more, of the programmes reviewed do not include a fundamental examination of learner reaction to the course which in its most basic guise could allow for future programme modification or acknowledgement of programme success.

Another study compared three groups of teachers participating in an in-service microcomputer applications training programme: one group was taught by computer-mediated learning, another group was taught on campus, and the last group was taught through mail-out correspondence. The results indicated that computer-mediated learning and correspondence learners spent more time-on-task than the on-campus learners and that the computer-mediated learners were less positive towards the course than the classroom learners (Cheng, Lehman and Armstrong, 1991).

Goodwin, Miklich, and Overall (1993) in another study found that computer-mediated learners developed stronger analytical skills and written communication skills, and were more motivated, compared to on-campus television-mediated learners. A major finding of this study was that 40% of the computer-mediated learners reported missing the face-to-face interactions, and the recommendation of the study was to explore alternative ways of meeting learners' interaction needs.

An early study compared Web-based learning to that in a traditional classroom setting. The study found that the Web-learners recorded a higher level of satisfaction with their Web-based course than did the traditional classroom learners (Magalhaes and Schiel, 1997). The course also had a unique component in that it utilised mentors for both groups, which assisted the learners in completing their courses. Findings revealed that learners preferred Web-based learning to classroom-based learning when a learning programme is purposefully designed with the learner in mind.

In another study involving two-way interactive video, graduate nursing students were surveyed about their satisfaction regarding the use of course technology. The overall majority of the students were very positive concerning the distance technology course and requested more technology-based opportunities (Larson, 1994).

Shaw and Pieter (2000) evaluated the attitudes, views, and experiences of a group of nutrition students towards asynchronous computer-mediated learning. The findings of this study revealed that there was no significant difference in student course satisfaction between the computer mediated students and the classroom students. An overwhelming majority reported technology difficulties (78%) at some point or another during the course, which may have contributed to this result.

A study by Gillham, Buckner, and Butt (1999) investigated the use of a Web-based course that provided support material for a traditionally taught course to ascertain learners' perceptions of the Website. The course was a communication studies programme at a UK University and the users were not technology enthusiasts. Results revealed that the Website was highly successful in introducing students to a Web-based learning environment. The students supported the use of the Web for support material but still preferred the face-to-face contact for the majority of their course.

Additionally, Siu and Chau (1998) examined the perceptions of marketing students at a Hong Kong University exposed to the Internet for a Web-based research course. The perceptions of the students were related to two factors: (1) information content and effectiveness; and (2) user-friendliness and navigability. The study revealed that students were more satisfied with the information content of the Web but were less satisfied with the navigability and user-friendliness of the Web environment. The researchers identified that satisfaction with content was related to the material being perceived by the students as being relevant to them in future research and work. This is an extension of Knowles' (1975, 1990) concept of adult learners needing to apply course content and material into practice. The study also noted that student dissatisfaction was centred on technical issues associated with the navigation and layout of the Webpages, that is, instructional design issues.

An investigation that compared the educational effectiveness through both students' perceptions of learning and their academic achievement, when delivering content through the Web and in a face-to-face classroom setting, was conducted by LaRose et al. (1998). The study revealed no significant difference in student achievement or satisfaction levels across the courses. Therefore, the researchers concluded that Web-based education is as educationally effective and enjoyable as live, face-to-face instruction. A significant limitation of this study relating to distance learning was that, the subjects were traditional residential students and so

were not representative of most distance students. As with most of the other studies cited to date, small sample sizes led to the possibility of limited statistical power, hence leading to small sample size errors.

Althaus (1997) studied student satisfaction in sociology students who opted into a Web-based sociology course. The participants had access to an electronic listserv and e-mail as a supplement to their face-to-face course. The authors reported that 73% of users of the electronic system reported a positive or favourable learning experience to using the technology, whilst only 9% reported a negative experience. The academic performance of students who used the electronic systems was better than that of those who did not. A limitation of this research was that the instructor who graded the tests and examinations was aware of who was participating in the discussion boards, which could have caused experimenter bias during the grading process.

A medium-sized study was conducted in 30 different technology-mediated learning courses from 7 American universities offering graduate education (Webster and Hackley, 1997). The distribution of learning covered a vast array of technology-enhanced media, but the primary modes were synchronous video systems with computer-based asynchronous supplements. The study found that technical difficulties experienced distracted from learning and that in face-to-face classroom settings, participants were often distracted by the effects of the technology as the instructor tended to focus on using technology within the classroom rather than on the live audience. Findings of this research indicated that technology could distract from learning, in any environment, if there are delays and/or problems in the delivery of material.

A Web-based continuing medical education course was the focus of a well-controlled study conducted in Canada (Curran, Hoekman, Gulliver, Landells, and Hatcher, 2000). The study focused on a CD-Rom–Internet–paper (hybrid)-based course, which was used by 52 voluntary recruited medical professionals. Two courses were offered: one self-paced and the other instructor-paced. In addition, the study utilised a control group for post-test comparison. The study revealed that the hybrid computer-based course resulted in a knowledge gain (pre- to post-test). It also revealed that the subjects reported favourable satisfaction levels for both the self-paced and the instructor-paced course. Whilst the study did not specify effectiveness criteria, it did report self-reported Levels I and III criteria. Limitations of the study were related to its small sample size ($n = 52$), and no description was given of the pedagogical and instructional design characteristics of the two computer-based courses.

The literature within the last decade is divided as to the overall benefits of technology on learner reactions, however the majority of the literature suggests that the learning outcomes of students using technology at a distance and those using technology in traditional face-to-face instruction are similar. The majority of the examined learner reaction literature compared face-to-face learning to computer-based learning. A limitation in this comparison is that the media being examined are based on different instructional design and pedagogical characteristics, which may lead to the no-significant difference phenomenon, as indicated by Russell (1999).

This anomaly indicates a need for further broader investigations. Based on research conducted to date, it is unclear whether the impact of ICT on learning is consistently positive or negative. It seems appropriate, therefore, to conduct inquiries to define and characterise the impact that Web-based education has upon the perceptions of the learner. In addition, research is required to identify what pedagogical and instructional design factors enhance learning.

2.6 Learner course achievement

2.6.1 Measuring learner achievement

The goal of any learning activity is for learning to take place. A common way to measure the effectiveness of instruction is to measure learner achievement. To measure learner achievement in e-learning environments, aspects of the e-environment that promote or inhibit learning must be considered (Chang, 1999; Chute et al., 1999; Hall, 2000a, 2000b, and Tobin 1998).

The primary goal of education is to bridge the gap between current and desired skills, knowledge, attitudes, and behaviour (SKAB). In order to measure whether desired SKABs have been attained, learner achievement needs to be measured. To this end, a number of studies have compared learner achievement in courses delivered via e-learning and courses delivered by other methods, principally traditional face-to-face instruction.

2.6.2 Learner achievement

In a study of a graduate level basic statistics course (Kennedy, 2000), students selected enrolment into either the face-to-face instruction mode, electronic only, or mixed method. Student achievement was measured via a pre/post-test exam. An analysis of covariance (ANCOVA) produced no significant difference among the three groups' pre/post-test scores. This study performed at Kirkpatrick's Level II may have been enhanced if a Level I analysis could have been concurrently conducted to ascertain the rationale for students self-selecting one mode of instruction over another. The results would have also been enhanced if a detailed description was given as to the instructional design variables of both modes, as the previous literature has indicated that a purely text-based Website distracts from student learning (Brogan, 2000; Van Rennes and Collis, 1998).

Another study by Schutte (1996), using similar methodology to that of Kennedy (2000), examined learner achievement in an undergraduate class where students were randomly assigned, into either a face-to-face or online class. Results from the study revealed that there was a significant difference in mid-term and final examination scores between the two groups, with online learners outperforming the class-based learners. Another finding of the study revealed that online learners communicated more frequently with each other than did their face-to-face peers.

In another study, Wegner, Holloway, and Garton (1999) sought to determine whether significant differences existed between the achievement levels of students studying through the Internet and those who completed a face-to-face lecture-based course within a graduate level curricular design and evaluation course. Participants' self-selected enrolment into either of the two groups. Knowledge achievement data was collected by a post-test that was graded by the instructor, and attitudinal data was collected from the standard class evaluations routinely administered by the university.

The study revealed no significant statistical difference between the two groups in terms of knowledge or attitude. Of note was that the Internet group reported negative findings in relation to a lack of direction and lack of content, whilst the face-to-face group reported positive findings in the two areas. Several major problems in this study limited its results. Firstly, there were differences between the instructional design methodologies of the two groups, thus the

results may not have reflected the technology but the instructional design. Secondly, the face-to-face group frequently received additional course material that was not available online, raising questions about content control and validity. Another major limitation was the lack of a pre-course test of knowledge, which limits a comparative analysis of pre- to-post knowledge differences, or a provision of a baseline for future comparisons.

A study that evaluated the effectiveness of computer-assisted instruction by determining if the use of a software program designed to reinforce classroom lectures produced higher cognitive achievement skills was undertaken by Carew (1997). Subjects were first-year nutrition students at the University of Vermont, who self-selected enrolment into either the computer-assisted instruction course or the traditional face-to-face class. Data was collected according to Kirkpatrick's (1998) Level I and Level II evaluation of effectiveness criteria.

The attitudinal data (Level I) revealed that 87% of the computer-assisted students believed that the instruction was useful. Of the computer-assisted learners, 78% believed that the instructional delivery method enhanced their course scores, whilst only 11% felt that the interaction had no impact upon their grades. The achievement data revealed a statistically significant difference in post-test scores, with the users of computer-assisted instruction scoring higher on the achievement tests than non-users.

Justen, Waldrop, and Adams (1990) examined the association between achievement and performance related to the interaction of feedback mechanisms within CAI, and group size. Participants for the study were voluntarily recruited from several upper-level college education courses into the quasi-experimental study groups. The first study factor was the type of CAI received (either paired or individual) and the second factor was the type of interactive feedback (minimal versus individual).

The data for this study were collected and analysed using an analysis of variance (ANOVA) to examine the significant differences between the instruction groups and two types of feedback. In relation to feedback mechanisms and group size the results of the study indicated that CAI students performed better on a post-test of knowledge, as compared to those CAI students who received extended feedback.

The researchers of the investigation believed that their report supported the use of CAI for small groups or for individual learning. The results of this study, however, do not support previous published reports that favour the enhancement of learning through extended types of feedback (Gilman, 1996; Waldrop, Justen and Adams, 1986). Application of these findings suggests that students learn better from direct, immediate feedback without extensive analysis of the responses. The Justen et al. (1990) study is interesting because it goes against findings from previous research. However, the study has several limitations, namely small sample sizes (group size ranged from 14 to 18, with a total of 68 recruited for the study).

An evaluation of an online course for medical practitioners by Conole, Hall, and Smith (2002) examined medical practitioners' reactions to and achievement after an online Neonatal Medicine course offered jointly by the University of Southampton and Southampton University Hospital during 2001. The researchers concluded that the learners enjoyed the experience and gained knowledge through the course. A shortcoming of the research was that it was conducted using a relatively small sample size ($n = 25$), and no pre-test of knowledge was delivered before the course to ascertain, at the very least, a baseline of-learner knowledge for later post-test comparison. Whilst the paper reports on percentage responses, no mention was made of the significance levels of the findings as a whole. The study failed to adequately report on the statistical findings of the course to allow for future comparisons or rebuttals. In addition, the researchers used an online tutor to guide and facilitate learning. However, the report failed to mention the extent of the tutor's involvement with the learners or the tasks undertaken, further limiting the study's findings.

As described previously, a well-controlled study by Curran et al. (2000) reported on a hybrid CD-Rom-computer-based course for medical professionals in Canada. The study concluded that there was an increase in pre- to-post-computer-based course test knowledge (mean 8.5, $Z -3.539$) at the < 0.05 level of probability. In addition the study found that self-reported performance changes from pre-course to post-course were significant at $p < 0.05$, suggesting that participants improved their self-reported competencies in the study area.

A further medical related study was conducted by Francis, Mauriello, Phillips, Englehardt, and Grayden (2000) and concluded that dentists attained knowledge as a result of their participation in two online courses. Post-test of knowledge confirmed that participants, on average, scored significantly higher on the post-tests. The t difference was reported at -5.5 for course 1 ($n = 18$,

$p < 0.001$) and $t = -5.6$ ($n = 16$, $p < 0.001$) for course 2. This study is very useful for interpretation and comparison purposes as the authors looked at several variables: namely, similar demographic profile survey variables of age, occupation years, gender, occupation, computer and Internet self-perceived skill level. In addition, the study reported a pre/post-test comparison (though the article only gives the test differences). However the Francis et al. (2000) study does have several limitations in regards to methodology and universal interpretation. The study actively recruited participants, participant numbers were small ($n = 31$), the specific pedagogical and instructional design components of the two courses were not mentioned, nor was the Cronbachs alpha reliability of the survey tools, all of which limited the study's findings.

Wiksten, Patterson, Antonio, De La Cruz, and Buxton (1998) performed a multilevel analysis of CAI compared to a lecture-based version of the same undergraduate applied anatomy and kinesiology course. The researchers reported a significant difference in the post-test of knowledge scores and the practical examination scores, with the traditional lecture-based participants outperforming the CAI participants. The researchers concluded that both instructional modes produced favourable passing results. However, it appeared from the data that the lecture-based participants reacted more favourable to their style of instruction as compared to those who interacted with the computer. This study is one of the most cited CAI studies, due to its random selection of subjects, strict protocols and controls, demonstrating reliability and validity, which produced sound findings from the observed data. Hence, this is an excellent attempt to explain the evaluative impact of ICT on learning.

A primary goal of education is to bridge the gap between current and desired skills, knowledge, attitudes, and behaviour (SKAB). An anomaly in the professional literature suggests the need for continued quality investigations to indicate student satisfaction and application of learning using ICT. It seems appropriate to conduct further controlled investigations to understand the impact of Web-based learning on learner achievement and what course aspects affect this achievement.

2.7 Pedagogy and instruction

During face-to-face instruction, the instructor has the opportunity and flexibility to adjust or modify the instruction quickly if warranted by the circumstances, whilst the learner has the

opportunity to seek clarification and extension of the learning experience quickly and in real time. Instruction via the Web does not necessarily enable the same timely degree of instructional modification, and asynchronous Web-based environments do not allow for real-time student feedback. Consequently, any oversights in the design and delivery of instruction using Web-based environments cannot be quickly remedied. This means that Web-based instruction needs to be based upon established theories of instruction and learning.

The remainder of this chapter is devoted to explaining how pedagogical and instructional design factors or moderators that have emerged from the review of the literature impact on learners' reactions, learner course achievement and the overall effectiveness of the Web-based course examined in this study.

2.7.1 Participation and interaction

Communication and interaction among learners in an educational course is an important component of effective instruction. For the purposes of this study, interaction was understood to be a two-type process. The first type is feedback or interactivity, either verbal or written, between people. This is termed social interaction. The second type of interaction is individual interaction, which refers to events that take place between the learner and the learning materials, for example textbooks or computer (Bates, 1991, 1996). Whilst this is not the only definition of interaction that is currently used (for instance Moore's [1989] three levels of interaction and Lundin's [1989] six levels of interaction), it is the most simple for this study. Interaction allows learners to learn from one another and from the instructors. Thompson (2000b) claimed that, due to the geographical dispersion of learners in e-learning courses, special attention must be made within the course design to allow for communication and interactions from peer-to-peer and peer-to-instructor. Thompson (2000b) revealed that inadequate levels of human interaction or communication are critical factors in the failure of technology-based learning courses, so attempts need to be made in the design of e-learning courses to reduce the psychological distance whilst increasing interaction between participants. Baylen and Sorensen (1998) believed that the literature reveals that technology is changing practice and that distance education is moving towards more interactive environments. Kearsley (1995) claimed that technology is one of the most important elements of contemporary education, with high levels of interaction being desirable as it positively affects the effectiveness of any education course.

Building on the work of Kearsley (1995), Urdan and Weggen (2000) indicated that e-learning courses could provide more collaboration and interaction with peers and experts than traditional face-to-face courses, which ultimately led to higher success rates than the live alternative. They identified case studies, role-playing, simulations, streamed video, chat rooms, bulletin boards, online references and e-mail as some techniques available electronically that can help to create an interactive online environment. This, in the opinion of the researchers, encouraged more critical reasoning than traditional classroom instruction settings.

In relation to the above findings, the amount, quality and timing of feedback provided to the learner has an important impact on learner satisfaction, both within face-to-face situations and within online learning environments. Web-based instruction can provide barriers to traditional type classroom feedback. For example, in a Web-based course, learners cannot simply raise a hand to ask a question or show a puzzled face to prompt the instructor to clarify an issue or point. Hence, the design and integration of feedback mechanisms influence the learners' experiences and levels of satisfaction (Neal and Ingram 1999).

Neal and Ingram (1999) suggested that learner feedback during and after the learning event is important to successfully measure levels of satisfaction and course success. The researchers suggest that questions related to the efficiency of what learners have learned within the course remain largely unanswered within e-learning courses.

A number of researchers have examined the importance of providing feedback to learners on both learning and motivation (Kluger and DeNisi, 1996; Locke, Shaw, Saari, and Latham, 1981). Feedback is important for a number of reasons and these reasons have been described in the literature (Kluger and DeNisi, 1996; Locke et al., 1981). The primary functions of educational feedback are firstly, to inform students of the accuracy of their responses; secondly, to maximise the student's willingness to participate in the learning process; and thirdly, to facilitate individual goal setting, so that students can improve on their previous performance. Cascio (1998) stressed that the importance of feedback is to also enable learners to learn from their mistakes and thereby increase the accuracy of future responses.

The literature indicates the importance of interaction to students studying in traditional face-to-face settings and studying at a distance, but relatively little has been written on revealing the levels of interaction that occur within Web-based courses. The challenge for Web-based

learning, and for this study, is to document the interaction that occurs within a Web-based course and to show how this type and level of interaction affects learner achievement and satisfaction. The literature revealed the importance of feedback on learner achievement and satisfaction. For the purpose of this study, Web-based education will be effective when feedback is provided (Moderator 1).

2.7.2 Timing of feedback

The timing of feedback has been identified as being important to the learner and therefore may affect the overall effectiveness of a programme (Kulik and Kulik 1988; Schroth, 1995; Wexley and Thornton, 1972). Kulik and Kulik's (1988) meta-analytical study of 53 research papers found that immediate feedback had a positive influence on learning, whilst another study revealed that delayed feedback slowed cognitive attainment (Schroth, 1995).

The timing or immediacy of feedback has been identified in influencing both course satisfaction and learner achievement levels in face-to-face education. For the purpose of this study, Web-based education will be effective when immediate feedback is provided (Moderator 2).

2.7.3 Ability to practice

Another moderator that can influence the effectiveness of learning is the ability to practice. The effect of practice is well established in the scientific and educational literature (e.g. Alliger et al., 1997; Cavanaugh, 1990; Gange, 1985; Goldstein, 1993; Wexley and Hinrichs, 1991; Wexley and Latham, 1991). Practice can take either an active or passive path, but it revolves around the ability of the learner to apply the information learnt, either through repetition or mini-tests, prior to advancement along the programme's content pathway. This ability to practice is an extension of the adult learning principles of Knowles (1987, 1990), Honey-Mumford (1986), Kolb (1984, 1985), Rogers (1994) and Vygotsky (1978), as outlined in section 2.3.2.

According to Wexley and Latham (1991), it is essential for learners to have the opportunity to actively practice using the information that they have just been exposed to in order for it to be learnt. For example, if the learner has been exposed to a motor skill, such as suture tying, they

need to actually repeat the motor behaviours in order for them to learn the motor task. If the learning object was text or verbal information, then active practice involves verbalising or writing down the information, often verbatim and when the subject matter is better understood in a consolidated format.

In contrast, passive practice involves the learner listening to or viewing/reading the course material without the need to repeat the information or to demonstrate comprehension of knowledge attainment or achievement. For instance, a motor skill might be visualised in the person's mind rather than physically repeated. This is the same for verbal/written information. Passive practice can also be achieved from watching others perform the demonstrated learning activity.

Wexley and Latham (1991) stated that active practice is more desirable than passive practice as it decreases the risk of the individual developing inappropriate motor behaviours or acquiring knowledge or information incorrectly. This is because the teacher and the student can reiterate key points or model appropriate behaviour and practice to correct the learner if required, whilst in passive practice learners have to rely on their own ability to self correct their practice and understanding. Others also support active practice (Gange, 1984, 1985; Gange and Briggs, 1979; Gange, Briggs, and Wagner, 1992) and emphasise that the objective of instruction is to challenge learners to demonstrate that they can perform, repeat or use what was taught to them.

Within a Web-based environment, the provision of active practice can be supported by prompting learners to repeat aloud after each session the material they were exposed to, or to write it down at the end of a lesson. Another active practice tool is utilising the Web's ability to provide mini-tests or self-check lists that can be auto-corrected at the server with hints and corrections made to reinforce the attainment of correct knowledge formation. The provision of testing, diagnostic assessment tools and a personal course journal (notebook) were key elements of the case study courses.

Another aspect of practice that can influence the effectiveness of the programme is whether the practice is undertaken in one continuous sitting (massed) or spread out over time (distributed) (Wexley and Hinrichs, 1991).

According to the literature reviewed, the most effective form of practice depends on the type of skill or task to be taught (Baldwin and Ford, 1988). Although not conclusively defined distributed practice is generally more effective for the acquisition and retention of motor skills and verbal information than massed practice because the rest allows for reflection and fatigue prevention (Baldwin and Ford, 1988; Goldstein, 1993; Wexley and Latham, 1991).

The ability to practice or apply the course content to the practical setting (in our case a clinical setting) or to answer content-based questions has been found to influence both overall course satisfaction and learner achievement levels. For the purpose of this study, Web-based education will be effective when the course allows for the ability to apply new knowledge to clinical or question-type responses (Moderator 3).

2.7.4 Whole versus part learning

Closely associated with the ability to practice is the size or length of the training session, unit or course. In essence, how much is the learner expected to learn during each session?

Web-based education can involve a mixture of whole or part learning, the use of each being dependant on the topic being studied. For instance, the learner can be made to master the task in its entirety without breaking it down into smaller units. Alternatively, the learner can be made to master individual components separately before they are combined. If each of the sub-units or components is discrete, then the task organisation is low.

The ability to break the learning material down into learner managed components will be viewed favourably by learners (Moderator 4).

2.7.5 Active versus passive learning

Another factor that can influence the effectiveness of Web-based education is the type of learning that the instruction promotes. Instruction can foster either active or passive learning or a combination of both (Gange et al., 1992; Sherry, 1996).

Empirical evidence supports the belief that active learning can positively influence learning outcomes. Wright, Woods, Millar, Penberthy, Williams, and Wampold (1997) examined the

longitudinal effects of active learning and concluded that active learning had positive effects as compared to non-active learning. In another study, the effects of active learning, as opposed to rote memorisation in an anatomy and physiology course, were investigated. The findings indicated that students preferred and liked active learning as opposed to rote memorisation (Lunsford and Herzog, 1997).

According to Wexley et al. (1991a, 1991b), it is vital that students be given opportunities to actively participate and to practice the information that they are attempting to learn. Wexley and Latham (1991) argued that active practice might be more effective than passive practice because active practice minimises the risk of students developing inappropriate behaviour or acquiring knowledge incorrectly. This is because active practice cues leading to incorrect practice are discarded as correct practices are applied.

In addition to active and passive learning, the instructional design and educational literature has documented the importance of incorporating interactivity into computer-based training and education programmes (e.g. Estes, Bronack, and Scjoeny, 1999; Stocks and Freddolino, 2000). Interactivity refers to the learner having the opportunity for interaction with other participants in the course, with other learners and/or instructors. Such opportunities may occur via discussion boards, chat rooms, and Web-cam conferencing. This study referred to this process as active interaction, whereas passive interaction was defined as an environment where the learner does not interact with others in the course.

For the purpose of this study, active versus passive learning is independent of active or passive interaction. This is because it is possible to have active learning with passive interaction and it is equally possible to have passive learning with active interaction.

The ability to apply course content to practice has been found to be beneficial in face-to-face education and, for the purposes of this study the ability to apply course content to practice or to actively learn will be positively viewed by learners (Moderator 5).

2.7.6 Learner autonomy

The final moderator is learner ability to determine and pace their exposure to the course material. Conceptually, learner ability to control the timing and amount of material that they are

exposed to is important because we all learn at different paces. Roberts, Fulton, and Semb (1988) investigated student autonomy in deadline setting as compared to instructor-set timing and found that self-setting had positive effects on both learning and student assignment compliance.

Conceptually, learner autonomy or self-pacing is important because it allows learners to assimilate course material at a pace set by them and not by others. Learner autonomy has been found to make learning tasks more pleasant and lead to higher satisfaction and attainment levels (Belbin and Belbin, 1972; Roberts et al., 1988).

The opportunity for learner autonomy or self-pacing of course material has been found to be beneficial in the classroom setting and this study will examine whether self-pacing is beneficial to Web-based learning (Moderator 6).

Technologically enhanced instruction and favourable or positive student satisfaction do not necessarily implicate the technology itself, but rather provide for a multifactor analysis that includes learning tasks, instruction style, and the art of teaching or instructional design (Phipps and Merisotis, 1999). There is little evidence to guarantee that learners could or would learn more from the interaction with technology (Bennett, 1991). Bennett (1991) concluded that it is plausible to use computers as an adjunct to learning that may enhance achievement, but the substitution of ICT as the primary mode of instruction should be questioned. The literature examined indicated that students can learn, are satisfied, and learn more quicker using ICT, but the studies to date fail to indicate how instructional and pedagogical course factors related to effective learning. This study termed these factors, “moderators”. This investigation therefore examined an online course’s e-pedagogical design moderators--clarified or enhanced through the literature review--as they affected student reaction and achievement within the selected Web-based courses.

2.7.6 Learner autonomy

In summary, the moderators that emerged from the literature and were examined in the study were:

- Learner course satisfaction (Level I which examined e-pedagogical issues);

- Learner course achievement (Level II);
- Learner application of course content into practice, and/or a behaviour change in professional practice as a result of undertaking the Web-based course (Level III);
- Web-based education will be effective when feedback is provided (Moderator 1);
- Web-based education will be effective when immediate feedback is provided (Moderator 2);
- Web-based education will be effective when the course allows the learner the opportunity to apply the new knowledge to clinical or question-type responses (Moderator 3);
- Learner ability to break lesson material down into learner managed components will be viewed favourably by the learners (Moderator 4);
- Learner opportunity to apply course content into practice has been found to be beneficial in face-to-face education and, for the purposes of this study, the opportunity to apply course content to practice or to actively learn will be positively viewed by learners (Moderator 5), and
- Learner opportunity for autonomy or self-pacing of course material has been found to be beneficial in the classroom setting and this study examined whether self-pacing is beneficial to Web-based learning (Moderator 6).

This study aimed to produce evidence of the e-pedagogical design characteristics that are both effective and efficient, or otherwise, for learning.

2.8 Summary

The review of the literature attempted to identify and refine moderators that affect learning; in particular Web-based learning. It attempted to quantify the effect each moderator had on the effectiveness of Web-based CPE in terms of learner attainment and satisfaction.

In this chapter, selected literature that examined the relationship between technologically enhanced learning, the reaction and achievement of participants, as well as the instructional and pedagogical design moderators that were found within this delivery medium was examined.

There is salient evidence of a relative paucity of research dedicated to explaining or predicting phenomena related to successful outcomes in Web-based learning. To facilitate the learning process, most educational Websites provide, at the minimum, static information such as a

syllabus, contacts, and course announcements. Others, such as the case study site, utilise interactive features such as asynchronous communication, online testing, bulletin boards, personal course learning journals, and diagnostic and learning tools that can be used to enhance interaction between the learner and instructor/facilitator (real or inanimate), the learner and other learners, and between the learners and the educational content--that allows them to implement course material into practice, and to apply a PBL approach. Bennett (1991) concluded that it is plausible for ICT to enhance learning, but there remains a significant need to identify specific interactions that will enhance learning. Therefore, it seems clear that another participant study should be done to produce evidence of the pedagogical and instructional design characteristics that are both effective and efficient for learning.

The following chapter will discuss the research methodology and procedures.

CHAPTER THREE

METHODOLOGY

3.1 Overview

Cohen et al. (2000) building on the work of Novak and Gowin (1984) noted that the conduct of research in education has had mixed results in contributing knowledge that aims to increase understanding of a particular teaching or learning event. This is in part due to the artificial nature of educational events and lack of adequate theories and methodologies. This study was underpinned by a case study approach and associated methodological devices required to prepare the survey instruments and their subsequent interpretation that would support the various claims and conclusions suggested by the research findings. The theoretical and conceptual basis--along with acceptable procedures for data generation, reproduction, and presentation--provide the basis required for this study to have meaning for both the academic and commercial sectors.

3.2 Research Methodology

This study was concerned with the way health care professionals undertook a Web-based continuing education course, particularly as it related to achievement, satisfaction, and participation.

A case study research paradigm was used to examine the teaching and learning phenomena. Burns (1997) proposed that case study research explains and interprets natural phenomena in a social setting and deals with human participants in everyday life. He argued that “social life [should] be studied as it occurs, in natural settings rather than artificial ones” (p. 301). Within the case study research design, a mixed method, case-study approach was selected.

Gall, Borg and Gall (1996) define the terms “qualitative”, and “interpretive” as being synonymous with natural settings where “attempting to make sense of, or interpret phenomena, is considered appropriate for the study of people in natural settings” (p. 29). The online surveys used by this study used both qualitative and quantitative data-gathering tools.

Choosing a research design that involved data-gathering methods that occurred in a natural setting required the researcher to address issues of validity and reliability. The idea of validity “hinges around the extent to which research data and the methods for obtaining the data are deemed accurate, honest and on target” (Denscombe, 1998 p. 241). Reliability is concerned with “stability, accuracy and dependability of data” (Burns, 1997). However, researchers using a case study research design do not easily accept the positivist terms for validity and reliability. Wolcott (1994) believed that case study research using quantitative data-gathering methods needed to “generating understanding” (p. 136), and Silverman (1993) advocated that “authenticity rather than reliability is often the issue in qualitative research” (p. 10).

Lincoln and Guba (1985) recommended that case study research should establish “trustworthiness” in order to verify the findings as worthy. They proposed that researchers should question themselves on “truth”, “value”, “applicability”, “consistency” and “neutrality”, in addressing issues in relation to the terms of conventional research methods of “internal validity, external validity, reliability, and objectivity” (p. 290). Burns (1997) contended that the effort required to produce trustworthy findings that provide authentic understanding might be more time-consuming and rigorous than expected (p. 383). Isaac and Michael (1997) claimed that case study inquiry data-gathering mechanisms play a similar role to conventional data-gathering methods, except that “the characterisation is distinctly different” (p. 221), and case study mechanisms seek to produce findings that are “credible”, “transferable”, “dependable” and “confirmable” (p. 221).

The challenge in selecting a case study approach was to address transferable generalisations, to record the quality and conduct of the study in detail, and to use multiple techniques ensuring accuracy and integrity. Table 3.1 outlines the conventional research design terms and those used by the researcher to establish trustworthiness in the case study research design of this study.

Table 3.1 Summary of methodological decisions explored

Topic	Decision	Area of exploration
Single or multiple cases	Single case	
Case study approaches	Descriptive approach (Yin, 1993) Interpretative approach (Willis, 1998) Mixed methods: qualitative, quantitative and comparative (Chenail, 2000)	
Case study components		Which combination of: Five components of research design (Yin, 1994); Six steps in conducting case study research (Soy, 1998)
Collecting data	Documents; Archival records surveys	Physical artifacts (tests and surveys)
Method of analysis (general)	Data reduction (Miles and Huberman, 1984b)	Pattern-matching (Yin, 1994)
Method of analysis (within-site)	Effects matrix Site dynamics matrix	Causal network
Method of analysis (cross-site)	Scatter plots; Site-ordered effects matrix	Causal models; Causal networks
Method of analysis (statistical)	Means Frequency; tables correlations	Cross-tab analysis; Principal component analysis; Discriminant analysis
Presenting the results	Data display	Matrices; Tables; Figures
Guide for the report		Outline

3.2.1 Case selection

The goal in conducting the case study was to gain a richer understanding of the impact of Web-based technology on education. The educational institution was chosen on the basis of several variables. The primary criterion was to select an institution that delivered continuing professional education courses via the Web, with no face-to-face or non-Web-based delivery. A second criterion for selection was that the CPE was accredited or endorsed by an independent industry regulatory body. This ensured that the educational content was current and of an appropriate nature in terms of content and assessment methodology. This is particularly important given the proliferation of technologies which at best is dubious and at worse intentionally false, particularly in the field of health care and education.

An interpretive single-case study underpins this investigation. Miles and Huberman (1994b) suggested that the main task of a case study is to explicate the way people in particular settings come to understand, account for, take action and otherwise manage their day-to-day situations

(p. 6). The natural context of the online learning environment provides an opportunity to gain an in-depth understanding of a phenomenon, which is, as Burns (1997) suggested, “replete with meaning for the subject, focusing on process rather than outcome, on discovery rather than confirmation” (p. 365).

The study was designed to examine a bounded system that had many variables. Denscombe (1998) maintained that a case study is “advantageous” when looking at the way people behave, in a community, in that the researcher can accommodate the “subtleties and intricacies of a complex social situation” (p. 39).

Merriam (1998) pointed out the difficulties of selecting boundaries for a case study but suggested that the approach was appropriate when the context can be a bounded phenomenon. Gall, Borg and Gall (1996) highlighted the use of case studies being used to produce detailed descriptions of a phenomenon in “its natural context and from the perspective of the participants involved in the phenomenon” (p. 549). In keeping with Burns’ (1997) contention that for a research study to be defined as a case study “it must be a bounded system” (p. 364), this case study was bounded in several ways: the characteristics of the phenomenon under study, geography, and the process of participant selection.

The “case” focused on the phenomenon under study--that of online education and its effectiveness from the perspective of the participants and hence for the delivery organisation. The geographical limits were defined by the service area of the case study provider, Med-E-Serv, which limited the study to Australasia.

The case study described in this research focused on learner satisfaction and achievement within an online learning environment. The approach was organised around a set of prefigured foci that included Web-based instructional design, pedagogy, learning efficiency, and proficiency; in effect, the effectiveness of Web-based learning.

The primary task was to describe the case study’s courses and how they were used and evaluated by the participants. The intent was to build the case report from the learners’ perspective. The hope is that the case study will provide depth and clarity to other evaluation findings, particularly the ‘no significant difference’ findings, and also provide a bridge to tacit knowledge about ICT use; in particular, Web use for education.

A timed convenience sample of responses was chosen from the institution, which provided online continuing professional education courses. The timed convenience sample occurred over a period of 4 months. The researcher's intent was to observe the types of instructional methods in the course and relate these instructional design issues to the effectiveness of the course from the learners' perceptions. The result of this study will be limited to reflections rather than generalisations.

This research focused on the user interface design of Web-based continuing professional education. Although the literature reviewed revealed many issues in distance learning, adult learning theory, and continuing professional education, it also revealed that the instructional design and associated educational effectiveness of online education was an area that was underreported in the educational literature. The majority of the literature tried to compare instructional design and effectiveness of online education to other forms of distance education or to traditional face-to-face education with the predominant result 'no significant difference'. This revealed a highly contentious methodological issue in trying to compare completely different courses that utilise different pedagogical and instructional design methods. The Web, unlike other media for education, is a software application and also a Website; hence it is a delivery medium, content provider, and subject matter displayer all in one. From the literature, this issue appears not to have been considered by other researchers--hence the 'no significant difference' phenomena.

3.2.2 Effectiveness measurement

The effectiveness of Web-based education was defined and measured using a modified Kirkpatrick's (1998) multilevel evaluation of effectiveness. Kirkpatrick (1998) described four different levels of assessment of effectiveness. Level I is described as the participant's reaction to the learning interaction, and was measured with a user satisfaction survey. Level II is the measurement of cognitive gains from the training programme, and was measured with a post-test of knowledge. For comparative purposes, a pre-test and post-test design was used, as it would reveal changes that occurred as a result of the educational intervention. Level III assessment was designed to address whether or not cognitive learning had carried over into practical applications. In an educational environment, this is difficult to measure. Specifically, in relation to CPE, practical applications of the result of the CPE session are difficult to access (Davis et al., 1995; Richardson and Norris, 1997). The Level III evaluation of effectiveness was

modified from Kirkpatrick's original intention of delivery some months after completion of the training. The reason for this was that the nature of Med-E-Serv's online courses requires the users to study over a period of time, usually several weeks. During this time, the participants put into practice or reject knowledge and training tools that were made available to them during their online CPE course. Therefore, these participants should have had ample time to reject or apply the CPE material into their work practices. Kirkpatrick (1998) claimed that the Level III analysis is the most difficult and time-consuming analytic process and that it requires a significant investment in time, finances and control on the part of the investigator. It is for this reason that the Director of Med-E-Serv and the Educational Training Manager assisted the researcher in analysing the respondents' replies to the application of knowledge questions. Level IV (Return On Investment-ROI) will not be reported on in this paper due to the commercial 'in-confidence' nature of the material to the case study provider.

3.2.3 Case study summary

Despite limitations, including narrow focus and limited representativeness; together with potential for subjective biases (Cohen et al. 2000), the applicability of findings from a case study are valuable because they provide background information for planning; sources of hypothesis for further investigations; and provide anecdotes to illustrate more generalized statistical findings (Isaac and Michael, 1997). Burns (1997) contended that case studies could be "very valuable as preliminaries to major investigations" (p. 365). Isaac and Michael (1997) also claimed that because of the intensiveness of case study methods, important "variables, processes and interactions" (p. 52) are brought to light and are useful for larger studies. Gay (1992) described the case study in terms of possible hypotheses generated from the results of the case study (p. 236). This case study examined the educational effectiveness of online education, an under-researched area. It was envisaged that the intensity of the study would produce rich data that may be of use in larger studies.

3.3 Research design

The purpose of the study was to perform a multilevel assessment of Web-based CPE from the perspective of the reactions of the learners (Level I), the learning of the participants (Level II), and learners' application of knowledge into practice (Level III) and course moderators that are assumed to impact on learner satisfaction. Thus, the research had 2 overriding objectives:

Research objective 1: Quantify the overall effectiveness of the Web-based CPE course.

Research objective 2: Assessing the influence of several factors (moderators) that are assumed to influence the effectiveness of the online learning event.

Objective 1 sought answers to the following questions:

1. Will learners enrolled in a Web-based CPE course have a positive reaction to the educational learning experience?
2. Will learners enrolled in a Web-based CPE course acquire the knowledge disseminated through the educational experience?
3. Do learners use the knowledge from the course in their work, that is, is the knowledge applied?

Objective 2 sought answers to the following question:

4. What are the successful and unsuccessful design influences and pedagogical techniques that enhance or distract from a positive learning experience in the Web-based CPE course?

In order to investigate objective 2 the following moderators were examined:

- Web-based education will be effective when feedback is provided (Moderator 1);
- Web-based education will be effective when immediate feedback is provided (Moderator 2);
- Web-based education will be effective when the course allows the learner the opportunity to apply the new knowledge to clinical or question-type responses (Moderator 3);
- Learner ability to break lesson material down into learner managed components will be viewed favourably by the learners (Moderator 4);
- Learner opportunity to apply course content into practice has been found to be beneficial in face-to-face education and, for the purposes of this study, the opportunity to apply course content to practice or to actively learn will be positively viewed by learners (Moderator 5), and
- Learner opportunity for autonomy or self-pacing of course material has been found to be beneficial in the classroom setting and this study examined whether self-pacing is

beneficial to Web-based learning (Moderator 6).

3.4 Pilot study

Locating a community where online CPE could be identified was vital to this study. The choice of the community was based on identifying industry approved and regulated online CPE courses. This ensured that the material was professionally recognised as being appropriate, relevant and factual to the participants as well as by their professional accreditation bodies. To identify the community, and learning provider/s, health care education regulatory bodies were contacted to identify Web-based education providers from their educational databases. The initial search yielded three online course providers. These providers and their respective courses were further limited by the need for the course/s to be entirely offered online with no residential, postal or telephone support or resources. This narrowed down the search to one educational provider--Med-E-Serv.

A key requirement from Med-E-Serv to participate in this study was the need for the study to be based on a sound research footing. To this end a detailed research proposal (study protocol) was prepared.

Yin (1994) recommended the use of a case study protocol as part of a carefully designed research project. This would include an overview of the project (with project objectives and case study issues), field procedures, questions and a guide for the report. Next, the case studies have to be designed, carried out and analysed. The analysis of the case study is the critical factor in this research. In relation to this, Yin (1994) identified five components of research design that are important for case studies:

1. The study's questions;
2. Its propositions (if any);
3. Its unit(s) of analysis;
4. The logic linking of the data to the propositions, and
5. The criteria for interpreting the findings.

Another approach is presented by Soy (1998), who draws upon the work of Stake (1995), and Yin (1994). She proposes six steps in conducting case study research:

1. Determine and define the research questions;
2. Select the cases and determine data gathering and analysis techniques;
3. Prepare to collect data;
4. Collect data in the field;
5. Evaluate and analyse the data, and
6. Prepare the report.

Both Yin (1994) and Soy (1998) recommended the use of a case-study protocol as part of a carefully designed research project that would include the following sections:

1. Overview of the project (project objectives and case study issues);
2. Field procedures (credentials and access to sites);
3. Questions (specific questions that the investigator must keep in mind during data collection), and
4. Guide for the report (outline, format for the narrative):

The field procedures and instrumentation were pilot-tested for one month in one of Med-E-Serv's courses to further define and refine the survey tools and procedures with the selected research cohort. Table 3.1 (see section 3.2) presents a summary of the decisions that were explored during the case study. The table is divided into three columns. The first column indicates the methodological approach and the second presents the decisions that have been made based upon the findings arising from the previous chapters. In the third column "Area of exploration" the choices for a methodological procedure are described. Decisions arising from the development of this table, together with recommendations from the pilot-testing determined the scope and shape of the research instruments and study procedures, which are presented below.

3.5 Selection of participants

For the purposes of this study, the term *participant* or *learner* refers to primary health care practitioners, including GPs, dentists, pharmacists, occupational therapists and nurses who were undertaking Web-based CPE courses as a part of their continuing professional education

requirements, unless otherwise stipulated. The 313 participants recruited for this investigation were undertaking CPE courses through the International CPE provider, Med-E-Serv. The individual learner opted to enroll in one of Med-E-Serv's 42 online learning courses. The courses, which are all industry recognised and accredited, range in duration from 1 hour through to 8 hours. Data from Med-E-Serv indicated that 100% of participants completed the courses over a period of time, rather than in one sitting.

The participants were recruited over a period of 4 months and the sample size of 313 is one of convenience. This represents an acceptable sample size for the 0.05 level of confidence with an affect size of greater than 50%. The power for this sample and affect size is markedly low, creating a greater chance of a type II error, or findings that do not support the hypothesis generalisations. Altering the level of confidence is not recommended with a low statistical power study, as this would enhance the chances of not creating generalisations whilst also creating a type II error (Isaac and Michael, 1997, p.193-196; Portney and Watkins, 1993).

3.6 Instrumentation

Instructional effectiveness was evaluated by four criteria: learning (cognitive) achievement; participant satisfaction with the instructional courseware or media; instructional transactions occurring through feedback; and retrospective self-reported performance change. The following are the electronic quantitative evaluation instruments and qualitative methods used for collecting data:

- **Demographic Profile Survey (DPS).** A demographic profile survey was developed to collect data on demographics, computer experience, computer access, and computer usage by course participants. Participants were asked to complete an 8-item electronic DPS developed as a Common Gateway Interface (CGI) submission form. The CGI submission forms permit bi-directional transfer of information between a user's computer and a Web-server. The DPS was a component of the Courseware Evaluation Survey (CES) (Level I) form (Appendix 3A).

- Pre-test and post-test (learner achievement --Level II). Identical learning course-item multiple-choice pre-and post-learning achievement tests were developed to measure participants' knowledge of the subject matter before and after participation in the courseware. The tests utilised the CGI format (Level II) (Appendix 5). The pre/post-test surveys were designed in consultation with the courseware provider, Med-E-Serv. The test items were developed according to the guidelines recommended by Haladyna (1994, 1997) who suggested that testing should test the learners' knowledge, comprehension, application, analysis, synthesis and evaluation of the subject matter. In essence, Haladyna's recommendations are based upon Bloom's taxonomy (1956) of learning.
- Post-learning Performance Self-Assessment Survey (Level III) (Appendix 6A and 6B). Participants were asked to respond to two performance statements as a part of the provider course evaluation. They were asked to indicate when and how they have or haven't used aspects of the course within their professional practice. The survey was completed following completion of the post-test course requirements. The reason for the short delay in administering this survey was that, due to the length of the course, participants have the opportunity, (and are indeed encouraged), to utilise key aspects of the courseware during the course before proceeding to the next component of the courseware programme (Level III) (Appendix 6A and 6B).
- Courseware Evaluation Survey (CES--Level I). A consultation team developed the 39 opinion statements. The team included the courseware provider, whose education/clinical director has over 15 years direct CPE experience, the research supervisor who has twenty years educational/clinical experience, and the researcher, who has 14 years educational/clinical experience. This process generated a total of 45 potential survey statements. The statements were reviewed for content and redundancy. Based on the review, a final list of 39 statements was derived (Appendix 3A). As can be seen from inspection of the 39 statements, face validity was apparent. Additionally, the rigour given to the development and pilot-testing of the statements ensures a degree of content validity for the opinion statements.

The CES (Level I) was also in CGI format. It was designed to collect information on the participants' perceptions of the quality and effectiveness of the Internet delivered course. The

survey included 39 items, distributed among 8 evaluative categories that were derived from the instructional design and pedagogical characteristics of the learning site and subsequent literature review. These categories included content, navigation and organisation, overall impressions, media utilisation and learning style. Each category included 1 to 18 evaluative statements, which participants were asked to rate on a Likert scale from strongly positive to strongly negative. All statements were positively worded (Level I) (Appendix 3A). The Level I survey also included one open-ended item.

The reliability of the 39 Likert type items was determined by calculating the inter-correlations (Cronbach’s alpha) for those statements. These correlations can be found in Table 3.2 and Appendix 3B. The mean inter-correlations were found to be 190.8571 ($n = 39$, variance 3433.4645, $SD\ 18.5328$). This correlation gave an estimated Cronbach alpha reliability of 0.9221. The CES reliability of 0.9221 is significant according to Nunnally (1978), who recommended a minimum level of 0.7. The Cronbach Alpha reliability values range from 0 to 1, with higher values indicating greater reliability, and therefore, the CES was considered statistically very reliable.

Table 3.2 Level I inter-correlations

RELIABILITY ANALYSIS - SCALE (ALPHA) (Refer to Appendix 11 for a complete break down)							
N of Cases = 168.0							
N of Statistics for Scale 190.8571 Mean 343.4645 Variance 18.5328 Std Dev 39 Variables							
Item Means		Mean	Minimum	Maximum	Range	Max/Min	Variance
4.8938	2.4821	5.7619	3.2798	2.3213	.7050		
Item Variances		Mean	Minimum	Maximum	Range	Max/Min	Variance
.8941	.1825	3.7565	3.5740	20.5844	.7480		
Inter-item Covariances		Mean	Minimum	Maximum	Range	Max/Min	Variance
.2082	-.2964	2.0657	2.3621	-6.9690	.0346		
Inter-item Correlations		Mean	Minimum	Maximum	Range	Max/Min	Variance
.3249	-.1298	.8936	1.0234	-6.8865	.0266		
Analysis of Variance							
Source of Variation		Sum of Sq.	DF	Mean Square	Q	Prob.	
Between People		1470.7326	167	8.8068			
Within People		8853.3333	6384	1.3868			
Between Measures		4500.6612	38	118.4385	3245.3563	.0000	
Residual		4352.6722	6346	.6859			
Total		10324.0659	6551	1.5760			
Grand Mean	4.8938						
Reliability Coefficients 39 items							
Alpha = .9221		Standardized item alpha = .9494					

Source: Level I Cronbach’s alpha scale created in SPSS V11.1⁸ (2000)

⁸ Figures and Tables derived from SPSS are presented in this paper in their native format, meaning that their style may not be consistent with other Figures and Tables presented elsewhere in this paper.

3.7 Course progression

Once enrolled, the learner commenced a specific online learning course. Each course consisted of an introduction, the learning objectives and content, together with an opportunity for learners to introduce themselves to the course facilitator and fellow learners. All participants completed a pre-test about their knowledge of the subject matter (Level II, the measurement of pre-post test knowledge). Only once this pre-test was completed were participants able to proceed to the learning material. Whilst studying the learning material the participants were exposed to diagnostic screening and testing tools (patient survey forms; diagnostic assessment proformas/flow charts) that would assist them with the unit being studied both whilst online and when dealing with patients in the clinical setting (Level III, the application of knowledge into practice). The diagnostic and screening tools were created to allow the participants to use them immediately with their patients in the clinical setting and hence apply the current learning course in practice. On completion of the course learning material, the participants had to complete a test (post-test) that assessed their knowledge of the content covered within the course (Level II). Results from this test were then used to compare participants' pre-course test knowledge level with that of their post-test knowledge level--in essence, this testing was used to ascertain cognitive changes as the result of completing the learning course.

The Level III data indicated the participant's application of knowledge in practice. It is at this Level III that the study varied from a typical application of the Kirkpatrick's model in that Kirkpatrick's model utilizes the Level III some time after the completion of the learning event. However, in this study, Level III was implemented during the study programme because of the implicit design of the courses that relied on the participants utilising material in practice over a period of time.

Following the completion of the above surveys the learner (if a GP/physician) had satisfied the requirements for awarding of continuing professional education points for RACGP (Group 1--5 points per hour), RACP (practice related CME--2 points per hour), ACCRM (professional development programme--5 points per hour) and GPMHSC (six hours of mental health workshops, including at least one 2-hour core skills workshop will be considered to have completed the skills training requirement for registration to Level One of the Better Outcomes in Mental Health Care Initiative. The normal non Med-E-Serv point requirement for GPMHSC Level One is 30 points). Learners (GPs/Physicians) who completed units outside of the context

of a course would still receive professional education points from their affiliated professional accreditation association at the rate of RACGP (Group 2--2 points per hour), RACP (practice related CME--0.5 points per hour) and ACCRM (professional development programme--1 point per hour). Non-GP/physician learners could use the course objectives and time commitment, whether a unit or a whole course, to apply for continuing professional education recognition or points from their respective practice accreditation organisation.

Level I (participant satisfaction with the course) data was collected at the very end of the course and this was the survey tool that the participants could elect not to complete without jeopardising the completion of the course. All other survey tools had to be completed prior to progression into the next part of the course. Appendix 4 outlines one of the 42 possible courses that the participants could have undertaken.

3.8 Study Procedures

3.8.1 Ethics clearance for the study

A standard ethics clearance for the study of human participants was authorised by the University of Tasmania Ethics Committee (H7200). Standard regulations for confidentiality and data collection procedures were required (see Appendix 7).

The Ethics Committee authorised a plain English information sheet about the research purpose, procedures and the requirements for the participants (see Appendix 8).

A statement of informed consent was posted on the case study Website and consent was given by the activation of the link and subsequent sending of the surveys (see Appendix 9). This consent form was also reused at the end of the post-test to again elicit participation and to explain the Level I survey.

3.8.2 Confidentiality

The provider and learners who participated in the study did so voluntarily. The learners who wanted to participate in this study did so by submitting the acceptance form and completing the survey tools that appeared before, during and after they completed their enrolled CPE course. The

CPE provider, whilst supplying the survey forms as a part of their courses, did not know which learners had participated or did not participate in this study, ensuring learner confidentiality.

3.8.3 Procedure of the study

The self-selected learners enrolled into one of Med-E-Serv's 42 online HCP CPE courses. Upon enrolling into the selected course and submitting those details, a Common Gateway Interface (CGI) submission form appeared in a new browser (pop-up) window. This CGI form was the informed consent form to participate in the study. The informed consent form was approved by the University of Tasmania's Social Science Ethics Committee (see Appendix 9). The learner elected to participate or not participate in the study. Learners choosing not to participate in the study closed the CGI information/consent form that then returned them to the beginning of their selected course. Learners electing to participate in the study then submitted the form by clicking on the accept icon. These learners were then electronically "tagged" by the Med-E-Serv server and their completed survey forms were copied into a separate database set up for the purposes of the study. This database collected the completed survey data together with a unique user code (tag) that was used for the purposes of the pre/post-test data collection. There was no difference in online presentation of material between that supplied to participants to those who elected not to participate, as all of the data collection was done behind the CGI design of the survey instruments. In addition, the participants and non-participants were not known to the researcher or to the course provider due to the server generating a randomly identifying code to the participants for data collection purposes. These identification codes were removed from the database following the participant's completion of the pre/post-tests.

The data collection elements pre/post-tests of knowledge (Level II) were standard elements normally required in the syllabus for the courses offered. The diagnostic tests and clinical tools were normal elements within the courses but previously not utilised to ascertain application of knowledge into practice (Level III). The study therefore gave the course provider an opportunity to view the effectiveness of the learning material in terms of knowledge application, synthesis and evaluation, as well as applicability to the clinical settings in which they were used.

The Level I reaction tool was distributed by the CGI at the completion of the post-test of knowledge. The participants completed the tool online using check or radio selection buttons in

which they chose their preferred responses. Upon completion of the tool the participants submitted the completed form via a submit button which then sent the data to the Med-E-Serv server which uploaded the data into a database for collection. No identifying markers or tags were assigned to the tool. Of all the tools used by the study, this was the only form that the participants did not have to complete to progress through the course.

The Level II test of knowledge pre-and post-test were distributed by the CGI during the progression of the course. The knowledge tests were identical for both participants and non-participants and occurred at the same level of study progression in the course. The learners answered the knowledge questions by the selection of the appropriate response within the radio/check buttons options. Completed test forms were submitted to the Med-E-Serv server that, upon completion of the post-test, would compare the results and return the completed tests with correct answers to the learner. Those learners who elected to participate in the study had a copy of their tests sent to an additional purpose-made research database for collection and later comparison of results. These forms had a learner identification code allocated to them so that pre/post-test comparison could occur. This unique learner identification code was not known to the course provider or researcher and was removed prior to data analysis.

The Level III application of knowledge data was ascertained by another CGI form that required the participant to demonstrate how they had applied the course diagnostic tools and clinical tools in practice within their clinical settings. This survey tool was a modified provider:researcher-developed tool. It contained both closed and open-ended questions. The subsequent open-ended subjective data was analysed by both the education/clinical director of Med-E-Serv and the researcher to ascertain whether the knowledge from within the course was indeed applied within practice. This form was completed following completion of the post-test of knowledge form.

3.8.4 Time-line for the stages of the study

The time-line for the design, data collection and analysis, and writing of this study is outlined in Table 3.3 below. The study began in 2002, with ethics approval given by the University of Tasmania. The major part of the data collection occurred in 2003. In 2003 data analysis began on the surveys. The first of the member checks happened late in 2003, with a final check during the middle of 2004.

Table 3.3 Study stages

2002											Nov	Dec
Study proposal												
Ethics												
2003	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Ethics												
Pilot study and review												
Thesis draft												
Data collection												
Result generation and second rater checking												
Member checking												
2004	Jan	Feb	Mar	Apr	May	Jun						
Result generation and second rater checking												
Thesis draft												
Member checking												
Thesis finalisation												
Submit thesis												

3.9 Data collection and recording

3.9.1 Data collection

Courseware effectiveness was evaluated by several criteria, including learning achievement (cognitive), participant satisfaction with instructional courseware, instructional transactions occurring within the courseware, and retrospective self-reported performance change, which were collected by a modified Kirkpatrick's multilevel evaluation technique.

For the purposes of this study a modified Kirkpatrick's (1998) four-level evaluation of effectiveness was applied to Web-based CPE. The first objective question, "will health care professionals enrolled in a Web-based CPE course have a positive reaction to the educational learning experience?", employed one independent variable, that is practitioner enrolment into a Web-based CPE course, and one dependent variable, reaction to the learning environment. The Level I tool investigated this question.

The second question, "will health care professionals enrolled in a Web-based CPE course acquire the knowledge disseminated through the educational experience?", implemented the same independent variable, practitioner enrolment into a Web-based CPE course, and the dependent variable relates to the impact that participation in a Web-based course had on cognitive achievement. The Level II tools investigated this question.

Associated with this question the third question asked whether learners use the knowledge from the course in their work, being concerned with the application of knowledge in practice, and was ascertained by the Level III tool.

For the Level I assessment, data collected was either ordinal in nature on the Likert-type response items ($n = 39$) or nominal in nature for the open-ended item ($n = 1$). Therefore, a chi-square analysis was selected as the statistical tool to examine the 39 Likert-type responses. The subjective nominal items were categorized and characterised using descriptive frequencies of responses for comparison purposes.

For the Level II assessment, preliminary analysis using Levene's homogeneity of variances indicated equality of variance within this dependent variable. Therefore, a paired sample *t*-test was selected as the statistical tool to examine differences of the dependent variable for the Level II assessment with the pre-test scores serving as the covariant factor.

For the Level III assessment the subjective nominal items were categorised and characterised using descriptive frequencies of responses for comparison purposes. The education/clinical director who managed the course in conjunction with the researcher determined purposeful and appropriate application of knowledge of the course material into practice. Respondent terms such as 'will use'; or 'have/am using' were taken to represent a positive use of the clinical tool and/or course material in practice. Chapter 4, analysis of Level III survey results indicated responses to the Level III survey. Following the course provider/researcher agreement on positive indicators of course material into practice, the data were categorised and characterised for comparative purposes. To assess the accuracy of coding, a second rater was trained to code a subset of the survey results to permit an assessment of the level of inter-rater agreement. The (rater) training process and assessing the degree of inter-rater agreement were as follows. The researcher instructed the second rater on how to use the coding spreadsheet (Figures 4.40, and 4.44 through to 4.47, and Tables 4.3 and 4.9). Each variable was discussed in turn, and decision rule(s) on how to code for each of these features were discussed. Any questions that the second rater had were addressed by the researcher and resolved. To illustrate the use of the coding sheet, the researcher and the second rater jointly coded several survey responses. Again, any questions and issues that arose during this process were addressed by the researcher and resolved. The session lasted approximately two hours. Following the session, the researcher and the second rater coded a subset of 10 survey responses. The per cent agreement between the

survey responses coded by the researcher and the second rater served as an index of coding accuracy and inter-rater agreement. Using 95% agreement as the cut-off for adequate inter-rater agreement, the degree of convergence between the two coders for the 10 responses was computed. For the initial subset of 10 responses, the percentage agreement between the raters was above 95% (Mean = 97.5%; *SD* = 3.00).

3.10 Data Processing and Analysis

The data in this study were analysed in order to develop insights and patterns inductively, and to “ground” and “saturate” the data (Cresswell, 1997, p. 56). Strauss and Corbin (1990) explained how a grounded approach is suitable for building theory: it is a method “that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon” (p. 23). In a case study using survey and record-keeping, a large volume of data is derived that needs to be organised and categorised in order to generate understanding of the process being examined.

The preliminary categorisation of the data occurred in relation to the research questions and on the basis of the 5 survey tools (CES, DPS, Level III, pre/post-tests). The survey responses were coded into two areas; “demographic nodes”, and “teaching/learning nodes”. The demographic nodes were grouped to reveal the characteristics of the informants; the teaching nodes were grouped according to the perceptions and actions of the informants.

Using these preliminary categorisations to assist further saturation of associated categories, coded data were extracted on hard copy for a visual analysis.

The overall object of this analysis was to seek and clarify emerging patterns in the data. Merriam (1998) stated that data of this kind uses constant comparison of segments of data to determine similarities and differences, and are then grouped in similar dimensions and, finally, categorised. Tesch (1990) referred to the activity of determining similarities and differences as “de-contextualization” and “re-contextualization” (p. 115). While she admits these words are cumbersome, the idea of taking raw data from one context and repositioning them in another is a simple explanation of how the pieces of coded information give meaning and explain “commonalities across the constituents of a phenomenon” (p. 115).

3.11 Limitations (weaknesses)

All research embeds decisions about the balance between available resources and the effectiveness of techniques. It was important therefore to recognise potential sources of bias and error in the conduct of this study. The pilot study was used to minimise and refine these limitations whilst the second rater and co-coding was used to strengthen the study and its subsequent findings. In addition, case studies, whilst a familiar education research method, has limitations. "It has acquired a reputation of being a method labelled as a category for anything that does not fit into experimental, survey or historical methods" (Burns, 1997, p. 364). Major problems for case study methods are possible researcher bias and lack of generalisability (Gay, 1992 p. 236). Other problems may be inquiry subjectiveness, the lack of immediate benefits in the results, and the "ethical risks and the [high] cost of time and money" (Stake, 1995, p. 45). Overextension of gathered information requires researchers to sort through the case study data to report only those cases and aspects of them that have the greatest bearing on the research questions.

3.12 Summary

This chapter has provided a description of the study methodology, and the substantiating rationale for its adoption. The case study site was selected following research and consultation with educational providers and industry governing bodies to ensure it was educationally appropriate and sound, allowing the researcher to focus solely on pedagogy and instructional design rather than on content issues. The issues of validity and reliability were discussed as they provided the theoretical framework for the research design, implementation and subsequent finding presentation and interpretation (Chapters 4 to 6).

The following chapter will present the results from the study. Following this, the findings are discussed and recommendations for further research are made.

CHAPTER FOUR

RESULTS

4.1 Overview

The purpose of the study was to examine the influence that pedagogical and instructional design characteristics had on the perceptions and learning of health care professionals studying several Web-based CPE courses through a commercial educational provider. The study used a commercial online education provider who provided a diverse mix of 42 educational courses that are accredited with leading health professional organisations within Australasia. This chapter presents the results of the analysis of the post-course reaction survey (Level I, participant satisfaction with the course), the pre- and post-course test of knowledge (Level II, knowledge gained from the course) surveys, application of knowledge and behavioural change into practice (Level III, application of course knowledge into practice) survey, and the pedagogical and instructional design moderator survey that was a component of the Level I survey. The chapter has been divided into two sections to correspond with the two research objectives, quantify the overall effectiveness of Web-based CPE instruction, and assessing the influence of several course factors (moderators) that were assumed to influence its effectiveness.

4.2 Presentation of results

During the 4-month data collection period, 1428 pre-tests were undertaken. This number represented 789 individual users. During the same data collection period, 703 post-tests were completed, representing 330 individual users. From the initial 789 individual pre-test participants, 40% ($n = 313$) completed both the pre-test and post-test (Level II, knowledge gained from the course). The Level I student satisfaction survey was completed by 21.3% ($n = 168$) of the initial 789 pre-test participants. Whilst on the surface this percentage appears low, the satisfaction survey was not available to the participants until after they had completed their post-test. Of all individual post-test users, 51% ($n = 330$) completed the participant satisfaction survey. The Level III (application of knowledge into practice) survey was completed by 100% of the individual post-test participants ($n = 330$) 73% of all completed post-tests (511 Level III surveys out of 703 post-tests). The reason for 27% ($n = 192$) of all post-test participants not

completing the Level III survey was due to the self-paced design of the Med-E-Serv courses. As previously indicated, the participants could choose to complete units and hence courses at their own pace, and this extended to the survey tools which could be completed at the key learning unit milestones or during their next logged-on session. All the survey tools, apart from the Level I survey, were required to be completed before the participant could progress--to the next learning area. This is illustrated in Table 4.1.

Table 4.1 Survey enrolments--participation rates

Individual# Level I	Individual# Level II*	Individual# Level III	Table to right indicates number of tests undertaken with individual user completion rates	Pre-test (total)	Individual pre-test	Post-test (total)	Individual post-test
168	313	330		1428	789	703	330

Individual refers to one participant/user, as indicated by a unique individual enrolment identification code.

* Completed both pre & post-tests during data collection period (see table segment to right)

4.3 Quantify the overall effectiveness of the Web-based CPE course

In addressing the overall effectiveness of the Web-based CPE course, three areas were investigated. The first area will be described in the section Learner Satisfaction (Level I) below referring to participant/learner satisfaction with both the course and the learning medium--the Web. The other two areas will be dealt with under the headings Level II course knowledge (section 4.3.3) and Level III, application of course content into practice (section 4.3.4). Results from all three areas of investigation will then be compiled to provide answers to the question of the overall effectiveness of the Web-based CPE course.

4.3.1 Learner Satisfaction (Level I)

In order to quantify the effectiveness of the Web-based CPE course, research question 1 asked, Will learners enrolled in a Web-based CPE course have a positive reaction to the educational learning experience?

The summary of the survey responses and the aggregate total for the objective data pertaining to learner satisfaction gathered from the 39 Likert-type items is found in Tables 4.2 and 4.3. These tables are organised to reveal the response variable with the subsequent data analysis from descriptive statistics (summary information about the distribution, variability, and central tendency of the variables). For ease of presentation, Pearson’s chi-square analysis for the non-parametric ordinal data, which analysed course evaluation variable counts and reported on asymptotic significance (small asymptotic significance values [< .05] indicated that the observed distribution does not conform to the hypothesised distribution. Typically, a value of less than 0.05 is considered significant), is not presented. However, 39 of the post-course evaluation items were determined to be significantly different from the hypothesised distribution. Therefore, frequency counts in the form of bar charts are presented in Figures 4.1–4.39, which represent the 39 statistically significant events from the Likert-type items on the post course satisfaction survey.

Table 4.2 CES descriptive statistics

Descriptive Statistics			
	N	Mean	Std. Deviation
course structure - objectives	168	5.54	.557
course structure - organisation	168	5.60	.504
course structure - content	168	5.63	.520
content - relevancy	168	5.64	.528
content - PBL	168	5.57	.565
content - knowledge	168	5.46	.674
content - experience	168	5.36	.749
graphics/media - purpose	168	4.49	1.056
graphics/media - presentation	168	5.08	.833
graphics/media - organisation	168	5.20	.835
medium - effective	168	2.48	1.179
medium - least effective	168	4.17	1.038
instructional design - rate	168	5.56	.624
instructional design - pacing	168	5.57	.615
instructional design - interactivity	168	5.19	.840
instructional design - organisation	168	5.42	.652
instructional design - navigation	168	5.39	.656
instructional design - purpose	168	5.34	.785
home page - organisation	168	5.29	.629
home page - instruction	168	5.11	1.017
impressions - future participation	168	5.76	.427
impressions - effective	168	5.70	.474
impressions - appealing	168	5.54	.618
impressions - favourable	168	5.58	.552
impressions - ease of use	168	5.55	.555
impressions - confident	168	5.07	1.030
impressions - feedback provided	168	4.88	1.149
impressions - feedback appropriate	168	4.48	1.496
impressions - feedback timely	168	4.41	1.545
impressions - interaction provided	168	4.80	1.133
impressions - interaction appropriate	168	4.75	1.275
impressions - interaction timely	168	4.48	1.414
impressions - value for money	168	5.05	1.619
impressions - more effective	168	4.67	1.125
impressions - usability	168	3.65	.479
impressions - layout	168	3.52	.524
impressions - academic objectives	168	3.61	.502
learning approach adopted	168	3.58	.510
Valid N (listwise)	168	2.88	.536

Table 4.3 CES descriptive statistics – for medium (outliners removed⁹)

Statistics		medium most effective	medium least effective
N	Valid	162	72
	Missing	0	0
Mean		2.40	2.83
Std. Deviation		1.054	1.760
Skewness		1.617	.166
Std. Error of Skewness		.191	.283
Maximum		5	5

Compiled in SPSS (2000)

Pearson's chi-square analysis indicated that none of the assumptions of performing chi-square analysis were violated. Such violations included ensuring that the 'minimum expected cell frequency', which should be 5 or greater (or at least 80 per cent of cells having expected frequencies of 5 or more), were not violated. This was indicated by the statement of the 'minimum cell frequency is' in the chi-square table footnotes. Chi-square analysis indicated that all the chi-square values obtained from the 39 Likert-type responses were associated with significance levels of less than 0.05 ($p < 0.05$) in 38 of the 39 cases, each having a p value of 0.000, which the statistical software package (SPSS) rounded down to three decimal places. Therefore, the actual associated significance value was less than 0.0005, which was significantly less than the specified alpha value of 0.05. Additionally, one case had an associated significance value of $p = 0.008$, which was also significantly smaller than the specified alpha value of 0.05.

In summary, 39 of the post-course evaluation (CES) items were determined to be significantly different from the hypothesised distribution due to small asymptotic significance values $< .05$, which Gravetter and Wallnau (2000) considered statistically significant. Therefore, these significantly different items are presented as Figures 4.1–4.39, which were all compiled in SPSS (2000).

⁹ The media of sound and video were removed, as they were not incorporated in the studied courses. These media were termed outliners.

Figure 4.1

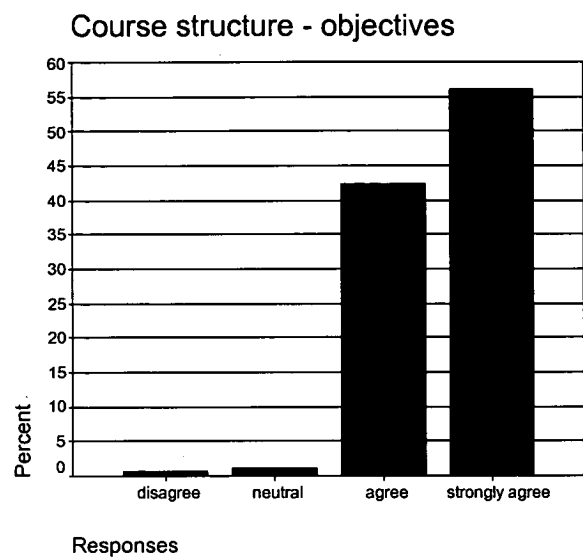
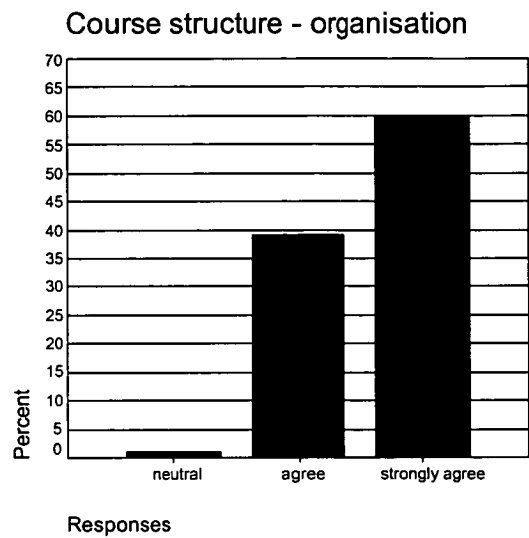


Figure 4.2



Count summary from CES items 1 and 2 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.3

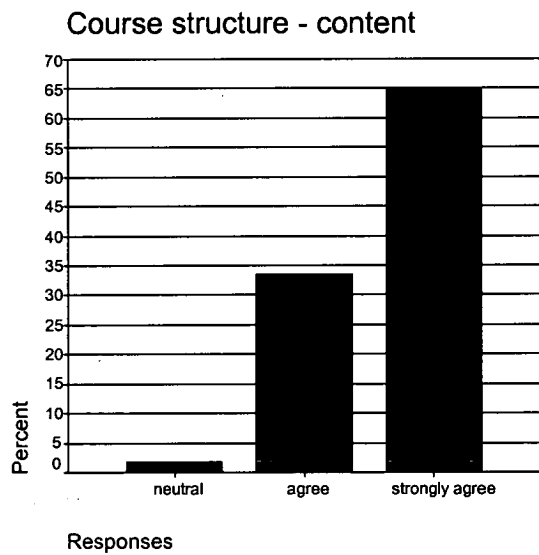
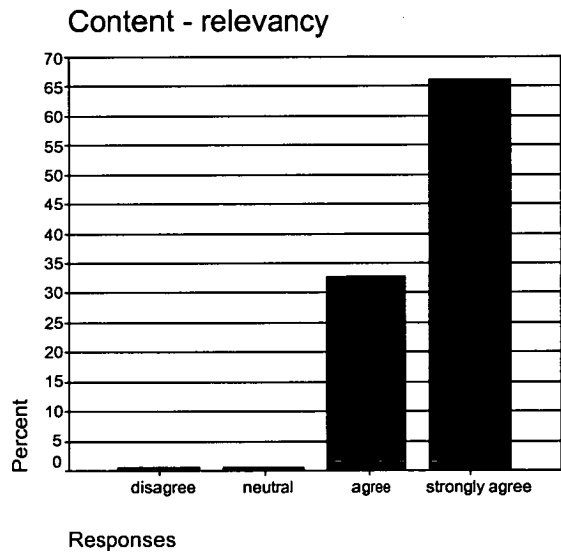


Figure 4.4



Count summary from CES items 3 and 4 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.5

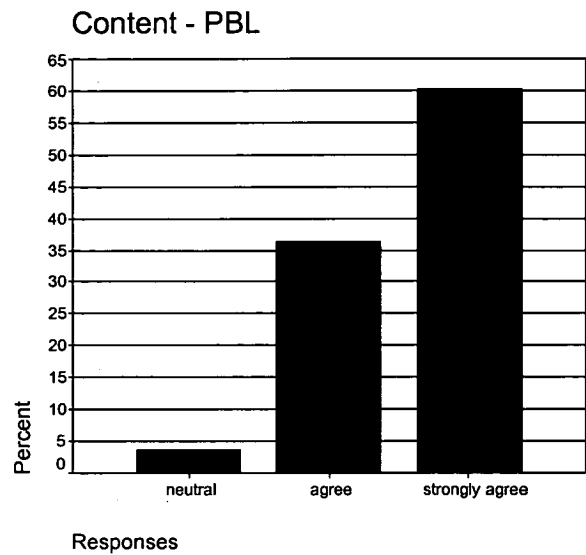
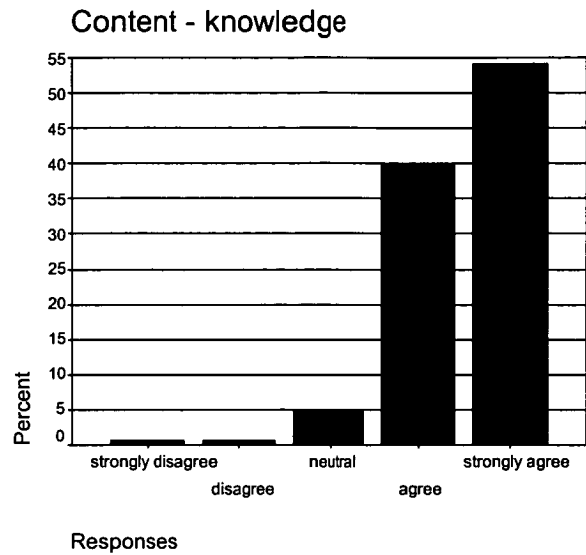


Figure 4.6



Count summary from CES items 5 and 6 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.7

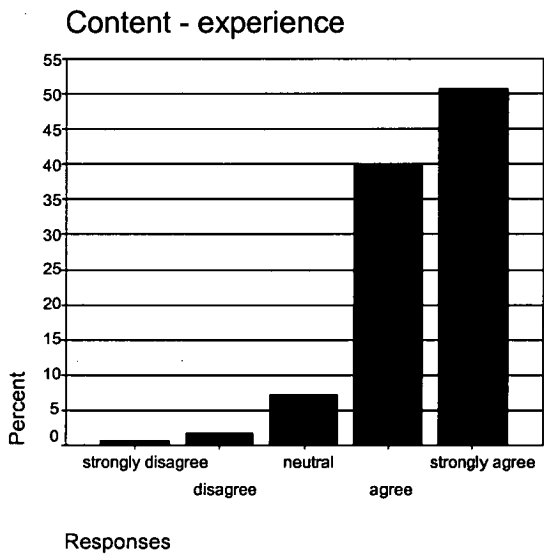
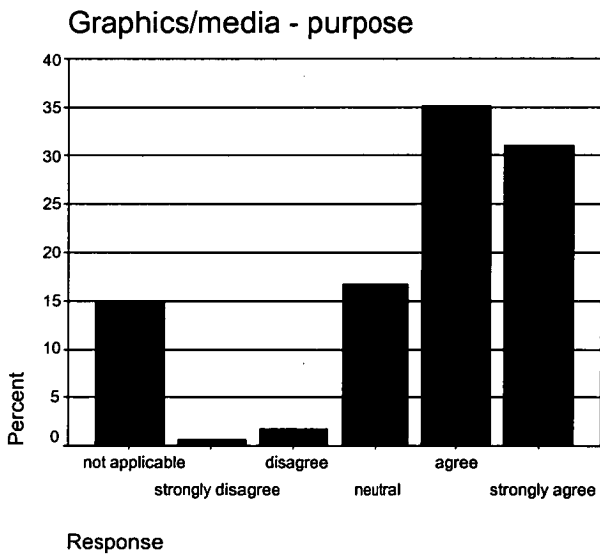


Figure 4.8



Count summary from CES items 7 and 8 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.9

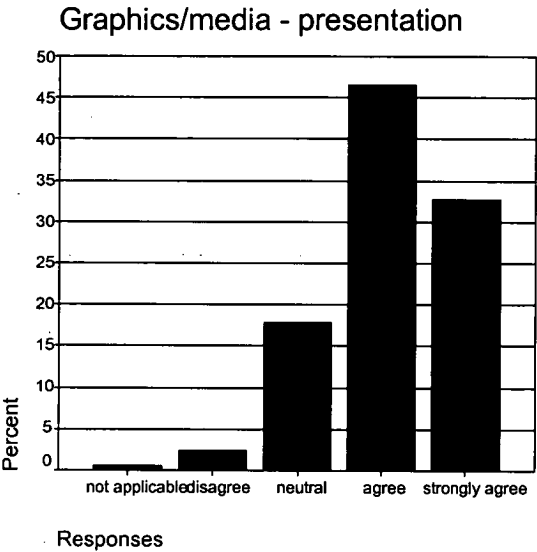
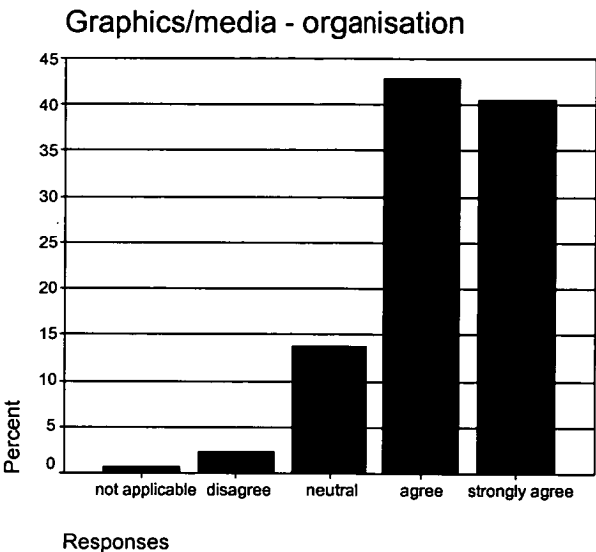


Figure 4.10



Count summary from CES items 9 and 10 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.11

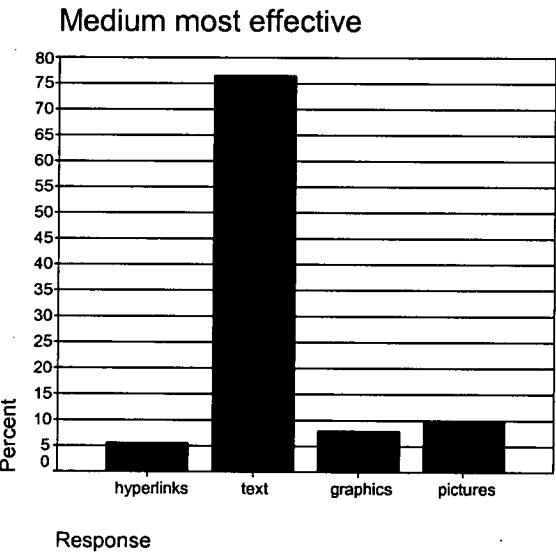
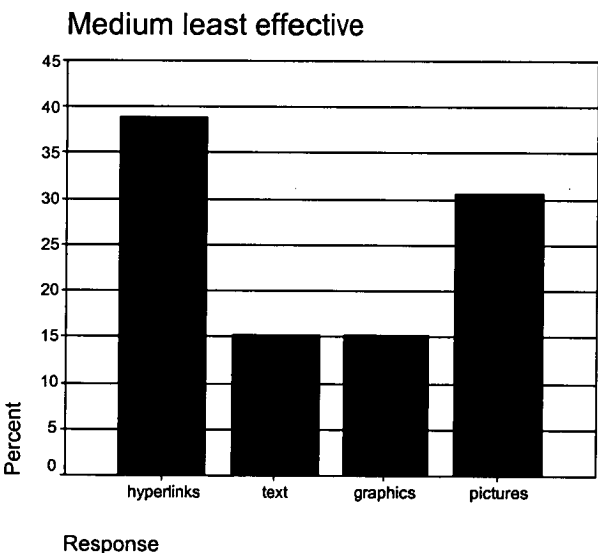
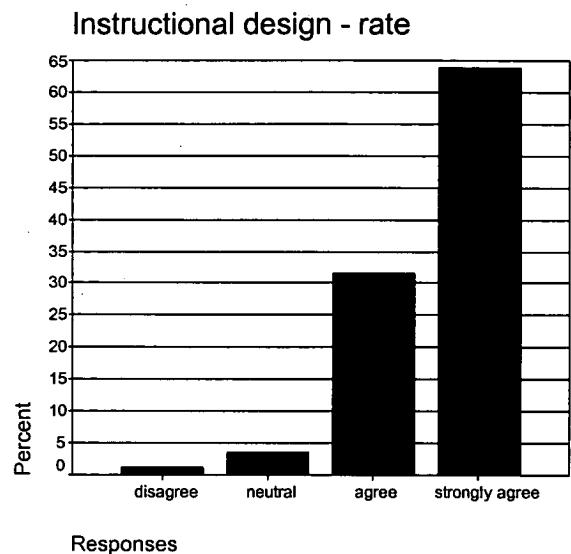


Figure 4.12



Count summary from CES items 11 and 12 measured by actual observed counts of participant selection of Likert-type responses (hyperlinks, text, graphics, pictures) ($n = 162$ and 72 respectively).

Figure 4.13



Count summary from CES items 13 and 14 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.14

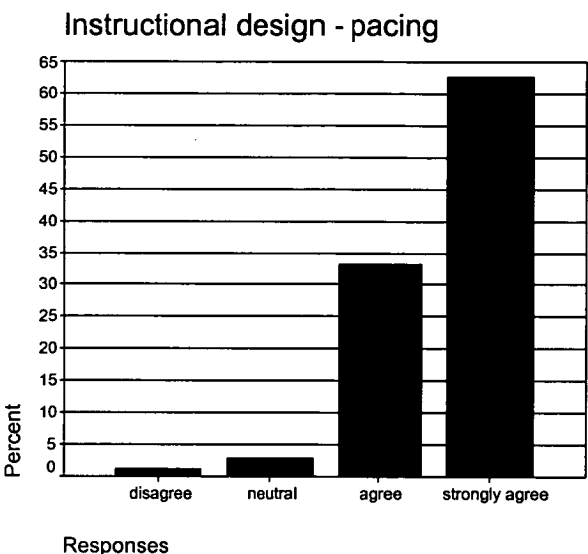


Figure 4.15

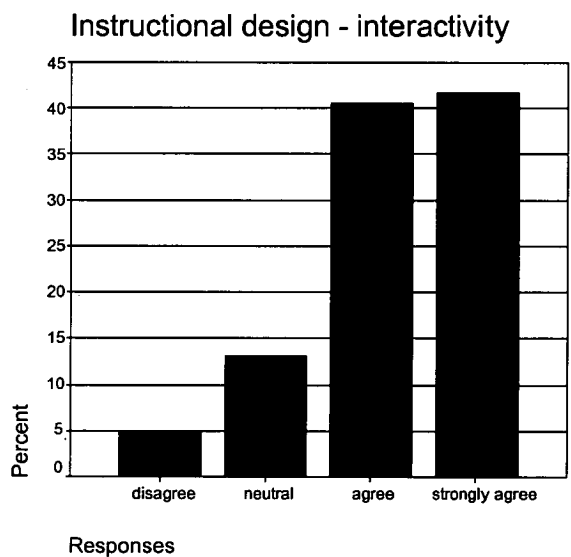
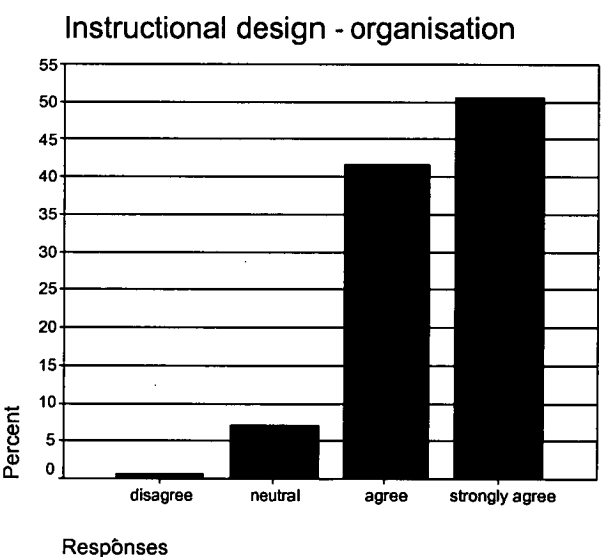


Figure 4.16



Count summary from CES items 15 and 16 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.17

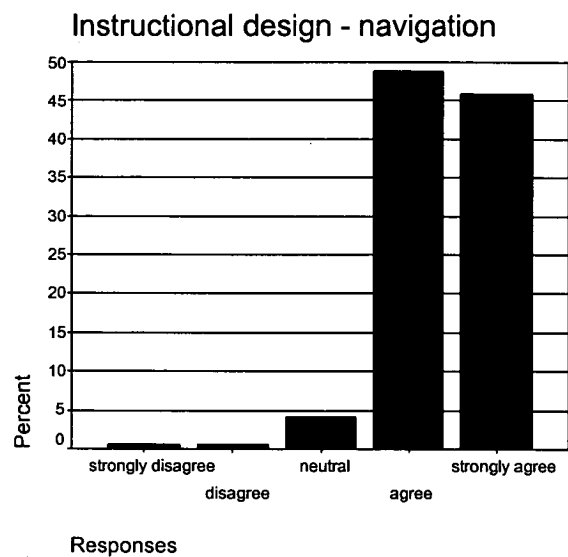
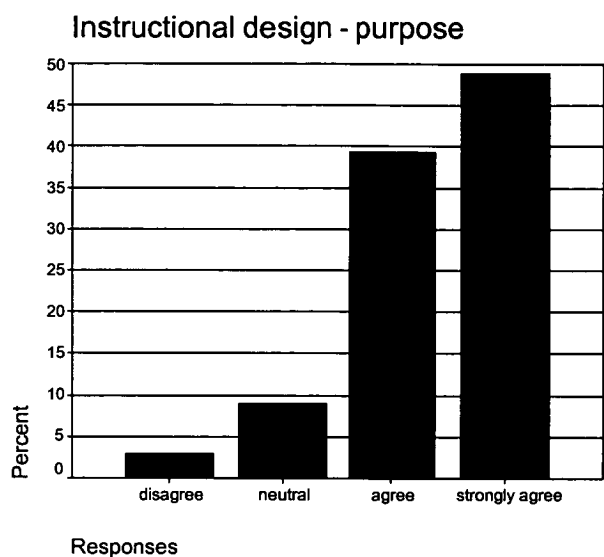


Figure 4.18



Count summary from CES items 17 and 18 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.19

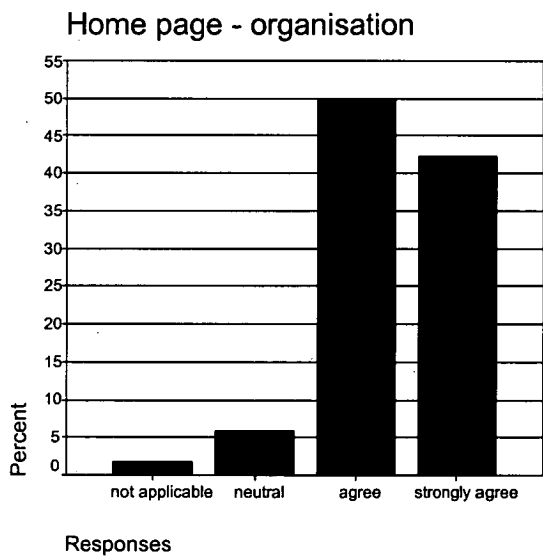
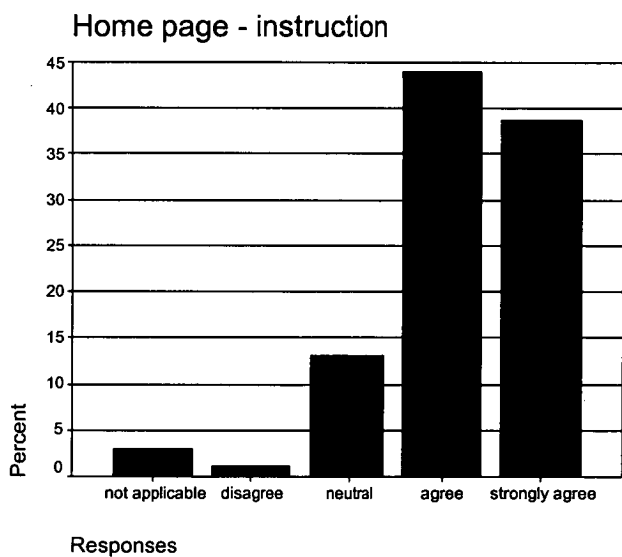


Figure 4.20



Count summary from CES items 19 and 20 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.21

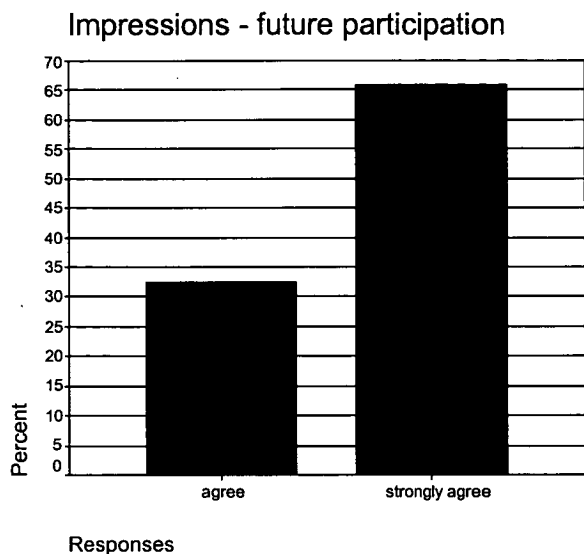
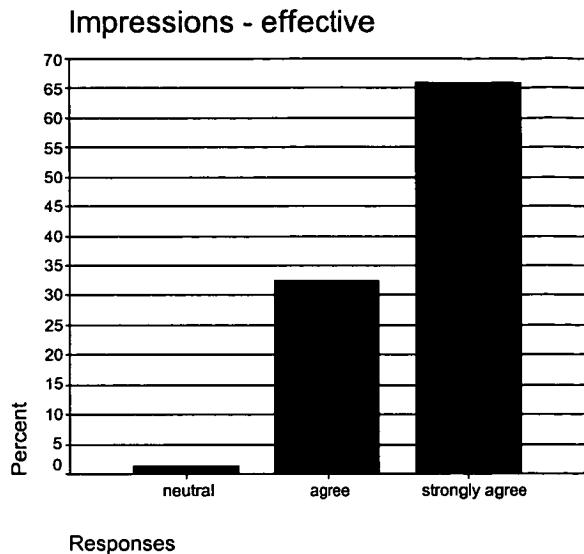


Figure 4.22



Count summary from CES items 21 and 22 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.23

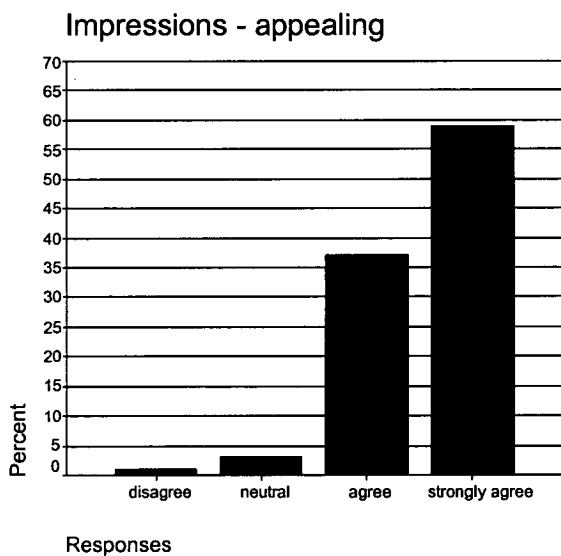
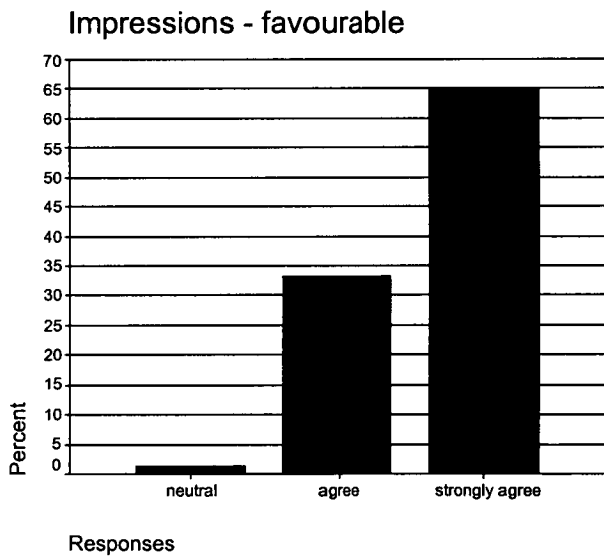


Figure 4.24



Count summary from CES items 23 and 24 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.25

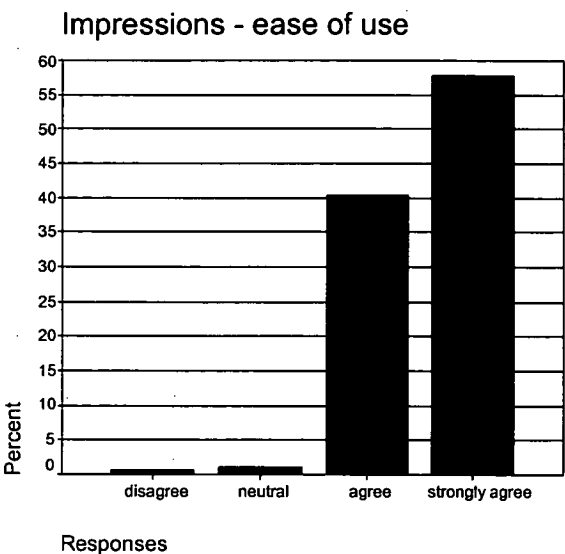
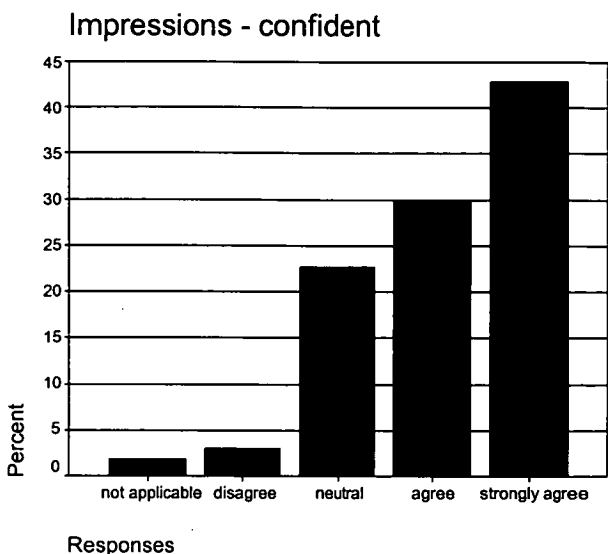


Figure 4.26



Count summary from CES items 25 and 26 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.27

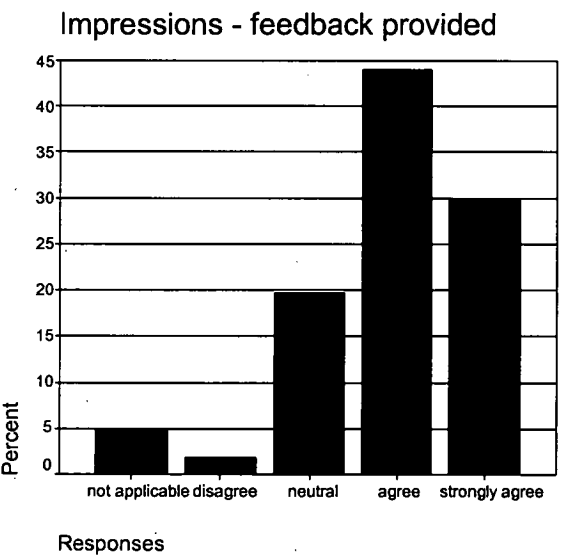
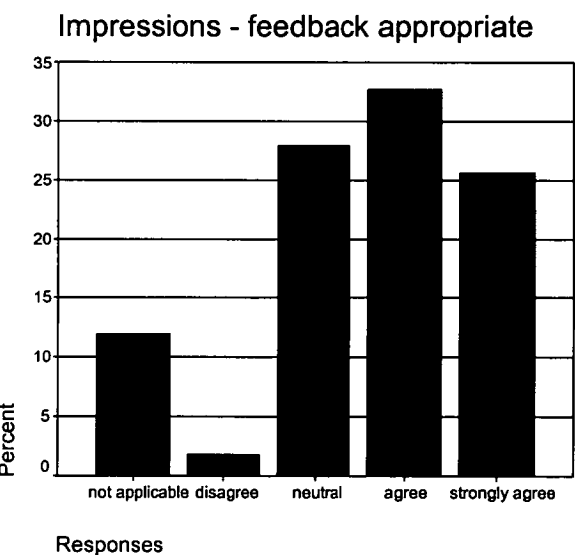


Figure 4.28



Count summary from CES items 27 and 28 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.29

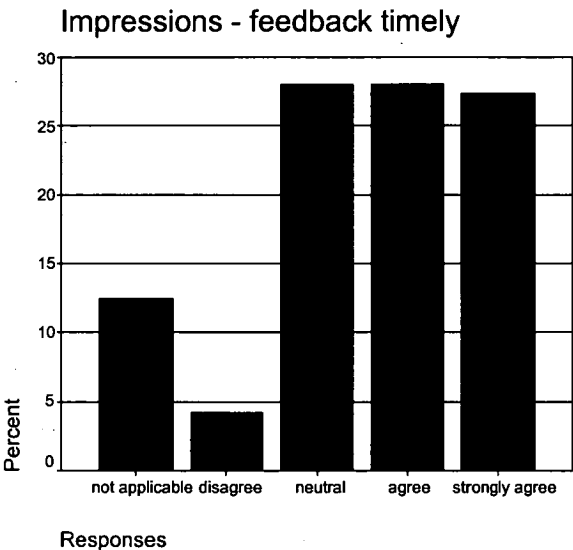
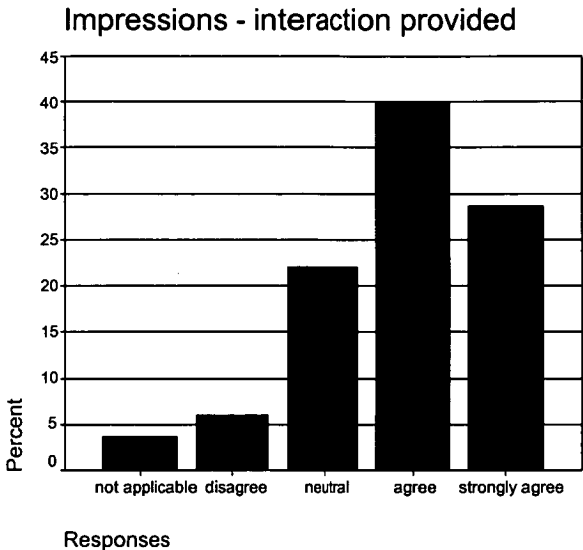


Figure 4.30



Count summary from CES items 29 and 30 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.31

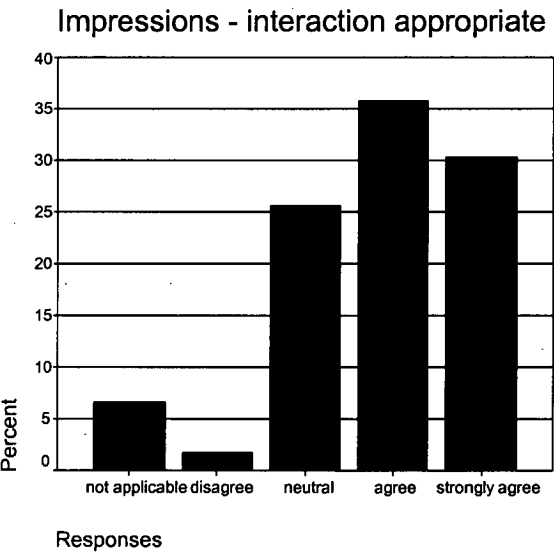
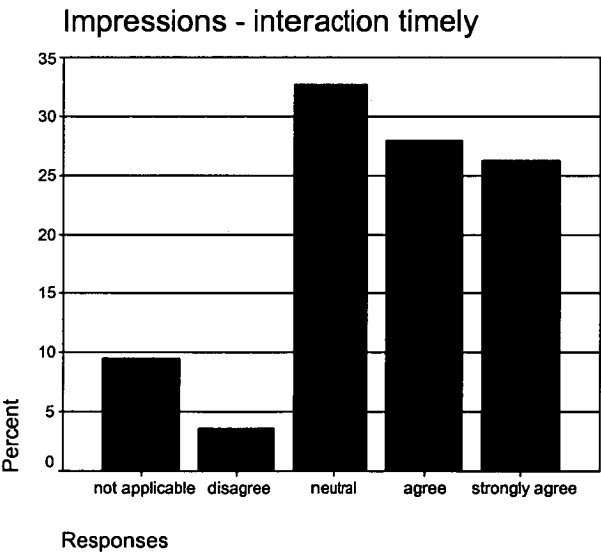


Figure 4.32



Count summary from CES items 31 and 32 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.33

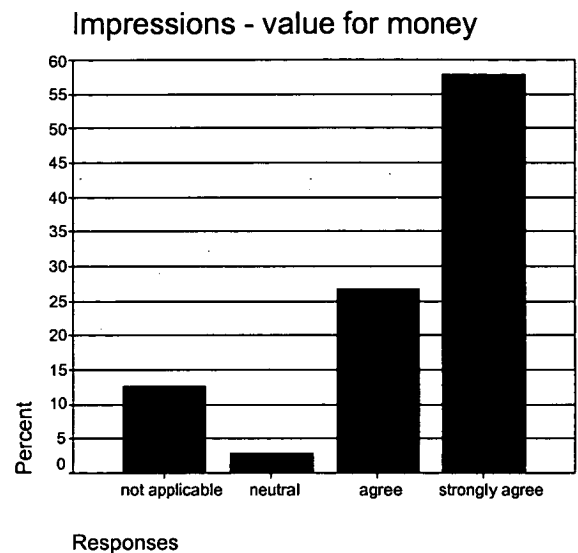
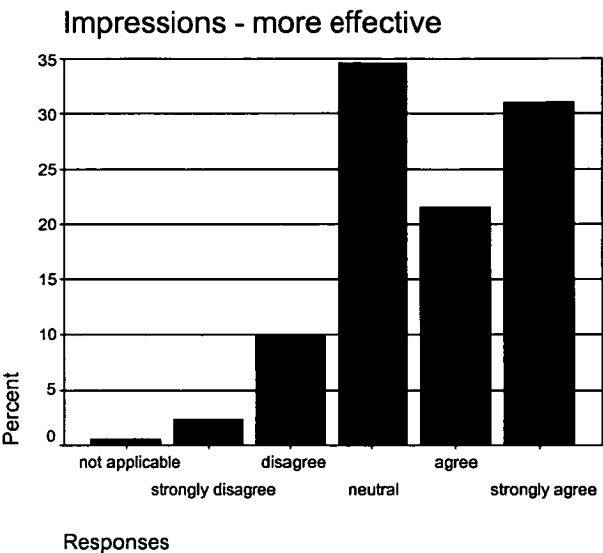


Figure 4.34



Count summary from CES items 33 and 34 measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.35

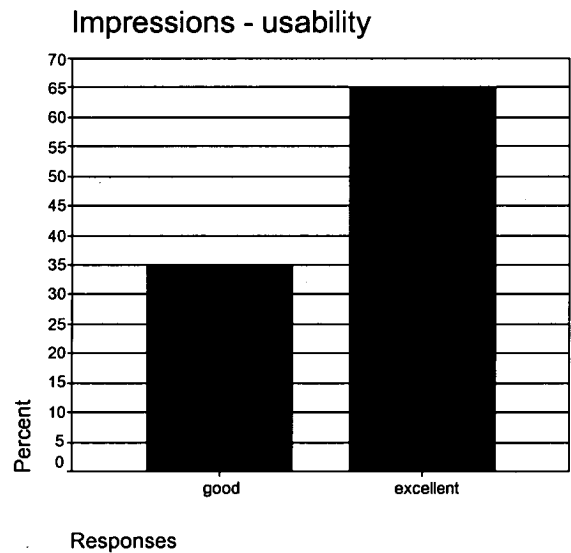
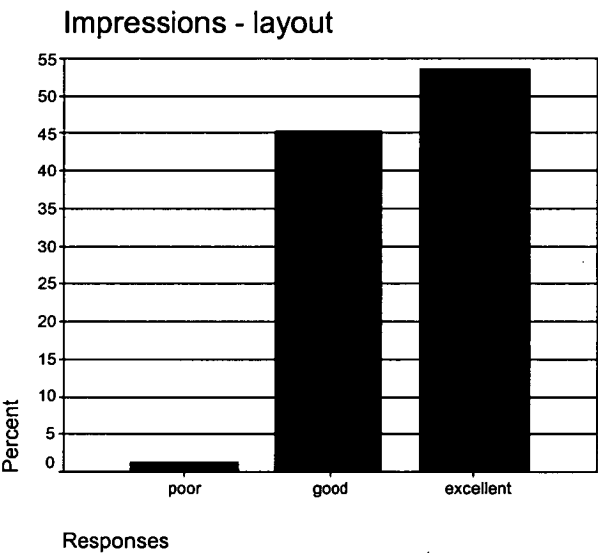


Figure 4.36



Count summary from CES items 35 and 36 measured by actual observed counts of participant selection of Likert-type responses (excellent, good, poor and very poor) ($n = 168$).

Figure 4.37

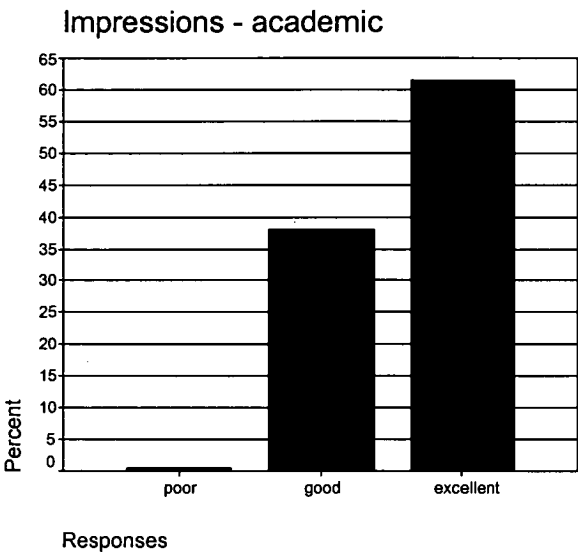
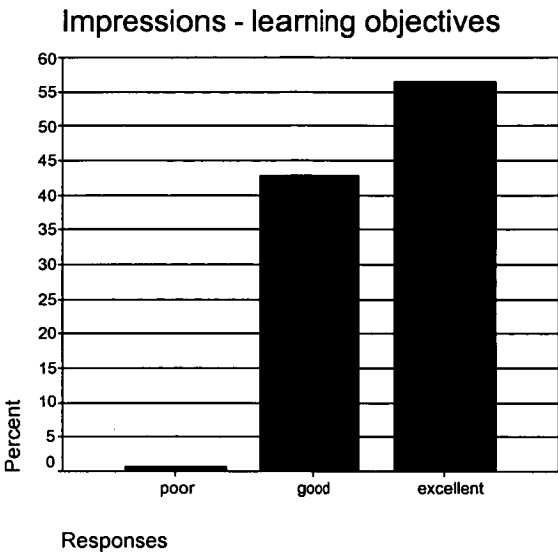
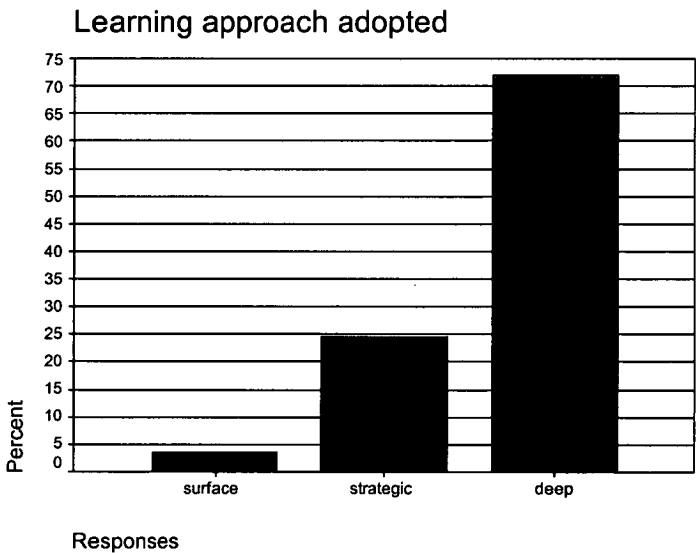


Figure 4.38



Count summary from CES items 37 and 38 measured by actual observed counts of participant selection of Likert-type responses (excellent, good, poor and very poor) ($n = 168$).

Figure 4.39



Count summary from CES item 39 measured by actual observed counts of participant selection of Likert-type responses (surface learning, strategic learning, deep learning) ($n = 168$).

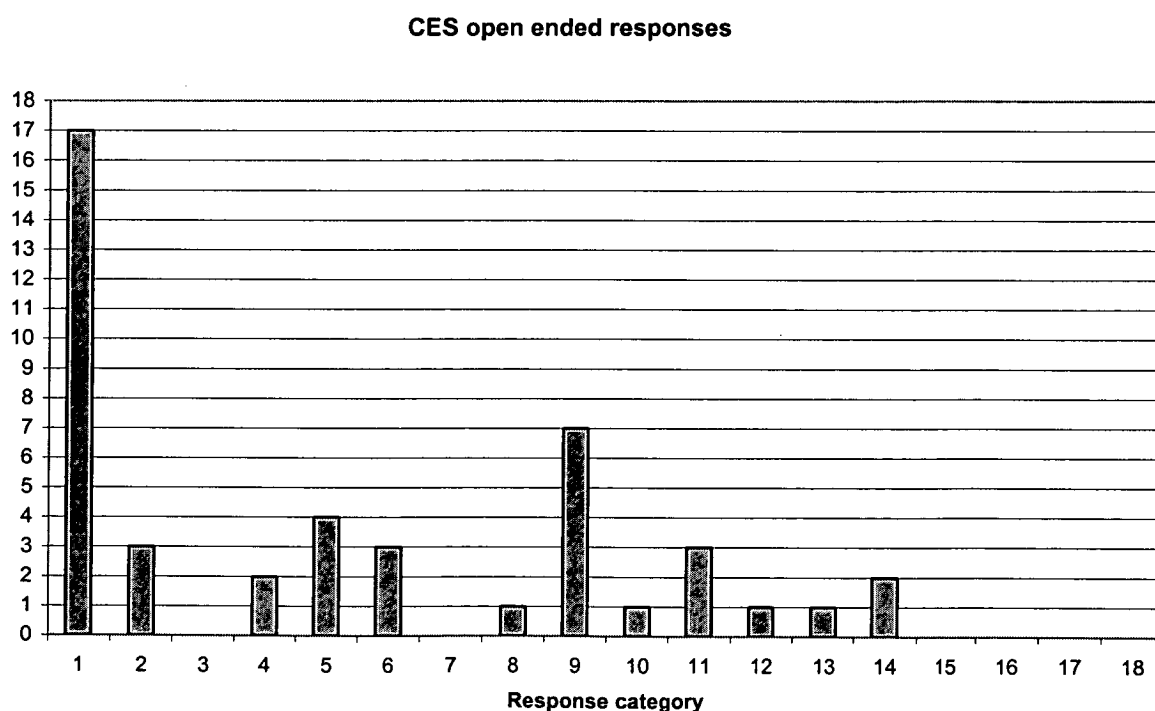
The analysis of the data for the 39 Likert-type questions produced 39 items that were determined to be statistically significant ($p < 0.05$). For each of the 39 significant items, as exemplified in Figures 4.1–4.39, the data revealed a tendency for the learners to have a favourable reaction or experience to the learning event for all of the variables examined. Although it can be concluded that there was a statistically significant positive or favourable reaction by/experience for the learners' to their study online, we cannot assume causality, as will be explained in Chapter 5.

The responses from the one open-ended question (“other comments”) was categorised into like content and counted for frequency (Table 4.4 and Figure 4.40). The table and figure are each constructed to present the grouped responses together with their respective frequency counts. Of the 168 individuals who completed the CES 45 or 27% added comments at the open-ended question.

Table 4.4 Frequency count summary of data from post-course satisfaction survey (CES)

Response category	n = 45	100%
1.Convenience such as place and time	17	38%
2.Technology limitations such as bandwidth (external to site)	3	7%
3.PBL	0	0
4.Association with accrediting organisation exams/CPE (i.e. RACGP)	2	4%
5.Need for additional information or links to same, or content suggestion/improvement	4	9%
6.Instructional design limitations such as navigation (internal to site)	3	7%
7.Better than Divisional/Pharmaceutical or other face-to-face CPE sessions	0	0
8.Content thoroughness such as objectives, lecture notes and case discussion follow-ups	1	2%
9.Value	7	16%
10.User friendliness	1	2%
11.CES limitations	3	7%
Other--listed		
12.A- ? does it change practice	1	2%
13.B – Need for face to face contact	1	2%
14.C – Referral to other Website	2	4%
15.D – Specific HCP response	0	0
16.E –Interaction with peers appreciated	0	0
17.F – Increased professional confidence	0	0
18.Ambiguous	0	0
Total count	45	100 %

Figure 4.40 Frequency count summary of subjective data from post course satisfaction survey (CES)



In, summary from the analysis of the data related to the reaction of the learners (Level I, satisfaction with the course), it appears that Web-based learning created favourable reactions within learner perceptions. The data indicate that there were at least 39 significant Web-based learning reactions, identifying that the learners viewed Web-based learning favourably.

4.3.2 Learner Satisfaction (Level I) Demographic Profile Survey (DPS)

The DPS was completed by 168 individual participants representing 22.3% of the total number of individual pre-test participants ($n = 789$), 51% of individual post-test participants ($n = 330$) and 33% of individual Level III participants. As the DPS was offered to participants immediately after completion of the post-test, this response represented 51% of participants, and the results indicate the demographic profile of the Web-based study Level I cohort. This number represents an acceptable sample size for the 0.05 level of confidence with an effect size of greater than 95%. However the power for this sample and effect size is markedly low, creating a greater chance of a type II error (Portney and Watkins, 1993), or errors due to small sample sizes. Therefore, the predetermined level of significance was established at the generally acceptable 0.05 level. The results of the DPS are presented in a side-by-side comparison of the frequency for the cohort as a whole as well as by gender in Table 4.5 and Figures 4.41–4.43.

Figure 4.41 DPS Gender breakdown

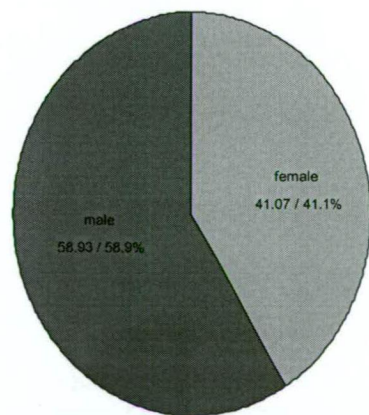


Figure 4.42 DPS Age breakdown

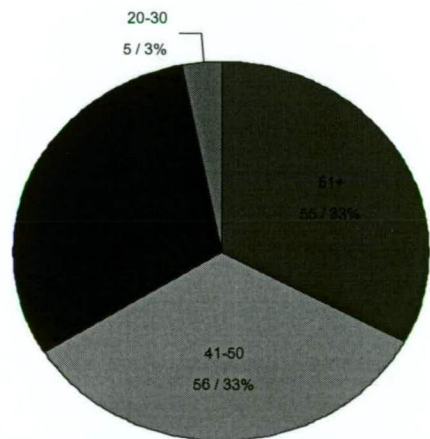
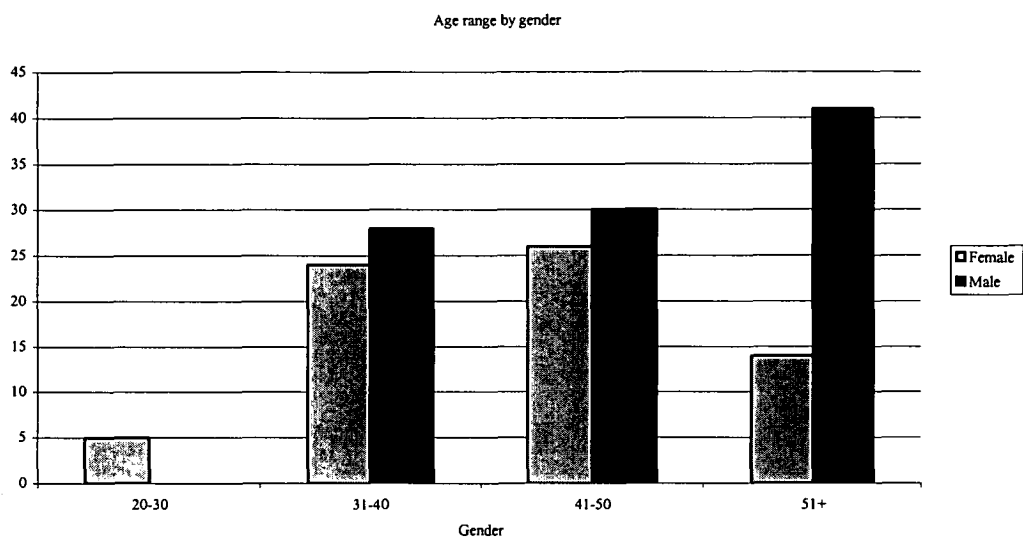


Table 4.5 DPS results

Variable	Male	Female	Total
Number	99	69	168
Percentage	59	41	100
Age			
20–30	0	5	5
31–40	28	24	52
41–50	30	26	56
51+	41	14	55
Occupation:			
GP	84	63	147
Other	15	6	21
Internet competency:			
Very poor	1	0	1
Poor	2	4	6
Good	65	46	111
Excellent	31	19	50
Computer competency:			
Very poor	1	0	1
Poor	5	6	11
Good	63	48	111
Excellent	30	15	45
Number of online Courses taken:			
1	14	11	25
2–3	20	12	32
4–5	14	12	26
6–7	9	14	23
8+	42	20	62
Place of study:			
Home	66	56	111
Work	33	13	46
Time of study:			
0000–0400	6	4	10
0500–0800	6	3	9
0900–1200	16	16	32
1300–1600	23	17	50
1700–2000	25	15	40
2100–2400	23	14	37
Day of study:			
Monday	11	10	21
Tuesday	17	16	33
Wednesday	16	7	23
Thursday	10	6	16
Friday	17	15	32
Saturday	15	4	19
Sunday	13	11	24

Figure 4.43 DPS Age break down by gender



The DPS indicated that the gender spilt was not significant and that approximately 1/3 of participants were in the age groups 31–40; 41–50; and 51+. Again, this produced no significant difference between the groups.

4.3.3 Learner Achievement (Level II, knowledge gained from the course)

Research question 2 investigated, Will learners enrolled in a Web-based CPE course acquire the knowledge disseminated through the educational experience?

Achievement data was collected by a pre-course and post-course evaluation using the identified test of knowledge for the individual courses. Appendix 5 contains one sample of the pre/post-test for one selected course. In addition, Table 4.6 indicates the content descriptors for the Med-E-Serv pre/post-tests as a collective. Individual participant pre-test and individual participant post-test numbers differ, due to a number of factors, including the course commencement date, as the data collection period for this study commenced in the last week of July 2003 and finished at the end of November 2003. This meant that some participants would not have had time to complete all the requirements for their course or for this study. In addition, due to participants being able to moderate their own learning unit and course pace, they were able to do so as quickly as possible or as slowly as possible. Therefore, participants could complete a course over a period of time greater than this study’s data collection period.

Table 4.6 Test descriptors (questions) for skill, knowledge, attitude and behaviour for all 42 courses

Skill	Knowledge	Attitude	Behaviour	Total number of questions
56	132	90	74	352

Table 4.7 Summary of means for pre-and post-course tests of knowledge

Learning module	Pre-test mean	<i>SD</i>	Post-test mean	<i>SD</i>	<i>t</i> -test	<i>p</i>
<i>n</i> = 42	78.524	18.709	94.484	8.602	-5.149	< 0.0005

A paired-samples *t*-test was conducted to evaluate the impact of the educational event (online learning) on learners' content knowledge test scores. Results are indicated in Table 4.7. These results indicate a difference in the two test scores, with a significant difference of less than 0.05. The obtained probability value was 0.000, with the actual probability value being less than 0.0005, which was significantly less than the specified alpha value of 0.05. Therefore, it could be concluded that there was a significant difference in learning from the pre-test time period to the post-test time period. The likelihood of obtaining these results from chance was, statistically unlikely to occur. Eta-squared statistical analysis, which measures the magnitude of the intervention's effect, was found to be 0.551. Cohen (1988) offered the following guidelines for the interpretation of eta-squared values: 0.01 = small effect, 0.06 = moderate effect, 0.14 = large effect. Given the study's Level II findings of eta-squared = 0.551, it was concluded that there was a large effect, with a substantial difference in course content knowledge (learning) scores obtained before and after the learning intervention (online course).

In summary, learner achievement (Level II) data revealed that there was a statistically significant increase in test scores from the pre- to post-test period. Pre- to post-test scores indicated an eta-squared value of 0.551, which indicated that learning did occur over the duration of the course. Whilst a gain in knowledge is to be expected from any educational event, the results from this study are worthy because of the large gain in knowledge that occurred from the pre to post-test phase of the course.

4.3.4 Application of knowledge and behaviour change in practice (Level III)

Research question 3 asked, Do learners use the knowledge from the course in their work, that is, is the knowledge applied?

Application of knowledge and behaviour change in practice was collected post-course using the identified application survey tool (Appendix 6A and 6B). The Level III survey was in two parts. The first survey was specific for the 24 courses, which included a clinical or learning tool (Appendix 6A), whilst the second survey was used for the remaining 18 courses that did not incorporate a clinical tool (Appendix 6B). Both types of surveys were comprised of two types of questions: Likert-type response items and an open-ended question (“Comments”).

From the studied courses (42), 57% ($n = 24$) included a clinical or learning support tool, which the participant could implement immediately into practice. Participant use of the support and clinical tools would highlight application of knowledge into practice. From these 24 courses, 306 participants completed the reporting for the Level III survey, representing 60% of the total number of Level III respondents ($n = 511$). In addition to the specific question of the use of the tools within these 24 courses, all the modified courseware provider evaluations contained a question relating to practice behavioural changes as a result of completing the educational event.

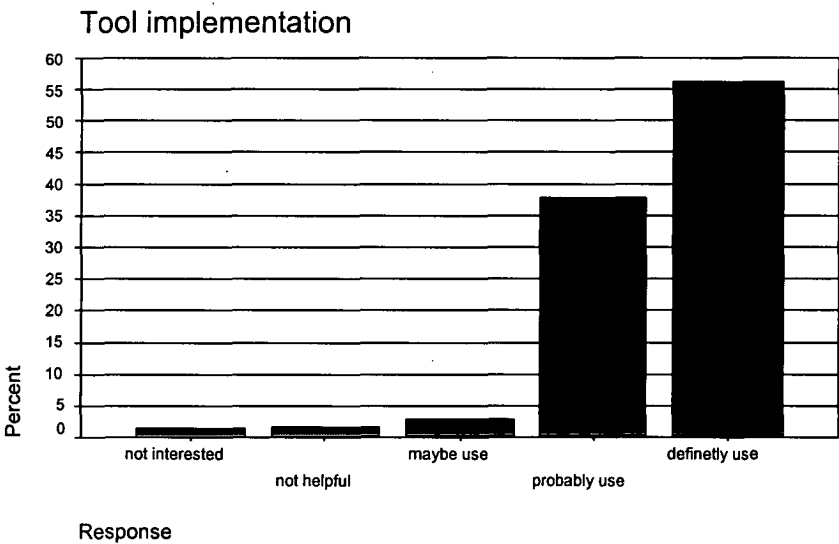
The Level III Likert-type questions concerning tool usage, practice behaviour change within the courses incorporating tools, and behaviour change in the courses which did not incorporate a diagnostic or learning tool, was examined using nonparametric tests (one-sample chi-square analysis) to examine how the variables compared with hypothesised values. These findings together with correlation analysis, was used to describe the strength and distribution of the linear relationships between the variables.

Figure 4.44 concerned participants’ responses to the question about clinical tool use from the 24 courses that incorporated a clinical tool as a component of the course. Of the 306 Level III Tool survey participants, 56.2% indicated that they ‘definitely will’ use or ‘are using’ the clinical tool within their practice. Fewer, (37.9%) of the participants indicated that they would ‘probably use’ the tool in practice. Therefore, the favourable incorporation of the tool into practice was indicated by 96.8% ($n = 297$ out of the total of 306 respondents) of the survey participants. This large percentage of favourable or positive tool usage or intended usage combined with 33.7% ($n = 103$) of respondents indicating that they ‘changed’ their practice or will ‘modify’ it as a result of completing the tool-associated courses indicated that the learning event had not only favourable effects on the participants but that their learning had carried over into their practice, as indicated in Figure 4.45. Fewer than 40% (39.9% $n = 122$) of the

participants indicated that they ‘had’ or ‘would’ review their practice, which according to Schon (1997) is a positive aspect of professional development. This therefore meant that 225 participants (73.6%) indicated a favourable behavioural experience in relation to undertaking one of the 24 tool-associated courses. Of the remaining participants, 24.5% ($n = 75$) indicated that the course ‘confirmed’ their practice, a response viewed as being neutral. Only 2% ($n = 6$) of the tool-associated course participants reported that as a result of completing the course their practice ‘was’ or ‘would be’ unchanged.

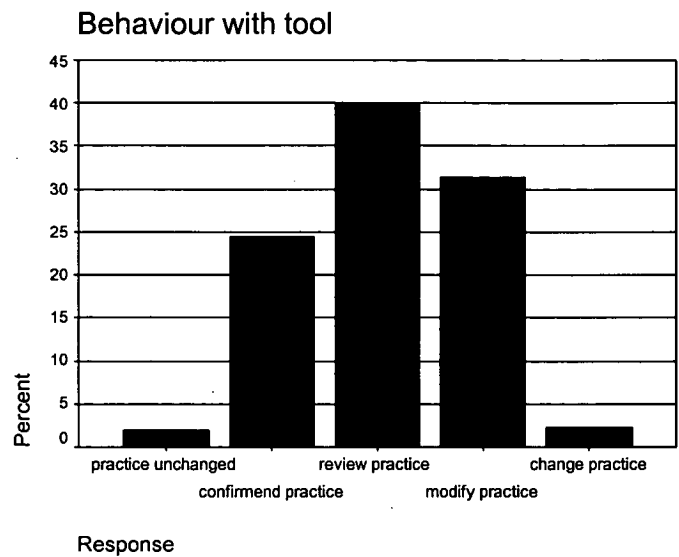
In relation to the 18 non-tool-based courses, 61.5% of participants ($n = 126$ out of 205 non-tool Level III participants) indicated that they had a favourable in-practice behavioural reaction to the educational experience (change, modify or review practice). The neutral response of ‘confirmed practice’ was indicated by 33.2% ($n = 68$) of participants. The remaining 5.4%, ($n = 11$) of participants indicated that they ‘did not’ or ‘would not’ change their practice as a result of completing the learning event, as indicated in Figure 4.46 (Figures 4.44–4.47 were compiled in SPSS [2000]).

Figure 4.44 Response to will you/have you implement/ed the clinical tool



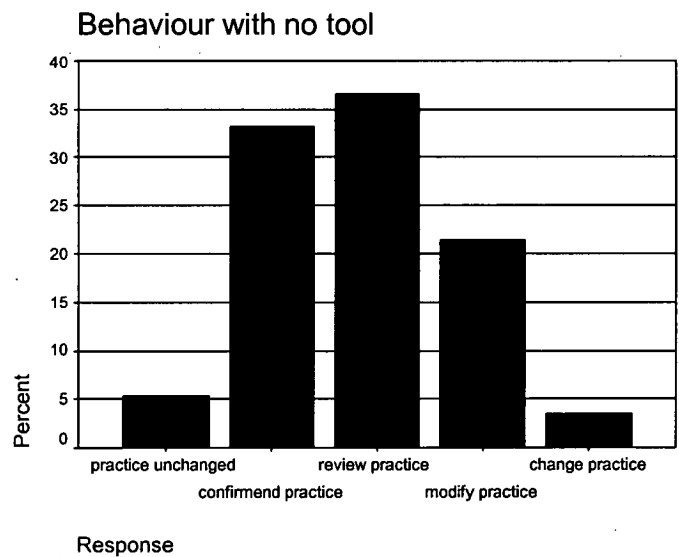
Count summary from Level III Tool Evaluation Survey item 14, measured by actual observed counts of participant selection of Likert-type responses (not interested, no not helpful, maybe use, probably use, definitely use) ($n = 306$).

Figure 4.45 Behaviour change associated with courses incorporating tool



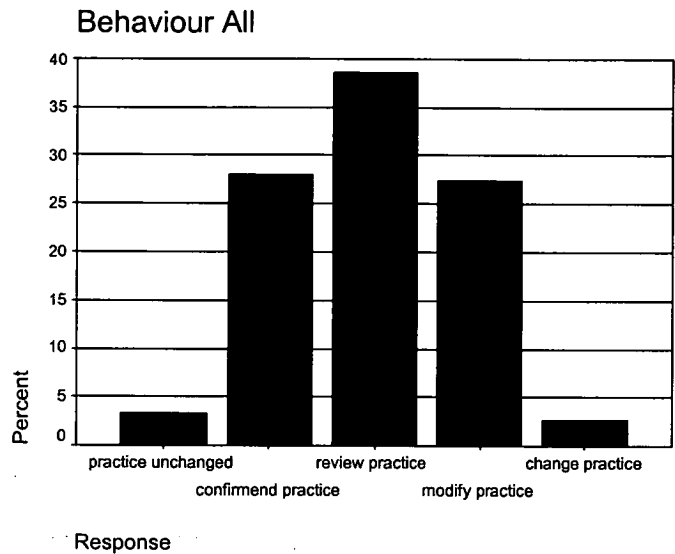
Count summary from Level III Tool Evaluation Survey item 13, measured by actual observed counts of participant selection of Likert-type responses (my practice was unchanged, I confirmed my practice, I reviewed my practice, I modified my practice, I changed my practice) ($n = 306$).

Figure 4.46 Behaviour change from non-tool courses



Count summary from Level III No-Tool Evaluation Survey item 13, measured by actual observed counts of participant selection of Likert-type responses (my practice was unchanged, I confirmed my practice, I reviewed my practice, I modified my practice, I changed my practice) ($n = 205$).

Figure 4.47 Behaviour change for all courses (*n* = 42)



Count summary from Level III Evaluation Survey item 13, measured by actual observed counts of participant selection of Likert-type responses (my practice was unchanged, I confirmed my practice, I reviewed my practice, I modified my practice, I changed my practice) (*n* = 511).

In relation to favourable responses for behaviour change as a result of completing any of the courses, Figure 4.47 and Table 4.8 graphically indicate that 30.1% (*n* = 154 out of 511) of participants ‘had’ or ‘would’ change or ‘modify’ their practice as a result of completing their online CPE course. The overall favourable behaviour reaction (review, modify and change) was indicated by most of the survey participants (68.7%, *n* = 351), whilst the neutral response of ‘confirmed’ practice was indicated by 28% (*n* = 143) of participants. Of the remaining participants, only 3.3% (*n* = 17) indicated that as a result of completing the course that their practice ‘was’ or ‘would not be’ changed.

Table 4.8 Behaviour change for all courses (compiled in SPSS [2000])

Behaviour all		Frequency	Valid Percent	Cumulative Percent
Valid	practice unchanged	17	3.3	3.3
	confirmend practice	143	28.0	31.3
	review practice	197	38.6	69.9
	modify practice	140	27.4	97.3
	change practice	14	2.7	100.0
	Total	511	100.0	
Missing	System	0		
Total		511		

An examination of the correlation between behaviour response and tool usage was investigated using Pearson product-moment correlation coefficient. A preliminary analysis was performed to ensure that no violation of the assumptions of normality, linearity and homoscedasticity occurred. Findings revealed a Pearson correlation of 0.750 at the 0.01 level of significance, as shown in Table 4.9. This correlation indicated that since 0.750 is relatively close to 1, then behaviour change and tool usage were positively correlated. This was also supported by the significance level being very small ($p < 0.01$), indicating that the correlation was significant and the two variables were linearly related. This interpretation of the correlational relationship is supported by Cohen (1988), who suggested that: $r = +0.10$ to $+0.29$ (small), $r = +0.330$ to $+0.49$ (medium), $r = +0.50$ to $+1.0$ (large). Therefore, this study's findings show that the relationship between tool usage and favourable behaviour change, as measured by the Level III survey, had a strong positive correlation ($r = 0.750$, $n = 306$, $p < 0.01$), indicating to the educational providers that the use of a clinical or diagnostic support tool within their course leads to or influences the behaviour of the participants in their professional practice.

Table 4.9 Pearson's correlation for all variables

		Correlations			
		behvwithtool	tool	behaviour no tool	behaviour all
behvwithtool	Pearson Correlation	1	.750**	.863**	.795**
	Sig. (2-tailed)	.	.000	.000	.000
	Sum of Squares and Cross-products	221.271	146.402	94.888	123.304
	Covariance	.725	.480	.465	.404
	N	306	306	205	306
tool	Pearson Correlation	.750**	1	.787**	.853**
	Sig. (2-tailed)	.000	.	.000	.000
	Sum of Squares and Cross-products	146.402	172.029	119.244	116.559
	Covariance	.480	.564	.585	.382
	N	306	306	205	306
behaviour no tool	Pearson Correlation	.863**	.787**	1	.833**
	Sig. (2-tailed)	.000	.000	.	.000
	Sum of Squares and Cross-products	94.888	119.244	179.005	85.527
	Covariance	.465	.585	.877	.419
	N	205	205	205	205
behaviour all	Pearson Correlation	.795**	.853**	.833**	1
	Sig. (2-tailed)	.000	.000	.000	.
	Sum of Squares and Cross-products	123.304	116.559	85.527	406.841
	Covariance	.404	.382	.419	.798
	N	306	306	205	511

** . Correlation is significant at the 0.01 level (2-tailed).

The chi-square analysis for behaviour change from the tool and non-tool courses revealed significance levels of less than 0.05 ($p < 0.05$) in both variables (tool usage and behaviour change) with an associated significance value of $p < 0.000$. As such, the actual associated significance value was less than 0.0005, which was significantly less than the specified alpha value of 0.05. This indicated that the findings were significantly different from the expected variable findings.

The issues of validity and generalisation of case study research require the statistical data to be both robust and statistically sound. Robustness of the statistical processes undertaken were made possible by referring to statistical approaches undertaken by other researchers who had used a similar case study design. Several researchers (Cohen, 1988; Keppel and Zedeck, 1989; McCall, 1990;) cited a need for chi-square and Pearson's correlation findings to be more statistically universal and robust by testing for the difference between correlation coefficients or to report on Z values. The formula below (Figure 4.48) was used to calculate the Z_{obs} or the statistical significance of the difference between the two correlation coefficients. The calculation will be explained step by step to aid clarity and to inform readers unfamiliar with this statistical procedure which cannot be performed by SPSS (V11.1, 2000) or NUD*IST (1997).

Step one is to convert correlation r -values into Z values (Appendix 10). From Table 4.9 (Pearson's correlation for all variables) above, the variable "Behaviour (no tool)", the r -value was **0.863** (r_1), and the behaviour with tool r -value was **0.750** (r_2). Transformation of r to Z values as indicated in Appendix 10 gives r_1 is $Z_1 = 1.313$, r_2 is $Z_2 = 0.973$ and the n values as ascertained from Table 4.9 (Pearson's correlation for all variables) above, are $n_1 = 205$ and $n_2 = 306$ respectively. The transformation of r -values into a standard score value (Z values) is done to ensure that the sampling distributions are approximately normal (Cohen, 1988; McCall, 1990).

Figure 4.48 Statistical significance of correlation coefficient difference formula

$$Z_{obs} = Z_1 - Z_2 / \sqrt{1/(N_1 - 3) + 1/(N_2 - 3)}$$

The Z and n values are then substituted into the formula above to obtain a Z_{obs} value of 3.757. According to McCall (1990), if the Z_{obs} value is between -1.96 and $+1.96$ then you cannot say that there is a statistically significant difference between the two correlation coefficients. Therefore, the null hypothesis (no difference between the two groups) can be rejected only if the Z_{obs} value is outside of these two boundaries (≤ 1.96 or ≥ 1.96). The results from the Z_{obs} calculation for the difference between the behaviour change for the tool-based courses and non-tool-based courses was outside the specified boundaries. Therefore it can be concluded that there was a statistically significant difference in the strength of the correlation between self-reported behaviour changes from the tool-based courses and non-tool-based courses. As such, self-reported behaviour change in practice was greater for the learners who undertook courses which included a clinical or learning tool as compared to those courses which did not.

4.3.4.1 Level III open-ended responses

In relation to the 24 courses which incorporated the use of a clinical tool, 144 participants completed the open-ended “comments” question. This represented 47% of the total number of participants who completed the Level III tool survey ($n = 306$). Of the remaining “non-tool” survey ($n = 18$) participants, 157 (77% $n = 205$) completed the open-ended “Comments” question. Therefore, 59% ($n = 301$) of all Level III survey participants ($n = 511$) completed the open-ended “Comments” question.

The responses to the open-ended subjective question “Comments” were categorised into like content and counted for frequency of appearance. For ease of presentation, a side-by-side table was constructed (Table 4.10) to present the categorised open-ended questions in terms of the tool or non-tool survey, together with comparison to the CES open-ended question survey (Level I).

Of statistical significance from the open-ended questions for the Level III survey and the Course Evaluation Survey (CES) was that 112 participants ($n = 346$), 32.4%, or 1 in 3 thought the online course was of value “Manna from heaven.” A need for the courseware material to provide additional information, shown by comments such as: “...please suggest... to further learning opportunities”; “I think there should be more specific questions with right/wrong answers to improve the assessment”; “...more information on ...” was indicated by 18% (62 out of 346) of participants.

In summary, the Level III (application of knowledge into practice or behaviour change) data revealed that 68.7% of participants made favourable behaviour change statements and this finding was combined with 1 in 3 participants indicating that this form of education was like “Manna from heaven”. This indicated that this form of CPE supported learner achievement, and satisfaction from the course and with the course.

Table 4.10 Categorised open-ended question responses

Response	Tool n = 144	No-tool n = 157	Both n = 301	CES n = 45	Total CES+ Level III n = 346	Total %
1.Convenience such as place and time	1	5	6	17	23	6.6
2.Technology limitations such as bandwidth (external to site)	2	2	4	3	7	2
3.PBL	2	2	4	0	4	1.2
4.Association with accrediting organisation exams/CPE (i.e. RACGP)	0	0	0	2	2	0.5
5.Need for additional information or links to same, or content suggestion/improvement	37	21	58	4	62	18
6.Instructional design limitations such as navigation (internal to site)	4	6	10	3	13	3.8
7.Better than Divisional/Pharmaceutical or other face-to-face CPE sessions	1	0	1	0	1	0.3
8.Content thoroughness such as objectives, lecture notes and case discussion follow-ups	4	18	22	1	23	6.6
9.Value	45	60	105	7	112	32.3
10.User friendliness	1	1	2	1	3	0.9
11.CES limitations	0	0	0	3	3	0.9
12. Other-listed						
A- ? does it change practice	0	0	0	1	1	0.3
B – Need for face to face contact	0	0	0	1	1	0.3
C – Referral to other Website	0	1	1	2	3	0.9
D – Specific HCP response	40	33	73	0	73	21
E –Interaction with peers appreciated	1	0	1	0	1	0.3
F – Increased professional confidence	1	0	1	0	1	0.3
18.Ambiguous	5	8	13	0	13	3.8
Total count	144	157	301	45	346	100

4.4 Moderator influence on the effectiveness of the CPE course

The second objective that the study examined in order to assess the effectiveness of the Web-based course was the influence that several moderators had on the course participants. The research question arises from this research objective to ascertain the successful and unsuccessful Web-based design influences and pedagogical techniques that enhanced or distracted from a positive learning experience in the selected Web-based CPE courses. The moderators were identified from the courses and associated literature relating to instructional design and learning theory. For ease of dissemination, the six moderators will be addressed in sequential order.

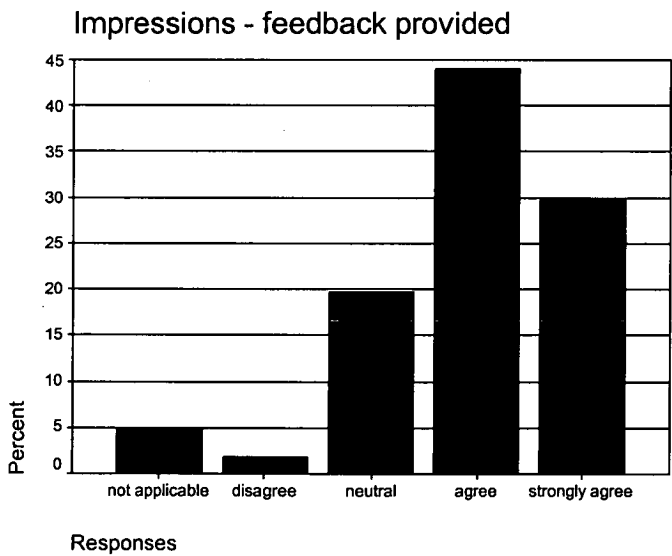
4.4.1 Moderator 1

The first moderator to be investigated was the influence of feedback. For the purpose of the study, feedback could be human, as in a personal e-mail message, or machine-generated as in server-automated messages. In addition to whether feedback is provided or not, the feedback could be immediate or delayed.

The assumption for Moderator 1 was that “Web-based education will be effective when feedback is provided”.

Just under three-quarters (74%, $n = 124$) of the participants indicated that they agreed or strongly agreed with the question “Feedback on my learning or queries was available from the course provider.” Only 1.8% ($n = 3$) indicated that feedback was not provided, whilst 4.8% ($n = 8$) selected “not applicable”. Thirty-three (33) (19.6%) participants chose the neutral response. Both responses may have indicated some participant confusion with the term feedback or with the overall question. Figure 4.49 indicates that these results are significant with a chi-square of 103.964, which exceeded the expected frequency of 33.6 ($p < 0.05$).

Figure 4.49 (compiled in SPSS [2000])



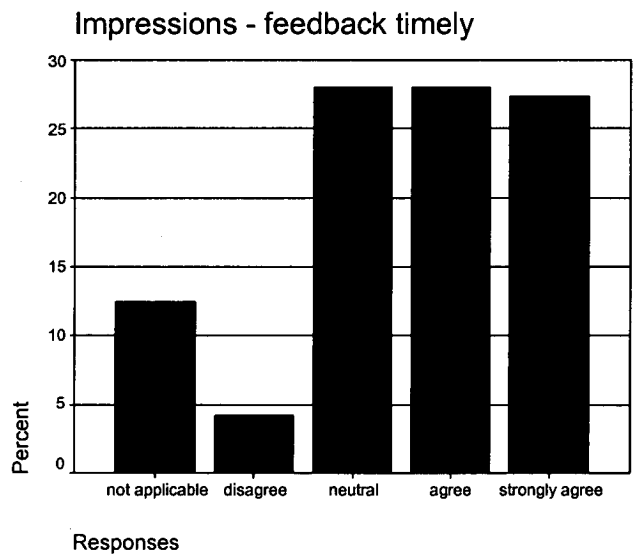
Count summary from CES item 27, measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

4.4.2 Moderator 2

The Med-E-Serv courses allowed for both immediate feedback (server-generated/automated) and delayed feedback (direct human feedback). The assumption for Moderator 2 was that “Web-based education will be effective when immediate feedback is provided.”

Over half the CES participants (55.4%, $n = 93$) indicated that they agreed or strongly agreed with the question “Feedback on my learning or queries from the course provider was timely.” Only 4.2% ($n = 7$) indicated that feedback was not timely. A high number of participants, 12.5% ($n = 21$) selected “not applicable”, and 28% ($n = 47$) of participants chose the neutral response. These responses may have indicated some confusion with the term feedback or with the overall question. Figure 4.50 indicated that these results were significant, combined with a chi-square value of 41.048 when it was expected to have a frequency of 33.6 ($p < 0.05$).

Figure 4.50 (compiled in SPSS [2000])

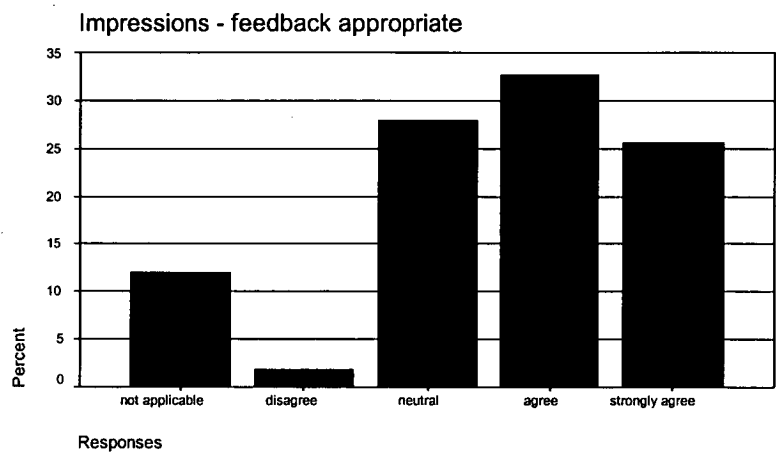


Count summary from CES item 29, measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Closely associated with the issue of feedback provided and the timing of feedback is user satisfaction with the feedback. A majority of the participants, 58.3% ($n = 98$, agree and strongly agree), believed that the quality of the feedback was appropriate to their e-mailed queries or e-mailed comments for the completion of their course. Twenty participants (11.9%) chose “not applicable”, and 1.8% ($n = 3$) believed that feedback was not appropriate. Twenty-eight percent (28%, $n = 47$) did not believe that the feedback was either appropriate or inappropriate. The

breakdown of learner satisfaction with the feedback is illustrated in Figure 4.51. This diagram indicated that these results are significant, with an associated chi-square value of 54.976 when it was expected to have a frequency of 33.6 ($p < 0.05$).

Figure 4.51(compiled in SPSS [2000])



Count summary from CES item 28, measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Pearson correlation of the three feedback variables indicated that both the correlation coefficients and p -values (significance level at the 0.01 level) for the three feedback variables (provided, timing and appropriateness of feedback) were significantly positively correlated and therefore linearly related. Table 4.11 summarises these relationships and their respective correlations.

Table 4.11 Pearsons correlation of feedback variables (compiled in SPSS [2000])

Correlations		impressions - feedback provided	impressions - feedback appropriate	impressions - feedback timely
impressions - feedback provided	Pearson Correlation	1	.609**	.582**
	Sig. (2-tailed)	.	.000	.000
	N	168	168	168
impressions - feedback appropriate	Pearson Correlation	.609**	1	.894**
	Sig. (2-tailed)	.000	.	.000
	N	168	168	168
impressions - feedback timely	Pearson Correlation	.582**	.894**	1
	Sig. (2-tailed)	.000	.000	.
	N	168	168	168

** Correlation is significant at the 0.01 level (2-tailed).

4.4.3 Moderator 1 and 2

Associated with the issue of feedback and the immediacy of the feedback was the issue of interaction with others. The examined courses provided interactivity in three ways. The first two feedback mechanisms--server and course moderator/facilitator--have already been discussed. The other form of feedback--or to use a better term, interaction--was that the learners could post on the course's bulletin board comments about the course, themselves or any other matter that they chose to submit. This researcher believes that interaction within a course would increase its instructional value and this could be measured in terms of learner satisfaction ("This course provided interactivity, which increases its instructional value"). The other variables that were investigated relating to interaction: "Interaction with other participants was available", "Interaction with other participants was appropriate", "Interaction with other participants was timely", are indicated in Table 4.12.

Table 4.12 indicated that the Pearson correlation coefficient for the four variables were 0.741, 0.691, 0.448, 0.834, 0.486, and 0.386 respectively. The significance level for all four variables was 0.000 (at the significance level of 0.01), which indicated a very low level of significance. This small significance level indicated that four variables were significantly positively correlated. Therefore, as each variable increases, the others also increase; and as one variable decreases, the other variables also decrease. As such, the correlation was significant and the four variables were highly linearly related.

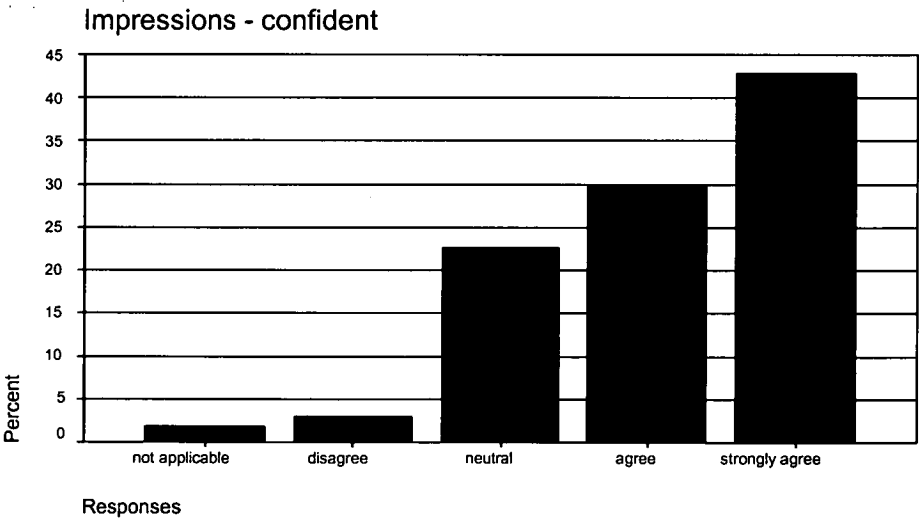
Associated with interaction with others, interaction also refers to interaction with the learning media. Figure 4.52 represents the self-reported participant reaction to the open-ended question of whether "the courseware makes me confident in using computers and technology", whilst Figures 4.53 and 4.54 represent the participants' beliefs in the course's media which they perceived to be the most and least useful in helping them to learn.

Table 4.12 Correlations of interactions (compiled in SPSS [2000])

		Correlations			
		impressions - interaction provided	impressions - interaction appropriate	impressions - interaction timely	instructional design - interactivity
impressions - interaction provided	Pearson Correlation	1	.741**	.691**	.448**
	Sig. (2-tailed)	.	.000	.000	.000
	Sum of Squares and Cross-products	214.518	178.750	184.911	71.286
	Covariance	1.285	1.070	1.107	.427
	N	168	168	168	168
impressions - interaction appropriate	Pearson Correlation	.741**	1	.834**	.486**
	Sig. (2-tailed)	.000	.	.000	.000
	Sum of Squares and Cross-products	178.750	271.500	251.250	87.000
	Covariance	1.070	1.626	1.504	.521
	N	168	168	168	168
impressions - interaction timely	Pearson Correlation	.691**	.834**	1	.386**
	Sig. (2-tailed)	.000	.000	.	.000
	Sum of Squares and Cross-products	184.911	251.250	333.946	76.571
	Covariance	1.107	1.504	2.000	.459
	N	168	168	168	168
instructional design - interactivity	Pearson Correlation	.448**	.486**	.386**	1
	Sig. (2-tailed)	.000	.000	.000	.
	Sum of Squares and Cross-products	71.286	87.000	76.571	117.905
	Covariance	.427	.521	.459	.706
	N	168	168	168	168

** Correlation is significant at the 0.01 level (2-tailed).

Figure 4.52 (compiled in SPSS [2000])



Count summary from CES item 26, measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.53 (compiled in SPSS [2000])

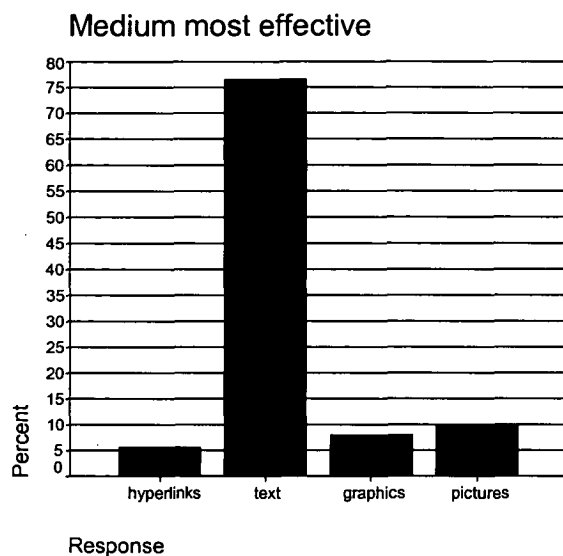
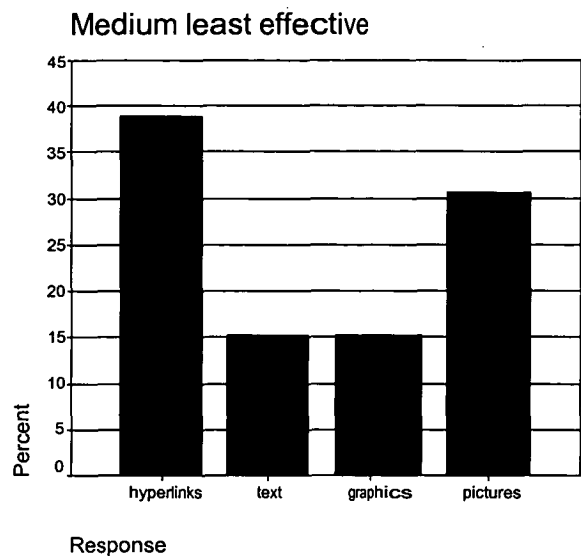


Figure 4.54 (compiled in SPSS [2000])



Count summary from CES items 11 and 12, measured by actual observed counts of participant selection of Likert-type responses (hyperlinks, text, graphics, pictures) ($n = 162$ and 72 respectively).

4.4.5 Moderators 3 and 5

The third and fifth moderators will be presented together as they are related. Moderator 3 investigated the assumption that learning will be effective when the course allows the learner the opportunity to apply the new knowledge to clinical or question-type responses. The fifth moderator examined the opportunity to apply course content to practice or to actively learn with the hypothesis being that this would be positively viewed by learners.

Figures 4.55–4.58 graphically describe the additional variables which assessed the learners’ reactions to the opportunity to apply course content both within the course and into practice. Other assessing variable results were described in previous sections which dealt with the Level II (knowledge gained from the course) and Level III (application of knowledge into practice) findings respectively.

Figure 4.55 (compiled in SPSS [2000])

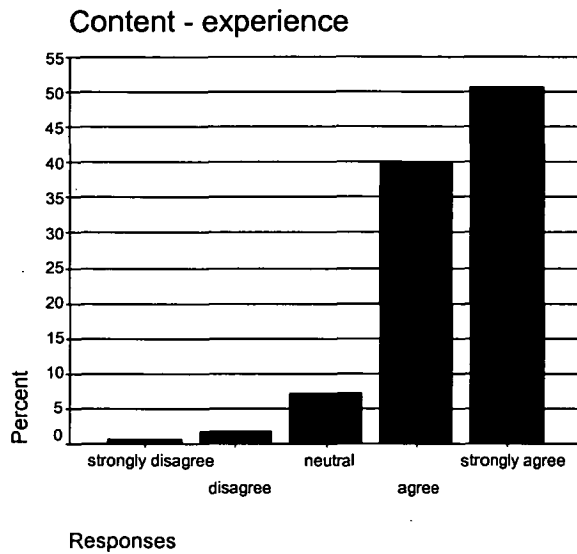
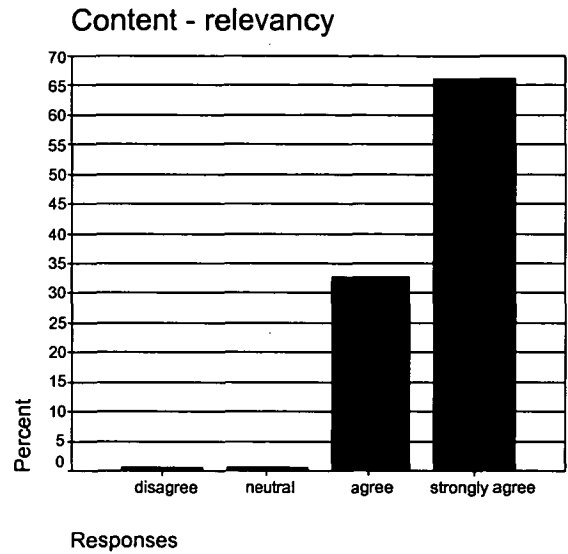


Figure 4.56 (compiled in SPSS [2000])



Count summary from CES items 7 and 4, measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Figure 4.57 (compiled in SPSS [2000])

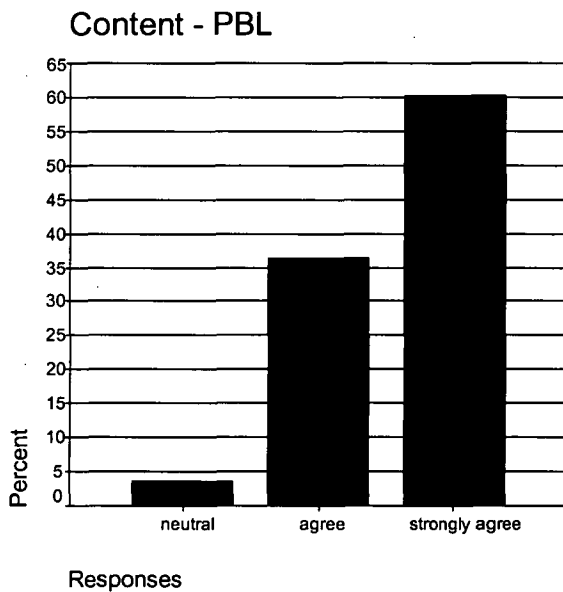
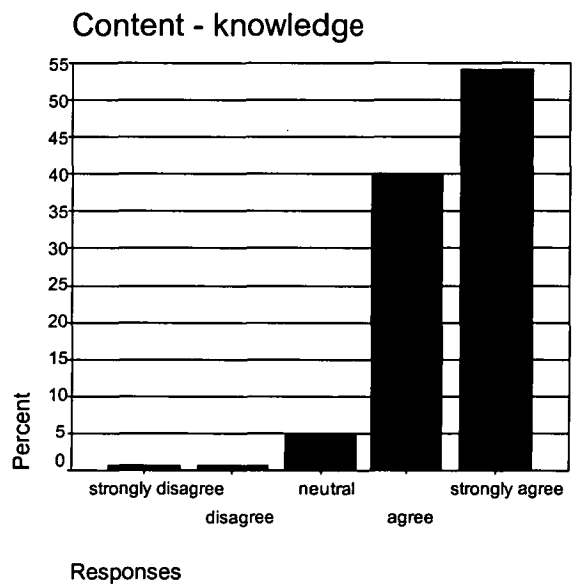


Figure 4.58 (compiled in SPSS [2000])



Count summary from CES items 5 and 6, measured by actual observed counts of participant selection of Likert-type responses (strongly agree, agree, neutral, disagree, strongly disagree, not applicable) ($n = 168$).

Moderator 3 results revealed that 98.8% (agree/strongly agree, $n = 166$) of participants reported that they had a favourable reaction to the proposition of the course subject matter being relevant to them (chi-square value of 197.429, when it was expected to have a frequency of 42.0 [$p < 0.05$]). Additionally, 96.4% ($n = 162$, agree/strongly agree) reacted favourably to the proposition of the content being representative of possible clinical scenarios or based on problem-based learning (PBL) approaches (chi-square finding for this variable was 81.250

when it was expected to be 56.0 [$p < 0.05$]).

In relation to the subject matter enhancing the learners' professional knowledge, 94.1%, ($n = 158$, agree/strongly agree) responded favourably to the proposition (chi-square value of 214.024 [expected value 33.6 $p < 0.05$]). Finally, 90.5% ($n = 152$, agree/strongly agree) of participants responded favourably to the proposition of the content enhancing their professional knowledge (chi-square findings were 185.215 at the $p < 0.05$ significance level, when the expected value was 33.6).

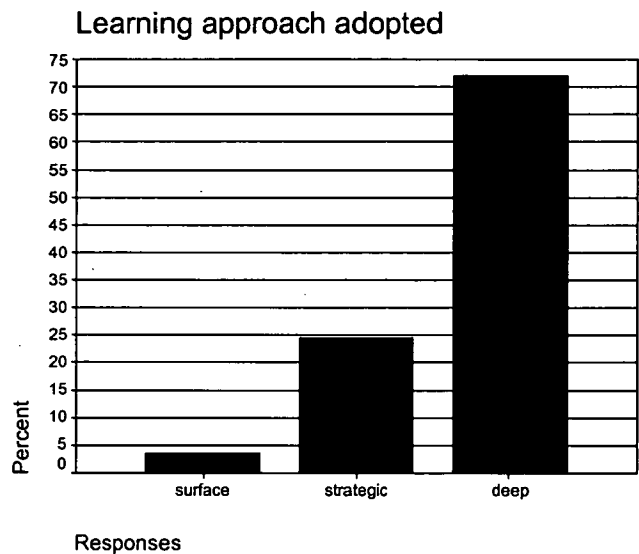
Pearson correlation coefficients for the four variables were 0.601, 0.368, 0.346, 0.596, 0.465, 0.368 and 0.704 respectively, as shown in Table 4.13. The significance level for all four variables was 0.000 (at the significance level of 0.01), which indicated a very low level of significance. This small significance level indicated that four variables were significantly positively correlated. Therefore, as each variable increases the others also increase. In addition as one variable decreases, the other variables also decrease. Consequently, the correlation was significant and the four variables were highly linearly related.

Table 4.13 Pearsons correlation coefficient for Moderator 3 (compiled in SPSS [2000])

Correlations					
		content - relevancy	content - PBL	content - knowledge	content - experience
content - relevancy	Pearson Correlation	1	.601**	.368**	.346**
	Sig. (2-tailed)	.	.000	.000	.000
	N	168	168	168	168
content - PBL	Pearson Correlation	.601**	1	.596**	.465**
	Sig. (2-tailed)	.000	.	.000	.000
	N	168	168	168	168
content - knowledge	Pearson Correlation	.368**	.596**	1	.704**
	Sig. (2-tailed)	.000	.000	.	.000
	N	168	168	168	168
content - experience	Pearson Correlation	.346**	.465**	.704**	1
	Sig. (2-tailed)	.000	.000	.000	.
	N	168	168	168	168

** . Correlation is significant at the 0.01 level (2-tailed).

Figure 4.59 (compiled in SPSS [2000])



Count summary from CES item 39, measured by actual observed counts of participant selection of Likert-type responses (surface learning, strategic learning, deep learning) ($n = 168$).

In relation to the self-reported learning approach supported by the online educational event, as indicated in Figure 4.59 and Table 4.13, six participants (3.6%) indicated that they believed the courseware made them undertake surface-based learning (minimal interaction, no need to understand the material). Nearly one-quarter (24.4%, $n = 41$) believed that the course made them learn by strategic learning methods (driven towards high attainment, that is not to make mistakes). The majority of learners reported that the course made them undertake deep-based learning (72%, $n = 121$). Chi-square analysis revealed that the learning approach value (124.107) exceeded the expected value (56.0, $p < 0.05$) making the finding statistically significant at the $p < 0.05$ level.

4.4.6 Moderators 4 and 6

Moderators 4 and 6 will be presented together as they are related. The fourth moderator concerned the learners’ perceptions on and ability in being able to break down their learning into manageable learning components: “I was able to control the rate of presentation of subject matter”. Moderator 6 concerned pacing of the learning module material: “It was easy to find out what you have completed already and what is still to be completed.” Both of these statements investigated the amount of learning material that was studied in a session (timing/rate), how much the learner had already completed, and how much of the course was left to complete (pacing).

The association between rate (timing) and pacing (how much completed and how much to complete) revealed chi-square values of 172.429 and 169.857 respectively (expected frequency 42.0), both with a significance level of 0.000, indicating that the two variables were highly associated. Additionally, the correlation coefficient for rate and pacing was 0.774, as indicated in Table 4.14. The significance level or *p*-value was 0.000,--a very low level--this small significance level indicated that rate and pacing were significantly positively correlated: as rate increases, pacing also increases, and as pace decreases, rate also decreases. Accordingly, the correlation was significant and the two variables were linearly related.

Table 4.14 Pearsons correlation coefficient for Moderators 4 and 6 (compiled in SPSS [2000])

Correlations		instructional design - rate	instructional design - pacing
instructional design - rate	Pearson Correlation	1	.774**
	Sig. (2-tailed)	.	.000
	Sum of Squares and Cross-products	64.994	49.571
	Covariance	.389	.297
	N	168	168
instructional design - pacing	Pearson Correlation	.774**	1
	Sig. (2-tailed)	.000	.
	Sum of Squares and Cross-products	49.571	63.143
	Covariance	.297	.378
	N	168	168

** . Correlation is significant at the 0.01 level (2-tailed).

4.5 SUMMARY

This chapter documented the results of this study into the overall effectiveness of online learning from the contexts of learner satisfaction, learning, knowledge and behaviour changes in practice following exposure to an online educational event, together with several instructional and pedagogical courseware moderators that may have impacted on this effectiveness.

The results have been presented in accordance with the study’s two research objectives and associated questions. Data from the five surveys (pre-test, post-test, demographic profile, satisfaction, and moderator surveys) were presented in sections that firstly related to the research objectives and then to the guiding research questions.

The following chapter will generate discussion, whilst the final chapter will draw conclusions based on the findings, and offer recommendations for future research.

CHAPTER FIVE

DISCUSSION

5.1 Overview

This chapter discusses the findings obtained from the data in relation to learner satisfaction, cognitive achievement, application of course knowledge into practice, as well self-reported practice change, as a result of undertaking one of the Web-based CPE courses offered by Med-E-Serv.

This discussion of results is presented in relation to the two overriding research objectives, which set out to determine the overall effectiveness of the Web-based courses and the e-pedagogical moderators that affected both learner satisfaction and course achievement. The following sections will discuss the e-pedagogical moderators and the overall effectiveness of the courses by examining the participant responses to the research questions that were guided by the two overriding research objectives and the extensive literature analysis.

Whilst the discussion and interpretation of the results pertaining to the research objectives appear linear, suggesting that they are distinct and separate, in reality they are overlapping. Some repetition, therefore, may occur because results may pertain to more than one question.

5.2 Interpretation of results

This section uses the case study data to formulate discussion and reflection, which will determine the structure for presenting the conclusion and recommendations from the study in Chapter 6. These recommendations will serve as an ongoing development guide for Med-E-Serv and others wishing to implement or refine online education courses.

There are several limitations to applying the results of this study. A single case study leads itself more to reflections rather than to generalisations, and the topic matter and providing institution may lend themselves more to some research methods than to others. Using generalisations, the observations and reflections that were derived from this study will be discussed.

5.3 Quantify the overall effectiveness of the Web-based CPE instruction

The first research objective was to quantify the effectiveness of the Web-based CPE courses from the perspective and achievement of the learners. This objective was concerned with ascertaining whether people enrolled in the online educational environment acquired knowledge (Level II), applied the course content into their professional practice (Level III) and, in general, quantified their reactions to studying in the virtual environment (Level I).

Whilst the evaluation criteria levels go in numerical order from Level I through to Level III, the surveys were not implemented in that order and so will not be discussed in numerical order. Instead, the levels as derived from the modified Kirkpatrick's multilevel evaluation of effectiveness criteria (Kirkpatrick, 1987, 1996, 1998) will be discussed in the order in which they were implemented and encountered by the learners.

5.3.1 Learner Achievement (Level II)

Learner achievement data revealed whether learners enrolled in a Web-based CPE course acquired the knowledge disseminated through the educational experience.

The data indicated that there was a statistically significant increase in learners' content knowledge from the pre-test to the post-test phase of the course. Whilst a gain in knowledge is to be expected from any learning event, the magnitude of knowledge increase from the pre to post-test phase found in this study was significant. The pre-test mean was 78.524 (*SD* 18.709) as compared to the post-test mean of 94.484(*SD* 8.602), $t(35) = -5.149$, $p < 0.0005$. The results indicated a difference in the two test scores, with a significant difference of less than 0.05, and an obtained probability value of 0.000. The actual probability value was less than 0.0005, which is significantly less than the specified alpha value of 0.05. Therefore, it can be concluded that there was a significant difference in cognitive achievement or learning from the pre-test time period to the post-test time period. Obtaining these results from chance is unlikely. Further support was indicated by the eta-squared value (0.551), which demonstrated the magnitude of the course's (intervention's) effect.

Cohen (1988) offered the following guidelines for the interpretation of eta-squared values:

0.01 = small effect, 0.06 = moderate effect, 0.14 = large effect. Given the study's Level II

findings of $\eta^2 = 0.551$, it was concluded that there was a large effect, with a substantial difference in course cognitive achievement (learning) scores obtained before and after the learning intervention (Web-based course).

The significant increase in learners' content knowledge is dissimilar to the findings of Wiksten et al. (1998), who reported that Web-based learners were outperformed by lecture-based learners in a pre- to post-test of comparison of knowledge. However, the Wiksten et al. study was conducted under a different study design and so the contrary nature of the findings may be due to this method difference rather than the researchers adequately reporting their study findings by not accounting for the pedagogical and instructional design components of the two observed media.

The results of this study are different to the findings of Boucher, Hunter, and Henry (1999), Kennedy (2000), Kinney et al. (1997), Russell (1999), and Wiksten et al. (1998), who all reported that, when compared to face-to-face courses the technology-based learners were outperformed by their face-to-face counterparts in terms of knowledge attainment. However, as discussed in the literature review, these studies had accountability restrictions that were not limited to trying to compare different pedagogically and instructionally designed courses. In addition, these were comparative studies whilst this study was not. These studies and others that reported "no significant difference" findings failed to acknowledge or incorporate into their study designs the impact of the learning medium on the design of learning and the teaching context. Jonassen et al. (1994) stated epistemological assumptions about knowledge, conditions for learning and media interaction considerations need to be acknowledged in educational research and taken into account when designing educational studies. This study's methodology, supported by Jonassen et al. (1994) and Clark (1983), addressed learning not only by the acquisition of knowledge but also by assessing how educational media and teaching characteristics supported or did not support learning. This was achieved by assessing learner satisfaction with both the pedagogical and instructional design characteristics of the courses specifically the media incorporated in the courses, that is whether the course was text-based, contained pictures, audio, hyperlinks etc. These findings will be addressed in the discussion on Level I section 5.3.3 and in the section on moderators in this chapter. This methodological approach was supported by Kozma (1991, 1994), who iterated that learning and teaching contexts should be studied and explained in terms of not only cognitive achievement but, equally as validly, in terms of media characteristics.

This study's Level II findings of learning, having occurred from the pre-test to the post-test period and following exposure to the Web-based courses, are supported by several other studies (Althaus, 1997; Schutte, 1996; Carew, Elvin, Yon, and Alster, 1984; Carew et al., 1987; and Waldrop, et al., 1986). Whilst several researchers reported an increase in student learning as a result of undertaking computer-based courses (Hutchinson, 1999; Jepson, 2002a, 2000b; Kinney, 1997; Mehta, 1998; Richardson and Norris, 1997; Shaw, 2000).

One study of note was that of Francis et al. (2000) which considered two online CME courses for health care professionals. The study found the t difference for pre- to post-tests of knowledge for two online courses, being -5.5 for course 1 ($n = 18$, mean -12.9 , SD 9.7 , $p < 0.001$) and $t = -5.6$ ($n = 16$, mean -21.2 , SD 15.4 , $p < 0.001$) for course 2. The Francis et al. study, whilst small and methodologically limiting, did produce similar Level II results to that of this study (pre-test mean 78.524 [SD 18.709]; post-test mean 94.484 [SD 8.602], t [35] = -5.149 , $p < 0.0005$ [$n = 313$, mean -15.96 SD 10.107 , $p < 0.0005$]). Accordingly, this study's Level II findings were supported by another study that, whilst being conducted using different methodological considerations and intentions found similar levels of attainment of knowledge for a similar cohort, which adds weight to this study's Level II findings.

Curran et al. (2000) study of medical professionals, cognitive achievement through a computer-based course was also supportive of this study's Level II findings. The Curran et al. study found a pre- to post-cognitive achievement mean of 8.5 and a Z score of -3.539 ($n = 52$, $p < 0.05$) which indicated that the physicians who undertook the computer-based course performed significantly better than physicians who did not undertake the computer-based course. These positive findings of cognitive achievement, despite a different methodological approach, were also brought out by this study's Level II findings.

Whilst the findings from this study indicated that learners' test scores improved from a pre-test mean of 78.524 (SD 18.709) as compared to the post-test mean of 94.484 (SD 8.602) ($p < 0.05$), it cannot be said with 100% certainty that the increase in knowledge was solely due to the Web-based courses, as the learners may have done additional reading or other CPE activities around the topic or just had their knowledge-base evolve naturally. However, the statistical findings of $\eta^2 = 0.551$ and $t = -5.149$ ($p < 0.0005$) indicated that there was a large effect obtained before and after the learning intervention (the Web-based course). These findings support the generalisation that the learners enrolled in Web-based CPE courses

acquired the knowledge disseminated through the educational experience (Research objective 1, question two). However, further studies are required to examine learning in a virtual world to further support the claim that learners do attain knowledge from learning online.

5.3.2 Application of knowledge and behaviour change into practice (Level III)

Answers to the questions about self-reported behaviour or practice change together with self-reported clinical assessment tool use (for those courses $n = 24$) were analysed to ascertain whether participants applied course knowledge to their work practice as a result of undertaking the Web-based courses. These questions together with an open-ended “Comments” question were used to address Research objective 1 (**Quantify the overall effectiveness of the Web-based CPE course**), research question 3 **Do learners use the knowledge from the course in their work, that is, is the knowledge applied?**

In relation to knowledge and behaviour change into practice as a result of undertaking one of the Web-based courses, survey data indicated that of the 24 learning courses that incorporated a clinical tool (57% of all courses, $n = 42$), 96.8% ($n = 297$ out of the total of 306 participants) of the survey participants indicated that they used the tool in their practice. This high percentage of tool usage or intended usage, combined with 33.7% ($n = 103$) of participants indicating that they changed their practice or would modify it as a result of completing the courses with a clinical tool, indicated that the learning event (course) was not only viewed positively by the learners, but that their learning had carried over into practice. This finding is supported by Schon (1997) who reported that review of practice was a positive outcome of any learning event therefore, this study’s findings that 39.9% ($n = 122$) of course participants indicated that they had reviewed or would review their practice was a positive learning outcome. This indicated the positive behaviour-changing practice associated with studying the courses that used a clinical tool. Of the participants, 225 (73.6%) had a positive behaviour change into practice as a result of undertaking one of the 24 tool-associated learning courses. Of the remaining participants, 24.5% ($n = 75$) indicated that the learning course confirmed their practice. This response was viewed as being neutral. This meant that only 2% ($n = 6$) of participants who undertook the courses that used a clinical tool reported that, as a result of completing the course, their practice was or would remain unchanged.

In relation to the 18 courses that did not use a clinical tool, 61.5% of participants ($n = 126$ out of 205 non-tool Level III participants) indicated that they changed, modified or reviewed their practice as a result of undertaking the Web-based courses. A neutral response of confirmed practice was indicated by 33.2% ($n = 68$) of participants, and 5.4% ($n = 11$) indicated that they did not or would not change their practice as a result of completing the course.

An examination of the correlation between practice change and use of the clinical tool found a correlation of 0.750 at the 0.01 level of significance (Table 4.8). What this correlation indicated was that since 0.750 is relatively close to 1, behaviour change and tool usage are positively correlated. This was also supported by the significance level being very small ($p < 0.01$) which indicated that the two variables are linearly related. This interpretation of the correlational relationship is supported by Cohen (1988), who suggested that $r = +0.10$ to $+0.29$ (small), $r = +0.330$ to $+0.49$ (medium), $r = +0.50$ to $+1.0$ (large). Therefore, this study's findings that the relationship between change and clinical tool usage, as measured by the Level III survey, indicated a strong positive correlation ($r = 0.750$, $n = 306$, $p < 0.01$).

This positive association of behavioural change as a result of undertaking the courses that used a clinical/decision-making tool was also supported by a Z_{obs} value outside Cohen's (1988) boundaries of ≤ 1.96 or ≥ 1.96 . The result was a Z_{obs} value of 3.757. This statistically significant difference in the strength of the correlation between self-reported behaviour change from the courses that had a clinical tool indicated that behaviour change in practice was more likely to have resulted from undertaking the courses that used a clinical tool as compared to those courses which did not.

An Internet education journal (ASTD, 2000) reported that 67% of training directors did not measure their training programmes' outcomes, whilst another study found that 51% of its members also did not measure their programmes' effectiveness past the Level II assessment standard (Hackett, 1997).

An examination of the adult education, continuing education, medical education, professional education and general education literature revealed no direct statistical findings relating to the evaluation of Level III data or regarding the application of course content into practice. One article reported that at the conclusion of a course (learning activity) the participants should be made to do something to demonstrate that they have not only learnt the course material but they

can apply this material into practice (Porter, 1997). This article, however, failed to descriptively or statistically relate how the evaluation of content was applied into practice. Another article (Palloff and Pratt, 1998), whilst suggesting how to evaluate learning into practice, also did not quantify whether course content was successfully applied into practice.

A study (Curran et al., 2000) that reported course knowledge application into practice used a self-reported performance change survey to ascertain changes in practice as a result of undertaking a computer-based CME course. The study examined self-reported ability to perform specific dermatological procedures. The study concluded that the computer-based course resulted in physicians reporting that their perceived competencies in performing task-based procedures had improved. The Curran et al. study examined 13 performance objectives whose Wilcoxon signed rank test (Wilcoxon matched pairs signed ranks tests) Z scores varied from -2.714 through to $Z = -4.221$. Whilst the Canadian study used the Wilcoxon signed rank test to report on the repeated measure of the pre- to post- self-reported performance change, it produced similar findings to this study's self-reported behaviour changes of Z_{obs} value of 3.757, and positive behaviour reaction (review, modify and change) of 68.7% ($n = 351$).

A series of occasional papers (Davis et al., 1992, 1995, 1999) indicated that application of objective methods to assess the educational needs of physicians resulted in a change in their performance. These occasional papers highlighted the need for participant (physician) encouragement activities such as reminders, outreach visits, audits and posted educational materials in order to encourage participants (physicians) to change their practice. In addition, the researchers (Davis, 1992, 1995, 1999) concluded that audits and courses without active practice have relatively little impact on changing physician performance. Whilst these studies used different methodologies to the present study in the form of randomised controlled trials and systematic reviews, they did conclude that participants could change their behaviour/practice as a result of pedagogically sound education.

The limited reported studies and subsequent publication of findings relating to course knowledge application into practice and behaviour changes resulting from undertaking an educational event indicates the need for further research. The findings from this study's Level III survey give support to the theory that Web-based education can support or promote behavioural changes into practice and that knowledge from the course can be used directly in practice.

Kirkpatrick (1998) iterated that a training programme could not be called effective unless a positive change in behaviour occurred (Kirkpatrick, 1998). It is therefore important to consider and measure behaviour changes as a result of undertaking an educational event. Kirkpatrick, in describing the Level III evaluation (application of knowledge into practice or practice behaviour change), stated that self-reported questionnaires can be used to ascertain changes in practice --as was undertaken in this study. He further stated that if the programme is to be offered again, then measuring and assessing Level III data is important both from a systematic course requirement and to evaluate effectiveness (Kirkpatrick, 1998). These evaluations of effectiveness considerations, combined with the American Society of Training Development (2000) and Hackett's (1997) findings of inconsistent and under-reported (evaluated) education programme evaluations, make this study's findings generalisable to other educational environments that want or need to evaluate the effectiveness of their educational events. This is particularly important for health care professionals whose CPE programmes and accreditation requirements are designed to improve HCP competence, performance and ultimately patient outcomes (an aspect which was extremely under-reported in the literature).

In summary, this study found that the overall positive behaviour reactions (review, modify and change) were indicated by 68.7% ($n = 351$) of Level III participants ($n = 511$). In addition, the self-reported use of the clinical/decision tool into practice was indicated by 96.8% ($n = 297$) of the survey participants ($n = 24$ modules and 306 participants). In relation to the 18 non-tool learning courses, 61.5% ($n = 126$) of the Level III participants ($n = 205$) reported a positive in-practice behavioural reaction to the educational experience (change, modify or review practice). The overall positive association of behavioural change as a result of undertaking the educational event that used a clinical/decision-making tool was also supported by a Z_{obs} value of 3.757. As a consequence, self-reported behaviour change in practice was greater for the participants who undertook the Web-based courses incorporating a clinical tool. These positive behavioural reactions to undertaking the Web-based courses were exemplified by comments such as, 1 in 3 (32.4%) participants stating that the online course was of value--"manna from heaven" and "...have encouraged others to use it..."

5.3.3 Learner satisfaction (Level I)

A post-course, learner satisfaction survey was used to investigate Research objective 1 (Quantify the overall effectiveness of the Web-based CPE course), research question 1 Will

learners enrolled in a Web-based CPE course have a positive reaction to the educational learning experience?

Descriptive statistical analysis revealed that of the 168 Level I (which reported on satisfaction with the course) participants 98.6% reported favourable reactions (agree 38.3%, and 60.3% strongly agree) in relation to the courses' structure (objectives, organisation, content), whilst 95% reacted favourably (agree 37.2%, strongly agree 57.8%) to the proposition of the courses' content (relevancy, PBL, knowledge, experience) and course materials being relevant to them. In relation to participant impressions (future use, effective, appealing, favourable), 98.1% responded favourably (agree 31.3, strongly agree 66.8%) to being satisfied with or to learning online. Of note was that 100% of the participants indicated that they would use online education courses again (agree 23.8%, strongly agree 76.32%). Closely associated with this finding was that 99.4% believed the academic content was both appropriate and effective for their stage of learning (agree 38.1, strongly agree 61.3). In addition to the above findings, 52.4% of participants indicated that the online learning event was more effective than similar face-to-face learning events (agree 21.4, strongly agree 31%) exemplified by a participant comment "...not have to leave my family ... to attend some tedious meeting in a restaurant". This response to the open-ended question not only revealed the participant's particular reason for enjoying the course, but was also typical of 38% of other participants who indicated convenience as a major benefit to studying the courses online.

The findings from this study's learner satisfaction (Level I) survey conflicted with several results presented in the literature. In particular, the work of Shaw and Pieter (2000), LaRose et al. (1998) and Wegner et al. (1999) all reported that no significant differences existed between students' perceived attitude towards and satisfaction from learning in a Web-based environment as compared to a face-to-face environment. However, these studies had several methodological and interpretative limitations, least of which was comparing different pedagogical and instructionally designed courses, which limited their general use. Whilst these studies reported no significant difference between the two learning groups, a careful analysis of the comparison results does indicate that both the face-to-face and Web-based groups did have a positive experience arising from the learning events, despite several technical and navigation issues with the online courses.

Other studies (Cheng et al., 1991; Shea et al., 2000; Webster and Hackey, 1997; Wiksten et al.,

1998) reported a significant decrease or negative response by students to studying computer-based or online courses. The major findings or limitations of these studies were that student satisfaction decreased due to instructional design (such as navigation) and technology issues (external line dropouts and slow download times), rather than the overall effectiveness of the learning event per se.

Despite the above studies conflicting with the results of this investigation, the overwhelming majority of the literature reviewed did, in fact, support this study's findings as well as identifying several technical (navigation and technology limitations) issues that contributed to the "no significant difference" and "negative user" satisfaction findings. These issues were also identified by this study. This result points to an I.T. industry wide need to address issues such as bandwidth restrictions and drop-out (external to the course) and improved site navigation (internal to the course—instructional design).

Schutte (1996) found that increased student satisfaction with Web-based learning led to an increased desire to undertake further Web-based education, which was borne out in this study's finding of 100% of participants indicating that they would undertake another online educational course.

Further to the above findings, Althaus, (1997); Carew et al., (1997, 1984); Curran et al, (2000); Jennett and Pearson, (1992); Jewett, (1998); Larson (1994); Magalhaes and Schiel, (1997); Russell, (1999); Siu and Chau, (1998); Thomas, (2000); Wentling et al., (2000); and Wisher and Curnow (1988) in their respective studies found that online learners had favourable experiences when undertaking a Web-based educational event. Indeed, Carew et al. (1997) found that 87% of his computer-assisted students believed that the instruction was useful (41% very useful and 46% useful), whilst 78% believed that the instructional delivery method enhanced their course scores. This current study found that reaction to instruction as defined by course structure (objectives, organisation, content) and content (relevancy, PBL, knowledge, experience) was significantly favourable (96.8%). Reaction to instructional delivery as defined by instructional design (organisation, navigation and purpose) was found to be 91.66% favourable (43.26% agree, 48.4% strongly agree). Of note however, was that this study did not link instructional delivery to enhanced course scores, as did Carew et al.'s study--though a generalisation about the two may be obtained from this study's findings.

Aspects raised by Wegner et al. (1999) and Francis et al. (2000) relating to convenience being a favourable or positive aspect of the course were also brought out by this study. The findings from this study found that 38% of the open-ended question participants indicated convenience as a major benefit of the Web-based courses. Typical comments relating to convenience included: “convenience ideal given other demands on time...”; “have young children ... ease at doing this at 10:30pm is unsurpassable”; “...most convenient way for me as an old rural practitioner to ... keep learning”; “...self paced ...fitted when it suits me”, and “...not have to leave my family ... to attend some tedious meeting in a restaurant.” This last response is noteworthy as it alludes to how Divisions of General Practice and pharmaceutical companies tend to provide en masse GP education. In addition, the response is also significant as no General Practice Divisions identified ICT-based CPE as a priority (GPCP, 1999), whilst this research study found that more than 1 in 3 HCPs undertaking the online courses referred to convenience of place and time as noteworthy enough to mention--aspects that make online education stand out from traditional face-to-face educational events.

A study that used different methods and intentions to that of this study but had a similar cohort, was that of Francis et al. (2000). It investigated the effectiveness of an online continuing dental education course. The dental education study found that student satisfaction with online learning was high. The dental study failed to report on student satisfaction stringently enough to equate to this study's Level I (participant satisfaction) interpretations. However, through reinterpretation of the dental course satisfaction data, its Level I findings would have been 81.5% positive for instructional delivery, which is statistically similar to this study's findings of 96.8%. The dental study's course structure and content would have been 75.63% positive, whilst this study found course structure and content to be 96.8%, which is some 21-percentage points higher than the dental study result. This higher participant satisfaction percentage may be due to an increase in quality of instructional design and pedagogical-technological knowledge and capabilities in the 2–3 years since the dental course was created. The findings may also be different due to a difference in the two study cohorts and the location of each study (North America and Australasia).

In summary, this study reported an overwhelmingly favourable participant reaction to undertaking the online courses. Indeed 98.6% reacted favourably to the proposition that course structures (objectives, organisation, content) were appropriate, 95% of participants reacted

favourably towards the content (relevancy, PBL, knowledge, experience) of the online materials. In addition 98.1% reported favourable reactions to impressions (future use, effective, appealing, favourable). A surprising result of this study was that 100% of the participants indicated that they would use online education again. This may be closely associated with 99.4% of participants indicating that the academic content of the course was both appropriate and effective for their level of learning. This finding, together with 52.4% of participants indicating that this form of education (online) is more effective than other traditional forms of face-to-face learning that the HCPs undertake to satisfy their CPE requirements, makes this study's findings both timely and industry-warranted. Associated with participant reaction were the underlying pedagogical and instructional design moderators that not only make up but also define how the learners interacted with and learned from this electronic medium. This is addressed in the following sections on moderators.

5.4 Moderator influences

The second part of this study addressed Research objective 2, **Assessing the influence of several factors (moderators) that are assumed to influence the effectiveness of the online learning event.** Research objective 2 sought answers to the research question, **What are the successful and unsuccessful design influences and pedagogical techniques that enhance or distract from a positive learning experience in the Web-based CPE course?**

From analysis of the literature and subsequent examination of the online learning site regarding (instructional design and pedagogical considerations) several moderators that were believed to have an influence on the effectiveness of online learning were identified. A post-course survey by 168 participants provided their reactions to the moderators. This survey also contained a demographic profile survey, which, at the request of the courseware provider, was implemented at the end of the course rather than at the beginning to ensure course instructional consistency pre- and post-study.

5.4.1 Moderators 1 and 2

The first two moderators examined the issue of feedback. Moderator 1 suggested that Web-based education would be effective when feedback was provided. Moderator 2 suggested that Web-based education would be effective when the feedback was immediate.

The design and integration of feedback mechanisms have been found to influence the learners' experiences and levels of satisfaction in face-to-face education and in computer-based education (Cascio, 1998; Kluger and DeNisi, 1996; Locke et al., 1981; Neal and Ingram, 1999; Schroth, 1995; Wexley and Thorton, 1972, Wexley and Latham, 1991). Indeed, Neal and Ingram (1999) stipulated that the measurement of learner satisfaction and course feedback is largely unanswered within the education literature. Several other researchers have expanded on the issue of feedback to state that feedback both increases student motivation within courses and also increases their satisfaction with the course (Kluger and DeNisi, 1996; Locke, 1981). Cascio (1998) implied that feedback also plays a role in knowledge attainment by praising correct responses whilst also instructing students on incorrect responses.

This study found that 74% ($n = 124$) of the participants indicated that believed (agreed/strongly agree) that having feedback on their learning or queries from the courseware provider was a valuable learning-support tool. This finding was statistically significant, with a chi-square value of 103.964, which exceeded the expected frequency of 33.6 ($p < 0.05$). In addition, 55.4% ($n = 93$) of participants had a favourable reaction (agreed/strongly agree) to the notion that feedback on their learning or queries from the courseware provider was timely. This was significant, with a chi-square value of 41.048 that exceeded the expected frequency of 33.6 ($p < 0.05$).

This study's findings, which indicate favourable participant reactions to feedback, is important as the research literature indicated that feedback may affect the overall effectiveness of the programme (Kulik, 1988; Schroth, 1995; Wexley, 1972). Kulik and Kulik's (1988) meta-analytical study of 53 research papers found that immediate feedback had a positive or favourable influence on learning, whilst another study revealed that delayed feedback slowed cognitive attainment (Schroth, 1995). In regards to the issue of feedback, one participant (2%) in the Level I course evaluation survey (participant satisfaction survey) mentioned missing the face-to-face contact. This issue was not mentioned in any of the other course surveys. However, it is mentioned in the literature (Gillham, 1999; Goodwin, 1993; Justen, 1990) that online learners' satisfaction was influenced by them missing face-to-face contact. Indeed, the Goodwin (1993) study indicated that 40% of its online learners missed the face-to-face contact, a 38 percentage point higher response than from this study's findings, a difference that may be attributed to learners' acceptance and experiences of using online learning changing over this ten-year period.

This study also found that 58.3% of participants believed ($n = 98$, agree and strongly agree) that the quality of the feedback was appropriate to their queries or comments for the completion of the learning material. This result was significant, with a chi-square value of 54.976, which exceeded the expected frequency of 33.6 ($p < 0.05$).

The issue of communication and interaction among learners in an educational or training course is also an important component of effective instruction. Communication was covered by the variable feedback whilst interaction referred to communication (either verbal or written) between people, which may be termed social interaction. Another type of interaction, individual interaction, refers to events that take place between a learner and the learning materials, for example textbooks, or the computer (Bates, 1991). Other researchers (Lundin, 1989; Moore, 1989; Thompson, 2000a, 2000b) suggest that interaction allows for learners to learn from one another and from the instructors. Thompson (2000a, 2000b) believed that, due to the geographical dispersion of students in e-learning courses, special attention must be made within the course design to allow for communication and interactions amongst and between peer-to-peer, and peer-to-instructor. Without adequate forms of interaction, technology-based learning courses often fail (Thompson, 2000a, 2000b). The courses examined in this study attempted to provide this interaction via email and pop-up browser window messages to participants, which reminded them of course material changes, their level of progress through the course, test scores, and generic encouragement remarks.

The association between interactions being perceived to increase instructional value (as measured by interaction [provided]) appropriateness and timing were found to have a chi-square value of 71.810, 78.964, 75.452 and 54.083 respectively, which exceeded the expected frequency values ($p < 0.05$). In addition, the Pearson correlation coefficient for the four variables was 0.741, 0.691, 0.448, 0.834, 0.486, and 0.386 respectively. The significance level for all four variables was 0.000 (at the significance level of 0.01), which indicates a very low significance. Thus, the correlation was significant and the four variables were linearly related. Therefore, it was generalised that learner satisfaction and learning was more likely to occur when not only feedback was provided but also when the course allowed for interaction amongst peers and facilitators. These findings were supported within the literature by Baylen and Sorensen (1998) who ascertained that technology is changing practice and that education is moving towards more interactive environments. This, according to Kearsley (1995), is one of the most important elements of contemporary education, with high levels of interaction being

desirable as interaction positively affects the effectiveness of any education course, as was indicated by this study's Level I–III and Moderator 1–2 results.

The interaction of learners with the course medium indicated that 72.7% ($n = 122$) of the participants believed that the use of the online educational course made them confident in using computers and technology in general. This largely favourable response was also supported by the chi-square analysis findings, which revealed a value of 104.679 ($p < 0.05$, expected value 33.6). In addition, the DPS found that self-reported Internet and computer perceived competency was also large (95.83% good/excellent and 92.85% good/excellent, respectively). The course media that the participants believed to be most beneficial to their learning were plain text (73.7%), whilst hyperlinks (16.8%) and pictures (13.2%) were perceived to be of least value.

5.4.2 Moderator 3 and 5

The 3rd and 5th moderators examined issues around the learners' ability to practice or apply the course content to the practical setting (in this case, the clinical setting) and to answering content-based questions. Within the literature, the ability to practice and apply course content in a problem-based learning manner has been found to influence both overall course satisfaction and learner achievement scores (Alliger et al., 1997; Cavanaugh, 1990; Estes et al., 1999; Gange, 1984, 1985; Goldstein, 1980, 1993; Sherry, 1996, 1997; Stocks and Freddolino, 2000; Wexley and Hinrichs, 1991; Wexley and Latham, 1991; Wright, 1998; Wright et al. 1998).

Within this study the Web-based courses encouraged the learners to write down notes using their individualised electronic notebook, to implement the clinical tool into their practice, and perform mini-tests and pre/post-testing. These pedagogical techniques were termed active practice tools (Wexley and Hinrichs, 1991; Wexley and Latham, 1991).

The use of the course clinical tool and pre/post-testing has been reported in the sections on Level II (knowledge gain from the course) and Level III (application of knowledge or behaviour change in practice) and so will only be briefly restated in this section. All of the 42 courses contained mini check-tests which the learners undertook midway through their respective courses. These mini check-tests were server marked but not reported in this study. Instead, learner reactions to content relevancy and towards problem-based learning (Barrows,

1994) were examined, as they were more reflective of the PBL philosophy supported by the courses.

This study found that 94.95% of Moderator 3 participants reported a favourable reaction to the course providing them with the opportunity to practice, apply course content, and expand on their prior knowledge. This finding, together with the Level III finding of 68.7% ($n = 351$) from the study's Level III participants ($n = 511$) reporting an overall favourable behaviour reaction combined with the Level II finding of $\eta^2 = 0.551$ and $t = -5.149$ ($p < 0.0005$) (pre-test mean of 78.524 [SD 18.709], post-test mean of 94.484 [SD 8.602], $p < 0.05$), concluded that there were several large effects obtained before and after the educational event, associated with the instructional and pedagogical design of the courses, which provided the learners with the ability to practice. In addition, several researchers (Alliger et al., 1997; Cavanaugh, 1990; Estes et al., 1999; Gange, 1984, 1985; Goldstein, 1980, 1993; Sherry, 1996, 1997; Stocks and Freddolino, 2000; Wexley and Hinrichs, 1991; Wexley and Latham, 1991; Wright, 1998; Wright et al. 1998) reported that practice had positive, favourable, consequences for learner satisfaction. Adding weight to this claim was this study's Level I findings, which indicated that participants had a favourable reaction to the course structures (98.6%), content (95%), and overall course impressions (98.1%). In addition, 100% of the participants indicated that they would use online education again. This response may have been indicative of the high academic and professional esteem in which participants viewed the courses, both variables combining to give a favourable reaction finding of 99.4%. These findings, together with 52.4% of participants believing that online education was more effective than other traditional forms of face-to-face learning that the HCP undertake to satisfy their CPE requirements, add weight to the benefits of studying using the Web.

The work of Knowles (1987), Jarvis (1987, 1999), Honey-Mumford (1986), Kolb (1984, 1985), Rogers (1994), Barrows (1994), American Society of Training and Development (2000) and Vygotsky (1978) emphasise the importance of learning to learn and building upon previous learning experiences and knowledge, particularly as they relate to the ability to practice. These attributes have been evaluated within this study's Web-based courses, as supported by Moderator 3 findings. Additionally, several researchers have cited journals, books and research devoted to adult learning with as yet no single universal understanding of adult learning (Brookfield, 1995). This is particularly so within computer-based learning environments (Moore, 1991) and also for health care professional CPE (Curran, 2000; Grant, 1998, 1999).

This study is contributing towards the establishment of a notion of adult learning, even if it is for one small component--health care professionals continuing professional education.

Wexley et al. (1991) postulated that active learning and practice is more conducive to learning and learner satisfaction than passive practice. This is also supported by others (Lunsford, 1997; Wright, 1997, 1998) and was found to be the case in this study. When asked to report on the learning style that they used as a result of undertaking the Web-based courses, 72% ($n = 121$) of participants indicated that they used deep learning methods that required them to look to an overall understanding of the course material. This finding was supported by the analysis of the study's Levels I–III data, which indicated that the online learners not only learnt but that they were also satisfied with and by the online learning experiences.

5.4.3 Moderators 4 and 6

Associated with the ability to practice is the size or length of the training session or course. In essence, how much is the learner expected to learn during each session? Moderator 4 examined the issue that learner satisfaction will be positive when the learner has the opportunity to break the learning course material down into learner-managed components. Moderator 6 was instructionally designed and pedagogically contrived to work both with Moderator 4 and independent of it. This moderator examined whether self-pacing is beneficial to Web-based learning.

Learners' ability to control the timing and amount of material to which they are exposed is important because learners all learn at different paces. Roberts et al. (1988) found that student autonomy, as compared to instructor-set timing, had positive benefits both on learning and learner satisfaction. This finding was also reported on in an early study by Belbin and Belbin (1972) and was indicated in this current investigation.

The association between rate (timing) and pacing (how much completed and how much to be completed) resulted in a chi-square value of 172.429 and 169.857 respectively (expected frequency 42.0, $p < 0.05$). In addition, the correlation coefficient for rate and pacing was 0.774 ($p < 0.05$). This small significance level indicated that rate and pacing are significantly positively correlated, and that the two variables were linearly related. Therefore, if learners can control the amount and progression of their course materials they will inherently be more

satisfied with the course itself.

In summary, the participants viewed all six pedagogical and instructional design moderators favourably. Several of the moderators were pedagogically similar and so the data were presented together. However, this was a particular characteristic of the learning environment, and another learning environment through a different provider may have used or not used the moderators to different pedagogical purposes. Consequently, the particular design characteristics of this study environment were influential in the measurement and reporting of the moderators.

5.5 Summary

This chapter has discussed the case study results in relation to the research objectives and associated guiding questions. In addition, the findings have been discussed from a theoretical perspective by reporting result findings in light of the literature review and methodological approaches used in the study. The following chapter will present an overview of the study together with conclusions and recommendations for further research that resulted directly from this research.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Overview

This chapter draws conclusions from the study, with a particular focus on the learning, application of knowledge and behaviour changes into practice, perceptions of learners to online education, and the moderators that affected this online learning environment. The conclusions are presented as they related to the two overriding research objectives and their associated discovery questions. The chapter then concludes with recommendations regarding further research that could be undertaken as a result of findings from this study.

6.2 Case study conclusion for the pedagogical, instructional design and general overall effectiveness of the Web-based CPE courses

The nature of pedagogy and instructional design are well described in the literature on face-to-face education and to a lesser degree in the literature on technology-based education. Pedagogy and supporting instructional design characteristics play a critical role in not only delivering educational content but also in describing the effect of an educational event. Such was the case with this study into evaluating the effectiveness of the Web as a learning environment for Web-based continuing professional education and the influence of several instructional design and pedagogical characteristics that predisposed its effectiveness.

This study found that learners learnt from the course content, applied this knowledge into practice and were highly satisfied from learning within the online educational environment. Participant responses of favourable or positive reactions to learning and course satisfaction were the result of several pedagogically-driven instructional design characteristics (moderators) unique to the learning environment. These moderators included learner autonomy in determining when and how long to learn. A finding supported by Siu and Chau (1998). The utilisation of scaffolding pedagogical features such as feedback, ability to practice, and applying course content to real-world or problem-based learning both within the course and within the work environment were all viewed favourably by the learners. Oliver, Omari, and Herrington (1998), also found that scaffolded computer-based learning environments were

viewed favourably by learners.

6.3 Theoretical, Methodological and Practical Implications

A number of implications arise from this study. The following section considers the key theoretical, methodological and practical implications.

6.3.1 Theoretical implications

As educational research continues to determine the effectiveness of various learning delivery media, an appreciation of current and future educational paradigms needs to be realised. The revolutionary abilities of ICT (that is, the Internet) in education have paralleled the printed book, School of the Air or television education in the appropriate historical timeframe. Research should therefore be directed at determining the multilevel effectiveness and e-pedagogical design moderators of educational events within the appropriate scope of educational delivery; in this case, face-to-face and technology-based. This researcher strongly believes that like delivery media need to be compared in order to ascertain the effects of pedagogy and instructional design characteristics on learning. Using the traditional classroom as the academic measuring stick may not be appropriate, depending on the needs and characteristics of the learners seeking education. Indeed sweeping generalisations and inconclusive findings about the effectiveness or otherwise of ICT-supported education need to be reviewed in the light of the most current educational paradigm.

The results of this study regarding satisfaction (reaction Level I), achievement (Level II), application of course content into practice (Level III) and the moderators were dependent upon the implemented e-pedagogical design of the courses. Altering the pedagogy and hence the instructional design (moderators) may impact on one or more of the evaluation levels and moderator reactions to produce results different to those found in this study. Altering the study cohort may have also altered the evaluation findings.

Medical education has been undervalued in the health care sector, so educational research to determine the effectiveness of various learning delivery media is required not only for this learning community but for the wider education community. This study examined the use of the Internet for continuing professional education in the relatively short time frame of the last

decade. The measuring sticks and the e-pedagogical design characteristics that this study used may or may not be appropriate for other learners or even for this particular cohort in a year or more, given the speed with which technology is not only changing our lives but also the educational arena. Therefore, the generalisations from this study need to be considered in the conceptual framework of its paradigm.

6.3.2 Research methodological implications

The researcher is aware that by using a single case-study approach, generalisation of results is restricted to similar contexts. Multi-case studies of varying contexts within the same study may have produced an opportunity for comparative analysis. However, it was the intention of the researcher to examine fully the phenomena under study and report on its findings in detail. This single case study may then be replicated or extended to similar learning environments. To conduct this study in another Web-based learning environment that has different parameters including geographical non-Australasian, educational non-CPE, delivery multimedia enhanced instructional design or professional community non-HCP would be advantageous to determine any difference in knowledge acquisition, knowledge application into practice, behaviour change in practice and the effect that different pedagogical and instructional design characteristics have in the knowledge and behaviour acquisition and application of course content into practice by the study cohort .

The case study design of the study lent itself to explanation and interpretation of the learning phenomena in a social setting that dealt with human participants in an everyday learning situation. The Level II test survey (knowledge gained from the course) was a normal unaltered component of the educational experience, in which the data were used in an author derived manner. This, together with a modified Level III (application of knowledge or behaviour change in practice) researcher-provider survey and an author-developed course/moderator satisfaction (Level I) survey, were all pilot-tested prior to the study occurring. The pilot study occurred over a month-long period. Following the pilot, minor modifications were made to some of the wording of the surveys. This process not only resulted in the formation of cohort-specific wording for study questions, it also reinforced when and how the specific surveys would be implemented. The process also allowed for specific identification of the study cohort and the instructional design and pedagogical implications of the learning site. This method ensured that the study design and associated questions would be robust. However, it

would have been invaluable to trial the surveys within a Web-based course where the users were from a non-HCP background. This would have allowed for further survey question clarity.

The researcher acknowledges that an alternative method of investigation may have served a different purpose. For example, a quasi-experimental method might have been used where participants were randomly exposed to three different learning sites based on the same material. The three experimental groups would be assigned to a pedagogically different model, a different instructional design model and the Med-E-Serv model. The independent variables would include the characteristics of the delivery medium (instructional design) and the pedagogical structure of the courses. The dependent variables would include the Levels I, II, and III surveys and the content of the courses. Data collected from these three models would enhance and further knowledge of the relationship between pedagogy and instructional design. For instance, is there a correlation (relationship) between the ability to break the course down into learner-managed components compared to when the learner does not have the opportunity to break the course down into learner-managed components? A component of this was examined in this study as Moderator 4. Additionally, would Web-based education be more effective when immediate feedback is provided than when immediate feedback is not provided? A component of this was examined in this study as Moderator 2.

Another limitation of this study was that 28 out of 42 (66.66%) of the courses were sponsored by pharmaceutical companies. The pharmaceutical company sponsors paid to have their logo and representative details displayed within the top right of the course's home page. The companies have no knowledge of or direct contact with the learners, nor do they have a say in the material that is displayed on the sites. The only contact they have with the learners is if the learner clicks on the contact representative link on the home page. This 'no direct knowledge' or contact, together with a research finding (Purcell, 2001) in to why GPs don't attend continuing medical education courses found that GPs were least concerned with drug company CME sponsorship (2% obliged to sponsor and 10% philosophically opposed, study size $n = 317$) as compared to other attributes (91% work pressure, 64% too tired). Drug company sponsorship was not considered an issue in this study as the participants self-selected enrolment into the courses with the knowledge that some of the courses were 'drug-company' sponsored.

6.3.3 Practical implications for Web-based continuing professional education

A number of findings derived from this study may have practical importance for individuals involved directly in designing and delivering Web-based education.

As previously mentioned in Chapter One, this study intended to contribute insights into how adults learn through a Web-based course. For this study's particular cohort, the learners were perceived to have been scaffolded in their learning by the provision of feedback during their learning, and by having the ability to apply course content to both problem-based learning questions/scenarios within the course and to their work settings. In addition, favorable participant satisfaction and learning was found to have occurred in courses that offered learners autonomy in terms of not only when they learned but also how much they could learn in a session. These processes and practices contribute insights into how and when HCPs learn in a virtual learning environment, giving future researchers theoretical insights in to HCPs learning styles.

In terms of practical outcomes this particular environment was found to contribute to knowledge acquisition and learner satisfaction. The next step would be to ascertain how this increase in knowledge and confidence might be used to or improve the performance of this particular collection of learners. To accomplish this an experimental design that uses three study groups which are randomly assigned is required. This study would have an online learning group that undertakes a course of predetermined content. The second group would receive no course, whilst the third group would receive a traditional face-to-face course based on the same content. All three groups would be monitored pre- and post-course for clinical and behavioural changes. None of the groups would be aware of what they were being monitored for. In addition, patients with a specified condition would be monitored pre- and post-course for improvements not only in care but also in terms of health improvement. Diabetes or depression would make the ideal content area as they are conditions routinely found in general practice and in the Australasian population.

The findings from this study regarding the moderator influences may be beneficial to other courseware providers in terms of the pedagogical and instructional design of their courses, specifically for HCPs. The findings contribute information required to address the challenges of how technology can be used effectively in education, challenges that are 'thinly' reported in the

educational literature. This study's findings are generalisable because learning was effective, which according to several educational researchers (Joy and Gracia, 2000; Schifter, 2000) is indicative of effective pedagogical practices.

Generalisations arising from this research and associated literature reviews are presented in Figure 6.1. These generalisations are listed to assist e-learning developers and Med-E-Serv in the maintenance and ongoing development of their e-learning courses.

Figure 6.1 Research generalisations

Research generalisations
<ul style="list-style-type: none"> • Allow feedback on learning process, content. This promotes active participation in the learning process.
<ul style="list-style-type: none"> • Show course outline in terms of content, objectives, and assessment methods. This promotes relevancy and student orientation within the course.
<ul style="list-style-type: none"> • Allow 1:1 (learner:learner; learner: instructor) as well as 1:many learning situations. This promotes problem-based learning and active participation.
<ul style="list-style-type: none"> • Keep text-based material short. Therefore, if it is more than one screen in length, participants will print it off rather than interact with it online, also allow for Word-based printing of materials.
<ul style="list-style-type: none"> • Keep all material within 3 clicks (jumps) from the home or main page. Navigationability of more than 3 links away leads to participants getting lost within the site.
<ul style="list-style-type: none"> • Allow an anchor to the top and bottom of the page rather than a hyperlink (instructional design and navigationability) as participants prefer to scroll through the material rather than <i>jump</i> around the page.
<ul style="list-style-type: none"> • Participants preferred embedded activities with images (instructional design consideration to break-up text with images).
<ul style="list-style-type: none"> • The use of clinical, diagnostic or learning tools results in higher attainment of material/content into the practice domain (PBL and active practice considerations).
<ul style="list-style-type: none"> • Participants prefer material that: <ol style="list-style-type: none"> 1. allows them to self-pace and determine when/where and how much to learn in a learning (study) sitting (learner autonomy); 2. has a clinical/content tool for application into the practice/work setting (active learning); 3. based on a PBL philosophy and allows application to apply content to practice both within the course material (tests, clinical scenarios), as well as in the practice setting; and 4. gives both immediate feedback (for example, on tests that are server generated [immediate], as well as by questions to facilitator [delayed]).

6.4 Recommendations for further research

This interpretative single-case study serves as a preliminary investigation into the use of the Web for education. As a consequence, of the generated interest in the topic of educational effectiveness and online education, by course developers and online education providers, the following recommendations would be starting points for further research.

Firstly, this community of health care professionals may be considered atypical. Other communities representing cultural and professional differences from the community of this current study should be considered. Replicated studies in different contexts using the same data collection methodology would serve as a comparison.

Secondly, whilst this study determined that learning occurred and that learners were satisfied by the online educational event and its pedagogically driven instructional design characteristics, it would be worth replicating with the same adult learning community again in 5–10 years to evaluate how the effectiveness criteria and moderators change with technological changes and with HCP changes in technology use within their undergraduate, post-graduate and practice settings over time.

A third suggestion for further research surrounds the opportunity for researchers to develop a more thoroughly controlled experimental study with random selection for experimental groups and controls. As appropriate, research studies seeking to compare the effectiveness of differently pedagogically and instructionally designed courses should seek to develop adequate and random controls to allow for replication of findings to occur in similar practice settings.

Fourthly, further research is needed to redirect the effectiveness comparisons between synchronous and asynchronous modes of learning to address the effectiveness of pedagogy for each given mode.

Fifthly, a research focus is required that describes the effects of technology on learning and the understanding of the relationship between the interaction of the cognitive processes and the characteristics of the learning medium. Learning is multifaceted and the effects can not be seen in isolation. Several multi-controlled case studies would be required to investigate cognitive approaches and the impact of the medium.

Future research should also be conducted to consider the effects of individual learner differences--such as age, gender, educational experience, motivation and computer competency--when using Web-based education. This has been highlighted by others (Phillips and Merisotis, 1999) in the distance education literature but not in the online-technology-based literature. Such a study would examine the understanding of how the learner, the learning task, and online learning interact.

Lastly, Web-based education can use both real and inanimate facilitators or teachers. Future research is needed that assesses the effectiveness of Web-based education when (1) an inanimate teacher is used, (2) when a real-animate teacher is used, and (3) when both an inanimate and real-animate teacher are used together. The reason this last study is warranted is that both forms of teachers (animate and inanimate) have unique advantages and disadvantages. Student reaction (perception, satisfaction), knowledge attainment and application of knowledge may be enhanced or diminished by the presence of either teaching model.

6.5 Study conclusions

To some degree, the challenges to effective online course design mirror the challenges of course design for traditional face-to-face environments. Time, effort, money, expertise and content are necessary to the design of any instructional event in any setting--all of which need to be based on and developed from a sound understanding of teaching and learning theories.

This study was conducted in a CPE setting to investigate the overall effectiveness of courses delivered solely through the Web. It must be noted that the reporting on this area of appropriate information was extremely inadequate in the literature. Of those studies examined, methodologies and reporting of findings were limiting, necessitating the current study.

Study findings revealed that learners using a commercial course significantly learnt from the experience (Level II [measure of knowledge gained from the course] - pre-test mean 78.524 [*SD* 18.709], post-test mean 94.484 [*SD* 8.602], $t [35] = -5.149$, $p < 0.0005$, eta-squared = 0.551), and that the learning was carried over into practice or resulted in behaviour changes into practice, which was indicated by 68.7% of course participants. Additionally, the pedagogical principles of providing active learning via the implementation or use of a clinical or diagnostic support tool resulted in a greater self-reported participant change into practice as compared to

courses that did not use such a learning tool ($Z_{obs} = 3.757$). Overall participant satisfaction (Level I) was found to be 97.23%, indicating that participants were extremely satisfied not only by doing the course but also by the course structure itself (instructional design). The pedagogically driven instructional design characteristics found that participant reactions were overwhelmingly favourable (satisfied) when feedback was provided in a timely manner. Additionally, the courses examined emphasised scaffolded learning methods of provision of practice, practice based on problem-based learning and learner autonomy in terms of deciding when to learn and how much to learn (pacing) in a sitting. These e-pedagogical course aspects were all viewed favourably (positive) by the participants and contributed to overall course satisfaction and learning achievement findings. Further, these e-pedagogical aspects combined with the specific nature of learning online were 'valued' by the course participants: "have young children ... ease at doing this at 10:30pm is unsurpassable"; "...most convenient way for me as an old rural practitioner to ... keep learning".

Finally, with the booming e-economy and e-learning market, the promise of learning anytime/anywhere is bringing more learners to the online education market. As a result, more people than ever before will be exposed to a single online learning experience than ever before. It is therefore imperative that these widely distributed, content- and learner-diverse educational events are of a high educational quality. This quality can be measured in part by the match of instructional objectives and content to the instructional methods used, and the degree to which the strengths of the World Wide Web medium is exploited to accomplish tasks and to facilitate and support learning in ways which are not possible without the computer and information superhighway which is the Internet. To conclude, a quote from one online participant best summed-up the overall effectiveness of Web-based education: "...this form of CME [education] is like manna from heaven."

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