Curtin University of Technology
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Development and Validation of an Instrument for Assessing Online Learning Environments in Tertiary Education: The Online Learning Environment Survey (OLLES)

John Francis Clayton

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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Date: 21st March 2007

Abstract

Increasingly the perceived benefits of using networked computers, software applications and computer simulations in learning activities are being exploited at all educational levels and within all curricula areas. As web-based and online software applications such as browsers, search engines, communication tools and data-bases mature, so does educator's use of this medium for teaching and learning. How we can investigate the impact of these technologies upon the educational experiences of learners was the fundamental concept addressed by this thesis. The study reports on the design, development and validation of a web-based survey instrument for use in online learning environments in tertiary education. The thesis investigated both previous psychosocial learning environment instrument development studies and the nature of environments created by the use of information and communication technologies. The research followed a two-phased instrument development process. Phase one focused on content validity, identifying salient scales and items and piloting the instrument with a limited audience. Phase two focused on construct validity, conducting an extensive field test with a web-based form and performing statistical analysis on the online data collected. Principal components analysis, with oblique and orthogonal rotations, confirmed the structure of a 35-item 7-scale instrument. The thesis concludes by confirming the new instrument, the Online Learning Environment Survey (OLLES), will allow conclusions to be drawn about student perceptions on the interactions occurring in their online environments in an economical and efficient manner.

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Increasingly the perceived benefits of using networked computers, software applications and computer simulations in learning activities are being exploited within all curricula areas. As web based and online software applications such as browsers, search engines, communication tools and data-bases mature, so does educator's use of this medium for teaching and learning. A key question to be addressed is what are the impacts of this increased use of online learning on the educational experiences of learners? The purpose of this chapter is to demonstrate how the online learning experiences of learners can be investigated in an efficient and economical way. The chapter is divided into five sections. Section 1.1, electronic technologies in education, provides a brief overview of how electronic technologies are used in educational settings. Section 1.2 is focused on computers, the Internet and education. As well as exploring the growing use of information and communication technologies in educational settings, the section provides historical overview of how educational institutions have used these technologies. Section 1.3 defines three common terms, the Internet, the World Wide Web and learning environments and explains how they are defined, used and perceived in this particular study. Section 1.4 details the theoretical framework of the research to be undertaken exploring learning environment research, constructivist views of learning and the growing use of the Internet to facilitate research. Section 1.5 describes the purpose of the research listing the background, aims, and significance of this study. Section 1.6 reviews this chapter and details how the remaining chapters in this study are structured.

1.1 Electronic Technologies in Education

The use of electronic learning and teaching technologies in formal educational settings, in a variety of formats, is, and has been, a common teaching practice (Association for Educational Communications and Technology, 2001; Further Education Resources for Learning, 2007; Hall, 2006; Illinois Online Network, 2006; Marshall, 2002). For example Mathematics teachers use calculators to solve complex problems, Science teachers use stopwatches in timed experiments, History teachers enhance lessons on an historical era with the use of short film clips, English teachers use video to analyze a Shakespearian play while Music teachers use specialist equipment to record and critique student performance. However, each of the

electronic learning technologies used in the scenarios described has been used as tools or resources within the existing face-to-face classroom to enhance, or to complement, existing teaching strategies. This use of electronic technologies in these cases is generally carefully timetabled around the availability of the technology, is often confined to and embedded within a defined physical space and is structured around traditional face-two-face teaching strategies. In essence, it can be argued using electronic technologies in these ways has not significantly altered the way learners learn or teachers teach.

1.2 Computers, the Internet and Education

1.2.1 Overview

The advent of the microcomputer in the 1980s, the creation of the Internet and the development of the World Wide Web have influenced all aspects of modern society including learning (Clayton, 2006; Looms, 2002; Reid, 1994; Sangster, 1995). The products of advanced information and communication networked technologies permeate our lives. These products extend from the personal computer in homes, offices and schools to the centrally-connected systems in businesses, banking and governments. Increasingly the perceived benefits of information stored in digital media are being exploited. Publishers, lecturers, tutors and content developers are producing e-books, course handouts, assignments, course references and resources with imbedded hypertext links, electronically generated and marked activities and cross references to other digitally stored information (Cleveland-Innes et al, 2005; Cunningham, Duffy, & Knuth, 2000; Illinois Online Network, 2006; Lynch, 2001; Phillimore, 2002; Schoch, Teoh, & Kropman, 2006). Advances in microchip technology, digital storage devices, web browser plug-ins and advanced software applications could see the integration of computers, portable electronic devices, digital gaming technology, television, and telecommunications in educational activities (Baggaley, 2006; Bates, 1995; Childress & Braswell, 2006; Looms, 2002). It has become apparent the sophistication and ease of supporting web browsers, Internet search engines and the advanced computer skills of learners means the classroom educational activity, both for the student and the teacher, is no longer constricted to, or confined by, text, print-based materials, time or space (Chang & Fisher, 1999; Chung & Ellis, 2003; Further Education Resources for Learning, 2007;

Ng, 2006). For example, Java-script, an object orientated computer language, can be used to provide instant feed-back for learners in short courses on grammar (Clayton, 2002). Virtual laboratories can be created to allow students to work in simulated situations (Craig & Messom, 2002). A range of digital video resources can be created to enhance interpersonal communication skills for librarians (Marshall & Cullen, 2003). Multimedia authoring tools can be used to create virtual classrooms for second year education undergraduates (Chambers & Stacey, 2005). Remote access to analytical instruments allowing real-time science experiments to take place can be used in university distance education science programmes (Baran, Conners, Quigley, & Currie, 2005). Enterprise-scale learning management systems, sometimes referred to as virtual learning environments, catering for tens of thousands of students, at geographically disperse locations, learning simultaneously online have been deployed (Benson & Palaskas, 2006). The demand for more flexibility in education, the improvement in technological capabilities of students and tutors, the increased connectivity of educational institutions, the increasing uptake of the Internet in homes and the reducing costs of such technologies and connections are making electronically-mediated education increasingly more viable, attractive and cost effective (Bartolic-Zlomislic & Bates, 1999; National Science Board, 2006; Nichols, 2004). Educational institutions at all levels have encouraged the development of digital environments since the networking of computers.

1.2.2 Educational Involvement: The Beginnings

The use and development of the Internet in the 1970s was almost entirely science focused and restricted to a small number of United States Government Departments and research institutions accessing on-line documentation. The broader academic community was not introduced to the communicative power of networking until the start of the 1980s with the creation of BITNET, (Because It's Time Network) and EARN (European Academic and Research Network)(Griffiths, 2001). BITNET and EARN were electronic communication networks between higher education institutes and were based upon the power of electronic mail (e-Mail). The development of these early networks was boosted by policy decisions of national governments, for example, the British JANET (Joint Academic Network) and United States NSFNET (National Science Foundation Network) programmes, that explicitly encouraged the use of the Internet throughout the higher educational system, regardless of discipline

(Leiner, et al, 2000). By 1987 the number of "computer hosts' connected to networks had climbed to 28,000 and by 1990 300,000 computers were attached (Griffiths, 2001). However, the development of the World Wide Web and Hypertext Markup Language, combined with parallel development of browser software applications such as Netscape and Internet Explorer, led to the eventual decline of these e-Mail based communication networks (Corporation for Research & Educational Networking, 2002). By the end of the 1980s educational institutions, at all levels, had joined the knowledge age.

1.2.3 Educational Explosion: The 1990s

The advances in, and decreasing costs of, computer software and hardware in the 1980s resulted in increased use of, and confidence in, computer technologies by teachers and learners. By the mid 1990s a number of educational institutions were fully exploiting the power of the Internet and the World Wide Web. Search engines, to locate and retrieve information, had been developed and a mini-publication boom of web sites occurred (Griffiths, 2001). Educational institutions from elementary levels to universities began using the Web and Internet to supplement classroom instruction, to give learners the ability to connect to information (instructional and other resources) and to deliver learning experiences. In short, the Internet altered some approaches to education and changed the way some teachers communicated with students (McGovern & Norton, 2001; Newhouse, 2001b). There was an explosion of instructional ideas, resources and courses on the Web during the last decade of the twentieth century, as well as new funding opportunities for creating courses with Web components (Bonk, Cummings, Hara, Fischler, & Lee, 1999). While some educators regarded "online education" with suspicion and were critical, many online learning activities were based on imitating or duplicating what happened in the classroom (Bork, 2001). The advocates of “online", "web assisted", or "Internet" learning argued the combination of traditional face-to-face teaching with online resources and communication provided a rich learning context and enabled differences in learning styles and preferences to be better accommodated (Bates, 2000; Mann, 2000). The use of the Internet and connected computers became ingrained in curriculum developments at all levels.

1.2.4 Educational Maturity: The Present

Although the introduction and integration of information and communication technologies in educational institutions continues to meet some resistance (Shannon & Doube, 2004; Mitchell, Clayton, Gower, Barr, & Bright, 2005) in the modern twentieth century educational institution the use of networked computers and the World Wide Web is ingrained (Marshall, 2002; National Science Board, 2006) and is seen as critical in maintaining an institutions and ultimately their survival (Byrnes & Ellis, 2006). As the use of computers, networks, educational software applications and the Internet has increased there has been a corresponding increase in institutional investment. Institutions have invested increasing amounts of resource, (physical, human and fiscal) into digital developments both in infrastructure and course content (National Science Board, 2006; O'Dwyer, Russell, Bebell, & Tucker-Seeley, 2005; Ringstaff & Kelley, 2002). It has become apparent educationalists need to develop appropriate strategies to deal with new information and communication technology-rich ways of teaching and learning (Palloff & Pratt, 2001; Salmon, 2000; Beldarrain, 2006; Kirkwood & Price, 2006). Research into online learning environments has matured and initial individually-led embryonic activities, focused on the limited introduction of web technologies, the small-scale development and application of web based software tools and plug-ins, the creation of digital resources and the acceptance of these activities by a limited audience, have been expanded upon and become more broadly focused. For example, national investigations into the barriers and enablers of staff adoption of learning and teaching technologies in vocational training institutions have been undertaken (Mitchell, et al, 2005). Reviews at an institution and national level of how institutions can provide appropriate, timely and relevant professional development opportunities for all staff have been reported on (Wilson & Stacey, 2004; Marshall, 2005; Mitchell, et al, 2005). The academic achievements of learners in online and traditional learning environments have been compared (Johnson, Aragon, Shaik, & Palma-Rivas, 2000; Ladyshewsky, 2004a; Suanpang, Petocz, & Reid, 2004). Research has also been undertaken investigating both the psychosocial and physical aspects of networked classrooms where physical aspects such as lighting and workspace contribute to student satisfaction and, therefore, student productivity (Zandvliet & Fraser, 2005). Research into the most

effective and efficient methods of using ICT has become an integral part of research / teaching and learning

1.3 Online Education Common Terms and Usage

1.3.1 The "Internet"

The development of the "Internet" has a relatively brief but well-documented history (Cerf, 2001; Griffiths, 2001; Leiner, et al, 2000; Tyson, 2002). The initial concept of the Internet was first mooted in the early 1960s. American computer specialists visualized the creation of a globally-interconnected set of computers through which everyone could quickly access data and programmes from any node, or place, in the world. In the early 1970s a research project initiated by the United States Department of Defense investigated techniques and technologies to interlink packet networks of various kinds. This was called the "Internetting" project and the system of connected networks, which emerged from the project, was known as the "Internet." The initial networks created were purpose-built - i.e., they were intended for, and largely restricted to, closed, specialist communities of research scholars. However, other scholars, other Government Departments, and the commercial sector, realized the system of protocols developed during this research, (Transmission Control Protocol (TCP) and Internet Protocol (IP) collectively known as the TCP/IP Protocol Suite), had the potential to revolutionize data and programme sharing in all parts of the community. A flurry of activity, beginning with the National Science Foundation (NSF) network NSFNET in 1986, over the last two decades of the twentieth century created the Internet as we know it today. In short, the Internet is a collection of computers joined together with cables and connectors following standard communication protocols (Clayton, 2006).

1.3.2 The "World Wide Web"

For many involved in education, there appears to be an interchangeability of the terms Internet and World Wide Web (**WWW**). For example, teachers will often instruct students to "surf the web" or alternatively to find information "on the net" with the assumption there is little, if any, difference between the two. However, there are significant differences. As mentioned in the previous section, the Internet is a collection of computers networked together using cables, connectors and protocols.

The connection established could be regarded as physical. Without prior knowledge or detailed instructions the operators of the connected computers are unaware of the value, nature or appropriateness of the material stored at the node they have connected with. The concepts underlying the **WWW** can be seen to address this problem. As with the Internet, the **WWW** has a brief but well documented history (Boutell, 2002; Cailliau, 1995; Griffiths, 2001). Tim Benners-Lee is recognised as the driving force behind the development of the protocols, simplifying the process locating the addresses of networked computers and retrieving specific documents for viewing (Johnson, 2005). It is best to imagine the **WWW** as a virtual space of electronic information storage. Information contained within the network of sites making up the Internet can be searched for and retrieved by a special protocol known as a Hypertext Transfer Protocol (**HTTP**). While the **WWW** has no single, recognizable, central or physical location, the specific information requested could be located and displayed on users' connected devices quickly by using **HTTP**. The development and refinement of **HTTP** was followed by the design of a system allowing the links (the **HTTP** code) to be hidden behind plain text, activated by a click with the 'mouse', and so we have the creation and use of Hypertext Markup Language (**HTML**). In short, **HTTP** and **HTML** made the Internet useful to people who were solely interested in the information and data contained on the nodes of the network and were uninterested in the underlying, detailed, technical knowledge on computers, connectors and cables (Clayton, 2006).

1.3.3 Learning Environments

The demands, sanctions and expectations within an environment (environmental press) give the social system its particular climate (Neilsen & Kirk, 1974). This general overview of social systems and their particular climates has led to the term learning environment being perceived differently by different individuals and groups. For example, it can mean learning tasks, virtual spaces or classroom psychosocial environments (Walker, 2003). For the purpose of this study, a learning environment will be described as the place, both virtual and physical, where teachers and students are assembled together to participate in the activities of learning. The essence of these specific learning environments is the interactions that occur between individuals, groups and the virtual or physical setting they operate within. The environment created, also referred to as climate, atmosphere, tone, ethos or

ambience, during this activity, is regarded as an important component in the learning process (Fraser & Wubbels, 1995). Since both teachers and learners hold views on the learning environment they operate within, these views will affect the way they participate in learning activities (Fraser, 1998a) and investigations can be undertaken in multiple ways from multiple perspectives (Fraser, 2001; Goh & Khine, 2002).

1.4 The Research Framework

1.4.1 The Field of Learning Environment Research

In monitoring performance or researching and evaluating the success or failure of time and resources spent in educational settings, a number of quantitative measures such as grades allocated, total number credits earned, participation rates in specified activities, graduation rates, standardized test scores, proficiency in identified subjects and other valued learning outcomes could be used (Dean, 1998; Fraser & Fisher, 1994). However, since these quantitative measures are in general focused on educational outputs they are somewhat limited. They do not adequately measure, monitor or truly evaluate the details of the educational process (Fraser, 1998b). Other measures can be used that are just as effective, for example, student and teacher impressions of the environment in which they operate are vital. Their reactions to, and perceptions of, this environment have a significant impact on individual and group performance (Fraser, 1998a). Indeed, research indicates student achievement is enhanced in those environments which students feel comfortable within and positive about (Dorman, Fraser, & McRobbie, 1994; Newby & Fisher, 1997b; Spencer, 2005; Waldrip & Fisher, 2003; Yarrow, Millwater, & Fraser, 1997). While it is possible to employ external researchers to observe and report on these learning environments, these studies are expensive to conduct and their findings are not unproblematic (De Jong & Westerhof, 2001). Learning environment instruments appear to offer an efficient, affordable and reliable tool to investigate the learning environment created.

The essence of a learning environment is the interaction that occurs between individuals, groups and the setting within which they operate. The investigation in, and of, learning environments has its roots nourished by the Lewinian formula, B=*f*(P,E). This formula identifies that behavior (B) is considered to be a function of (*f*) the person (P) and the environment (E). It recognizes that 'both the environment and its interaction with personal characteristics of the individual are ‘potent

determinants of human behavior' (Fraser, 1998b, p 529). Since the classroom is a place where teachers and students congregate for long periods of time to participate in the activity of learning, the classroom environment created, also referred to as climate, atmosphere, tone, ethos or ambience, during this activity is regarded as an important component in the learning process (Fraser & Wubbels, 1995). But how and in what ways can the learning environment affect student and teacher performance? How can these effects be measured?

The first school environment instruments were developed as early as 1958, however, these early environmental instruments were somewhat limited as they were awkward to use and they were not based on a clear, coherent theory (Fisher & Fraser, 1990). Over thirty years ago two researchers, Herbert Walberg and Rudolf Moos, began independent studies on educational environments. Walberg developed the *Learning Environment Inv*entory (LEI) while Moos developed social climate scales, one of which was the *Classroom Environment Scale* (CES) (Fraser & Wubbels, 1995). In essence, these instruments investigated three dimensions. Firstly, the relationships created and applied within the environment, secondly, the personal development and growth the environment either encouraged or discouraged and finally, the systems used to monitor or control the environment (Moos, 1979). Subsequent research of educational environments can be seen to have been built upon ideas first developed by Kurt Lewin and Henry Murray and their followers C. Robert Pace and George Stern (Fraser, 1998b; Fraser & Wubbels, 1995). The association between the learning environment variables and student outcomes has provided a rationale and focus for the application and development of learning environment instruments (Dorman, et al, 1994; Newby & Fisher, 1997b). The two instruments first developed by Walberg and Moos have spawned many new lines of research and the creation and application of many new learning environment instruments spanning many countries (Fraser, 1998a; Fraser & Wubbels, 1995; Koul & Fisher, 2005; Wahyudi & Treagust, 2004). The field of learning environment research and the development and application of economical perceptual measures is one of robustness and growth (Fisher & Fraser, 1990; Fraser, 1991, 2001; Goh & Khine, 2002; Tobin & Fraser, 1998).

1.4.2 Constructivist Views of Learning

Over the last four decades the views held by constructivists have significantly influenced the way education is conceptualised and delivered (Posner, Strike, Hewson, & Gertzog, 1982). The separation between knowing and doing, described by the folk categories of 'know what' and 'know how' (Brown, Collins, & Duguid, 1989, p32) can no longer be sustained, A foundational premise of constructivism is the concept that knowledge is actively constructed by the learner, not passively received from the environment they learn within (Driver, 1989; Gilbert, 1993). To put it simply it appears impossible to transfer ideas, facts, processes and concepts wholesale into students' heads and expect these to remain intact or unaltered (Treagust, Duit, & Fraser, 1996a). In short, the broadcasting of material to students does not necessarily mean learning is occurring. This concept of tutor as broadcaster is illustrated in Figure 1.1.

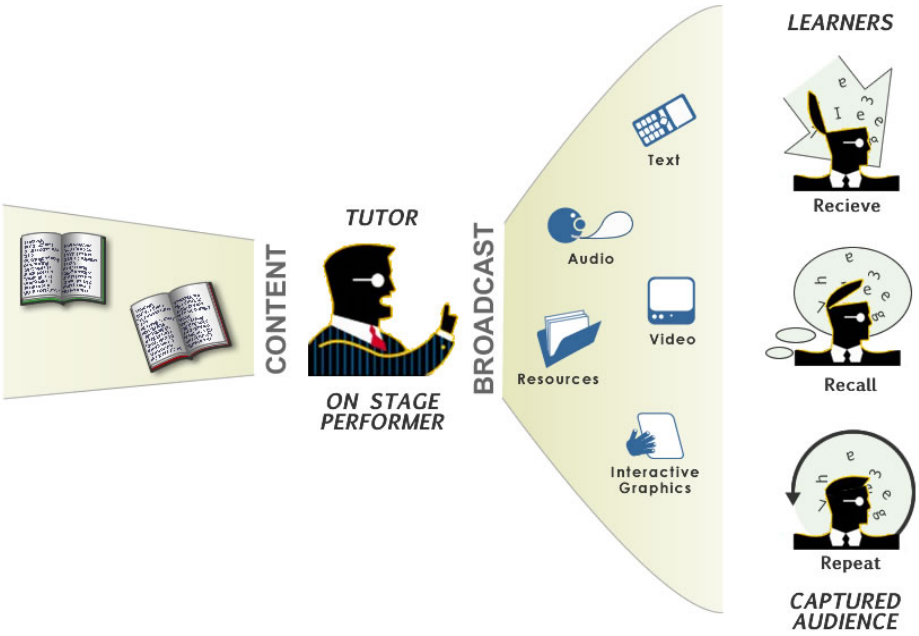


Figure 1.1. Tutor broadcast

Constructivists acknowledge learners hold views of the world and meanings for words that are intelligible, (coherent and internally consistent) plausible, (reconciled with the views currently held) and fruitful, (useful to the learner in making sense) (Osborne & Freyberg, 1985; Treagust, Duit, & Fraser, 1996b). These views held by the learner are resilient and resistant to change (Bell, 1993). For conceptual change to occur the learner must be able to identify and recognize their existing ideas and

beliefs, evaluate these beliefs and ideas in light of the context of study, and decide, where necessary, to reconstruct these ideas or beliefs taking into account the learning that has occurred (Gunstone, 1994). In short, the tutor is not the font of all knowledge, they actively encourage student engagement with content, they facilitate learning. This concept of tutor as facilitator is illustrated in Figure 1.2.

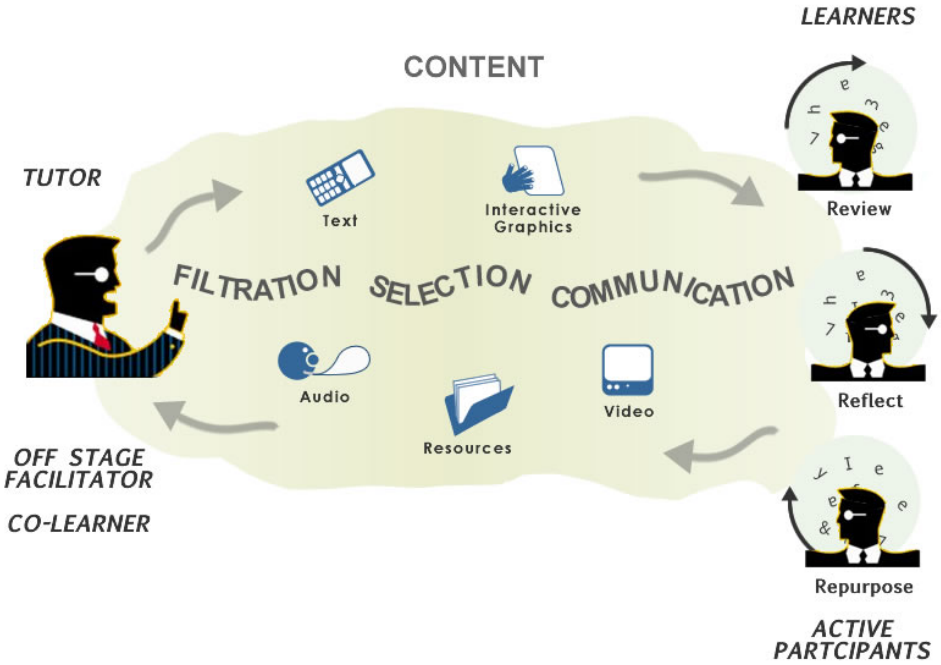


Figure 1.2. Tutor facilitators

Acceptance of these ideas have significantly influenced teaching and learning in a number of disciplines. Strategies, techniques and approaches have been rethought, focusing on conceptual change, the development of understanding, rather than the piecemeal accretion of facts and formulas, the recall of knowledge (Fensham, 1998; Tobin & Fraser, 1987; Treagust, et al, 1996b). From a constructivist perspective, learning takes place as students actively engage with ideas presented to them. Their 'robust' conceptual framework mediates this engagement. This means learning is concerned with ideas, their structure and the evidence for them. It is not simply the acquisition of correct responses, a repertoire of set behaviors (Duit & Confrey, 1996; Duschl, 1998; Scott, Asoko, & Driver, 1991). This fundamental shift, from broadcasting information to participant engagement, means there is a need to foster learning environments supportive of conceptual change. It is important that teachers

and students are aware of how their teaching and learning roles have changed. It is also important that the effect of these changes on students learning is measured.

In the field of learning environment research the *Constructivist Learning Environment Survey* (CLES) has been developed to enable researchers to monitor the development of constructivist learning environments (Taylor, Fraser, & Fisher, 1997). The survey is based on five scales: personal relevance, uncertainty, critical voice, shared control, and student negotiation. Through small-scale qualitative studies and large-scale quantitative studies, it has been established the scales used have a satisfactory internal consistency and factorial validity. It has been suggested the CLES could be used to enrich researchers' understandings of the impact on students of innovations and alert them to issues and concerns that may be encountered (Taylor, et al, 1997). This instrument has been modified to investigate the underlying shift from teacher-centered instruction to learner-centered construction of knowledge in Science CLES for Science and Mathematics CLES for Mathematics (Harwell, Gunter, Montgomery, Shelton, & West, 2001). These instruments are complemented by the *Constructivist On-line Learning Environment Survey* (COLLES) (Taylor & Maor, 2000) and the *Constructivist Virtual Learning Environment Survey* (CVLES) (Maor, 2000).

1.4.3 Internet Facilitated Research

The first attempts at collecting data using networked computers began with relatively clumsy asynchronous email surveys in the mid nineteen eighties (Andrews, Nonnecke, & Preece, 2003). The establishment of client-server interactions facilitated through the development of web forms and the development of database technologies led, in the last decade of the twentieth century, to the increasing deployment of dynamic Internet-based surveys (Musch & Reips, 2000; Reips, 2002b). As connected computing technologies have matured and webpage authoring applications for the creation of interactive web forms have been deployed, the use of Internet-based surveying has increased and is now widely used in social science research and educational institutions (Buchanan, Johnson, & Goldberg, 2005b; Kraut, et al, 2004; Reips & Neuhaus, 2002; Shannon, Johnson, Searcy, & Lott, 2002; Upcraft & Wortman, 2000; Yun & Craig, 2000). Research into the benefits and limitations of using web-based forms, while still in its infancy, has been robust. It is

perceived the costs, in terms of both time and money, for publishing a survey on the web are low compared with costs associated with conventional surveying methods. For example, the costs of paper, ink, printing and postage are eliminated and, as a result, research can be perceived to be less expensive (Baron & Siepmann, 2000; Chatman, 2002; Gunn, 2002; Wright, 2005). It has also been argued the Web offers significant advantages over more traditional survey techniques in the collection, storage and collation of data. For example, the use of connected computing technologies offers researchers a simpler, more streamlined method for the collection and protection of data (Buchanan, et al, 2005a; Mertler, 2003). With effective software, the tedious data entry stage is eliminated and there is a greater assurance data acquired is free from common entry errors (Andrews, et al, 2003; Schmidt, 1997; Solomon, 2001). Since there is no separate data entry phase, tabled results can be available for analysis soon after the data collection phase, speeding up the research process (de Leeuw & Nicholls II, 1996; DePaolo & Sherwood, 2006).

However, the use of web-forms, as with any method of collecting data, does have limitations. These limitations have been compounded by the fact the rapid increase in use and deployment of Internet-based surveys has been led to some extent by computer programmers, providing technical solutions, rather than by survey methodologists and many of the solutions are technical and lack, it could be argued, a theoretical foundation (Dillman & Bowker, 2001; Shannon, et al, 2002). Allied to this is the lack of researcher knowledge on the technical literacy of potential respondents. For example, how do researchers know if the respondents have the necessary technical competencies to access the form at the appropriate location, understand the functionalities of web-browsers and use the required input devices to complete all questions (Clayton, 2003; Reips, 2002a; Schwarz & Reips, 2001). There are also issues based on the identification of the sample (Dillman & Bowker, 2001; Wright, 2005) and the volunteer, non-random nature of the respondent group (Mertler, 2003).

Despite limitations and potential barriers created by technological literacy levels of potential participants, the benefits of using Internet-forms such as reduction in operational costs, the potential wider range of participants, the speed of data collection and subsequent analysis described above, has made the development,

deployment and implementation of web surveys very popular and the use of these instruments is growing rapidly.

1.5 Research Purpose

1.5.1 Background

A close examination of the term 'online learning' could lead to a simple definition, such as, 'the use by students of connected (online) computers to participate in educational activities (learning)'. While this definition is technically correct, it fails to explain the full range and use of connected computers in the classroom. To Radford (1997) the term 'online learning' was used to denote material accessible via a computer using networks or telecommunications rather than material accessed on paper or other non-networked medium. Chang and Fisher (1999) regarded a web-based learning environment as consisting of digitally formatted content resources and communication devices to allow interaction. Zhu, McKnight and Edwards (2007) describe online instruction as any formal educational process in which the instruction occurs when the learner and the instructor are not in the same place and Internet technology is used to provide a communication link among the instructor and students. To Siragusa (2005) online learning is when students are using the Internet to interact with content, other students and their tutors.

This range of definitions and interpretations of online learning is a reflection of the variety of ways educationalists, at all levels, use connected computers in learning. For example, in one situation a group of 14-year-old students, following a pre-prepared unit in a supervised computer laboratory, may use the information storage capacity of the World Wide Web to gather additional resources to prepare a presentation on the Antarctica. A second group of 12-year-olds, studying the same topic in a classroom with a dedicated computer work station situated by the teacher's desk, could use the communicative functions of the Internet to establish mail lists with Antarctic staff to follow studies being undertaken on weather patterns. A third group of 10-year-olds, consisting of small pockets of learners in isolated locations using home-based connected workstations, may use an educational courseware package or a learning management system, incorporating information storage and communicative functions, to participate in a complete distance unit studying animal life in the Antarctic. Each of the groups, and the individuals within those groups,

undertaking the tasks described have used the functions of connected computers in slightly different ways to achieve different learning objectives. The technical competencies required, the learning support needed and the physical location of the students in each case is different and distinct.

It is possible a distinct and describable learning environment for each of the groups has been created. Therefore, the creation of a separate and distinct instrument to measure all the activities described would be a difficult if not impossible undertaking. However, in each of the scenarios described there is a range of assumptions. Firstly, the students' will have a functional knowledge of computer operations, (such as starting the computer and shutting the computer down) secondly, there is an assumption they are able to use software applications appropriately (such as opening the application and using some of the tools available) and there is an assumption they will be able to enhance their knowledge of the subject (such as being able to store information for modification or retrieval). These examples demonstrate how it may be possible to identify and describe common features of connected computer and web-based activities. Given this possibility, the natural extension would be to investigate and explore them. It is then conceivable that a common instrument to investigate aspects of the digital learning environment created could be developed. The identification of broad areas of investigation is the subject of further exploration and explanation in Chapter 2 (section 2.2).

1.5.2 Research Aims

The increased use of computers in education, the creation of virtual learning environments based on web services, and the increased investments by educational institutions (both fiscal, physical and human) in the development of networked environments are impacting on all aspects of education. There is a need to ensure these learning environments are beneficial to the institution’s learners and educationalists. The outline of learning environment research, constructivism, and the development and use of perceptual measures indicate a potential method of efficiently and economically investigating ever-expanding online learning environments. The main aims of this study are to:

1. review online learning environments created by networked computers and to identify core generic activities undertaken by learners and teachers, within these environments, for investigation;
2. develop, pilot and validate a web-based perceptual measure, the *Online Learning Environment Survey* (OLLES), based on the identified core activities, to aid the investigation of online learning environments; and
3. identify and validate appropriate procedures and processes in the development, delivery and collection of data using Internet-based learning environment instruments.

While it is hoped the perceptual measure will prove useful at all levels of education, the initial focus of the development will be on the post-secondary, tertiary, sector.

1.5.3 Significance of this Study

There are a number of aspects that contribute towards making the development of the OLLES significant.

1. Firstly, tertiary educational institutions, in the move to develop courses for online delivery, should be careful to ensure that the participants, both students and tutors, are comfortable in, satisfied with and benefit from the learning environment created. It is hoped the development and use of the OLLES will serve to illuminate those features that assist students and tutors in the online learning environment and also to highlight those features with the potential to create barriers to learning. The identification and description of these aspects could be used to provide guidance for future online learning environment developments.
2. Secondly, aspects of the research proposed, particularly the development and use of a new learning environment instrument, have the potential to illustrate how online learning environments, and the changes that might occur in these environments, can be economically monitored for effectiveness.
3. Thirdly, the identification of appropriate processes and procedures when using web based forms to gather data will contribute to pedagogical research in general.
4. Finally, the research proposed in this study is intended to be viewed as making a contribution to the larger research field of learning environment studies.

1.6. Summary and Overview of Thesis Structure

Research and evaluation on the assessment of academic achievement and other learning outcomes is well established and valued. However, this chapter has illustrated these measures alone cannot provide the complete picture of the important social and psychological aspects of the learning environment students and teachers experience and interact within. A learning environment could be considered to be an amalgam of roles, activities, goals, relationships, interactions, conditions, circumstances and influences that combine to provide the conditions for growth of the individual. In these times of educational change, often driven by the use of information and communication technologies, it would appear timely to explore the development and application of sound learning environment measures to investigate the perceptions of participants in the virtual climates created. This thesis will explore and investigate electronically-connected learning environments and how we can measure the perceptions of students and teachers operating within these environments.

The remainder of the thesis is structured into five separate, interwoven chapters. Chapter Two reviews the literature related to learning environment research, online learning and studies of technology rich learning environments. Chapter Three investigates the area of learning environment instrument development and lists the three identified stages in psychosocial instrument development. The remainder of the chapter describes how this research was conducted in two-phases based on the concepts of content and construct validity. Chapter four reports on the range of activities undertaken in phase one of the research project; content validity. This chapter describes firstly, the identification of the scales and items for the measure secondly, the development of dynamic web-pages and database to deliver the instrument and collect data thirdly, instrument modification after a peer review and limited pilot of the instrument. Chapter five describes the range of activities undertaken in phase two of the research project; construct validity. The chapter reports on the field testing of the OLLES and the statistical analysis undertaken to confirm the structure of a 35-item measure. Chapter six provides a detailed summary of the thesis. Reporting on the major findings of the study and making recommendations for further research.

Chapter 2: Review of the Literature

This chapter provides a review of the literature in three broad categories, psychosocial learning environments, flexible learning with networked computers and investigations of online learning environments using perceptual measures, related to this study. The chapter is divided into three major sections which are further divided into key topics. Section one, psychosocial learning environments, is divided into four sub-topics and explores the theoretical concepts used in the creation of perceptual measures over the last 35 years. This section also illuminates the flexibility and robustness of these measures. Section two, flexible learning with networked computers, is divided into four sub-topics and explores the ways educational institutions and tutors are utilizing information and communication technologies to communicate with students and provide learning activities. This section also identifies five key relationships and activities occurring in all digital environments. Section three, investigations of online environments using perceptual measures, is divided into two sub-topics and identifies eight studies into, and nine instruments used in, the investigations of connected-computer and web-based activities. The chapter concludes by asserting the growing influence of using connected computers and the web-based applications in education institutions, by tutors and by learners, justifies the development of a perceptual measure to explore the learning environment these new applications and tools help create.

2.1 Psychosocial Learning Environments

This section explores the theoretical concepts and developments used in the creation of perceptual measures over the last 35 years and will provide a conceptual overview of learning environmental research. The section is divided into four broad topics. Topic one, social climate dimensions and the influence of Rudolf Moos, identifies the three social climate dimensions, highlighted by Moos, upon which a great deal of learning environment research is based. Topic two, levels and types of analysis, describes levels at which learning environments can be investigated and the types of forms used. The concepts of alpha, beta, private and consensual press and forms such as personal, group, actual and preferred are briefly reviewed. Topic three, range and flexibility of learning environment measures, details the use of perceptual measures in a variety of situations in a variety of countries, from the investigation of the

interactions that occur in subject-specific classrooms and specialist laboratories, to the exploration of the impact of the introduction of technical innovation. Topic four, review, as well as providing an overview of the section, also notes the feasibility of developing a measure to explore computer-connected environments.

2.1.1 Social Climate Dimensions and the Influence of Rudolf Moos

As mentioned in the previous Chapter (see section 1.4.1), for nearly four decades learning environment researchers have found the perceptions of participants undertaking educational activities provide a comprehensive insight of the environment within which they work (Fraser, 2001, 2002). Researchers have used the insights obtained from the data collected to improve teaching and learning practices (Fraser, Giddings, & McRobbie, 1992; Newby & Fisher, 1997b). The ability to measure, gather and analyze data on activities occurring in educational environments can be seen to be a decisive component in the evaluation of teaching practice and for the prediction of educational performance (Anderson & Walberg, 1974; Dorman, 2002). But what are the pertinent psychosocial characteristics within the learning environment?

Moos' (1976) has convincingly argued there are three dimensions underpinning all socially created environments. Vastly different social environments, including educational, can be investigated using these social climate dimensions (Moos, 1991). The three dimensions Moos identifies are outlined below:

- *Relationship Dimension* – assesses "the extent to which people are involved in the setting, the extent to which they support and help each other, and the extent to which they express themselves freely and openly" (Moos, 1979, p. 14).
- *Personal Development Dimension* – assesses "the basic directions along which personal growth and self-enhancement tend to occur in the particular environment" (Moos, 1976, p. 331).
- *System Maintenance & System Change Dimension* – measures the "extent to which the environment is orderly and clear in its expectations, maintains control and responds to change" (Moos, 1979, p. 16).

These three broad categories of dimensions are based upon individual dimensions or scales. For example, the relationship dimensions include dimensions of involvement, cohesiveness, and support. The personal development dimensions include dimensions of independence, competition and autonomy. The system maintenance and system change dimensions include dimensions of order and organisation, clarity, control and innovation (Moos, 1976, pp. 330-331). These dimensions should not be regarded as isolated elements within the environment in which they interact. These dimensions crafted by Moos have been used extensively in the construction and development of a number of learning environment inventories and surveys (Fraser, 1998a, 1998b; Walker, 2002; Yarrow, et al, 1997) and will be used in the creation and development of the OLLES the focus of this study. The broad dimensions and interactions are illustrated in Figure 2.1.

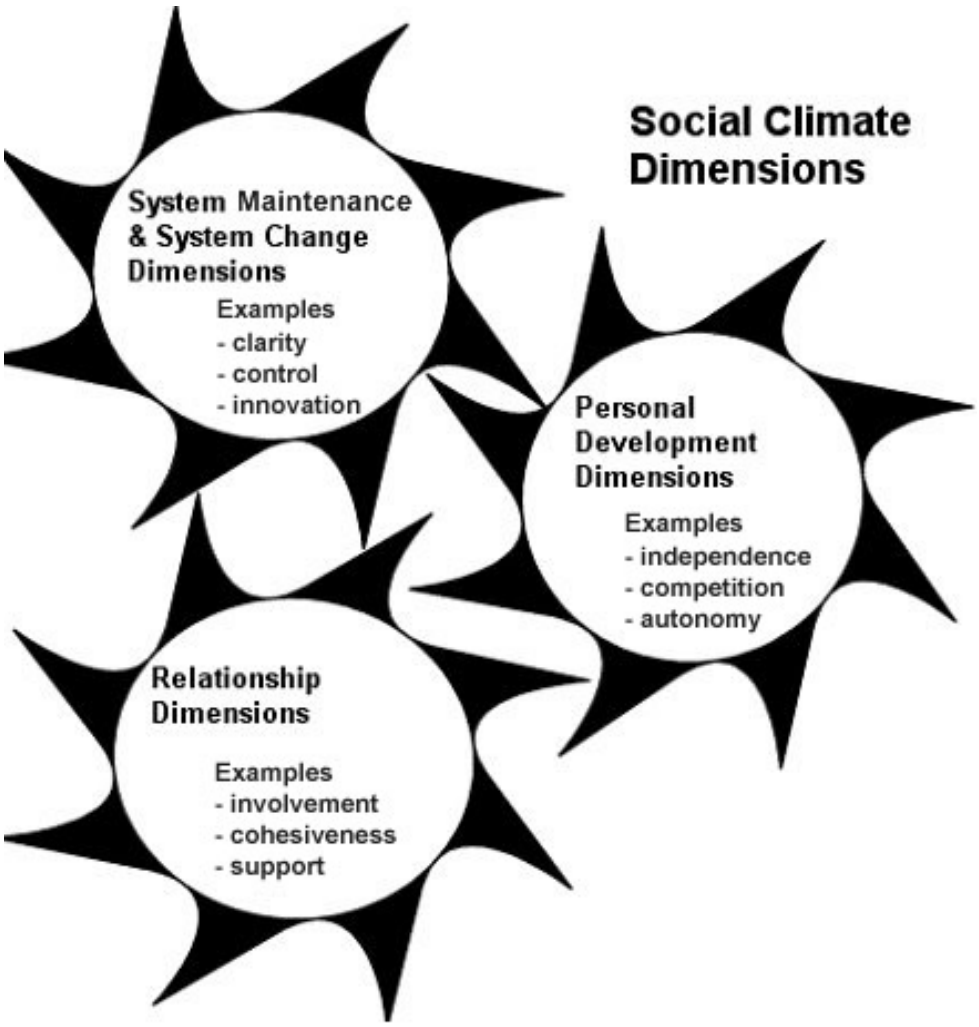


Figure 2.1. Moos' social climate dimensions.

2.1.2 Levels and Types of Analysis

As mentioned in Chapter 1 (refer to section 1.3.3), learning environments can be explored and investigated in multiple ways from multiple perspectives. For example, the perceptions of teachers, students or observers can each shed differing lights on the environment created (Fraser, 2001, 2002). The perceptions held by participants can be classified according to the role of the participant in relation to the environment investigated. For example, those perceptions held by external observers are classified as *alpha press*, while those perceptions held by the milieu of inhabitants are classified as *beta press* (Dorman, 2002; Fraser, 1998b). These views can be subdivided further when we distinguish between the idiosyncratic view held personally by an individual participating in the learning environment, *private beta press* and the views that are common or shared by the members of that environment, *consensual beta press* (Fraser, 1998a). Since there can be considerable differences between the views held on the learning environment by the individual, *private beta press*, the views shared by the group, *consensual beta press*, and those held by an external observer, *alpha press*, it is critical that researchers decide their unit of analysis before undertaking any study on the learning environment (Fraser, 1991).

The learning environment as perceived by an external observer, *alpha press*, is identified as low inference measures exploring the directly-observable, specific and explicit phenomena (Dorman, 2002; Neilsen & Kirk, 1974). These external observations have a number of limitations. For example, the size and characteristics of the sample available for study are limited (Neilsen & Kirk, 1974), they involve the expense of reimbursement for external observers (Fraser & Fisher, 1994), they are substantially less valid in predicting student outcomes (Anderson & Walberg, 1974) and although in principle external observations can be replicated for reliability, this is not usually done in practice as each researcher develops new observation schemes for his/her specific studies (Neilsen & Kirk, 1974). Inventories and surveys, *beta press instruments*, seeking the perceptions of the milieu of inhabitants are high inference measures, asking the respondent to make judgments about the meaning of what is going on around him/her or what she/he feels about the psychosocial environment he/she has worked within (Aldridge, Dorman, & Fraser, 2004; Dorman, 2002; Neilsen & Kirk, 1974). These beta press instruments can be further distinguished as '*private*' beta press (perceptions that individual students have of an

environment) assessed with personal forms, eliciting information from students about their role in the environment (Dorman, 2002; Fraser, Giddings, & McRobbie, 1993), or '*consensual'* beta press (a shared perception that members of a group have about an environment) assessed with group or class forms, eliciting an individuals' judgment of the environment as a whole (Fraser, 1998b; Walker, 2002). The data obtained by the various beta press instruments have been found firstly, to be useful in tapping into what is actually taking place in the psychosocial environment (Anderson & Walberg, 1974) secondly, to account for considerably more variance in student learning outcomes (Fraser & Fisher, 1994) and, finally, to enable reuse of validated instruments and surveys with large samples with confidence (Neilsen & Kirk, 1974), ensuring a consistency of data collection in investigations undertaken.

A distinct and notable feature of a number of perceptual measures is they not only have a form to measure students' or teachers' perceptions of their experienced or actual environment, but they also have a separate form that will investigate the students' and teachers' desired or preferred environment (Fraser, 1998b). The use of both forms has allowed the exploration of whether student achievement is higher in their actual or preferred learning environment. Studies that have been completed indicate that class achievement of certain outcomes could be enhanced by making changes to the 'actual' classroom environment to make it more congruent with that 'preferred' by the class (Fraser, 1998a). Although the scales and items on both the actual and preferred forms are identical, there are subtle differences between the two forms. Firstly, the instructions on completing the instrument are changed (Fraser, 1998a; Fraser, et al, 1992). Secondly, there is a difference in wording. Often this difference is the verb used in the item (Hong, 2001; Kim, Fisher, & Fraser, 1999; Newhouse, 2001a). For example, in the actual form the verb 'do' may be replaced by the verb 'like to', in the preferred form (Aldridge, et al, 2004). A practical example could be the item 'I work alone on projects', in the actual form being reworded to state 'I prefer to work alone on projects' in the preferred form. Sometimes these student actual and preferred forms have been complemented by data obtained from the administration of tutor versions of the same instrument, providing researchers with multiple sets of rich data from the same learning environment (Trinidad, Aldridge, & Fraser, 2005; Walker, 2003).

2.1.3 Range and Flexibility of Learning Environment Measures

Since the early awkward measures developed in the late 1950s (Fisher & Fraser, 1990) there has been considerable growth in the development of learning environment inventories and instruments, and the data collected from these perceptual measures addresses critical questions of interest and concern to educationalists (Fraser, 2002). These inventories and instruments are extremely versatile and they have been developed and applied in a variety of learning situations. Instruments can be used to, explore the association between student outcomes and the classroom environment, investigate the differences between students' and teachers' perceptions, or determine if students achieve better in environments that approximate their preferences (Fisher, Aldridge, Fraser, & Wood, 2001; Fraser, 2002; Fraser & Walberg, 1995). The feedback generated from analysis of the data can be used for guiding attempts to improve teaching. For example, Yarrow, Millwater and Fraser (1997) were able to use perceptual measures to support, mentor and advise pre-service teachers in improving their knowledge of the classroom environment and their practice. Harwell, Gunter, Montgomery, Shelton and West (2001) were able to use perceptual measures in aiding teachers to integrate technology into their classrooms. These inventories and instruments can be designed to gauge perceptions on specialist classroom environments. For example, the *Science Laboratory Environment Inven*tory (SLEI) has been developed to explore upper secondary and higher education laboratory environments (Fraser, et al, 1992), the *Computer Laboratory Environment Inventory* (CLEI) explores students' perceptions of the various aspects of the computer laboratory (Newby & Fisher, 1997b). Learning environment instruments have been designed to explore the variety of uses of computer technology in classrooms. For example, the *Computer Classroom Environment Inventory* (CCEI) was used to evaluate the effectiveness of the use of a computerized database in promoting inquiry skills (Maor & Fraser, 1993); the *Geography Classroom Environment Inventory* (GCEI) explored the impact of computer-assisted learning in geography in Singapore (Teh & Fraser, 1993, 1994), the *New Classroom Environment Instrument* (NCEI) investigated the impact of using portable computers in the classroom (Newhouse, 2001b). Instruments have also been developed to explore the introduction of new teaching strategies or to monitor pedagogical approaches. For example, the Constructivist Learning Environment

Survey was created to enable researchers and teachers to monitor the development of constructivist approaches in science and mathematics classrooms (Taylor, et al, 1997), the *Metacognitive Orientation Learning Environment Scale-Science* (MOLES-S) was developed to provide insights into factors influencing student metacognition in science classrooms (Thomas, 2003), the *Distance Education Learning Environment Survey* (DELES) has been designed to investigate the psychosocial learning environment in post-secondary distance education (Walker & Fraser, 2005) and the *Technology-Rich Outcomes-Focused Learning Environment Inventory* (TROFLEI) has been designed with a focus on technology and outcomes focused learning in secondary school classrooms (Aldridge, et al, 2004).

Learning environment instruments and inventories should not be regarded as limited to, or constrained by, the location in which they are developed (Fraser, 2001, 2002; Wubbels, 1993; Yarrow, et al, 1997), or the specific learning situation they are designed to investigate (Harwell, et al, 2001; Joiner, Malone, & Haimes, 2002). A number of instruments have been successfully used in several countries to investigate the classroom environment. For example, the Questionnaire on Teacher Interaction, first used in the Netherlands to investigate interpersonal relationships within the science classroom, has been successfully used in Australia (Fisher, Rickards, & Fraser, 1996). The *What Is Happening in this Class* (WIHIC) has been utilized in classrooms in both Taiwan and Australia with satisfactory results (Aldridge, Fraser, & Huang, 1999). The *Conception of the Nature of Sport Ability* (CNAAQ) instrument has been translated into Norwegian and used successfully in Norway (Ommundsen, 2001). The Constructivist Learning Environment Survey has been translated into Mandarin (Aldridge, Fraser, Taylor, & Chen, 2000) for use in science classrooms in Taiwan and also translated into Thai to improve the collaborative learning environment in a computer classroom in Thailand (Wanpen & Fisher, 2004). Specific instruments and inventories, developed and applied in specific situations, have been modified or adapted to investigate perceptions in a range of activities. For example, the SLEI has been modified to investigate perceptions of chemistry with the development of the *Chemistry Laboratory Environment Inven*tory (CLEI) (Wong & Fraser, 1993), the What Is Happening In this Class? questionnaire has been modified to investigate the nature of Chinese language classrooms with the development of the *Chinese Language Classroom Learning Environment Inventory*

(CLCLEI) (Lian, Wong, & Der-Thanq, 2006). The *College and University Classroom Environment Inventory* (CUCEI) has been used to investigate the reforms of calculus educators to provide deeper conceptual understanding (Joiner, et al, 2002), and the *Web-based Learning Environment Instrument* (WEBLEI) has been used in the development of a teacher-designed website for students studying junior science and physics at a Queensland Secondary School (Chandra & Fisher, 2005). Individual scales created for specific instruments have been combined to investigate different environments. For example, the associations between classroom psychosocial environment and academic efficacy were investigated using selected scales originally used in What Is Happening in this Class questionnaire and the Constructivist Learning Environment Survey (Dorman, 2001). The *Teacher's School Environment Survey* (TSES) has been created by adapting and using scales from several instruments (Huang, 2001). In some cases non-discipline-specific instruments and inventories have been modified or adapted to investigate perceptions in specialist activities. For example, the Constructivist Learning Environment Survey has been modified to investigate Science (CLES - Science) and Mathematics (CLES - Mathematics) (Harwell, et al, 2001).

While quantitative research, using learning environment instruments, provides the researcher with an overview of the learning environment created, it may not be able to provide the rich insights to the learning environment that qualitative research can produce. Beginning in the late 1990s there have been moves beyond the customary practice of choosing either qualitative or quantitative methods and, instead, combining qualitative and quantitative methods within the same study (Fraser & Tobin, 1998; Yarrow, et al, 1997). The combination of qualitative and quantitative allows the researcher to study the research site in more detail, providing multiple views of the environment being investigated. In describing the combination of methods (Tobin & Fraser, 1998) have used the metaphor of *bricolage*. To them a *bricoleur* selects from the available materials those that are satisfactory for completing a task. They suggest that researchers, by employing a variety of techniques, will be able to illuminate learning environments in new ways and obtain credible and authentic outcomes. Examples of using qualitative and quantitative methods are illustrated in studies by Loup, Ellet, Chauvin, Lofton, Evans and Hill (1993) who investigated how the combination of multiple learning environment

measures and trained, external observations could provide a more comprehensive picture of the learning environment. Fisher and Churach (1998) reviewed the use of the Internet in science classrooms using the Constructivist Learning Environment Survey classroom observations and personal interviews, Aldridge, Fraser, and Huang (1999) used observations and interviews to make more meaningful interpretations of data gathered using the Constructivist Learning Environment Survey, Newhouse (2001a) investigated a computer-supported learning environment using lesson observation, interviews and a perceptual measure, the New Classroom Environment Instrument, Hofstein, Nahum, and Shore, (2001) used Science Learning Environment Inventory and structured interviews with students and teachers, to enhance their findings and Koul and Fisher (2006) used the *Questionnaire on Teacher Interaction* (QTI) extensively to identify exemplary science teachers for further observation.

2.1.4 Review

The last four decades have encompassed ongoing growth in the development, application and validation of learning environment inventories, surveys and instruments. Researchers have delineated at least 10 areas of research using the types of measure described in the section above. They range from the effect on classroom environment of antecedent variables (such as subject, gender, year,) to using environment instruments to facilitate changes in classroom life and to monitoring the effectiveness and impact of educational innovations (Dorman, Aldridge, & Fraser, 2006). The data collected from these perceptual measures has been used to address critical issues of interest and concern to educationalists at all levels (Fraser, 2002). The description of the levels of analysis, the variety of learning environments explored, the range of educational activities investigated, the international uptake and the growing use psychosocial measures in large scale educational investigations, clearly demonstrate the flexibility and versatility of perceptual measures as a valued research tool. It is apparent a perceptual measure could be developed to investigate the digital environments created by the use of connected computers.

2.2 Flexible Learning with Networked Computers

This section explores the concepts, theories, research and applications used in the creation and maintenance of digital learning environments. The section is divided

into four broad topics. Topic one, overview of ICT use in educational settings, reviews the use of ICT in educational institutions and classifies educational usage into four levels-informational, supportive, blended and dependent. Topic two, online learning and teaching research, reviews the growing body of research undertaken in digital environments. It highlights how investigations undertaken in and about online environments has matured from the initial light-weight background studies to more in-depth and complex studies exploring theories, philosophies, pedagogy as well as emerging technical tools and applications. Topic three, identification of generic activities in digital environments, explores interactions occurring in online environments. The intention is to identify core activities occurring in online environments regardless of subject, setting, time or place, for example, learner-content, learner-tutors, learner-computer and learner-learner. Topic four, review, as well as providing an overview of this section, asserts the identification of core activities and relationships in digital environments, using a perceptual measure to investigate participant perceptions of this environment, would be possible.

2.2.1 Overview of ICT Use in Educational Settings

The following scenario involves the modern pre-tertiary school English / science / technology / arts classroom. The teacher outlines to the class a "project" they are about to undertake. The project is relatively straightforward. In small self-selected groups, students will choose an animal / invention / person, relevant to their current studies to research. They will gather background information on the topic and, by using appropriate software application, will be tasked to make a 10-minute presentation to their fellow students in one month's time. This presentation will be stored on the schools' network and, at a parents' reporting evening at the end of the school term, will be retrieved to demonstrate student progress in the subject. As well as using the more traditional print-based resources such as books, newspapers and magazines, learners will also use information contained on compact disks (CDs) and they will be allocated time to "surf the web" or "access the Internet". What is not obvious in this gathering of resources phase is the assumption that using connected computers will enable the students to have a greater variety of quality resources to use in their presentation. There is an expectation students, with some guidance, will be able use the connected computer and associated software applications to search for information on their topic. It is also an expectation students will be able to locate,

access, store, retrieve and manipulate a range of useful, free, valuable, electronic resources. This basic scenario of a class project focused on resource gathering can be seen to be occurring in classrooms, at all levels, across the world. Indeed networked computers, the "Web", the "dub.dub.dub", the "Internet" is becoming an integral, seamless tool in the teaching and learning process.

As noted in Chapter 1 (section 1.2.3), this integration is, in part, driven by technological advances in, and decreasing costs of, computer software and hardware, resulting in the increased use of, and confidence in, information and communication technologies (ICT) by teachers and learners. However, the levels of integration of the functionalities of the web and the Internet differ from one educational institution to another. For example, some institutions may establish informational websites providing potential students with information on courses offered, on staff roles, responsibilities, research interests and qualifications, physical and virtual resources available to students and maps illustrating the layout of the institution, past, present and upcoming events and a range of policy documents (Ells, 1998). Other institutions may supplement these institutional information resources with a range of student and tutor areas to make available links to external resources, course units, notes and handouts and tools to encourage interactivity (Bonk, et al, 1999). Still other institutions will deploy sophisticated learning management systems incorporating resource publication and presentation functionality, the ability to communicate asynchronously and synchronously, formal and informal assessment options and access to student administration tools such as electronic logs, results and grades (Benson & Palaskas, 2006). At the individual course level, four levels of web and Internet usage can be identified (Bonk, 2001; Bonk, et al, 1999; Ells, 1998; Zhu, et al, 2007)

1. *Informational*: Information, such as upcoming events, course syllabus, class notices, tutorial and lecture notes and links to required text and other resources are provided.

2. *Supportive*: Links to supplementary resources, the library, Internet sites are provided as well as opportunities to participate in competency-building courses in areas such as note taking, essay writing and examination preparation.

3. *Blended*: While the course may have a face-to-face component a number of major course components such as quizzes, chat, messaging and tutorials using threaded discussion are held solely on the web.

4. *Dependent*: All course activities such as enrolment, assignments, assessments, and simulations, entire course content and activities are on the web.

Educational institution levels of use and the resulting Internet-Learner relationships created are illustrated in Figure 2.2.

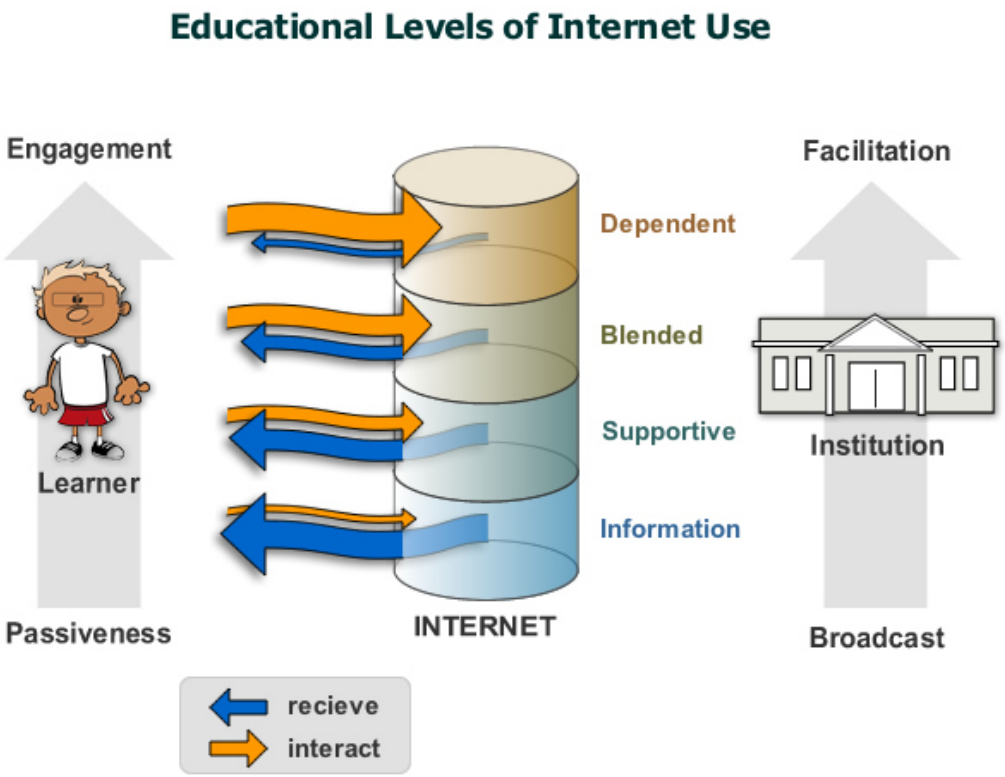


Figure 2.2. Educational levels of Internet use

While some educators are cautious of the perceived benefits derived from the ever-increasing use of the web and Internet by educational institutions and subject disciplines (Bork, 2001; Dalziell & Sim, 2006; Swenson, Rozema, Young, McGrail, & Whitin, 2006; Taylor & Maor, 2000), e-learning advocates are convinced the provision of access to numerous online resources allied with the use of a range of asynchronous and synchronous communication tools, provides a richer, more interactive learning environment enabling differences in student learning styles to be better accommodated (Bates, 2000; Haynes, 2002; Ladyshewsky, 2004b; Mann, 2000). In the move from the traditional face-to-face environment to the on-line

environment, new ways of teaching and learning are developed, implemented, examined and fostered. The new strategies adopted represent a significant change in the learning environment for both the teachers and learners, a paradigm shift (Chang & Fisher, 2001; Further Education Resources for Learning, 2007; Kent, O'Neil, & Page, 2006; National Science Board, 2006). In short, the relatively rapid embracement of information and communication technologies by educational institutions has altered teachers' approaches to the provision and sequencing of educational activities, has modified the way information is presented to learners and has changed the ways teachers communicate with students, students communicate with teachers and each other (Illinois Online Network, 2006; McGovern & Norton, 2001; Newhouse, 2001b; Suhonen & Sutinen, 2006).

2.2.2 Online Learning and Teaching Research

In the long history of educational activity, the use of connected computers in teaching and learning is a recent phenomenon. Therefore, it is not surprising initial investigations and explorations of computer-networked learning, the use of the World Wide Web and students' and teachers' perceptions of the learning environments created using these technologies, focused on providing a background to the area of study. Initial studies generally focused on individuals/tutor and/or student acceptance of electronic delivery of course materials (Benson & Vincent, 1997; Holzl & Khurana, 1999), the most appropriate computer technologies to use in teaching in these new online environments (Cottman, 1997; Ortiz, 1993), investigations of the cultural design of course sites to accommodate non-western beliefs (Clayton, 2001), the costs of developing and delivering technology-rich courses (Bartolic-Zlomislic & Bates, 1999; Harapnuik, Montgomerie, & Torgerson, 1998) or the apparent effectiveness of these environments in enhancing learning (Maor & Fraser, 1993; Teh & Fraser, 1993, 1994). These background studies were augmented by the publication of findings by individuals using new technological tools in their teaching practice, including, issues faced by students such as access to the technology, connection speed and reliability (Chin, 1999), the benefits flexibility offered as it overcame the loneliness and isolation of traditional distance teaching (Alderman & Milne, 1999), the impact of Internet usage on students' attitudes towards science and constructivist learning environments (Churach & Fisher, 1999) and the improved computer skills acquired while participating in online courses

(Clayton, 2000). While the above studies were informative and served to highlight the educational potential of using connected computers and the World Wide Web in teaching and learning, in many instances they failed to examine critically the pedagogical issues of these environments.

Since the start of the twenty-first century, research into online learning has increased significantly. Although background research studies are still undertaken (Naqvi & Ajiz, 2006; Simsek, 2005), a significant change in focus in online learning research has occurred. As educational institutions increasingly use content authoring tools and resource repositories to move from traditional paper-based resources to digital formats (Clayton & Gower, 2006; Connoley, 2006; de Salas & Ellis, 2006), educational institutions have recognised tutors' and learners' need to acquire core information and communication technological competencies to succeed in the current educational climate (Mitchell, et al, 2005; Perez & Murray, 2006; Robertson, Fluck, Webb, & Loechel, 2004). Correspondingly, the depth, breadth and complexity of research explorations in digital environments have expanded. For example, investigations in the use of learning management systems has progressed from simple explanations of how the tools were used (Smith & Hardaker, 2000) to how the functionalities of learning management systems can be extended and deployed as an institution wide repository and student resource centre for reusable objects such as course materials, digital videos, audio files, tutorial notes and even traditional lectures (Clayton & Gower, 2006; Kuiper, McMurtrie, & Ronald, 2005). How digital material is formatted and created has migrated from simple hyperlinked web pages (Lynch & Horton, 2002) to reviews on how tutors can use advanced computer algorithms to create interactive digital materials (such as linked glossaries, concept maps, embedded audio and video links), to the creation of multiple navigational structures to help students meet their individual learning style (Abel, 2006). Studies have also been undertaken to investigate how students, referencing their own personal experiences and resources, can collaborate in digital and distributed environments to improve their critical thinking skills and create new shared knowledge and understanding (Rae, Roberts, & Taylor, 2006). These also included student perceptions of the value of using social communication tools within a specific course (Stacey & Rice, 2002). Strategies designed to ease workloads by a reduction in the number of tutor generated responses to student discussion postings,

by using instructional techniques to engage students in peer feedback, have been undertaken (Ertme, et al, 2007) and ways of enhancing the student educational experience by monitoring students sense of community, generated by an analysis of discussion board postings, have been described (Dawson, 2006). Investigations of students' perceptions and acceptance of web-based learning (Felix, 2001) have been built upon and evaluations and investigations of specific courses using the electronic logs of student activity, (i.e. audit trail data), are being explored (Kennedy & Judd, 2004). These research studies have been complemented by studies on the comparison of academic achievement of students in face-to-face and online settings. On the one hand Ladyshewsky (2004a) noted, in an investigation of over 1,400 postgraduate business studies students' academic achievements, there was no significant difference between online and traditional participants, while on the other hand Suanpang, Petocz and Reid (2004) described how students, with basic technological competence and access to the Internet, have greater success in some aspects of their learning, including the award of final grades, than those students in a traditional classroom environment.

The evidence shows information and communication technologies are assuming an increasingly critical role in educational institutions. Individual tutors beliefs about, and perceptions of, the benefits of and/or barriers to introducing information and communication technologies into their teaching and learning is the best predictor of the successful integration of technology into learning environments. It is not surprising significant bodies of research have been created focused on the theoretical foundations of online learning, evaluation of the quality of online courses, the identification of appropriate teaching strategies, the identification of appropriate learning techniques and, most importantly, effective ways tutors and institutions can integrate the findings of this research within institutional processes and teaching practices. For example, research has been undertaken to ascertain the preparedness of teachers in diverse disciplines to integrate connected computer technologies and the functionalities of the Web into learning activities and programmes (Jamieson-Proctor, Burnett, Finger, & Watson, 2006; Liang, Walls, Hicks, Clayton, & Yang, 2006; Niess, 2006). Other studies have illustrated how the introduction and integration of ICT into institutional web portals, distance course offerings and traditional classrooms, has not only altered the learning experiences of tutors and

learners, but also has often highlighted through the process of integration the inadequacies of some institutional policies and procedures on workload, provision of professional development, technological infrastructure and support (Bain, 2004; Lefoe & Albury, 2006; Shannon & Doube, 2004; Wilson & Stacey, 2004). These studies have been complemented by explorations of the way institutions model the use of ICT in their own operations and how institutions structure and make available professional development opportunities to staff (Hall & Hudson, 2006; Mulholland, 2006; Shannon & Doube, 2004; Wilson & Stacey, 2004). A strong focus of research activity has been on those institutions offering accredited teaching certificates, diplomas and degrees and post-graduate courses as well as critically reviewing the use of ICT in the courses they deliver (Mulholland, 2006; Steketee, 2006). Investigations have also been undertaken in how to model best practice for pre-service teachers. For example, investigations on the design, production and application of multiple-use video clips, integrated across several disciplines, have been reported on (Hall & Hudson, 2006). Pre-service teachers have been exposed to virtual worlds, focused on specific topics, to demonstrate the benefits of using ICT for defined learning activities and sequences (Gibson, 2002). The extended use of discussion forums in the mathematics education, exploring participants' prior conceptions on mathematics, was seen as a valued tool in the creation of a community of learners (Chinnappan, 2003).

2.2.3 Identification of Generic Activities in Online Learning

Three connected computer or WWW based educational activities on the Antarctica were described in Chapter 1 (section 1.5). The first scenario (*scenario one*) 14-year-old students, following a pre-prepared unit in a supervised computer laboratory illustrated how the information storage and retrieval functions of the WWW could be used to expand available student resources. In this scenario, students could be directly supervised and assisted in their tasks by a teacher responsible for a dedicated computer suite established at the school. The second scenario (*scenario two*) 12-year-old students, following a pre-prepared unit using a dedicated computer work station situated by the teacher's desk demonstrated how the communication features of connected computers could be used to provide authentic examples to enrich student understanding. In this scenario students' could work independently of the teacher, who was, however, present to offer guidance and support. The third scenario

(*scenario three*) 10-year-olds, consisting of small pockets of learners in remote locations using home-based connected workstations described how web based educational management platforms could be used to provide educational opportunities for isolated pockets of students. In this scenario, students were completely independent and they relied on the information and communication technologies provided by their tutor for guidance and support. Each of the groups described used connected computers in different ways to achieve different objectives. The technical competencies required, the learning support needed and the physical location of the students in each case appears to be different and distinct.

Scenario one illustrated how the information storage and retrieval functions of the WWW could be used to expand available student resources. In this scenario, students could be directly supervised and assisted in their tasks by a teacher, physically present, responsible for a dedicated computer suite established at the school. *Scenario two* demonstrated how the communication features of connected computers could be used to provide authentic examples to enrich student understanding. In this scenario, students could work independently of the teacher, who was, however, present to offer guidance and support. *Scenario three* described how web-based educational management platforms could be used to provide educational opportunities for isolated pockets of students. In this scenario, students were completely independent and they relied on the information and communication technologies provided by their tutor for guidance and support. Initially, it appears to be impossible to investigate each scenario using a common instrument, there does not appear to be any 'commonality'. However, on closer examination, we find this is not the case. Relationships identified within the online learning environment, relationships that can be described and investigated, are explained in more detail in the following paragraph.

In each of the scenarios described there is an assumption students have acquired the appropriate functional knowledge of computer operations. For example, there is the assumption that students will be able to:

- know if the computer is turned on or turned off,
- use a keyboard and computer mouse,
- view information presented on a visual display unit, and

- select and/or use appropriate software applications.

A student - computer relationship, common to all scenarios, can be identified, described and investigated. This can be further expanded by focusing on our understanding of the process of learning and the relationships created in this process. In each of the scenarios identified, the learners are seen to be engaged in purposeful learning activities meeting specific objectives. The objectives of the activity, the selection of tasks and the ICT tools to be used are designed, structured and facilitated by a tutor. Therefore, a tutor - student relationship, once again common to all scenarios, can be identified, described and explored. Morihara (2001) broadens these two relationships and identifies student - student interaction, student - media interaction (i.e. the students interaction with content knowledge presented in a variety of formats, such as audio files, video as well as text) and the outcomes of learning in the environment created as generic features of online learning. Haynes (2002) agrees and outlines four features of online activity. These are,

1. student - interface relationships,
2. student - tutor relationships,
3. student - student relationships,
4. student - content relationships,

Although these four broad categories appear to identify all aspects of online learning they do not investigate how the learner, as an individual, approaches, contributes to, reacts to, and reflects upon his/her experiences in this digital environment. The importance of creating time for and encouraging self-reflection on the learning process is well documented by constructivists (Gilbert, 1993; Gunstone, 1994; Hewson, 1996; Posner, et al, 1982). It would appear to be crucial to investigate if, when and how this personal reflective activity takes place in online learning activities. If we include student reflection in the list of generic activities in online learning, we can now identify, describe and explore five broad categories of online learning. These five broad categories are outlined below;

1. <u>Student - Media Interaction</u>: How is the student is engaged with digitally stored information and how do they relate to the information presented?
2. <u>Student - Student Relationships</u>: How, why and when do students communicate with each other and what is the nature of this communication?

3. Student - Tutor Relationships: How, why and when do students communicate with their tutor and what is the nature of this communication?
4. Student - Interface Interaction: What are the features of the interface created that enhance / inhibit student learning and navigation?
5. Student Reflection Activities: How are students encouraged to reflect on their learning, are they satisfied with the environment and how do they relate to the environment created?

2.2.4 Review

Does the use of connected computer technology and information and communication software truly enrich the learning experiences of participants? Clearly, there is a need for critical evaluations online learning environments and the interactions that take place within them. One potential method of economically and efficiently evaluating online learning environments is to canvas the views of those participating in this environment by using robust and validated perceptual measures. In essence, the theoretical concepts, processes and procedures underpinning learning environment research activities for the last 35 years should be relevant to environments created by the integration of information and communication technologies.

2.3 Investigations of Online Environments Using Perceptual Measures.

Over the last decade of the twentieth century and the first decade of this century there has been a concentrated focus on developing instruments that measure the learning environments created by the use of computers, network technologies and software applications such as Internet browsers and computer simulations. This section identifies ten previous perceptual measures, used in nine specific studies, to investigate the environment created when using either computers, connected computers, the Internet or the World Wide Web. Each of the identified instruments is briefly described and a table is provided identifying the scales used in each of the ten instruments. The final topic of this section, review, as well as providing an overview of the section notes, the robustness and reliability of the measures explored indicate a valid measure could be developed for online learning environments.

2.3.1 Computer Laboratory Environment Inventory (CLEI) & Attitude toward Computers and Computer Courses (ACCC)

Newby and Fisher (1997b) developed two instruments to assess the learning environment created within a computer laboratory. The first, the Computer Laboratory Environment Inventory, was based upon some of the scales developed for the Science Laboratory Environment Inventory. These scales are outlined below in Table 2.1

Table 2.1 *Description of each scale in the CLEI*

Scale	**Description**
Student Cohesiveness	Extent to which students know, help, and are supportive of each other.
Open-Endedness	Extent to which laboratory activities encourage an open-ended divergent approach to the use of computers.
Integration	Extent to which laboratory activities are integrated with non-laboratory activities and theory classes.
Material Environment	Extent to which the laboratory is suitable and available for use.
Technology Adequacy	Extent to which the hardware and software is adequate for the tasks required.

The second instrument, the *Attitude toward Computers and Computer Courses* (ACCC) is based on four scales and these scales are outlined below in Table 2.2

Table 2.2 *Description of each scale in the ACCC*

Scale	**Description**
Lack of Anxiety	Extent to which the student feels comfortable using a computer.
Enjoyment	Extent to which the student enjoys using a computer.
Usefulness of Computers	Extent to which the student believes computers are useful.
Usefulness of Course	Extent to which student found the course useful.

Although Newby and Fisher believed further refinement and development of both instruments was required, it was concluded researchers could use either instrument with some confidence.

2.3.2 Constructivist On-line Learning Environment Survey (COLLES)

Taylor and Maor (2000) developed a Constructivist On-line Learning Environment Survey to measure students' and tutors' perceptions of online learning from a social constructivist perspective. This survey is based on six scales and these are outlined in Table 2.3

Table 2.3 *Description of each scale in the COLLES*

Scale	**Description**
Professional Relevance	Extent to which engagement in the on-line classroom environment is relevant to students' professional worldviews and related practices.
Reflective Thinking	Extent to which critical reflective thinking is occurring in association with online peer discussion.
Interactivity	Extent to which communicative interactivity is occurring online between students and between students and tutors
Cognitive Demand	Extent to which challenges and communicative role modeling is provided by tutors.
Affective Support	Extent to which sensitive and encouraging support is provided by tutors.
Interpretation of Meaning	Extent to which students and tutors co-construct meaning in a congruent and connected manner.

Taylor and Maor argued COLLES could be a useful tool in accessing the educational benefits of online learning in these early days of online distance education.

2.3.3 Geography Classroom Environment Inventory (GCEI)

Teh and Fraser (1994) in investigating computer-assisted learning (CAL) in Singapore schools, developed the Geography Classroom Environment Inventory. This inventory is based on four scales shown in Table 2.4

Table 2.4 *Description of each scale in the GCEI*

Scale	**Description**
Gender Equity	Extent to which boys and girls are treated equally by the teacher.
Investigation	Extent to which the skills and processes of inquiry are used in problem solving and investigation.
Innovation	Extent to which the teacher plans new and varying activities and techniques, and encourages students to think creatively.
Resource Adequacy	Extent to which the computer hardware and software are adequate.

Teh and Fraser concluded appropriate computer-based teaching could be effective with slow learners. They also suggested that other researchers would find this instrument useful in future studies of CAL classroom environments.

2.3.4 Web-Based Learning Environment Inventory (WEBLEI)

Chang and Fisher (2001) in exploring increased educational use of the Internet and the developments of web-based learning have developed a Web-Based Learning Environment Inventory. Chang and Fisher argued the instrument provides practitioners and researchers with an additional tool to reflect on and evaluate the use, acceptance and effectiveness of web-based learning environments. The inventory is based on four scales and the scales and selected associated items are outlined in Table 2.5

Table 2.5 *Example of items for each scale in WEBLEI*

Scale	**Example of Individual Items**
Emancipatory Activities	I can access the learning activities at times convenient to me.
	I decide when I want to learn.
Co-participatory activities	The flexibility allows me to meet my learning goals.
	The tutor responds promptly to my queries.
Qualia	I enjoy learning in this environment.
	I felt isolated towards the end of my course of study.
Information Structure and Design Activities	The scope of the lesson is clearly stated.
	The web-based learning approach can substitute traditional classroom approach.

2.3.5 New Classroom Environment Instrument (NCEI)

Newhouse (2001a) has developed the New Classroom Environment Instrument to measure students' perceptions of using portable computers in the classroom. (Newhouse, 2001a) concluded the instrument, when combined with lesson observations and interview data, provided an effective means of describing differences between teacher-class combinations and explaining the dynamics of the classroom. The instrument is based on eight scales and the scales are outlined in Table 2.6

Table 2.6 *Description of each scale in NCEI*

Scale	Description
Involvement	The extent to which students have attentive interest in class activities and participate in discussions. The extent to which students do additional work on their own and enjoy the class.
Affiliation	The level of friendship that students feel for each other, that is, the extent to which they help each other with homework, get to know each other easily, and enjoy working together.
Teacher Support	The amount of help, concern, and friendship which the teacher directs towards students. The extent to which the teacher talks openly with students, trusts them, and is interested in their ideas.
Group Work	The extent to which students are able to work collectively in class on tasks and activities assigned by the teacher.
Competition	The emphasis placed on students competing with each other for grades and recognition. An assessment of the difficulty of achieving good grades is included.
Order and Organisation	The emphasis on students behaving in an orderly and polite manner and on overall Organisation of assignments and classroom activities. The degree to which students tend to remain calm and quiet.
Teacher Control	How strict the teacher is in enforcing the rules, and the severity of the punishment for rule infractions. The number of rules and the ease of students getting into trouble.
Innovation	How much students contribute to planning classroom activities, and the amount of unusual and varying activities and assignments planned by the teacher. The extent to which the teacher attempts to use new techniques and encourages creative thinking in the students.

2.3.6 Technology-Rich, Outcomes-Focused Learning Environment Inventory (TROFLEI)

Two studies, have reviewed the eight original scales in the What Is Happening In this Class? questionnaire and, using the WIHIC scales, developed the Technology-Rich, Outcomes-Focused Learning Environment Inventory (Fisher, et al, 2001; Aldridge, et al, 2004). One study used a nine-scale instrument (TROFI) (Fisher et al, 2001) to investigate how information and communication technologies can be used effectively to maximise educational outcomes for individual students. While the second study

used the fully developed 10 scale instrument TROFLEI (Aldridge, et al, 2004). The refined instrument is based on ten scales and is outlined in Table 2.7

Table 2.7 *Description of each scale in TROFLEI*

Scale	**Description**
Student Cohesiveness	The extent to which students know, help and are supportive of one another.
Teacher Support	The extent to which the teacher helps, befriends trusts and is interested in the students.
Involvement	The extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class.
Task Orientation	The extent to which it is important to complete activities planned and to stay on the subject matter.
Investigation	The extent to which skills and processes of inquiry and their use in problem-solving and investigation are emphasised.
Cooperation	The extent to which students cooperate rather than compete with one another on learning tasks.
Equity	The extent to which students are treated equally by the teacher.
Differentiation	The extent to which teachers cater for students differently on the basis of ability, rates of learning and interests.
Computer Usage	The extent to which students use their computers as a tool to communicate with others and to access information.
Young Adult Ethos	The extent to which teachers give students responsibility and treat them as young adults.

The studies tentatively concluded (TROFEI) was found to be valid and reliable at the high-school level across a number of different subjects and learning areas (Fisher, et al, 2001) and the second study concluded TROFLEI was confirmed to be a valid measure of classroom environment although they recommended further validation work be conducted with the TROFLEI in other countries (Aldridge, et al, 2004).

2.3.7 Online Learning Environment Survey (OLES)

In online learning one study reviewed a range of learning environment surveys and inventories (including DELES, CLES, TROFLEI and WIHIC) and selected from them scales relevant to the e-learning environment to create a new survey, the *Online*

Learning Environment Survey (OLES) (Trinidad, et al, 2005). The survey is based on eight scales and these are outlined in Table 2.8

Table 2.8 *Description of each scale in OLES*

Scale	**Description**
Computer usage	The extent to which students use their computers as a tool to communicate with others and to access information.
Teacher Support	The extent to which the teacher helps, befriends, trusts and is interested in the students.
Student interaction and collaboration	The extent to which students have opportunities to interact with one another, exchange information and engage in collaboration.
Personal relevance	The extent to which there is a connection between students' out of school experiences and their classroom experiences.
Authentic learning	The extent to which students have the opportunity to solve real world problems that are authentic.
Student autonomy	The extent to which students have opportunities to initiate ideas and make their own learning decisions, and the locus of control is student oriented.
Equity	The extent to which students are treated equally by the teacher.
Asynchronicity	The extent to which the asynchronous nature of the discussion forum promotes reflective thinking and the posting of messages at times convenient to the students.

The authors of the study concluded the measure was sound and could be confidently used, especially when combined with qualitative research approaches, to explore ways educators can make improvements in e-learning environments.

2.3.8 Computer Classroom Environment Inventory (CCEI)

Maor and Fraser (1993) utilized the Computer Classroom Environment Inventory measure to evaluate the effectiveness of the use of a computerized database in promoting inquiry skills. Maor and Fraser concluded the inventory used had an acceptable internal consistency and successfully measured distinct, although somewhat overlapping, aspects of classroom environment. This instrument is based on five scales shown in Table 2.9

Table 2.9 *Description of each scale in the CCEI*

Scale	Description
Investigation	Extent to which the student is encouraged to engage in inquiry learning.
Open-Endedness	Extent to which computer activities emphasize an open-ended approach to inquiry.
Organisation	Extent to which classroom activities are planned and well organized.
Material Environment	Extent to which the computer hardware and software are adequate and user-friendly.
Satisfaction	Extent to which the student is interested in using the computer and in conducting investigations.

2.3.9 Distance Education Learning Environments Survey (DELES)

Walker (2003) has developed the Distance Education Learning Environments Survey to measure students' perceptions of learning in distributed environments and dispersed locations. The survey is based on six scales and these are outlined in Table 2.10

Table 2.10 *Description of each scale in DELES*

Scale	Description
Instructor Support	The extent to which the teacher is approachable and responds quickly with feedback.
Student Interaction & Collaboration	The extent to which students have opportunities to interact with one another, exchange information and engage in collaboration.
Personal Relevance	The extent to which there is a connection between students' out of school experiences and their classroom experiences.
Authentic Learning	The extent to which students have the opportunity to solve real world problems that are authentic.
Active Learning	The extent to which students have the opportunity to take an active role in their learning.
Student Autonomy	The extent to which students have opportunities to initiate ideas and make their own learning decisions and the locus of control is student-oriented.

A further scale of “Enjoyment of distance education” was used in the field test of the DELES instrument and a listing of selected items is shown in Table 2.11

Table 2.11 *Example of items used in “Enjoyment” scale in DELES*

Scale	Description
Enjoyment of distance education	• I prefer distance education. • Distance education is exciting. • I enjoy studying by distance.

Walker has concluded DELES was found to be valid and reliable in identifying students’ perceptions of distance learning and should influence how an institution will design distance education courses in the future.

2.3.10 Review

Over the last two decades, the impact of integration of ICT into teaching and learning has been demonstrated to be of significant interest to educationalists. Of critical importance is how, in what ways and to what extent, are these new and emerging technologies impacting upon the computer-connected relationships in online learning environments. Also of significant interest is how the specific, often limited, functionalities of ICT tools used by teachers and learners, such as content presentation, quiz, assignment, forums and chat, potentially constrain the learning environment created. The above review of eight learning environment studies in the area of technological impact and integration, the identification of the nine measures used in these studies and the description of the associated scales used to create these measures, clearly demonstrates the feasibility of developing perceptual measures capable of successfully analysing the range of learning environments created when using connected-computers and the World Wide Web in teaching and learning.

2.4 Summary

Perceptual measures have been successfully used in educational settings for nearly 40 years. The focus on obtaining data from those participating in the environment rather than relying on the views of external observers or academic outcomes has provided rich insights into how the environment is created and maintained. Relationships existing between individuals, individuals and tutors, encouraging or discouraging participation, are illuminated. The data generated from perceptual

measures have informed, challenged and, where necessary, changed existing teaching and learning practices. Early learning environment surveys and inventories exploring the broad picture of learning environment activities and relationships have been expanded. Instruments have been developed to investigate the environments of specialist disciplines, such as the computer laboratory, or technical innovations teachers introduce. Through ongoing research and refinement instruments developed have been proved to be flexible, reliable and cost-effective. The influence of constructivism and the growing use of computers in education are reflected in the number of surveys and inventories that have been developed and tested, exploring the influence they are having on learning environments.

Given the growing influence of using connected computers and the World Wide Web in education, it would appear timely to develop an instrument that explores the learning environment these new tools help create. It is expected any instrument developed to explore the environment created should firstly, be based solidly on past research in learning environment research, secondly, incorporate, and where necessary, expand upon previous studies undertaken in this area and finally, be aware of and incorporate constructivist views of learning on the need to create environments to promote conceptual change. The development of a perceptual measure incorporating these criteria, the identification of potential scales and items, and questionnaire delivery is the focus of the next chapter.

Chapter 3: Research Design and Methodological Framework

The previous description of learning environment research demonstrated the feasibility of developing economical perceptual measures capable of successfully analysing a range of learning environments from multiple perspectives. The advent of electronic databases, and the interconnectivity of dynamic Web-pages with these databases, would appear to make the collection, storage and manipulation of data generated by these perceptual measures, an attractive, and cost effective option. The following chapter outlines the research design and methodology used in the development of perceptual measures to investigate online learning environments. This chapter is divided into four sections and associated topics. Section one, psychosocial instrument development, investigates the process and procedures used in seven previous studies in instrument development. From these investigations three stages of development and the intuitive-rational theoretical approach, followed in the development of learning environment instruments, are identified and described. Section two, psychosocial-instrument creation, presentation and delivery is divided into five topics. This section reviews the identification and creation of salient scales and items and the benefits and barriers of using web-forms in the collection and storage of data. Section three, research design and methodology for the OLLES, details and describes the design and methodology used during this study. It describes how the research was conducted in two phases based on the concepts of content and construct validity. It also explores how ethical, sampling and limitation issues will be addressed. Section four, summary, anticipates the research were reliable if the project allows conclusions to be drawn about the reliability and validity of the scales and individual items used in the OLLES instrument

3.1 Background: Psychosocial Instrument Development

As mentioned in Chapter 2 (see section 2.1) psychosocial instruments have been developed and validated to explore participant perceptions in a range of educational settings or during the introduction of innovative initiatives. Although the nature of the social environment or initiative the psychosocial instruments investigate can vary markedly, instrument developers have taken great care to ensure the instruments are soundly developed and rigorously tested (Aldridge, et al, 2004; Dorman, 2002;

Fraser, 1991, 1998b, 2002). In particular, the field of learning environment research appears to follow a general methodology in the development and validation of instruments. This section will begin by reviewing eight previous psychosocial instrument development studies and identifying the steps undertaken in the process. The section will then identify the theoretical approach, the intuitive-rational approach upon which these studies have their basis. The section concludes by noting the approach identified will be the approach used in the development and validation of the OLLES measure.

3.1.1 University Residence Environment Scale (URES)

In the development of the *University Residence Environment Scale* (URES), Moos (1979) conceptualised the varied social environment settings could be characterised by three domains of social environment dimensions: relationship dimensions, personal growth or goal-orientated dimensions and system maintenance and change dimensions. To explore the environment, Moos developed three forms, an actual, preferred and expected form. To ensure the scales and items developed for these forms were relevant Moos followed a set procedure outlined below:

1. Meetings were arranged with students to find "likes and dislikes' within the environment.
2. Various social-environmental scales were explored and research materials were studied to find complementary scales and items.
3. Observations of teachers working within the environment were solicited.

These three steps guided the development of a preliminary questionnaire. To ensure the scales and items used investigated relevant aspects of the environment being explored, Moos completed two further steps.

4. The initial instrument created using steps 1-3 above was reviewed by students and staff involved.
5. The preliminary questionnaire was modified to accommodate these views and a final instrument was created.

3.1.2 Science Laboratory Environment Inventory (SLEI)

In the development of the Science Laboratory Environment Inventory, Fraser, Giddings and McRobbie (1993) were guided by five very similar criteria to those used by Moos. These criteria are described below:

1. A review of the literature was undertaken for the purpose of identifying dimensions considered important in the unique environment of the science laboratory class.
2. Guidance in identifying dimensions was obtained by examining scales in existing classroom environment instruments.
3. Sufficient dimensions were chosen to provide coverage of the three general categories of dimensions, (relationship, personal development and system maintenance and system change) identified by Moos.
4. Views, of numerous science teachers and students, were elicited on the draft versions of items of the SLEI to ensure dimensions and individual items were considered to be salient.
5. To achieve economy in terms of time needed for answering and scoring, the SLEI contained a relatively small number of reliable scales, each containing a fairly small number of items.

3.1.3 Geography Classroom Environment Inventory (GCEI)

Four criteria guided Teh and Fraser (1993) in the development of the Geography Classroom Environment Inventory. These criteria are summarised below:

1. *Consistency with literature on Computer-Assisted Learning.* (A review of the literature was undertaken to identify scales considered important in the unique environment of computer-assisted learning).
2. *Coverage of Moos' General Classification.* (Sufficient dimensions were chosen to provide coverage of the three general categories of dimensions identified by Moos).
3. *Salience to Classroom Environment of Researchers, Teachers and Students*. (Views of geography teachers and students were obtained on draft versions of sets of items of the GCEI to ensure dimensions and individual items were considered to be salient. Also views of educational researchers were sought on the adequacy, suitability and relevance of the items that made up the scales).

4. *Salience to Computer Education Experts*. (Computer education experts vetted the items and scales for relevance).

3.1.4 Catholic School Classroom Environment Questionnaire (CSCEQ)

In the development of an instrument to investigate the classroom environment in Catholic and government secondary schools, Dorman, Fraser and McRobbie (1994) were similarly guided by four criteria. These criteria are listed below:

1. *Consistency with literature.* (The instrument was to be consistent with literature on the purpose and mission of Australian Catholic schooling).
2. *Coverage of Moos' three general categories.* (Sufficient dimensions were chosen to provide coverage of the three general categories of dimensions identified by Moos).
3. *Salience to stakeholders*. (Views of principals, academic colleagues, practicing teachers and researchers with expertise in learning environment research were sought to ensure the instrument focused on the issues facing Australian Catholic Schooling).
4. *Economy*. (It was considered important that the instrument was economical in terms of time needed for administration and scoring).

3.1.5 Technology-Rich, Outcomes-Focused Learning Environment Inventory (TROFLEI)

Fisher, Aldridge, Fraser and Wood (2001) in the development of *Technology-Rich, Outcomes-Focused Learning Environment Inventory* (TROFLEI), followed a five-step process

1. Interviews with students, teachers and ICT industry personnel to ensure that dimensions were salient.
2. Ensuring consistency with Moos' scheme for classifying the dimensions of any human environment.
3. Adopting and adapting scales and items from widely-used general classroom environment questionnaires such as the What is Happening in this Class? questionnaire.
4. Field testing the instrument with students and interviewing them.

5. Conducting various statistical analyses with data from the sample of 386 student responses (e.g., factor analysis and item analysis) to refine the scales and furnish validity and reliability information.

3.1.6 Extended Practicum Learning Environment Inventory (EPLEI)

In the development of the *Extended Practicum Learning Environment Inventory* (EPLEI) Kennedy and Dorman (2002) followed six principles:

1. First, the instrument should reflect the literature relating to learning environment research. Accordingly, previously-developed instruments for assessing environments were examined.
2. Second, the instrument had to reflect literature relating to supervision in teacher education.
3. Third, the instrument's design should be consistent with general psychometric principles in that it should possess, ideally, several internally-consistent, mutually-exclusive scales.
4. Fourth, individual scales should reflect the different year levels of the school and classroom learning environments impacting on student teachers participating in practicum.
5. Fifth, the instrument should be relatively economical to administer, answer and score.
6. A final consideration was that the instrument should provide coverage of Moos' three general categories of human environments: relationship, systems maintenance and change, and personal growth.

3.1.7 Distance Education Learning Environments Survey (DELES)

In the development of the Distance Education Learning Environments Survey, Walker (2003) was guided by a three stage approach:

1. Stage 1 - *Identification and development of salient scales*. This stage included four activities a review of the literature to identify key aspects to investigate in distance learning environments, a review of previously-developed learning environment instruments for scales that could be modified, classify and develop new scales, and develop a set of scales for review by a panel of experts.

2. Stage 2 – *Writing individual items*. This stage included three activities, consideration of negatively-worded or reverse score items, the adaptation, modification and creation of scales and items, pilot testing and review.
3. Stage 3 - *Field testing and analysis*. This stage included two activities. Firstly, field testing of the instrument followed by statistical analysis.

3.1.8 The Three Stages of Instrument Development

The seven studies outlined above illustrate a consistency of approach to the development of learning environment instruments. Although there are occasionally minor differences in wording, sequencing and sentence structure, the development of the instruments follows a familiar pattern. The pattern established by these studies involves three core stages:

1. Stage 1; Identification of salient dimensions and items related to the field of study. This phase involves firstly, a review of literature of both the area to be studied and of previous learning environment research in this area. Secondly, salient scales and items identified are reviewed by participants of the environment to be investigated (teachers and learners) and by educational researchers to ensure the scales are adequate, suitable and relevant.
2. Stage 2; Coverage of social climate dimensions identified by Moos. This phase ensures sufficient dimensions and items are selected to provide coverage of Moos' three general categories of human environments (Personal Growth, Relationships, and Systems, Maintenance and Change).
3. Stage 3: Field testing and analysis. This phase involves firstly, the piloting of the questionnaire with a sample of the target population, ensuring the instrument is economical in terms of time needed for participant completion and researcher administration and scoring. Secondly, the data is reviewed and statistically analysed studying the internal consistency and discriminant validity of each scale.

3.1.9 The Intuitive -Rational Approach

The above description of the three phases of instrument development is based to a large extent upon what is regarded by instrument developers as an intuitive-rational approach (Aldridge, et al, 2004; Kennedy & Dorman, 2002; Walker, 2003). In

essence, the intuitive-rational approach involves developers in the identification of salient dimensions, the writing of items, and field testing. To reduce the bias of researcher-generated scales and items, the validation of the scales rests heavily on the subjective opinions of the researcher and other experts in the field (Dorman & d'Arbon, 2001). This intuitive-rational approach can be, and often in learning environment research is, complemented by statistical analysis and factor analytic approaches (Aldridge, et al, 2004; Dorman & d'Arbon, 2001). To ensure internal consistency of instruments (i.e. how well the items in the scale measure the construct identified), the statistical procedure Cronbach Alpha coefficient is generally used (Chang & Fisher, 2001; Clayton, 2004; Newhouse, 2001a). To ascertain discriminant validity (i.e. how well the individual scales measure the construct they are designed to measure and how the scales in the instrument diverge from each other and measure separate constructs), the statistical process of using the mean correlation of a scale with the remaining scales as a convenient index is generally used (Clayton, 2004; Trinidad, et al, 2005; Walker & Fraser, 2005). Principal Component Analysis (PCA) procedures are used to firstly, potentially reduce the number of variables in the scale and secondly, to detect structure in the relationships between variables (StatSoft, 2003). Recent learning environment studies have used the procedures of PCA with varimax rotation (Fisher, et al, 2001; Walker, 2003). Although applying these mathematical functions is potentially challenging to many researchers, the procedures described can be performed with desktop computers using statistical computer packages now widely available (Aldridge, et al, 2004).

3.1.10 Review

This section has reviewed seven previous studies focused on the development and validation of psychosocial measures. From these studies a three-stage approach to the development of instruments was identified; identification of salient dimensions and items related to the field of study, adequate coverage of Moos' social climate dimensions, and field testing and analysis. Theoretically, this staged process can be classified as an intuitive-rational approach complemented by statistical analysis and factor analytic approaches. This is the approach that will be followed in the development of the OLLES instrument.

3.2 Psychosocial Instrument, Creation, Presentation and Delivery

As mentioned above, set patterns can be identified in the creation and validation of psychosocial instruments. Similar set patterns can be observed in the creation, presentation and delivery of these instruments. The purpose of this section is to describe previously established patterns and explore emerging techniques. This section is divided into five topics. Topic one, identification of salient scales and instrument structure**,** reviews the processes used in the identification of scales, the structuring of scales and items, the writing of individual items and the classification of forms developed. Topic two, presentation of instruments, will compare and contrast Internet and pencil and paper methods of delivery. Topic three, database procedures, will review the structure of databases created in Internet facilitated research. Topic four, technical issues, will discuss issues generated by the creation of web forms and the collection of data from the Internet. Topic five, review, concludes Internet-facilitated research is indeed an economically viable option to collect data.

3.2.1 Identification of Salient Scales and Instrument Structure

In the identification of salient scales and individual items to be used in the construction of measures, a number of strategies and techniques have been used. In the creation of new scales, and items it is of critical importance the key elements of the environment to be investigated are identified (Walker, 2003). To identify these aspects, researchers can firstly, complete an extensive literature review of the field and be guided by previously developed scales and items considered to be relevant (Fisher, et al, 2001; Newby & Fisher, 1997b; Trinidad, et al, 2005) (refer also to Chapter 2, section 2.2) and secondly, compliment this literature review by extensively interviewing subject specialists (Fisher & Fraser, 1990) or including them on a peer review panel of the potential instrument (Walker & Fraser, 2005). Researchers following these two steps will ensure dimensions and individual items, regarded by subject specialists as salient, are covered.

In writing individual items, there has been an historical practice of the inclusion of a comparable number of positively-and negatively-worded items within an instrument to guard against passive responses (Taylor, et al, 1997). It appears from studies conducted that the removal of negatively-worded items has not affected the reliability of the instruments tested (Fisher, et al, 2001; Walker, 2003). In fact, it has

been suggested, positively-worded items actually improve response accuracy and internal consistency (Aldridge, et al, 2004; Dorman, et al, 2006).

When salient scales have been developed, items identified and written in the preferred manner, the developer must choose the level of analysis. In general, these can be either personal forms, private beta press instruments investigating the students' personal perceptions of the learning environment, or class forms, consensual beta press instruments investigating the students' perception of the learning environment as a whole (Fraser, 1998a; Fraser, et al, 1993).

In the structuring of identified scales and associated items within learning environment measures, two distinct methods can be followed. The first, the more traditional method, is to cycle the items of a particular scale at identified intervals throughout the measure. In essence, a 'block' is created containing an individual item from each of the identified scales within the measure. The pattern of item distribution established in the inaugural block is then repeated throughout the measure. This is illustrated in the *My Class Inventory* (Fraser, 1998a). In this measure, items for the scale 'Satisfaction' were presented in five separate blocks with an interval of 5; they were presented at numbers 1, 6, 11, 16, and 21. Correspondingly, items for the scale 'Cohesiveness' were also presented in five separate blocks with an interval of 5; they were presented at numbers 5, 10, 15, 20 and 25. The underlying rationale for this method of presentation is the assumption the randomness of the items would reduce bias (Taylor, et al, 1997). An alternative presentation format, first used in the development of Constructivist Learning Environment Survey, is to present all items for individual scales sequentially. This means the 'block' created is based solely on items examining a specific aspect of the environment, a scale. The underlying rationale for this method of presentation is to reduce confusion and provide learners with contextual cues (Fisher, et al, 2001). The initial findings indicated the presentation of items in a block manner did not affect participants (Taylor, et al, 1997) and this method has been followed in recent learning environment instrument developments (Clayton, 2004; Dorman, et al, 2006; Fisher, et al, 2001; Walker, 2003).

In the past it has been common practice to administer separate actual (what is actually happening in the environment) and preferred (what participants would prefer to be happening in the environment) versions of the surveys at different times, this is

expensive both in resources used and participant and researcher time and effort. To reduce these costs the developers of the Technology-Rich, Outcomes-Focused Learning Environment Inventory pioneered the inclusion of two adjacent response scales on the same sheet (Fisher, et al, 2001). This has been duplicated in the development of the digital version of the Constructivist Virtual Learning Environment Survey (Maor, 2000) and also, to some extent, in the development of the Online Learning Environment Survey (Trinidad, et al, 2005).

It was envisaged the OLLES developed in this study would have no negatively worded items, would be structured with items for each identified scale being delivered sequentially, and would simultaneously explore students' perceptions of their actual and preferred environment using a personal form.

3.2.2 Presentation of Instruments

Measuring the learning environment using quantitative perceptual instruments has a number of advantages over other forms of evaluation (Fraser & Fisher, 1994; Fraser & Walberg, 1995). These benefits are summarized below:

1. First, paper-and-pencil perceptual measures are more economical.
2. Second, they are not limited and are based on students' experience over many classes.
3. Third, perceptual measures involve pooled judgments rather than single observations
4. Fourth, students' perceptions, because they are important determinants of student behaviours, are valuable.
5. Fifth, perceptual measures account for considerably more variations in student learning

In the administration of the questionnaires it has been common to use 'pencil and paper' forms, with the administrator collating the responses and supervising data entry in an appropriate database (Fisher & Fraser, 1990; Fraser, et al, 1992; Fraser & Walberg, 1995). To aid the process of data entry, instruments are carefully designed. They ask students to select from a range of options, an appropriate response. For example, the Science Laboratory Environment Inventory begins by providing students with directions on how to complete the questionnaire. They are informed that the form is designed to gauge opinion and that there is no 'right' or 'wrong'

answers. Students are asked to think about a statement and 'draw a circle' around a numbered response. The range of responses is 1 - 5 and the meaning of each response is carefully explained, for example, 1 means that the practice takes place 'almost never' while 5 indicates the practice occurs 'very often' (Fraser & Fisher, 1994; Fraser & Tobin, 1998). Data are analyzed by obtaining a total score for a specific scale. This scoring is often completed manually. Advancements in connected-computer technologies and statistical software applications offer researchers a simpler, more streamlined method for the collection, storage and manipulation of data and have made it possible to dispose of, in appropriate studies, 'paper-and-pencil' instruments and manual data entry (Clayton, 2003). With effective software, the tedious data entry stage is eliminated and there is a greater assurance data acquired is free from common entry errors (Schmidt, 1997). Since there is no separate data entry phase, tabled results can be available for analysis soon after the data collection phase (de Leeuw & Nicholls II, 1996). The costs in terms of both time and money for publishing a survey on the web are low, compared with costs associated with conventional surveying methods. For example, costs of data entry, paper, ink and printing are eliminated, and as a result, research can be much less expensive (Baron & Siepmann, 2000; Benfield & Szlemko, 2006). The process of 'pencil and paper' instrument administration is illustrated in Figure 3.1.

Figure 3.1. Paper-based survey procedures

Although some researchers are cautious of using the Internet to gather data (Benfield & Szlemko, 2006), and others have found some instances where the results from Internet psychology experiments and tests appear to differ slightly from paper-and-pencil psychological tests (Buchanan, et al, 2005a; Buchanan, et al, 2005b), there

appears to be general agreement that there is no significant difference in the pattern of responses received from Internet surveys and traditionally-administered pencil and paper forms (Birnbaum, 2000) or postal conducted surveys (Andrews, et al, 2003). For example, (Carini, Hayek, Kuh, & Ouimet, 2001), in analysing data collected from first year and senior college students in both web-based and conventional methods, found that when discrepancies existed they tended to be very small. (Whelchel & Schechter, 2001), in using both traditional and Internet methods in surveying graduating students found, although there were slight differences in gender responses, there was no overall difference in Internet and paper responses. (Baron & Siepmann, 2000) found, in a study investigating the determinants of the desire to reduce risks, there was no significant difference in 31 items (from a survey containing 32 items) between 42 subjects completing a paper questionnaire and 49 subjects completing a web questionnaire. (Baron & Siepmann, 2000) concluded the very small effects observed for most items in their study should help allay concerns that data gathered via the Web may be very different than that collected from paper. The process of 'web-form' instrument administration is illustrated in Figure 3.2.

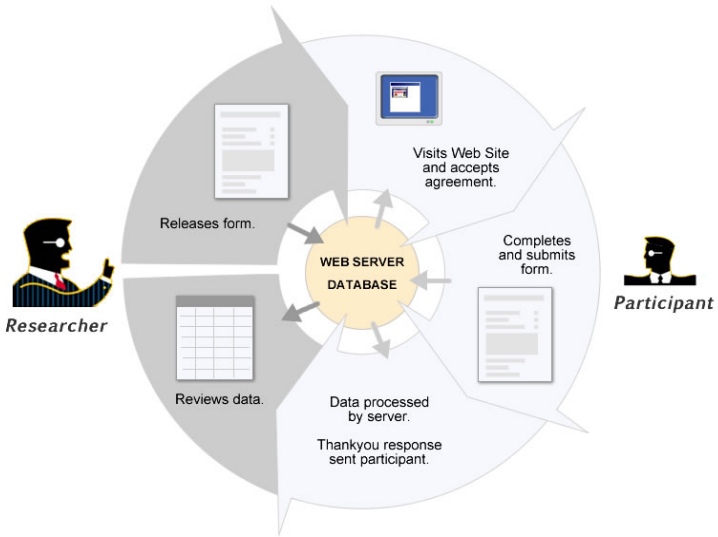


Figure 3.2. Web-based survey procedures

In recent learning environment research studies, pencil and paper administration of instruments is increasingly being replaced by electronic versions delivered through the Internet. For example, (Maor, 2000) developed the Constructivist Virtual Learning Environment Survey, which uses a digitally-submitted questionnaire as the method of gaining data. (Joiner, et al, 2002), in the collection of data during an investigation of the effects of calculus reform, used electronically-connected

database. (Walker, 2002), during the development of the Distance Education Learning Environments Survey, found a web-based version of the actual form, while taking longer to develop initially, was much faster to reduce and analyze. (Trinidad, et al, 2005) have argued that the use of web-based surveys in learning environment research will continue to grow.

It is apparent the advent of electronic databases, the interconnectivity of dynamic web-forms with these databases, makes the collection, storage and manipulation of data generated by server-based perceptual measures, an attractive and cost effective option.

3.2.3 Database Procedures

When using dynamic web-forms to generate data to be stored on a digital database, a clear set of procedures must be established to ensure data is gathered, stored, retrieved and manipulated in a consistently reliable and robust manner (Clayton, 2003; Solomon, 2001). Before outlining the procedures to be followed, it would be profitable, at this early stage, to distinguish between the terms 'data' and 'information'. Data can be regarded as a collection of raw electronic facts stored in isolation. In this raw state data has generally little meaning, for example, the response to an item is 5. On the other hand, information can be seen to be a collection of raw pieces of data that have been selected and manipulated to convey meaning; in short, it is useful (Whitten, Bently, & Barlow, 1994). An example could be the mean of 4 was generated from 25 responses to an item. If we accept these definitions are useful it becomes important, when creating an interactive database, to ensure data generated by the participants' completion of a web-based form is stored in a specific place within the database and that this data is secured and able to be easily manipulated to produce information in the form of reports useful to the researcher. It would appear a relational database, accessible only to the researcher, would meet the requirements outlined above. A relational database stores all its data inside tables. All operations, (searching, manipulating, analysing), on data are done on the tables themselves. The results of these operations are the creation of other tables, which can then be utilized to report on the data collected (Lozano, 1999). If a relationship database is created there is a need to identify the types of tables created

and how these tables are internally structured. To best illustrate the procedures to be used, a brief three-step scenario is outlined in Table 3.1

Table 3.1 *Establishing database procedures*

Participant Action	**Database Procedure**
Individual participant accesses a web-form →	A numerical identifier, a key, is randomly produced for each participant.
Participant views a scale based upon the three social climate dimensions identified by Moos. →	A separate table is created for each scale. This table is uniquely identified using alphabetic characters.
Participant completes individual items within the scale. →	Each item in the scale is uniquely identified using the alphabetic characters used in the table produced for each scale and a numeric character to identify each item.

From this brief scenario, we can now create the tables and identify the relationships used in the collection of electronic data. The database should have the generic heading of the instrument being developed. This database could then be divided into three overarching categories based upon the social climate dimensions identified by Moos. These three categories can be further divided into tables to represent individual scales. These tables will be structured upon individual items. To investigate effectively or query different tables within the database each table and item must be clearly identified and labeled. For example, a table based on the scale of Involvement is within the relationship dimensions outlined by Moos. The items that make up this scale can be identified numerically (1, 2, 3, … etc). The social climate dimension and scale can be identified alphabetically, I = Involvement, RD = Relationship Dimension. By using these alphabetical and numerical identifiers we can label each item within the table. For example, the third item within a table created to store data generated by the scale involvement, would be labeled RDI 3. The label is made up of a base identifier (RDI) and a numerical identifier for the particular item. This system of identification will be used in the development of databases in this study. A overview of the database structure and the created relationships is illustrated in Figure 3.3.

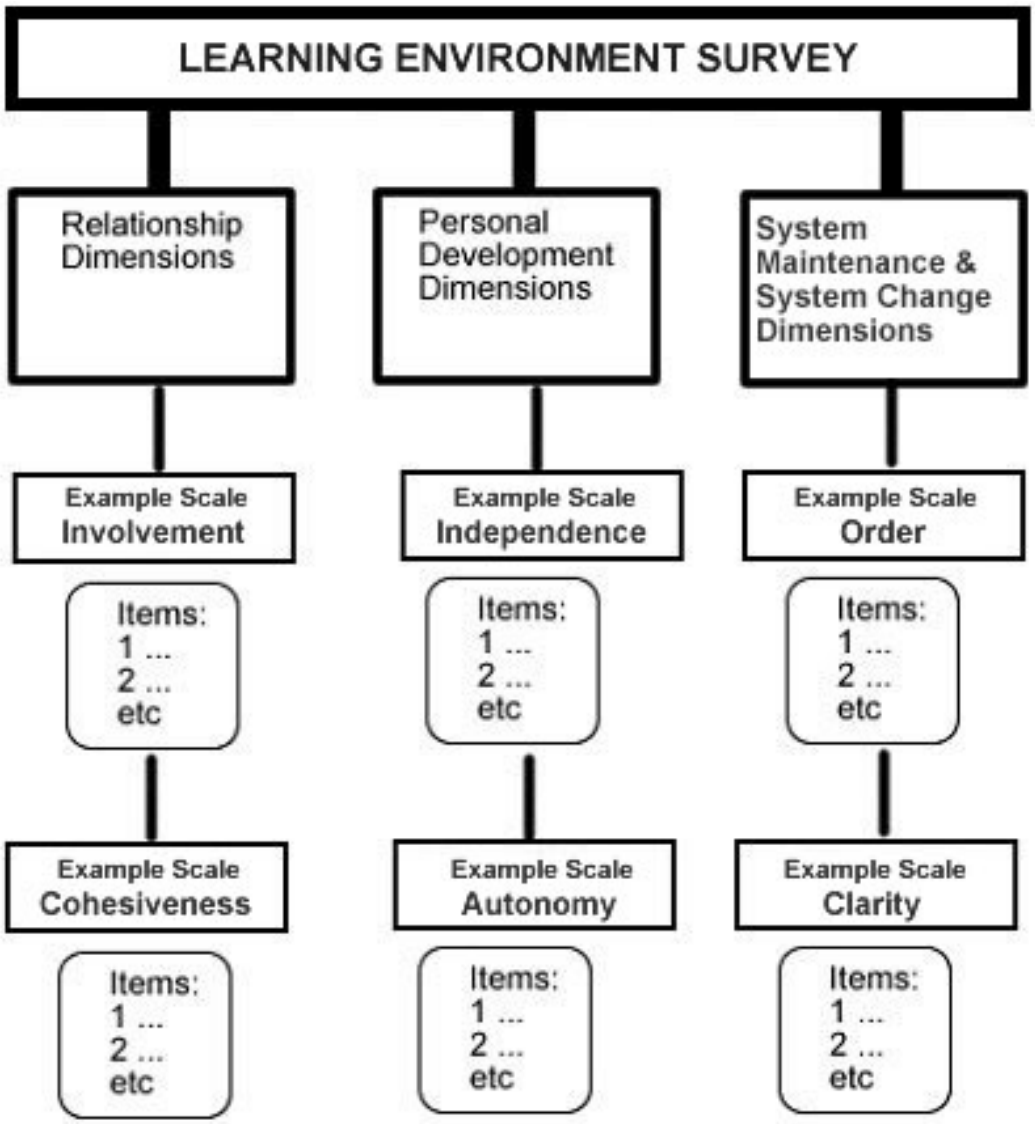


Figure 3.3. The OLLES database structure and relationships

3.2.4 Technical Issues

However, the delivery of web-based forms and the collection of data from those forms are not unproblematic. Technical problems such as power failure, Internet connection loss, Internet connection speed can frustrate researchers and participants alike (Benfield & Szlemko, 2006). These technical issues can be created by the researchers themselves in the development of the forms. For example, a number of research experiments and activities conducted on the Internet are developed using scripting languages to create interactive web pages. While this enhances the visual presentation of the form, allowing the researcher more control over layout and structure, the use of these scripts becomes problematic when they rely on the type

and functionality of the client's web browser (Reips, 2002a). When there is incompatibility there can be computer crashes, network error messages and slow performance, increasing the likelihood of non-completion and drop-out, and in some cases, potentially driving students to disable web-browser functionality to reduce frustration (Buchanan & Reips, 2001). This defeats the purpose of using the scripts in the first instance. These problems can be addressed by using server-side applications like *Common Gateway Interface* (CGI) reducing the dependence upon the web browser being used by the participant and minimizing non-completion and drop-out (Schwarz & Reips, 2001).

The design of web-forms for surveys is a complex task and has led to the development of some survey forms being dictated by computer and programming specialists rather than survey professionals thus potentially reducing the normal academic rigor used in the development of questionnaires (Dillman & Bowker, 2001). To some extent these problems are being addressed with the development of software applications with simple user interfaces to generate forms with researchers needing limited knowledge of technical details (Benfield & Szlemko, 2006; Reips & Neuhaus, 2002; Wright, 2005). These have been complemented by the development of Internet-managed survey sites where users can design their survey online and automatically generate database-web form relationships (Macro International, n.d; Questionmark, 2006; SurveyMonkey, 2006). However the use of hosted solutions is not without limitations. Although the protection of data from external unauthorised access has been partially addressed (Reips, 2002a, 2002b), ethical concerns remain regarding the researchers' lack of assurance regarding security and access to collected data on the host site (Brem, 2002; Wright, 2005). In short, when using external hosts for Internet based research, it should not be assumed participants have the same protections as afforded by traditional non-Internet-based research.

3.2.5 Review

The use of Internet technologies in research can be perceived as being economically viable, enabling accuracy in data entry and shortening research timeframes. However, care must be taken to ensure firstly, the target population has the technological skills and knowledge to access and complete the research instrument and secondly, procedures are established to ensure the results of the survey are not

compromised by unsolicited and non-responses. This section has argued in specific situations, such as investigating the online learning environment with an Internet-based perceptual measure, the use of web technologies is indeed a viable alternative to traditional pencil and paper methods.

3.3 Research Design and Methodology for the OLLES

The above overviews of psychosocial instrument development and psychosocial instrument creation, presentation and delivery, demonstrate the feasibility of developing reliable, Internet-based, economical, perceptual measures capable of successfully analysing online learning environments. This section describes the research design and methodology to be used specifically in the development of the OLLES instrument. The section is divided into seven topics. Topic one, overview, examines content and construct validity and identifies the logical phases of research to be undertaken. Topic two, phase one, reviews the processes and procedures used in the creation, review and pilot of the instrument. Topic three, phase two, reviews the processes and procedures used in the field testing of the instrument. Topic four, ethical considerations, reviews ethical aspects such as voluntary participation, informed consent, recognition of cultural diversity, individual differences and confidentiality. Topic five, sample, describes how the sample was selected for this study. Topic six, limitations, illuminates how limitations identified were addressed. Topic seven, review, argued the review of content and construct validity assisted in the development of a logical design for this study.

3.3.1 Overview

Although three stages have been identified in the development of learning environment instruments (see 3.1.10 above), these stages are neither linear nor independent. Indeed the stages can be seen to be interwoven, interdependent and overlapping. For example, it would be wise to refer to Moos' social climate dimensions when identifying salient scales. Field testing of a draft instrument, with a limited audience, could be seen to be an integral part of individual item identification. To accommodate this integrated nature of instrument development, two research concepts were reviewed - content and construct validity. In content validity, researchers check against the relevant knowledge of the domain (in this study, online learning and relevant learning environment research studies), and

ensure all aspects pertinent to the domain are identified (Trochim, 2006). Construct validity, the degree to which inferences can legitimately be made from the research undertaken, is rather more complex to describe. In essence, if you can prove there is firstly, convergent validity (in this study items in a scale measure the construct identified) and secondly, discriminant validity (in this study individual scales measure a single construct), you can legitimately demonstrate construct validity (Trochim, 2006). Based on the review of these concepts the research was undertaken in two phases. Phase one focuses on content validity and includes the identification of salient scales and items relevant to online learning, the coverage of Moos' three relationship dimensions and the review and pilot of the instrument with a limited audience. Phase two focuses on construct validity and includes the field testing of the instrument, statistical analysis and reporting of the findings. The detailed procedures followed in each of the phases are explained in more detail below.

3.3.2 Phase One: Content Validity

In phase one, the creation and piloting of a draft version of the OLLES instrument, a set procedure was followed. Firstly, the researcher reviewed the literature on teaching and learning using networked computers and the Internet and, guided by previous learning environment research studies in this domain, identified pertinent scales and associated items for inclusion in the draft instrument. Secondly, the researcher used a user friendly HTML authoring application to create dynamic web-forms for each of the salient scales identified. During the construction of this web-form, individual items, within each appropriately-labeled scale, were allocated a code number to facilitate the collection of data. Thirdly, using the created web-forms and unique scale and item identifiers, an electronic database was created to store the data generated. Fourthly, both the web-forms and the associated electronic database were placed in a password protected folder on a secure web-server. Fifthly, specialists in the web-form creation and database management were asked to test and review the web-form database interaction and comment on the appropriateness and functionality of the relationships created. Finally, online learning tutors, researchers in learning environment research, researchers involved in questionnaire construction, instructional designers developing multi-modal courses and online post-secondary students were asked to form a peer review and test panel to review and comment on the potential scales and items identified by the researcher and the visual appeal, user

friendliness and layout of the web form. During this step the data obtained from the pilot field testing of the instrument was reviewed.

Potential composition of peer review panel

The employing institution of the researcher included a dedicated online learning development centre offering over 300 post-secondary courses with an online component. Over 200 tutors had been involved in either online professional development, the delivery of online activities or creation of digital content. The institution also employed three research facilitators who monitored research within its two faculties and an "online users group" which met regularly to investigate the issues and trends in online learning. The researcher was currently studying at an Australian university renowned for it's skills and knowledge of learning environment instruments. The researcher's institution offered two undergraduate research methods and one post-graduate research methods courses with a strong online component. Members of these varied groups were asked to be part of the review panel for phase one of the project.

3.3.3 Phase Two: Construct Validity

After completion of phase one, the modified version of the instrument was field-tested with a larger audience. In this field-testing phase a set procedure was followed. Firstly, the researcher ensured the dynamic web-forms, the unique identifiers for the scales and items, matched the modified version of the instrument. Secondly, using the modified versions of the web-forms and unique scale and item identifiers, the electronic database will be modified to store the data generated. Thirdly, both the modified web-forms and the updated electronic database were placed in a password protected folder on a secure web-server. Fourthly, specialists in the web-form creation and data base management used in phase one were once again, asked to test and review the modified web-form / database interaction and comment on the appropriateness and functionality of the relationships created. Fifthly, tutors, institutions and academic societies involved in the offering of post-secondary online learning activities were individually approached to participate in the research study. All potential participants were informed of the scope, nature and purpose of the project and they were asked to forward the request for participation to other post-secondary online learning educators. Finally, data gathered during this phase was

analyzed and reported on using the general statistical procedures described in section one of this Chapter (see section 3.1.9).

Potential data sources for field testing of the instrument

The employing institution of the researcher included a dedicated online learning development centre and offered a range of online activities. The researcher, through attendances at online learning-focused conferences, seminars workshops and focus groups nationally and internationally, had formed a number of personal contacts with other online educators. The researcher had also participated in virtual conferences and/or courses focusing on the online learning environment organized by tertiary institutions in Australia, Scotland, Canada and the USA. Using these academic contacts as a starting point, the researcher firstly, sought active participation in the field-testing of the instrument from the students participating in online courses delivered by these academic contacts and secondly, requested the academic contacts to forward information on the research study to other online educators within their institutions, to online educators at allied institutions, seeking their, and their students, active participation in the research project.

3.3.4 Ethical Considerations

As demonstrated in the sections outlined above there exists an extensive body of literature on the design and delivery of web-based forms and the identification of factors influencing response rates and sample size. However, the ethical issues posed by undertaking Internet based research have often failed to keep pace with technological advancements (Andrews, et al, 2003; Shaw, Madge, & O'Connor, 2006). While the collection, storage and security issues around research data have been casually addressed (Shannon, et al, 2002; Solomon, 2001), other ethical aspects such as voluntary participation, informed consent, recognition of cultural diversity, individual differences and confidentiality have not been fully explored or resolved (Kraut, et al, 2004; Shaw, et al, 2006). How this study identified and addressed ethical concerns is explained in the sections below.

Informed consent and voluntary participation

The ethical aspects of informed consent and voluntary participation should be seen to be interwoven into social science research. In essence, these aspects mean

prospective research participants are fully informed of the purpose of the research, the procedures and potential risks involved, and must give their initial and ongoing consent to participate (Shaw, et al, 2006; Trochim, 2006). It was proposed in this study that all participants, during all stages, would be made aware of the purpose of their involvement in the project. They would be informed of the voluntary nature of their involvement and their right to withdraw from the research project at any time. Since some of the research relies on digital responses from distributed locations, a number of issues, unique to electronic surveys, needed to be addressed (Shannon, et al, 2002). Firstly, the user would be required to 'click' on a button to begin the survey. Participants would be informed this action signified their acknowledgement of their informed participation. Secondly, at identified steps during the survey, respondents would be asked to 'click' on a 'next' button. Participants would again be informed this action signified their acknowledgement of their continuing informed participation.

Confidentiality, anonymity, potential harm

When participating in research studies all participants need to be assured potential identifying information collected during the study will remain confidential to those conducting the research. A far stricter standard is the principle of anonymity. This ensures participants will remain unidentified, even to the researchers, during all phases of the study. (Trochim, 2006) If anonymity and/or confidentiality of research participants is respected throughout the investigation, there should be no resulting harm to participants in the project. During all stages of this study no information was sought identifying individual participants, their course of study, their tutor or their institution. During the data collection stages all participants were allocated an automatic number based on the order of submission. The data was stored in a password protected folder and only the researcher and the researcher's supervisors had access to raw data generated. By following these procedures, respondents could be assured that their data were anonymous. It was also made clear to participants the data gathered would only be used for the purpose of the research and any subsequent publications or conference proceedings.

Recognition of cultural diversity and individual differences

Since this research elicited responses from a number of distributed locations, national and international, the potential cultural and spiritual beliefs of participants needed to be respected (Rata Skudder, Angeth, & Clayton, 2003). During all stages of this study, the researcher ensured appropriate electronic contact details were made available. Any participant who required further information or explanation during the various stages of the research was able directly to contact the researcher for further information. When requests were made for information in a language other than English, attempts would be made to respond to these requests. However, sometimes it was beyond the ability of the researcher to fill all requests. But all individuals were treated with respect and cultural sensitivity at all times.

Access to participants

The researcher, after receiving ethical approval from the supervising institution, approached prospective participants for their involvement in various stages of the research proposed. For the first stages of the research, peer review of scales and piloting of the instruments, a memo outlining the nature of this phase of the research, was distributed to tutors and other researchers. For the peer review panel, attached to this memo were additionally, the draft scales and items drawn up by the researcher (see Appendix A). After further modifications and adjustments to the instrument, the electronic database, and the web pages, national and international academic contacts of the tutor were contacted by electronic mail. This mail message included the details and purpose of this stage of the research project. Included in this message was the 'clickable' uniform resource locator of the instrument. The first page of the instrument contained an explanation of the purpose of the research and a statement that sought the participant's consent. The instrument did not seek any personal details that could identify individual respondents.

Overview of procedures

In essence, during this study, a number of protocols and procedures were implemented effectively to address any potential ethical concerns. Firstly, in all forms of communication with potential participants the purpose and reason for the study was clearly articulated. Secondly, the entry page of the instrument developed

was separated from the data collection aspects of the form. This initial page contained a description of the research, a brief overview of the nature of the instrument, the expected time respondents would need to complete the survey and an assurance from the researcher respondents would not be identified in any way. This page also contained the electronic contact details of the researcher. It was stressed a strict adherence to these protocols and procedures would be maintained to ensure all participants in this project would not be placed at risk and the data generated will be used only for the purposes described.

3.3.5 Description of the Sample in Field Testing

Internet surveys are potentially available anywhere, any time to everybody and the potential sample is vast and ever-growing. However, the wide-spread availability of the instrument does not guarantee a representative sample of the research population will be surveyed. A number of general and specific issues on the nature of the sample and potential bias are raised. Firstly, when conducting Internet surveys, consideration must be given to the possibility that a significant portion of the research population may not have, or may choose not to have, ready access to the Internet and therefore the instrument (Shannon, et al, 2002). Secondly, even if the targeted research population has Internet access, potential participants may not be comfortable with the functionalities of the delivery technology used and may not respond (Solomon, 2001; Yun & Craig, 2000). Thirdly, when participants do respond, they may respond in a more open or closed manner in a distributed environment than they would in a pencil and paper environment, threatening the uniformity of investigation and the data collected (Buchanan, et al, 2005b; Kraut, et al, 2004). Fourthly, because the instrument is listed on the Internet with a specific publicly-accessible location, it is feasible responses from participants outside the identified target group, unsolicited responses, may be received (Shannon, et al, 2002). Finally, participation in the survey is voluntary and data generated by sample, consisting of those who volunteer, are potentially biased (Cohen & Manion, 1994; Malaney, 2002; Mertler, 2003). The risks to the integrity of the study, raised by the issues outlined above, can be mitigated through careful selection of the sample using appropriate recruitment processes and procedures (Faas & Schoen, 2006).

In establishing the appropriate processes and procedures for this study the first three issues identified were not considered to be significant. The population to be sampled was to be ‘online learners’ familiar with, through the course of their studies using the web, networked computers and information and communication technologies. They would also be familiar with the functionalities and intricacies of web browsers and online data collection techniques and have ready access to the Internet. The fourth issue, unsolicited responses, was addressed by the application of a set technical procedure. Firstly, the instrument was placed in a closed location on a controlled web-server with the Uniform Resource Locator (URL) hidden from the public and unlinked to other URLs on the server or the Internet. In effect, this meant the researcher had personally to distribute the link to potential participants using identified e-mail addresses. By ensuring only identified respondents had access to the URL, and therefore the form, it was intended the potential of unsolicited responses would be reduced.

The final issue, voluntary participation and potential bias, was addressed by using a variety of strategies. Since personal e-mail invitations generate more responses than scattered e-mail requests for participation on list serves (Chesney, 2006), the researcher personally approached identified participants, both students and tutors, by e-mail. This initial contact included the Internet link to the survey, as it was anticipated a number respondents will complete the survey on the receipt of the e-mail communication (Yun & Craig, 2000). Under the conditions outlined above, clearly the researchers contact base was limited. To expand the potential pool of contacts, while still retaining a personal feel, a technique called either ‘snowballing’ (Cohen & Manion, 1994) or the ‘pass-along effect’ (Norman & Russell, 2006) was employed. This technique asks individuals who meet the criteria of a study, and have been personally approached in the first instance, to forward the request for participation to others whom they know would meet the criteria established (Trochim, 2006). It was anticipated this snowballing/pass along technique would ensure a diverse range of respondents, diluting the initial reliance on voluntary participation from a select group. It was also anticipated this diverse sample could reduce the magnitude of sampling error and make it more likely the sample would be representative of the population as a whole (Gordard, 2001).

3.3.6 Addressing Identified Limitations of the Study

As mentioned previously, the number of participants involved in the online learning environment is vast and forever growing and the theoretical population for a study of this size is potentially immense. Therefore, the researcher's reliance on a relatively limited number of voluntary participants, based initially on personal knowledge, could be regarded as using a sample of convenience. While these samples are less complicated to create and, from a researcher's view, more easily identifiable, samples of convenience, or non-probability, samples may not accurately reflect the characteristics of the population as a whole (Best & Kahn, 1998; Cohen & Manion, 1994; Gordard, 2001; Trochim, 2006). It could, however, be argued the initial sample is enhanced by using the pass along / snowballing research technique, increasing the diversity of the sample and reducing the magnitude of sampling error. Given the potential numbers, the size of the theoretical population, this argument is relatively weak. However, while samples of convenience, or non-probability samples, may not accurately reflect the views of the population as a whole, they are considered acceptable to use in pilot and field testing studies where no sweeping generalizations will be made (Cohen & Manion, 1994; Gordard, 2001). Since the purpose of the study is to define, refine and validate a new survey instrument, investigate the creation of dynamic web pages and associated electronic databases and not to make sweeping generalizations, it was deemed appropriate to use the potentially-limited sample described.

In the intuitive-rational approach identified in this study (see Chapter 3.1.9), the researcher can be regarded as the primary constructor and modifier of the scales and items that constitute the instrument in all phases of the project (Aldridge, et al, 2004). It would be legitimate to argue prior conceptions held by the researcher could influence decisions made and scales selected. Indeed, researchers at different ends of a theoretical spectrum could interpret the literature, and the data generated to make modifications to the instrument, in a different manner (Begg, 1993). While it is legitimate to argue that prior conceptions held by the researcher will influence decisions made, these can be overcome. By ensuring the development of scales and items drawn extensively on previous learning environment research, by ensuring the phases of the project and the different techniques used to generate data are followed

and by ensuring the researcher is aware of these research limitations, any bias caused by the researcher's prior conceptions should be limited.

3.3.7 Review

The design of a research study to incorporate the three recognised stages of psychosocial instrument development is a complex task. However, by reviewing the concepts of content and construct validity, a logical design emerges, including two distinct, yet integrated, phases. Phase one is focused on sound development, while phase two is focused on testing for reliability. This section has also detailed the protocols, procedures and methods followed in addressing ethical concerns, sampling issues and identified limitations. It could be argued the research will be considered valid and reliable if the findings draw attention to potential advantages/barriers of the online learning environment, reports on the reliability and validity of the scales and individual items used in the OLLES instrument and allows conclusions to be drawn about using Internet techniques in learning environment research studies.

3.4 Summary

This chapter reviewed previous research studies focused on the development and validation of psychosocial measures and identified three generic stages used in the development of these instruments. It was summarised this staged process could be theoretically classified as an intuitive-rational approach complemented by statistical analysis and factor analytic approaches. However, although a staged approach was identified, it was demonstrated these stages were neither linear nor independent; they were interwoven, interdependent and overlapping. To accommodate the integrated nature of instrument development, two research concepts were reviewed - content and construct validity. Based on the review of these concepts, it was decided the research would be undertaken in two phases. Phase one would focus on content validity including the identification of salient scales and items and a review and pilot of the instrument with a limited audience. Phase two would focus on construct validity including the field testing of the instrument and statistical analysis.

The chapter also reviewed psychosocial measure creation, presentation and delivery. It reviewed past and emerging practice and identified patterns. These patterns led to the conclusion that the OLLES measure developed would have no negatively-worded

items, would be structured with items for each identified scale being delivered sequentially, and would simultaneously explore students' perceptions of their actual and preferred environment using a personal form.

Given the advantages of using electronic databases in the collection, storage and manipulation of data generated by server-based perceptual measures, it was decided to use this medium to deliver the form created. Care was taken to ensure firstly, the target population had the technological skills and knowledge to access and complete the research instrument and secondly, procedures were be established to ensure the results of the survey were not compromised by unsolicited and non-responses and, finally, ethical issues were adequately addressed.

This research could be considered reliable if the broad perspectives generated in the project illuminate previous research findings, draw attention to potential advantages / barriers of the online learning environment, and allow conclusions to be drawn about the reliability and validity of the scales and individual items used in the OLLES instrument and the method of instrument administration and data collection. The reporting on the two phases of the research project described in this chapter is the focus of the next chapter.

Chapter 4: Phase One, Content Validity, Discussion and Results

This chapter reports on the range of activities undertaken in phase one of the research project; content validity. The chapter has been divided into four broad sections and associated sub-topics. Section one, identification of scales and the creation of individual items, reports on the selection of scales and items for the OLLES instrument. Section two, creation of dynamic web-pages and connected database, describes how the OLLES instrument was prepared for Internet-based delivery and how the associated database was structured. Section three, peer review and pilot of web-pages, reports firstly, on the feedback received from peers who reviewed the scales and items in the measure secondly, describes the results of limited pilot of the instrument with students and finally, discusses the modifications made to the scales and items, the web-pages and database structure as a result of the feedback received. Section four, summary, reviews the activities and actions undertaken during this phase of the research.

4.1 Identification of Scales and Creation of Individual Items

As noted in Chapter 3 the identification of appropriate scales and items in the creation of perceptual measures follows a recognised pattern. Firstly, the area to be investigated is described and the relevant literature is reviewed. Secondly, previous learning environment studies in the field are explored are appropriate scales and items are identified. Finally, the proposed scales are described and potential items are identified. The reporting on the identification of scales and items, following the pattern described, is the focus of this section. The section has been divided into five sub-topics, Student - Interface Interaction, Student - Student Relationships, Student - Tutor Relationships, Student - Media Interaction and Student Reflection Activities.

4.1.1 Student Interface Interaction

When the learner 'logs on' to the computer, (i.e. establishes a connection), immediately an interactive relationship is created between the computer and the learner. The learner through input devices (key board, mouse, microphone, video, and scanner) interacts with the computer. The computer through a range of output devices (printer, visual display unit, sound card, video card) interacts with the learner. The initial relationship created, while apparently 'two-way', is actually input

dependant. For example, to print a document the learner must use the functionality of the software application to specifically instruct the computer to print that file (input). When the computer receives the instruction, it processes the command, checks if a printer is connected, and carries out the specific task (output). Without specific input from the learner, the instruction, the computer will not function. Online activities can also be regarded as input dependant. The learner must select from a dedicated web-space the appropriate 'tools' (such as access resources, chat, forums, calendar, messaging) to participate fully in the course. It would appear important to investigate how this web-space, the *interface*, is structured, laid out and organized.

Schroeder (1997) found, when studying activities in virtual worlds, two levels shaped how virtual worlds were organized. Students' continual use of, or the lack of use of, particular tools and functionalities influenced the shaping of the system. Tools and functionalities consistently used are expanded and developed. Tools rarely used are modified or eliminated. Morine-Dershimer and Kent (1999) investigated organisational or structural issues; they argued students must understand the specific rules and expectations of communication within the environment. Student participation and achievement will be governed by how well they understand the rules. However, too detailed explanations of how to use the site and the tools provided can be detrimental. The support tools used, and the explanation of their use should be minimal (Swaak & De Jong, 2001). Recent studies (Pandir & Knight, 2006; Schrepp, Held, & Laugwitz, 2006) have argued user's perceptions of the visual appeal the sense of enjoyment and satisfaction of their engagement with home pages are as important in engaging users as the functionality or performance of the system. In essence the interface, (navigational tools and devices) should be carefully designed, structured and explained to orient and engage the user and provide them with a sense of direction (Zhu, et al, 2007). It is assumed a visually appealing, easily navigable interface, with clear instructions, will reduce anxiety correspondingly increasing student confidence and achievement.

There are three broad factors to be considered when designing or investigating the interface for online courses. Firstly, there is what could be regarded as technological issues. What is the level of technology required to make the system operate smoothly? This would include software applications, browser capabilities and plug-ins. Secondly, what is the required level of student technological capability to

successfully learn within the environment? This would include the types of software applications students are required to use and the types of activities (for example, printing, copying, or saving) students will be engaged in. Thirdly, how is the environment organized and ordered? This would include the ease of navigation, the visual layout and appearance of tools on the screen and the explanations provided.

Potential Scales and Items

Previous learning environment research has, to some extent, investigated the broad factors outlined above. Newby and Fisher (1997b) in the instrument Attitude toward Computers and Computer Courses developed items using the scales, 'Lack of Anxiety' and 'Enjoyment'. These scales explored the extent to which the student felt comfortable using a computer and the extent to which students enjoyed using a computer. It was found these two scales were reliable, and although needing further testing, could be used with some confidence. Fisher, Aldridge, Fraser and Wood (2001) in the development of Technology-Rich, Outcomes-Focused Learning Environment Inventory adapted a scale 'Computer Usage' which investigated how students used the computer as an access and communication tool. They found this scale was reliable and could be used with some confidence. For this instrument it is proposed a scale 'Computer Anxiety and Competence' will be developed. The scale, the Moos dimension it fits within, and examples of items associated with the scale are illustrated in Table 4.1

Table 4.1 *Preliminary scale: Computer anxiety and competence*

Scale	Description	Items
Computer Anxiety and Competence [PD]	Extent to which the student feels comfortable and enjoys using computers in the online environment.	I have no problems using a range of computer technologies. If necessary I can electronically store information on my computer or disk.

Fraser, Giddings and McRobbie (1992) in the creation of the Science Laboratory Environment Inventory developed items using the scale 'Rule Clarity'. This scale investigated the extent to which behavior in the laboratory is guided by formal rules. Teh and Fraser (1994) in exploring the effects of computer-assisted learning (CAL)

in the development of the Geography Classroom Environment Inventory developed items using the scale "Resource Adequacy". This scale investigated the extent to which the computer hardware and software used by students was adequate to run the software application. Maor and Fraser (1993) in the instrument Computer Classroom Environment Inventory developed items using the scale 'Material Environment'. This investigated the extent to which the computer hardware and software was adequate and user friendly. All three scales have been found to be reliable. For this instrument it is proposed a scale 'Material Environment and Rule Clarity will be developed. The scale, the Moos dimension it fits within, and examples of items associated with the scale are illustrated in Table 4.2

Table 4.2 *Preliminary scale: Material environment and rule clarity*

Scale	Description	Items
Material Environment and Rule Clarity [SM & SC]	Extent to which behaviour in the online environment is guided by formal rules and extent to which the computer hardware and software are adequate and user friendly.	The instructions provided to use the tools within the site are clear and precise. I have no problems in seeking appropriate help files that explain tool use.

4.1.2 Student - Student Relationships

Software applications have been developed in web based environments for large groups of people to share ideas and resources. These ideas and resources are stored at one node (a server) and all members of the network can view and comment on the stored items. In web enclosed environments, those environments that can only be accessed with individual entry rights or codes, these applications have been expanded and specific tools, for example, Activity Room (Maor, 1998), Instant Messaging (Denham, Little, Komzak, et al, 2006), and Video Communication (Scott, Quintero, Quick, & Linney, 2007) have been developed to allow those given rights to the web enclosed environments, the ability to share ideas, concerns, thoughts and resources. In all situations described, the user, by using the appropriate protocol, software application or web browser tool, is able to establish relationships with others connected to their network. There are a number of relationships created in this computer connected or web based environment. Firstly, private communication between individuals can occur (i.e., one-to-one). Secondly, individuals can

communicate with small or large groups (i.e., one-to-many). Thirdly, communication can occur that involves all participants (i.e., many-to-many) (Miller & Miller, 1999). The individuals' participation, the perceived success or failure of these communication groups established, is dependant upon individuals posing queries or responding to posed. Isolated queries, in an isolated environment, are meaningless.

The concept that knowledge is personally constructed is a fundamental concept of constructivism (Driver, 1989; Driver, Asoko, Leach, Mortimer, & Scott, 1994). Some constructivist theorists would also argue that the acquisition of knowledge is socially mediated, it is the result of an active, cooperative enterprise of persons in a relationship (Gergen, 1985; Treagust, et al, 1996a). It is seen, although individuals construct their own individual meanings, the process of constructing meaning is embedded within the social setting of which the individual is a participant (Treagust, et al, 1996a). The interaction, the dialogue, the verbal and textual exchanges, between people allows individuals to find common ground with each other and make sense of concepts, words or the world that surround them. It is argued, the active exchange of ideas and experiences, fosters internalized dialogue, which in turn promotes higher-level thinking (Lee & Ertmer, 2006; Morine-Dershimer & Kent, 1999). While some tutors have found considerable difficulty in creating and sustaining meaningful educational dialogue in computer assisted collaborative learning, and computer mediated conferencing environments (Moore & Marra, 2005; Owen, 2000), others have found activity room discussions, although time consuming, was productive and rewarding (Campbell, 2004; Maor, 1999).

When investigating student-student relationships we should focus on how the student generates and responds to the queries generated by individuals and groups on a personal level.

Potential Scales and Items

Previous research has, to some extent, investigated the factors outlined above. Newby and Fisher (1997a) in the perceptual measure Computer Laboratory Environment Inventory developed items using the scale 'Student Cohesiveness'. This scale explored the extent to which students know, help, and are supportive of each other. Newhouse (2001a) has developed New Classroom Environment Instrument developed items using the scale 'Affiliation'. This scale explores the level of

friendship that students feel for each other, that is, the extent to which they help each other with homework, get to know each other easily, and enjoy working together. In TROFLEI a scale 'Cooperation', which explored how students cooperated rather than competed with each other on learning tasks, was developed (Fisher, et al, 2001). In the development of this instrument it was proposed a scale 'Student Cohesiveness and Affiliation' be developed. The scale, the Moos dimension it fits within, and examples of items associated with the scale are illustrated in Table 4.3

Table 4.3 *Preliminary scale: Student cohesiveness and affiliation*

Scale	Description	Items
Student Cohesiveness and Affiliation [RD]	Extent to which students work together, know, help, support and are friendly to each other.	I communicate regularly with other students in this course. Other students provide feedback on activities I have done.

4.1.3 Student - Tutor Relationships

While student - student relationships, allowing students to contribute to each other's growth and development and providing students with a sense of autonomy, is important, student - student interaction in isolation is insufficient. There is a need for guidance from the tutor on aspects of content the students may find difficulty comprehending or concepts they do not fully understand (Roth, Tobin, & Ritchie, 2001). The moderating of, and the tutor's ability to guide and monitor students' discussion is regarded as the key to successful e-education (Bunker & Ellis, 2001; Salmon, 2000; Vonderwell & Zachariah, 2005). There is a notion of circularity in this communication process. Input from one part of the communication structure established leads to changes in the other parts of the system. For example, student communication on a particular concept will affect how the tutor responds. The tone and detail of the tutor's response will affect students' future postings (Moore & Marra, 2005). It could be argued students' perceptions of the tutor's interpersonal behavior are an important aspect of the learning environment and will influence their achievement and performance (Levy, Rodriguez, & Wubbels, 1993; Vonderwell & Zachariah, 2005). Although, in a connected computer environment, the tutor is only one node on the network there are a number of relationships the tutor can create and maintain. Firstly, private communication between the tutor and individual students

can occur (i.e., one-to-one). Secondly, the tutor can communicate with small (one too few), or large groups (i.e., one-to-many), established within the course (Further Education Resources for Learning, 2007).

In many connected computer or web-based courses there is a second, invisible, level of tutor-student communication, this is in the form of pre-set computer marked activities. The communication channel can be regarded as invisible in that there appears to be no direct relationship between student activity, marks, and feedback received and students. The computer - student relationship appears to be the dominant and sole relationship. However, this does not take into account the tutors creation of the activities and their pre-recorded responses to student actions. The tutor instructs the computer to respond in particular ways to student input. Since the tutor is responsible for the task design, type of input and nature of response, the relationship established is a student - tutor relationship, mediated by the computer (Clayton, 2002). Since the types of questions posed will influence student achievement (Morine-Dershimer & Kent, 1999), tutors must be able to ask suitable questions and sequence those questions in an order that will generate understanding (Gilbert, Boulter, & Rutherford, 2000). The pre-recorded feedback preset by the tutor to activate on student input, will influence student motivation, interaction and progress (Ho & Tabata, 2001). It has been argued there is a positive relationship between academic efficacy, students' perceptions of their competence to do specific activities, and academic motivation, effort and performance (Dorman, 2001).

When investigating tutor-student relationships there are two considerations that must be taken into account. Firstly, how the tutor responds to the queries generated by individuals and groups on a personal level, secondly, how they create and maintain computer mediated interactive activities.

Potential Scales and Items

Previous research has, to some extent, investigated the broad factors outlined above. Newhouse (2001a) in the development of the NCEI developed items using the scale ‘Teacher Support”. This scale explored the amount of help, concern, and friendship, which the teacher directs towards students and the extent to which the teacher talks openly with students, trusts them, and is interested in their ideas. Taylor and Maor (2000) in the development of the Constructivist On-Line Learning Environment

Survey developed items using the scale 'Affective Support'. This scale investigated the extent to which sensitive and encouraging support is provided by tutors. (Aldridge, Dorman, Fraser (2004) in the development of the Technology-Rich Outcomes-Focused Learning Environment Inventory deployed the scale 'Teacher Support' which investigated how the teacher befriended, trusted and was interested in students. Walker and Fraser (2005) in the development of the Distance Education Learning Environment Survey developed items using the scale 'Instructor Support'. This scale investigated the extent to which the teacher is approachable and responds quickly with feedback. For this instrument it is proposed a scale 'Tutor Support' will be developed. The scale, the Moos dimension it fits within, and examples of items associated with the scale are illustrated in Table 4.4

Table 4.4 *Preliminary scale: Affective support*

Scale	Description	Items
Affective Support [RD]	The extent to which the tutor guides students in their learning and provides sensitive, ongoing and encouraging support.	I have the autonomy to ask my tutor what I do not understand. The feedback I receive from my tutor helps me identify the things I do not understand.

Maor and Fraser (1993) in the development of the CCEI developed items using the scale 'Open-Endedness'. This scale investigated the extent to which computer activities emphasized an open-ended approach to inquiry. Teh and Fraser (1994) in the development of the GCEI developed items using the scale 'Innovation'. This scale investigated the extent to which the teacher planned new and varying activities and techniques, and encouraged students to think creatively. Walker and Fraser (2005) in the development of the DELES developed items using the scale 'Active Learning'. This scale investigated the extent to which students had the opportunity to take an active role in their learning. For this instrument it is proposed a scale 'Active Learning' will be developed. The scale, the Moos dimension it fits within, and examples of items associated with the scale are illustrated in Table 4.5

Table 4.5 *Preliminary scale: Active learning*

Scale	Description	Items
Active Learning [PDD]	The extent to which the computer activities support students in their learning and provide ongoing and relevant feedback.	The feedback I receive from activities / quizzes is meaningful. I am motivated by the responses I get from the activities / quizzes included in this course.

4.1.4 Student - Media Interaction

There are a number of aspects that need to be taken into account when reviewing content provided to students in a connected computer environment. Firstly, there are physical considerations. When using print based materials, the student generally reads the material at 'arms length' moving from page to page by hand. The physical position of the arms in relation to the eyes mean the print material is held below head level and the reader looks down on the information presented. Computer presented information is viewed on a visual display unit (VDU) that is in a fixed position, generally positioned at eye-level. The presence of input devices in front of the VDU, keyboard and mouse, ensures the material is presented at a distance further than arms length. To view the information the reader uses the keyboard or mouse to move from section to section. Secondly there are differences in presentation. Information in print can be regarded as static, the text, graphics and photos used to explain concepts or illustrate processes remaining constantly unchanging. While it is possible to enhance material by supplementing the text with audio or videotapes, these are separate and distinct items utilizing specialist devices. Information presented via the computer is dynamic, the text, graphics and photos can be animated to illustrate complex relationships. Audio and video components can be embedded in the material and be reviewed on the same device.

There are many critical components to online education, none of which have anything to do with the presentation or the technology used in the production or delivery (Further Education Resources for Learning, 2007; Illinois Online Network, 2006; Zhu, et al, 2007). Learning materials must be complete and well organized students need to know what is going to happen, what is to be learnt, why it is to be learnt, the purpose of it, and how they will be assessed (Kearsley, 1998; Atkins,

2001; Zhu, et al, 2007). Therefore a guide, which outlines learning objectives, provides self-evaluation exercises, glossary of key terms and summaries of the material presented, should be an integral part of the learning package (Gilbert, et al, 2000; Kearsley, 1998; Zhu, et al, 2007). Swaak and De Jong (2001) argued if information is clearly organized and assignments are well defined, students should have no difficulties in following the sequence and making sense of content provided. As well as providing the student with an overview of how the course is structured and organized, tutors must take care to sequence and chunk material to meet the needs of the students participating in the course. Firstly, tutors must be able to anticipate students' level of reasoning skills and be aware of problems they may encounter when dealing with particular concepts or reviewing content presented (Zembal-Saul, Starr, & Krajcik, 1999). The importance of the teacher knowing the subject and being able to intervene at the appropriate moment is critical (Roth, et al, 2001). While students should have sufficient information, either provided within the course or hyper-linked to, to complete tasks set (Frazer, 1986; Illinois Online Network, 2006), material to be learned needs to broken down into comprehensible chunks to facilitate understanding and retention (Atkins, 2001; Kearsley, 1998). The most general ideas of a subject should be presented first and then progressively differentiated in terms of detail and specificity (Chang & Fisher, 2001; Zhu, et al, 2007). In chunking information, it is argued students are more likely to form an opinion if they are forced to think about it. The tutor must be able to provide objective information so the students can reflect and form their own opinion (Frazer, 1986; Illinois Online Network, 2006). Owen (2000) has argued students engage in activities, which generate ideas and knowledge (they are producers not consumers) in order to 'trigger' prior knowledge we should make at least a minimum amount of knowledge available particularly explanations. Chang and Fisher (2001) argues that instruction should be designed to facilitate extrapolation and or fill in the gaps (going beyond the information given) and to facilitate perception, realistic environmental settings should be used in the presentation of materials.

When investigating student – media interactions there are two considerations that must be taken into account, firstly, how the information is sequenced and chunked and does the sequencing and chunking assist the online learner, secondly, how is information visually displayed and does this presentation appeal to participants?

Potential Scales and Items

Previous research has, to some extent, investigated the broad factors outlined above. Teh and Fraser (1994) in the development of the GCEI developed items using the scale 'Innovation". This scale investigated the extent to which the teacher plans new and varying activities and techniques, and encourages students to think creatively. Maor and Fraser (1993) in the development of the CCEI developed items using the scale 'Organisation'. This scale investigated the extent to which classroom activities were planned and well organized. Newhouse (2001a) in the development of the NCEI developed items using the scale 'Involvement' This scale investigated the extent to which students had attentive interest in class activities and participated in discussions and the extent to which students did additional work on their own and enjoyed the class. Chang and Fisher (2001), in the development of the Web-Based Learning Environment Inventory, authored items using the scale 'Information Structure and Design Activities', a section of this scale explored if the course was well structured and organized. For this instrument it is proposed a scale 'Order and Organisation' will be developed. The scale, the Moos dimension it fits within, and examples of items associated with the scale are illustrated in Table 4.6

Table 4.6 *Preliminary scale: Order and organisation*

Scale	Description	Items
Order and Organisation [SM & SC]	Extent to which class activities are clear, well organized, stimulating and assist student comprehension.	The learning objectives are clearly stated for each topic. The information presented kept me focused on the terms and concepts explained.

Maor and Fraser (1993) in the development of the CCEI developed items using the scale 'Organisation'. This scale investigated the extent to which classroom activities were planned and well organized. Chang and Fisher (2001) in the development of the WEBLEI developed items using the scale 'Information Structure and Design Activities'. A section of this scale explored whether the materials presented followed accepted instructional design standards. Instructional design standards include the visual display of material reviewed. For this instrument it is proposed a scale 'Information Design and Appeal' will be developed. The scale, the Moos dimension it fits within, and examples of items associated with the scale are illustrated in Table 4.7

Table 4.7 *Preliminary scale: Information design and appeal*

Scale	Description	Items
Information Design and Appeal [SM & SC]	Extent to which class materials are clear, stimulating and visually pleasing to the student.	The backgrounds used in tables and pages enhanced the look of the material. The material showed originality and creativity in the layout.

4.1.5 Student Reflection Activities

In web based and connected computer learning environments, the computer mediates all the relationships created within that environment. Electronic mediation eliminates traditional physical cues that are present in face-to-face relationships. The tutor cannot smile, glare or raise an eyebrow if things are going right or wrong. Students cannot nudge or wink at each other or look bored, excited or vacant when the tutor is explaining concepts. Students can't look over the shoulder of the student sitting next to them to review material presented or look appealingly at a tutor when things have gone wrong. These physical cues within the face-to-face classroom environment prompt students and teachers to stop, modify or continue with the behavior being exhibited. In the web based and computer-connected environments these physical cues are not present. To attract attention, from the tutor or other participants in this virtual environment, they have to use the input devices and tools provided to communicate with others, to respond, to ask for clarification or provide support. Students then have to be conscious of their own learning and be able to recognize when they must actively seek answers or provide support. After the course has been completed students must also reflect on the environment they have been participating within and ask themselves if they were satisfied with learning in the environment created. For example, did they enjoy learning in this environment, were they motivated by the environment, did the course meet their learning needs? In short, students must reflect on the way they learn both during the activities within the virtual learning environment and after the course has been completed.

Zariski and Styles (2000) have argued very little is known about how students acquire, modify or adapt appropriate learning strategies to suit the new environment of online learning. (Illinois Online Network, 2006) has speculated it is likely that students need be highly self regulated and be responsible for organizing and

reflecting on their learning. They must become self-directed learners. Radloff and de la Harpe (2001) argued self-directed learners will not only have knowledge and understanding of content, they will also have a positive attitude to learning and to themselves as learners. They will have the ability to reflect on their learning and a willingness to continue learning throughout life. To achieve this, students must have opportunities for reflection and introspection in order to make sense of experience gained (Armarego & Roy, 2000; Further Education Resources for Learning, 2007). There are a number of strategies that can be employed to achieve this result. Zariski and Styles (2000) argued students will have a more self-regulatory and more sympathetic approach if they have the opportunity to frankly discuss the benefits and drawbacks of online learning. Maor (1999) provided students with the opportunity to have shared control over 20% of their assessment. She believed this self-assessment would increase self-reflection amongst the participants. Fairholme, Dougiamas, and Dreher (2000) outlined the strategy of students compiling weekly online journals based around probing questions that would encourage students to reflect on their activities.

Potential Scales and Items

Previous research has, to some extent, investigated the broad factors outlined above. Taylor and Maor (2000) in the development of the COLES developed items using the scale 'Reflective Thinking'. This scale investigated the extent to which critical reflective thinking is occurring in association with online peer discussion. Duschl and Waxman (1991) have noted the *Individualized Classroom Environment Questionnaire* (ICEQ) contain items within a scale 'Investigation'. This scale explores the emphasis on the skills and processes of inquiry and their use in problem solving and investigation. Maor and Fraser (1993) in the development of the CCEI developed items using the scales, 'Investigation' and 'Satisfaction'. These scales investigated the extent to which the student was encouraged to engage in inquiry learning and the extent to which the student was interested in using the computer and in conducting investigations. Walker and Fraser (2005) in the development of the DELES developed items using the scale of 'Enjoyment. This scale investigated the extent to which students enjoyed learning in a distance environment. It must be noted Walker regards this scale as a 'measure' and as such cannot be regarded as a social climate dimension. Chang and Fisher (2001) in the development of the WEBLEI

developed items using the scale 'Qualia'. This scale explored six categories, enjoyment, confidence, accomplishments, success, frustration and tedium. For this instrument it is proposed a scale 'Reflective Thinking' will be developed. The scale, the Moos dimension it fits within, and examples of items associated with the scale illustrated in Table 4.8

Table 4.8 *Preliminary scale: Reflective thinking*

Scale	Description	Items
Reflective Thinking [PDD]	Extent to which reflective activities are encouraged and how students enjoyed learning and participating in this environment.	I feel a sense of satisfaction and achievement about this learning environment. I am satisfied with my experience of using the Internet and learning online.

4.1.6 Review of dimensions, scales and items

The above reviews of the literature and previous learning environment research enabled the researcher to create an exploratory instrument containing 8 scales and 88 associated items. The lowest number of items associated with any individual scale was 10 and the highest number of items associated with any individual scale was 14. The matrix on the next page, Table 4.9, provides a descriptive overview of the scales, items and associated dimensions of the initial instrument (full descriptive details of the initial instrument are outlined in Appendix *A*).

Table 4.9 *Matrix of dimensions, scales and items of the initial OLLES instrument*

Scale	**No of Items**	**Description**	**Item**
Affective Support [RD]	14	The extent to which the tutor guides students in their learning and provides sensitive, ongoing and encouraging support.	The tutor responds promptly to my queries.
Student Cohesiveness and Affiliation [RD]	11	Extent to which students work together, know, help, support and are friendly to each other.	I communicate regularly with other students in this course.
Reflective Thinking [PDD]	10	Extent to which reflective activities are encouraged and how students enjoyed learning and participating in this environment.	I felt a sense of satisfaction and achievement about this learning environment.
Active Learning [PDD]	10	Extent to which the computer activities support students in they're learning and provide ongoing and relevant feedback.	The feedback I received in activities/quizzes helped me identify the things I got wrong.
Computer Anxiety and Competence [PDD]	10	Extent to which the student feels comfortable and enjoys using computers in the online environment.	I have no problems using a range of computer technologies.
Material Environment and Rule Clarity [SM &SC]	11	Extent to which behavior in the online environment is guided by formal rules and extent to which the computer hardware and software are adequate and user friendly.	The rules on how to navigate the online course are clearly explained.
Order and Organisation [SM &SC]	12	Extent to which class activities are clear, well organized, stimulating and assist student comprehension.	There was a contents page included that outlined the main points to be presented in each section.
Information Design & Appeal [SM &SC]	10	Extent to which class materials are clear, stimulating and visually pleasing to the student.	The choice of colours and style used in the text helped me read clearly.

4.2 Creation of Dynamic Web-Pages and Connected Database

In the not too distant past the creation of dynamic web-pages to gather data from participants required developers to acquire sophisticated HTML programming and/or JavaScript language skills (Dillman & Bowker, 2001). However, the ongoing development of user friendly "what you see is what you get (WYSIWYG)" software applications, such as Dreamweaver® and Front Page®, has made the task of creating dynamic web-pages for Internet-based research a relatively simple task (Reips & Neuhaus, 2002; Wright, 2005). Web-survey developers using these WYSIWYG software applications can create sophisticated and complex forms with basic word processing skills. The application Front Page®, was used by the researcher to create the initial version of the OLLES web-survey and the application Microsoft Access® was used to create the associated database. This section is divided into three topics. The first, web-page creation outlines how the measure was structured and presented to participants. Images are used to illustrate the key features identified. The second topic, database structure, describes how the descriptors used in the drop-down menus in the web-pages helped define the structure of the Access database. The final topic, review, describes how the dynamic web-pages and database was made accessible and available for limited local testing.

4.2.1 Dynamic Web-page Creation

The process of web-page development began with the creation of a visually appealing HTML template ensuring font style and size, background and border colours, and image placement remained consistent throughout the instrument. The instrument was structured around three interdependent sections which were presented to participants in a linear sequence. The participant had to complete section 1, introduction, before access would be granted to section 2, data-collection then, all aspects of section 2 had to be completed before access to the final section, confirmation, was granted. The sections and processes and procedures involved are explained in more detail below.

<u>Section 1</u> (introduction): This section consisted of two pages. Page one was designed to introduce participants to the rationale for the research project, inform them any information collected during the research would remain confidential and assure them participation in the project was voluntary and they could, if they wished, withdraw

from the project at any stage without penalty. A “clickable button” was provided for participants to access the second section of the web-form. Participants were informed by “clicking” this button their consent to participate in this research project was assumed. See Figure 4.1.

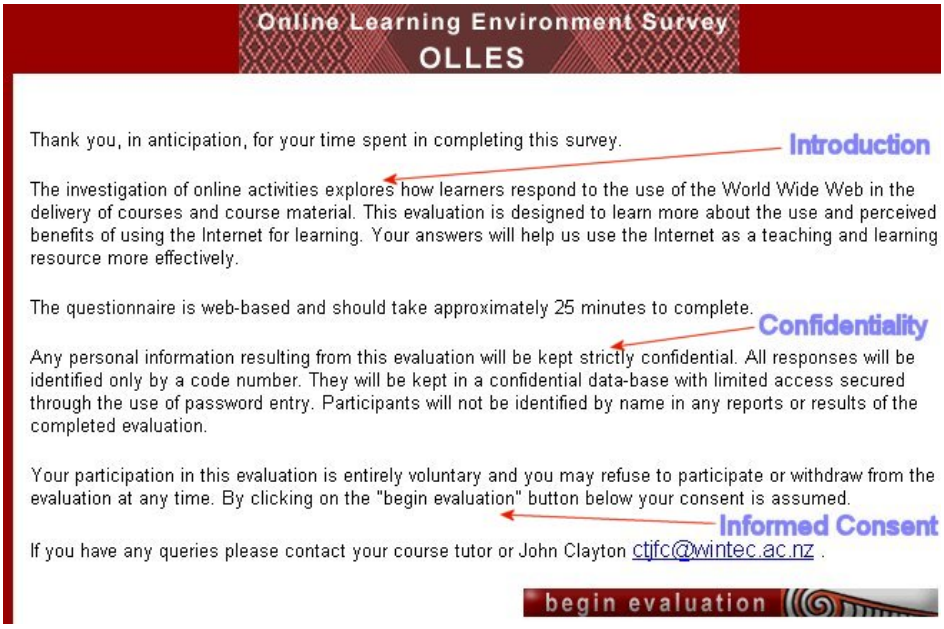


Figure 4.1. Introduction page to the initial OLLES

When participants “clicked” the button a second page, instructions, was presented. This page contained instructions on, the structure of the form, the anticipated time it would take participants to complete and finally how the participants could use the “drop-down” menus provided to select their response to a particular statement. See Figure 4.2.

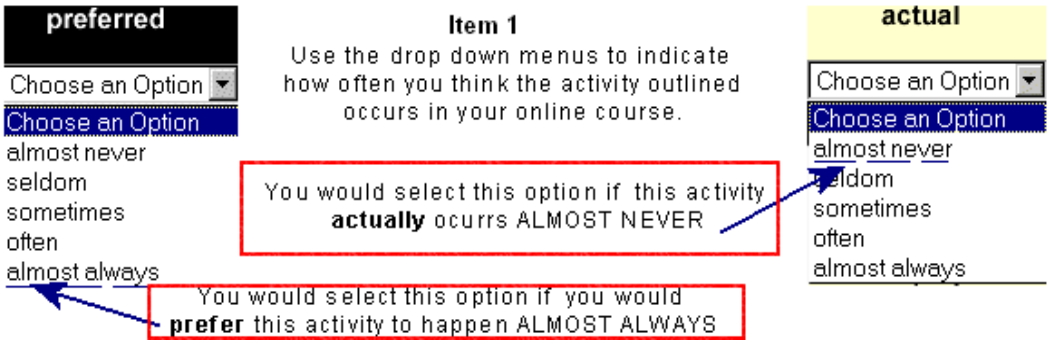


*Figure 4.2.*Instruction page of the initial OLLES

Section 2 (data-collection): This section was the largest section of the instrument and contained eight individual pages created for each of the identified scales identified in

the OLLES measure. A general format of presentation, brief instructions followed by presentation of items and associated drop-down menus, was followed in all eight pages in this section. This is demonstrated in Figure 4.3.

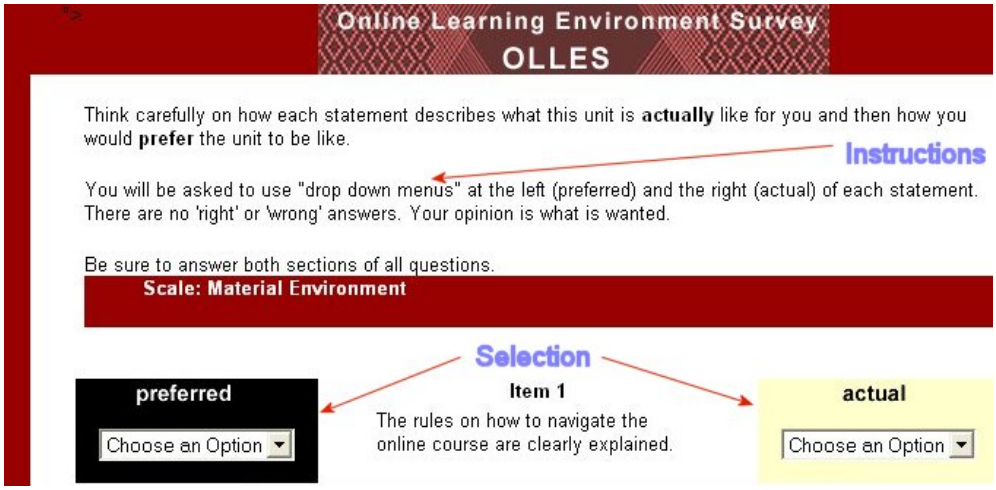


Figure 4.3. Data-collection page of the initial OLLES

Section 3 (conformation): When the eight data-collection pages in section two had been completed a final submission button was presented the participant. Participants were once again informed by "clicking" this button their continued consent to participate in the research project was assumed. A final conformation page, thanking the participants for their participation and once again reassuring them all information collected would remain confidential was the presented to all participants. See Figure 4.4.

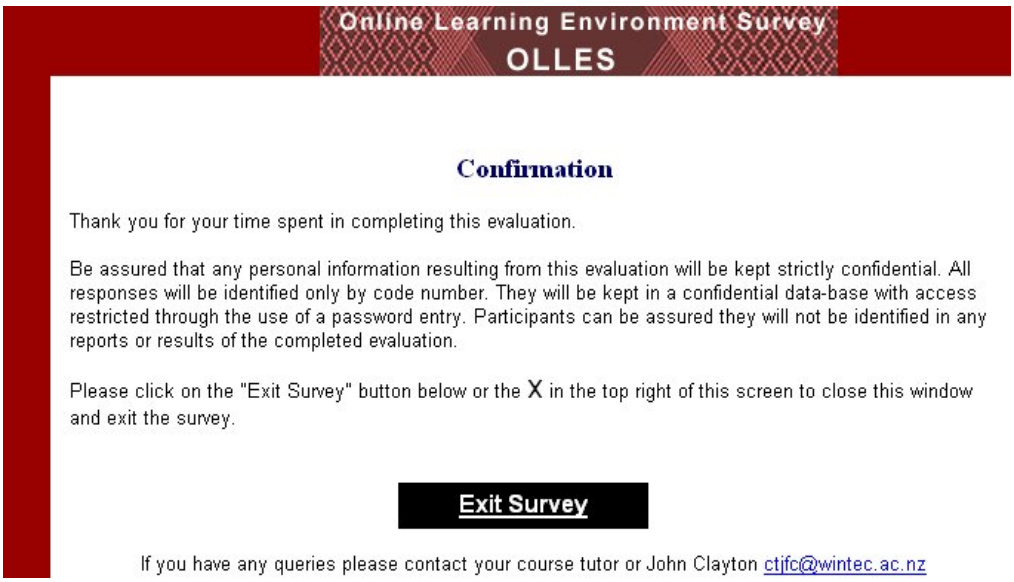


Figure 4.4. Conformation page of the initial OLLES

4.2.2 Database Structure

Each of the scales deployed in the OLLES instrument was allocated a "base-identifier" directly related to the social climate dimension it was associated with and each of the items in the scale were sequentially numbered. The base identifiers for each scale are shown in Table 4.10

Table 4.10 *Base identifiers of scales in the OLLES instrument*

Scale	**Dimension**	**Base Identifier**
Reflective Thinking	Personal	PRRT
Information Design and Appeal	System	SMIDA
Order and Organisation	System	SMOO
Active Learning	Personal	PDDAL
Affective Support	Relationship	RAS
Student Cohesiveness and Affiliation	Relationship	RDSCA
Computer Anxiety and Competence	Personal	PDDCAC
Material Environment and Rule Clarity	System	SMMERC

During the creation of the web-form the built in functionalities of the HTML editor allowed the author to specify how the participants input was to be recorded and stored. Two "drop-down" menu items were created for each individual item within the instrument. On the left was a "drop-down" menu to record the students' perceptions of their preferred environment and on the right was a "drop-down" menu to record the students' perceptions of their actual environment (see Figure 4.3. above). By using the "drop-down box properties of the HTML editor the author was able to, identify specific item, the scale the item belonged to, and identify if the response was from the actual (a) or preferred (p) drop down menu. See Figure 4.5.

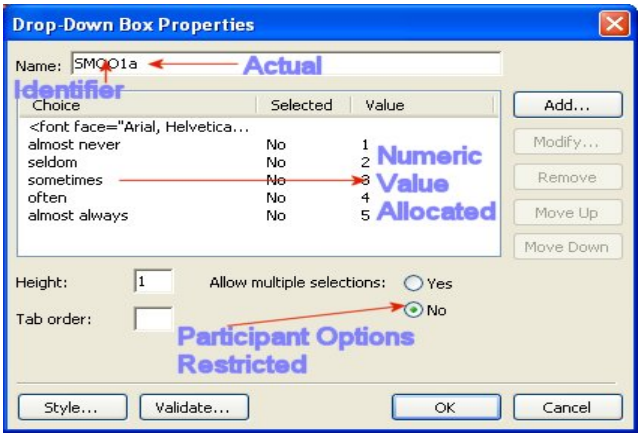


Figure 4.5. Drop down menu functionalities of HTML authoring application

The identification system used in the creation of the drop down menu items in the web-form was the underlying structure used in the establishment of the database for the OLLES. Since Front Page® was the HTML editor chosen to create the dynamic web-pages it was appropriate a compatible database application package be chosen to store the data. The layout of the access database is shown in Figure 4.6.

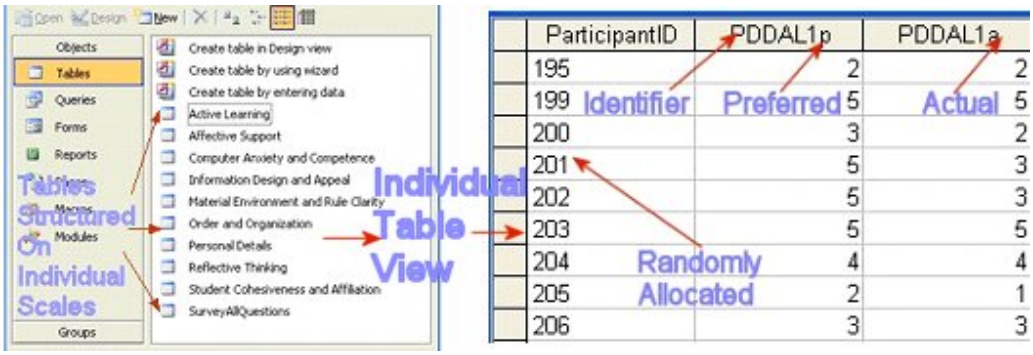


Figure 4.6. Database structure and table view for OLLES

The application chosen was Access Office 2000. When the participant had completed all sections they clicked a “submit” button. Clicking this button activated an asp script (active server page) and the data was saved to the identified table in an access database. Since server side scripting was used to perform the insert on the table in the database the client machine only needed to have adequate Internet access and an appropriate web-browser. This reduced potential technical problems and ensured data was entered in a consistent manner.

4.2.3 Review

The above descriptions of the creation of dynamic web-pages and relationship database enabled the author to create a demonstrator environment on a local area network (LAN). The researcher had access to a networked test-server on which the required scripting language (asp) was installed. This demonstrator environment consisted of two folders, folder one contained the 11 individual pages that constituted the instrument and folder two, contained the associated database and tables. A series of technical tests were conducted by the researcher firstly, from a locally networked desktop to the server and secondly, from a locally networked computer laboratory to the server. This testing was undertaken to ensure the web-pages were displayed correctly and in the required sequence. This web-page presentation testing was followed by review of the functionality of inputting of data from completed web-

pages into the appropriate columns in the identified table. This functionality was again tested from a networked desktop and the networked computer laboratory. Both functionality tests were successful and the researcher was able to make the instrument location available to a limited local audience for more extensive testing and detailed review.

4.3. Peer Review and Pilot of Web-Pages

This section is focused on the review of the demonstrator environment created for the OLLES instrument. This section is divided into seven interrelated topics. Topic one, participants, describes; the composition of peer review panel established to review the scales and items in the instrument identifies the initial pilot sample and the three expert reviewers of the web-page-database architecture. Topic two, review of scales, addresses the comments the peer review panel made on the 8 scales of the instrument. Topic three, review of items, addresses the comments the peer review panel and pilot group made on the 88 items of the instrument. Topic four, modifications to scales and items, presents the matrix of dimensions, scales and items of the refined instrument. Topic five, review of web-page and database, discusses the visual appeal of the web-pages created and the usability and efficiency of the data based procedures used. Topic six, web-page modifications, describes the significant changes made to the delivery of the instrument as a result of the feedback received. Topic seven, database review, describes how asp scripting was replaced by web-form functionality in the collection of data.

4.3.1 Participants

A 14 member peer review panel was established to review the initial OLLES instrument. The members of this panel were drawn internally from the school of education (3), the online learning centre (2), and online users group (4) and externally from educationalists at distance education providers in New Zealand (3) and learning environment specialists from the Australian institution supervising the authors' doctorate (2). The peer review panel were sent a word document (see Appendix A) which outlined the purpose of the research, the five 5 broad areas of activity that can be identified and described in online learning and a brief overview of learning environment research. They were then asked to review the items and scales and make comments.

Forty eight students undertaking an online supported course in research methods in social sciences were approached to participate in the initial pilot of the instrument. The author was invited by the tutor as a guest facilitator of a two hour face-to-face tutorial providing a brief over view of learning environment research and the concepts of perceptual measures. The last part of the session was a 'hands-on' demonstration of the OLLES instrument in a dedicated computer laboratory. In this laboratory students were provided the link to the form and asked to complete and comment on the dynamic pages in relation to the online activities they had experienced during the online supported sections of their research course.

Three individuals, a multimedia designer and two database developers, with extensive experience in web-page creation and database management from the information and technology services team of the researchers' institution were asked to critically review the visual appeal and usability of the web-pages, the appropriateness of the database structure created, and the efficiency of interactions between the web-pages generated and the connected database.

4.3.2 Review of Scales

The peer review panel examined each of the scales in the measure and suggested both major and minor changes. The panel firstly suggested alterations to individual scale names. For example, it was noted by some members of the panel items in the scale *affective support* were in fact focused on the cognitive support provided by tutors. They suggested the scale name be changed to reflect this. There was general agreement the name *tutor support* was more reflective of the focus of the scale and the name was changed in the refined instrument. They also noted the majority of the items in the scale *student cohesiveness and affiliation* were focused on student collaborative activities. They suggested the scale name be changed to reflect this. There was general agreement the name *student collaboration* was more reflective of the focus of the scale and the name was changed in the refined instrument. The panel also suggested changes to identified scale descriptors, focus and names. For example, to the review panel the scale, *computer anxiety and competence*, attempted to measure two distinct and separate aspects firstly, anxiety and secondly, competence, within a single scale. To meet the panels concerns the scale was renamed, *computer competence*, and associated items for this scale were adjusted to reflect this change

of focus. Similarly the scale, *material environment and rule clarity*, again attempted to measure two distinct and separate aspects within the one scale. Once again the scale was reviewed and the scale was re-focused and renamed, *material environment.* The descriptor now focused on *the extent to which the computer hardware and software were adequate and user friendly*. The associated items for this scale were also adjusted to reflect this change of focus. The panel also noted similarities with parts of the descriptors of the scales *order and organisation* and *information design and appeal* and they suggested the descriptors of both scales be reviewed. To accommodate these suggestions the descriptor for the scale *order and organisation* was changed to, *the extent to which class activities are well organized and assist student comprehension*. The three other scales, *reflective thinking, active learning* and *information design and appeal* remained unchanged.

4.3.3 Review of Items

As well as some minor spelling and grammatical errors both the peer review panel and the pilot group found there were a number of generic inconsistencies in the items presented in the scales. For example, tense inconsistencies such as '*I enjoyed using the Internet as a means of accessing information*' compared with '*I enjoy learning and participating in this learning environment'* were consistent throughout the instrument. All items were reviewed and it was decided the present tense would be used in all items in the refined instrument. The reviewers also felt 'computer-jargon', possibly not clear to all potential participants, was often used. For example, phrases such as the "*web-based learning approach*" and "*locate the web-browser software*". Again all items were reviewed and identified items with computer-jargon were either modified of reviewed. They peer review panel also noted some items attempted to measure more than one distinct activity, they were double-barreled, for example, *the environment is well structured and I found no difficulty in organizing my self*, and I *enjoyed learning and participating in this learning environment and found using the Internet for learning is stimulating* and this could lead to participant confusion. Again all items were reviewed and double-barreled items were either removed or restructured. The review panel and the pilot group also noted duplications of items in the scale such as *I am confident and competent using a range of computer technologies* and *I have no problems using a range of computer technologies.* These duplications were able to be overcome with the creation of

single items such as *I am confident and competent using a computer*. Finally the review panel and the pilot group commented on vagueness of items such as *all material appeared quickly on my screen* and *there was a contents page included that outlined the main points to be presented in each section.* All items were reviewed and 'vague' items were removed or re-focused.

4.3.4 Modifications of Scales and Items

The above reviews of the scales and items enabled the author to refine and restructure the initial measure to 8 scales and 61associated items. The lowest number of items associated with any individual scale was 7 and the highest number of items associated with any individual scale was 9. The matrix below, Table 4.11, provides a descriptive overview of the scales, items and associated dimensions of the refined instrument (full descriptive details of the refined instrument are outlined in Appendix B).

Table 4.11 *Matrix of dimensions, scales and items of the draft OLLES instrument*

Scale	**No of Items**	**Description**	**Item**
Tutor Support [RD]	8	The extent to which the tutor guides students in their learning and provides sensitive, ongoing and encouraging support.	The feedback I receive from my tutor helps me identify the things I do not understand.
Student Collaboration [RD]	8	Extent to which students work together, know, help, support and are friendly to each other.	I communicate regularly with other students in this course.
Reflective Thinking [PDD]	8	Extent to which reflective activities are encouraged and how students enjoyed learning and participating in this environment	I am satisfied with my experience of using the Internet and learning online.
Active Learning [PDD]	7	The extent to which the computer activities support students in they're learning and provide ongoing and relevant feedback.	The feedback I receive from activities/quizzes is meaningful.
Computer Competence [PDD]	8	Extent to which the student feels comfortable and enjoys using computers in the online environment.	I have no problems using a range of computer technologies.
Material Environment [SM &SC]	7	Extent to which the computer hardware and software are adequate and user friendly.	The instructions provided to use the tools within the site are clear and precise.
Order and Organisation [SM &SC]	9	Extent to which class activities are well organized and assist student comprehension.	The learning objectives are clearly stated for each topic.
Information Design & Appeal [SM &SC]	7	Extent to which class materials are clear, stimulating and visually pleasing to the student.	The material presented is visually appealing.

4.3.5 Review of Dynamic Web-Pages and Database

In the initial pilot all students appeared to have the necessary technical abilities and knowledge of web-browser functionality to complete the web-pages with minimal problems. However, as illustrated in Figure 4.3. above, both the preferred and actual forms of the measure were presented simultaneously to the students. The pilot group, through the use of the text box provided (see Appendix B) and queries asked of the developer in the testing phase, were not clear on the differentiation of the actual and preferred forms and why they were both being measured simultaneously. In essence participants were confused taking extra, and to them, unnecessary time reflect on what 'preferred' and 'actual' meant during the answering of each individual item. The multi-media developer questioned the physical placement of items requiring participants to select items from both the left and the right parts of the screen. As well as being inefficient it could lead to increased non-response to items, either on the left or right, as student scrolled down the screen to answer other items. To reduce this confusion and potential of non-response it was decided, in the full field testing of the refined instrument, to investigate students' perceptions of their actual environment only. The multi-media developer also queried the efficiency of delivering the instrument in so many pages. These queries were re-enforced by participants' frustrations by the perceived length of the instrument. These frustrations and queries appeared to be caused by the presentation of the instrument in 11 separate pages (2 for the introduction, 8 to present the individual scales and 1 for confirmation). To address these frustrations it was decided in the field testing of the refined instrument to present the measure in only three sections. Finally, the multi-media developer also commented on the visual appeal of the form. To the developer them form was created with limited attention to the use of colour with red, black, yellow and white all being used indiscriminately. To address these concerns the template of the refined OLLES instrument was reviewed and redesigned. A designed margin was created and various shades of blue (from dark to pastel) were consistently used throughout the instrument.

4.3.6 Modifications to Web-Pages

The above reviews of the dynamic web-pages enabled the author to refine the visual appeal of the initial instrument and restructure the delivery of the individual pages. In the presentation of the refined OLLES instrument for field testing participants would review three pages and these pages would seek students' perceptions of their actual environment only. The variations of pages one (introduction and informed consent) and three (conformation and thank you) from the original instrument were generally limited to improving visual appeal of the pages and no significant changes to the method of delivery or information presented were made. However, the variations to page two (instructions and data-collection), were significant. Firstly, instead of instructions on the use of drop-down menus and the provision of an explanation for the term *actual* being presented on a separate web-page, these instructions and the explanation were integrated at the start of this data-collection page. See Figure 4.7.

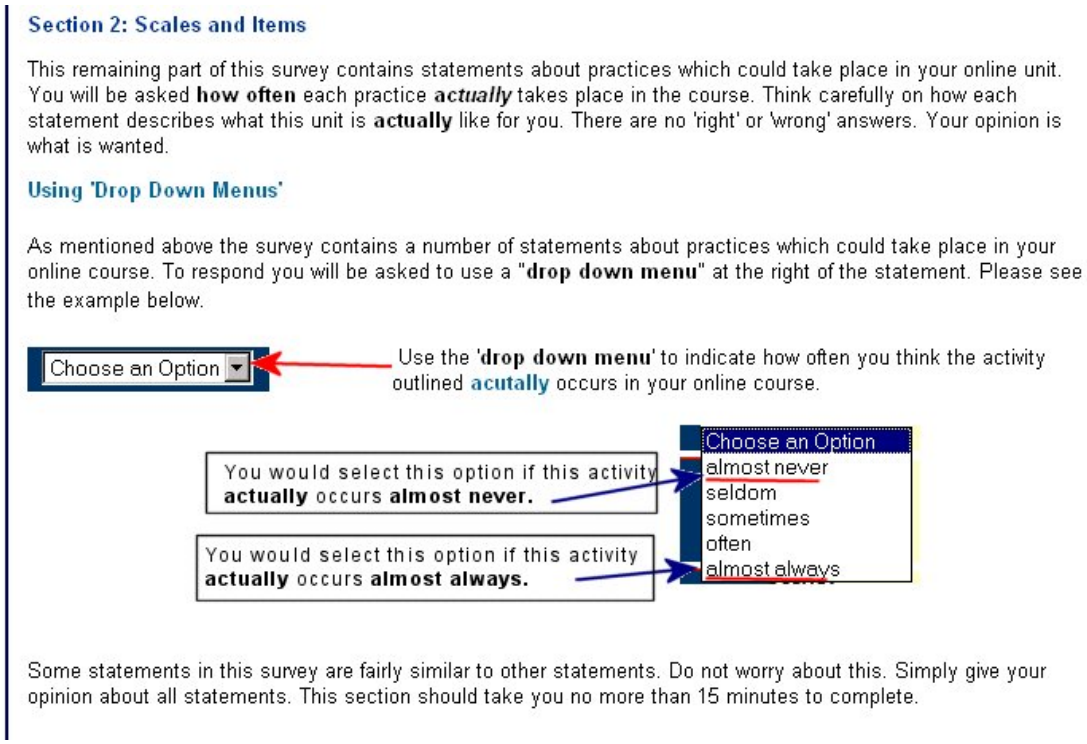


Figure 4.7. Web-page instruction section of the refined OLLES

Secondly, instead of presenting a separate web-page for each of the individual scales, all of the scales and associated items were presented sequentially within this single data-collection page. The refined instruments' focus on the investigation of participants' perceptions of their actual environment only was also reflected in the restructuring of this page. See Figure 4.8.

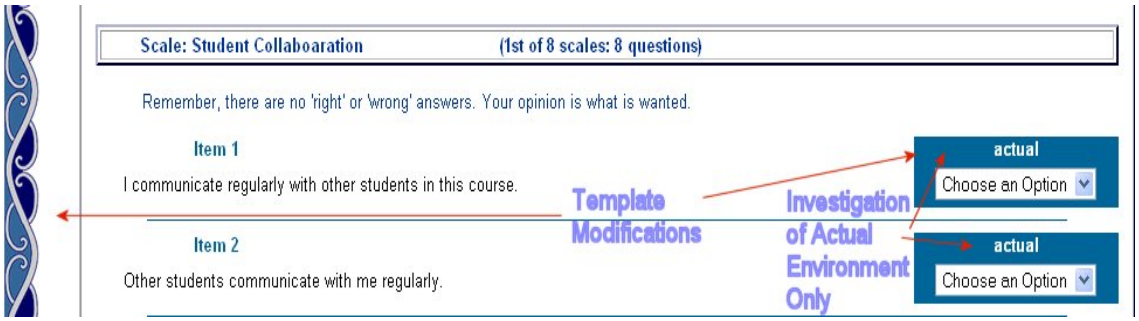


Figure 4.8. Presentation of scales in the refined OLLES web-page

Finally, instead of 8 separate "clickable" data-entry buttons being presented to participants the restructuring of the data-collection page meant only one "clickable" action was needed to submit all the data to the associated database. See Figure 4.9.

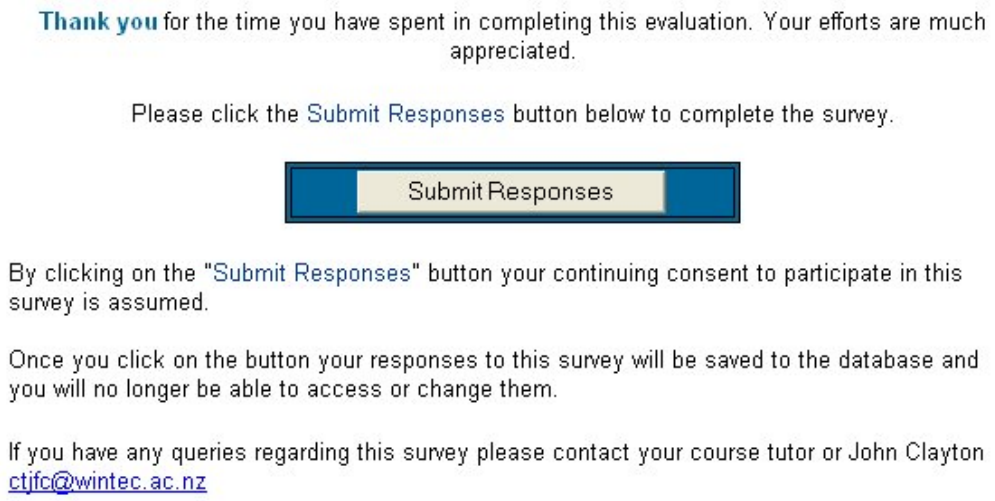


Figure 4.9. Submission of data from the refined OLLES web-page

4.3.7 Review of Database Structure and Procedures

In the review of the web-pages the multi-media developer noted pages had been created as active server pages (asp). He questioned if the OLLES form was to be modified by people with only basic word processing skills, if the creation of the pages in this manner would allow ongoing modification of the pages by this target group. In essence he noted while the pages could be modified in sophisticated HTML authoring applications the technical skills required to ensure the pages functioned appropriately in a real-time environment could be beyond the basic skills of most instrument developers. These comments were re-enforced by the database experts who noted modifications to the actual number of items presented to participants in

the dynamic web-page meant the corresponding tables and columns in the database created had to be manually re-configured. They regarded this as inefficient and time consuming. They also noted the server used to collect and redistribute the data collected must support asp scripting language and any changes to the measure required a basic knowledge of this asp scripting language. These comments from the multi-media developer and the database experts indicated the OLLES form was potentially technology bound by a specific scripting language and database. In essence the OLLES instrument and associated database would not be easily ported to other systems and would be hard to modify.

To overcome these issues it was suggested by the database experts the measure could be created as normal HTML pages using the functionality of *web-forms* to collect the data. This meant the data would be collected in a comma separated values text file (csv). These csv files could then be directly exported to, or imported by a number of software and statistical software application packages. Since the data-collected would be handled by a form-processor located on the server, the comma separated value nature of the data-collected would automatically generate the table and column structure of the database to be used. This would eliminate the need for continual manual configuration of the OLLES database if the number of items used in the measure was altered. In the database experts' opinion individual developers would only need to be aware of the URL of the form-processor on the server and would not need in-depth knowledge of specialised scripting languages. In essence the use of web-forms and associated form-processors would reduce the technological literacy costs of individual developers, ensure modifications to the database structure would always be linked by changes to the HTML web-form and a range of form-processors located in different server-environments could be used in the deployment of the measure. Since these suggestions would increase the portability of the OLLES measure while reducing the technological literacy costs of developers they were adopted and implemented in the refined data-collection and storage in the field testing of the measure.

4.4 Summary of Phase One

This chapter began by reporting on the identification of 8 scales and 88 individual items to construct the initial OLLES instrument. The matrix produced indicated the

instrument covered the five identified activities of online learning environments and provided sufficient coverage of Moos' three social climate dimensions. This initial instrument was then sent to a peer review panel for their comments and suggestions. The chapter then described how user friendly "what you see is what you get (WYSIWYG)" software application FrontPage was used to construct the 11 individual web-pages of the OLLES instrument. It also described how the web-pages generated helped shape the structure and operation of the associated connected database. Limited testing of the delivery of the instrument and the functionalities of the associated database within a demonstrator environment encouraged the researcher to begin limited testing with a small group of research students.

The peer review panel made both minor and major changes to the initial instrument. Scales were renamed and refocused and individual items were clarified and sometimes deleted. The refined instrument of 8 modified scales and 62 items was described in a second matrix. The pilot testing of the instrument and the review of the web-page-database architecture by a panel of experts generated the most significant changes. The confusion created by the simultaneous presentation of both the preferred and actual forms was eliminated by the decision to investigate only students' perceptions of their actual environment. This also addressed the multi-media developers concerns about potential non-response to items. The potential frustrations caused by the delivery of the instrument as 11 separate pages were addressed by the presentation of the instrument in 3 pages, introduction, data-collection and confirmation. To increase the instruments' portability (the ability to be re-used in a number of operating environments) and to reduce the technological literacy costs for instrument developers' it was decided to use the functionality of web-forms and the associated form processor to collect data and to automatically shape the associated database.

With the refinement of the scales and items, the recreation of the web-pages and database the instrument was ready for more extensive field testing. This result of this field testing is reported in the next chapter data analysis and results: phase two; construct validity.

Chapter 5: Phase Two, Construct Validity, Discussion and Results

This chapter reports on the range of activities undertaken in phase two of the research project; construct validity. The chapter is divided into five broad sections and associated sub-topics. Section one, preliminary field testing, reports on preliminary activities undertaken to test the web-form presentation and data-collection functionality of the online form. In this section preliminary investigations undertaken to gauge the quality of the instrument and the potential reduction of the number of items within the measure, are explained. Section two, report on field testing of the OLLES, describes the sample and the processes and procedures used in analysing the data. It concludes by confirming that the 49-item OLLES instrument is structurally sound and reliable. Section three, discussion of refined version of the OLLES, reviews individual scales and comments on the trends the data exposed. During this phase apparent duplicate items, investigating similar interactions, were identified for further review. Section four, tentative modifications to the OLLES instrument, identifies duplicate items and, through further factor analysis, concludes a more concise 35-item version of the OLLES appears to be structurally sound and reliable. Section five, summary, reviews the activities and actions undertaken during this phase of the research.

5.1 Preliminary Field Testing

This section is divided into five topics. The first, web-form functionality testing, describes the preliminary testing undertaken to confirm the web-form functionality under a range of conditions and simultaneous use. It also explains how a preliminary sample was selected to test the robustness of the form and the quality of the measure. Topic two, the preliminary sample, briefly describes the characteristics of the sample. Topic three, data analysis and discussion of individual items, reviews the procedures undertaken to reduce the number of items in the measure and comments on the reliability of the refined measure. Topic four, data analysis and discussion of reliability and validity, reviews the internal reliability and discriminant validity of the instrument. Topic five, review, confirmed the refined instrument could be used in more extensive testing.

5.1.1 Web-Form Functionality Testing

When the draft OLLES instrument had been refined and the data-collection procedures using the web-form processor had been established, a real-time production environment linked to the Internet was created. This production environment consisted of two folders, folder one contained the three individual pages of the instrument and folder two contained the storage area for the comma-separated values text data files (CSV) generated on participant submission. A series of technical tests was conducted by the researcher firstly, from a normal office desktop and secondly, from an Internet-enabled computer laboratory. This operational testing was undertaken to ensure the web-pages were displayed in a visually-pleasing manner in the required sequence. This web-page presentation testing was followed by a review of the functionality of the data collection from completed web-pages into the appropriate CSV file. Both the presentation and functionality tests were successful and the instrument's Internet location could now be made accessible from distributed locations. However, to ensure there were no operational, technical or data-collection issues when multiple participants accessed the form simultaneously from distributed locations, the researcher decided initially to limit the accessibility of the instrument and to conduct a rigorous pilot of the measure and data-collection process. Learning environment researchers have often used the results of such pilot studies to report on progress (Clayton, 2004; Walker, 2002) or to investigate the quality of the questionnaire (Chang & Fisher, 1999; Clayton, 2005). It was decided the data collected in this functionality testing would be used to check the quality of the questionnaire and make minor refinements if appropriate.

The researcher made an e-mail approach to two tutors from the researcher's institution, one tutoring in a diploma in information technology and the other in a bachelor degree in health studies, and, additionally, one entry-level business studies tutor from a private tertiary institution in Auckland. The e-mail outlined the purpose of the study, the anticipated time-frame, anticipated participant time commitment and provided the link to the pilot form. Tutors were requested to report on any major issues participants encountered during the completion of the survey. All three tutors agreed to participate and proceeded to employ the notice/news function of their course to inform students of the research particulars.

5.1.2 The Preliminary Sample

The Internet link to the survey was closed after seven days and 103 participants had completed the draft version of the OLLES with no reported problems. There appeared to be a slight gender bias in the sample with 62 of the respondents being female and 41 male, this could be attributed to the predominance of females undertaking the health studies degree. The age range of the sample was reasonably spread from 15 years to over 50 years with no age group being in the majority, see Figure 5.1.

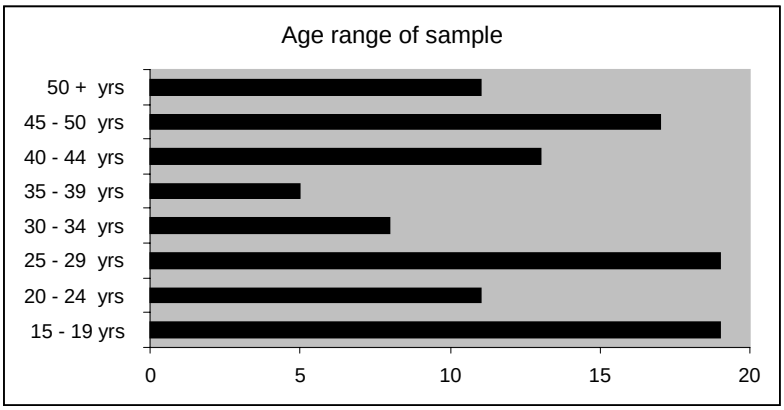


Figure 5.1. Number and age range of students in the preliminary study

The technological literacy of the samples could be considered to be excellent with a significant majority (74) accessing the Internet on a daily basis and the entire sample accessing the Internet at least once a week, see Figure 5.2.

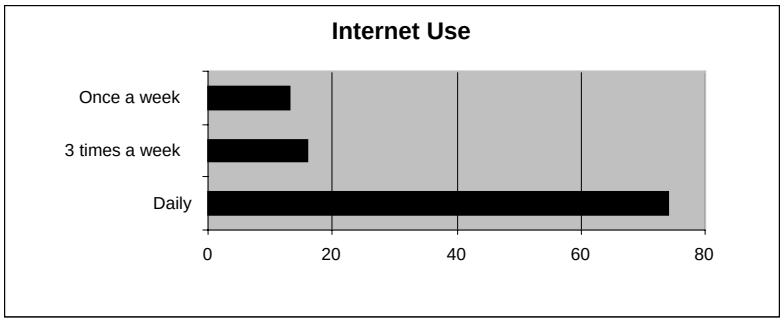


Figure 5.2. Availability and use of the Internet in the preliminary study

5.1.3 Data Analysis and Discussion of Individual Items

In the draft version of the instrument presented for field testing, three of the scales (Active Learning, Material Environment and Information Design and Appeal) were

made up of seven items while the remaining five scales had greater than seven items, (Tutor Support 8, Student Collaboration 8, Computer Competence 8, Reflective Thinking 8, and Order and Organisation 9). In order to present the scales and items in a consistent manner, to ensure economy in participants' completion time of the questionnaire and to reduce the number of variables to be explored, it was decided to review the number of items in the scales, Student Collaboration, Computer Competence, Reflective Thinking and Order and Organisation, to ascertain if the number could be reduced to seven without compromising the integrity and quality of the measure.

The review involved three steps. Firstly, using the CORREL function of Microsoft Excel, each item in the identified scales was compared with all items simultaneously. The resulting correlation highlighted potentially-weak items, as illustrated in Table 5.1 below where the item RDSCA 8, *All students in this course get on well together*, was significantly weaker than the other items in the scale.

Table 5.1 *Example of correlation table identifying potentially redundant items*

RDSCA1	*RDSCA2*	*RDSCA3*	*RDSCA4*	*RDSCA5*	*RDSCA6*	*RDSCA7*	***RDSCA8***
0.77	0.82	0.64	0.78	0.74	0.72	0.63	***0.43***

The second step involved using the statistical software application package STSTAT 11 to create a correlation matrix, then to subsequently use the transpose functionality to generate an inter-item correlation matrix, using the mean correlation of an item with the remaining items as a convenient index. The resulting matrix highlighted potentially-weak items as demonstrated in Table 5.2, where the item PDDCAC 5, *I know what to do if a computer 'error message' occurs during my learning*, was relatively weaker than the other items in the scale.

Table 5.2 *Inter-item correlation matrix: Computer competence*

PDDAC1	*PDDAC2*	*PDDAC3*	*PDDAC4*	***PDDAC5***	*PDDAC6*	*PDDAC7*	*PDDAC8*
	0.59	0.62	0.54	0.45	0.50	0.44	0.43
0.59		0.45	0.47	0.33	0.59	0.48	0.32
0.62	0.45		0.52	0.26	0.66	0.45	0.54
0.54	0.47	0.52		0.53	0.43	0.46	0.39
0.44	0.33	0.26	0.53		0.21	0.25	0.15
0.50	0.59	0.66	0.43	0.21		0.38	0.45
0.44	0.48	0.45	0.46	0.25	0.38		0.55
0.43	0.32	0.54	0.39	0.15	0.45	0.55	
0.51	0.46	0.50	0.48	***0.31***	0.46	0.43	0.40

Finally, again using the statistical software application package STSTAT 11, the Cronbach Alpha of the scale with seven items and with more than seven items, was compared, to ensure the removal of identified items did not affect the reliability of the scale and ultimately the measure. For example, in the scale O*rder and Organisation*, the Cronbach Alpha on 9 variables was 0.90 and the Cronbach Alpha on seven variables was 0.89. Since the removal of the items did not significantly affect the reliability of the scale, the items identified were removed from the scale. The items removed from the identified scales, the initial and the adjusted Cronbach's Alpha is illustrated in Table 5.3

Table 5.3 *Redundant items and Cronbach Alpha comparisons*

Scale	**Initial Alpha**	**Items removed**	**Adjusted Alpha**
Computer Competence	0.85	I know what to do if a computer 'error message' occurs during my learning.	0.86
Student Collaboration	0.85	All students in this course get on well together.	0.86
Tutor Support	0.86	I have the autonomy to pose questions for the whole group to respond to.	0.85
Order and Organisation	0.90	I am able to easily find help on terms or concepts I do not understand.	0.89
		There is a glossary included that reviews key terms and concepts and helps me understand the topic.	
Reflective Thinking	0.88	I feel a sense of satisfaction and achievement about this learning environment.	0.88

(*N= 103)*

5.1.4 Data Analysis and Discussion of Reliability and Validity

In checking if, firstly, each item within the same scale is assessing a common construct - internal consistency - and secondly, each scale within a measure is assessing a separate construct - discriminant validity - learning environment researchers follow two common procedures (Aldridge, et al, 2004; Chang & Fisher, 2001; Clayton, 2005; Fisher, et al, 2001; Lian, et al, 2006; Wahyudi & Treagust, 2004; Walker, 2003; Walker & Fraser, 2005). The Cronbach Alpha reliability coefficient is generally used as an index of scale internal consistency and a

convenient discriminant validity index (namely, the mean correlation of a scale with other scales) is used as evidence the scale measures a separate dimension distinct from the other scales in this measure. These procedures were used in the analysis of data from the OLLES initial field test and the results are detailed in Table 5.4

Table 5.4 *Internal consistency and discriminant validity scores for the exploratory measure*

Scale	**Items**	**Discriminant Validity**	**Alpha Reliability**
Computer Competence	7	0.15	0.86
Material Environment	7	0.32	0.79
Student Collaboration	7	0.06	0.86
Tutor Support	7	0.38	0.85
Active Learning	7	0.35	0.90
Order and Organisation	7	0.39	0.89
Information Design and Appeal	7	0.36	0.88
Reflective Thinking	7	0.10	0.88

(*N= 103)*

The alpha for the scale, Active Learning (at 0.90), could be considered to be excellent. The alpha for the scales Information Design and Appeal, Reflective Thinking, Tutor Support, Student Collaboration, Order and Organisation, and Computer Competence (all above 0.80), could be considered to be good. The remaining scale, Material Environment (alpha above 0.75), could be considered acceptable. The discriminant validity results for three of the scales, Reflective Thinking, Student Collaboration and Computer Competence (all below 0.16); indicate these scales appear to be measuring distinct aspects of the learning environment. The discriminant validity results for the five remaining scales, ranging from 0.32 to 0.39, indicate the scales appear to be measuring distinct but somewhat overlapping elements of the learning environment.

5.1.5 Review

It is recognised high internal reliability, as demonstrated by the Cronbach Alpha reliability coefficients, and acceptable discriminant validity scores does not necessarily mean there is an assurance of high-quality results obtained by using a

refined OLLES instrument. However, the results are pleasing and encourage more extensive testing. The results of this extensive testing are detailed below.

5.2 Report on Field Testing of the OLLES

This section is divided into five topics. The first, soliciting participation, describes the techniques used in soliciting responses to participate in the study. It also explains the mixed response, to the researcher at least, to the request for participation. However, the number of responses to the study was deemed sufficient to continue further analysis. Topic two, the sample, describes the characteristics of the sample. Topic three, statistical procedures, as well as confirming statistical procedures used, describes in more detail the two types of factor analysis, orthogonal (varimax) and oblique (oblimin), selected for this study. Topic four, reliability and validity of the OLLES instrument, reports on the findings of the statistical analysis undertaken, reviews the procedures undertaken to reduce the number of items in the measure and comments on the reliability of the refined measure. Topic five, limitations and review, acknowledges the limitations of the data collected and reviewed but concludes the refined instrument could be used with some confidence if appropriate procedures are followed.

5.2.1 Soliciting Participation

The researcher made an e-mail approach to a number of tutors within higher educational institutions who were known to employ online learning in their courses. The e-mail contact outlined the purpose of the study, the interactions to be investigated, the anticipated time-frame, anticipated participant time commitment, assurance all data collected would remain confidential and the URL link to the OLLES form. Responses to the e-mail were mixed. Firstly, although some tutors were willing to participate, institutional ethical consent was required before they could make the form available to students. As one respondent noted, the time frame for the research would have been long-closed by the time the ethical committee granted permission. Secondly, it appeared that some tutors were under pressure from their employing institutions to increase the number of research outputs. They were using their online courses to generate data in the investigation of a number of topics and did not want their groups to be “over researched”, as one reply noted. Thirdly, a number of tutors did not feel their course was sufficiently dependent on web-tools;

they supplemented courses with face-to-face block sessions or regularly scheduled tutorials, and were hesitant about the quality of data participants would generate. However, a core group of tutors, based in three institutions in New Zealand and one institution in Australia, agreed to participate. The specific disciplines involved were education students studying towards a graduate diploma in information technology, midwifery nurses and sports science students studying anatomy and physiology, tourism students studying various global destinations, communication students studying writing fundamentals and entry level business students studying accountancy.

In learning environment research, the numerical size of the sample used to validate the instrument is inevitably variable. For example sample size can range from a thousand or more (Dorman, 2003; Nix, Fraser, & Ledbetter, 2005; Zandvliet & Fraser, 2005), between five hundred and thousand (Dhindsa & Fraser, 2004; Teh & Fraser, 1993; Walker & Fraser, 2005), between two and five hundred (Fisher, et al, 2001; Johnson & Stevens, 2001) and less than two hundred (Elen & Clarebout, 2001; Maor & Fraser, 1993). In recent studies of digital learning environments a sample size of 325 was used in the validation of a measure investigating online activities (Trinidad, et al, 2005), a sample of 334 was used in the preliminary validation of a measure investigating features of web-based learning (Chang & Fisher, 2001) and a sample of 261 was used in investigating higher education students' perceptions of their class web-site (Siragusa, 2005). Therefore, although the response to the survey was regarded as mixed by the researcher, the 284 respondents were deemed sufficient to draw attention to potential advantages/barriers of the online learning environment and to allow tentative conclusions to be drawn about the reliability and validity of the scales and individual items used in the OLLES instrument and the method of instrument administration and data collection.

5.2.2 The Sample

The data collected contained 294 rows of responses, however 10 of the rows contained limited or no response, (i.e. at least 60% of the items were not completed). These were regarded as unsolicited responses and were deleted from the final sample. Of the 284 rows of responses remaining some items had not been completed (216 non-responses to the 15,848 identified responses) and the mean of the item was used as a substitution for the non-response. There appeared to be a significant

gender bias in the sample, with 184 of the respondents being female and 100 male and this could be partially attributed to the predominance of female participants undertaking the midwifery courses.

The age range of the sample was reasonably spread from 15 years to over 50 years with no age group being in the majority, see Figure 5.3.

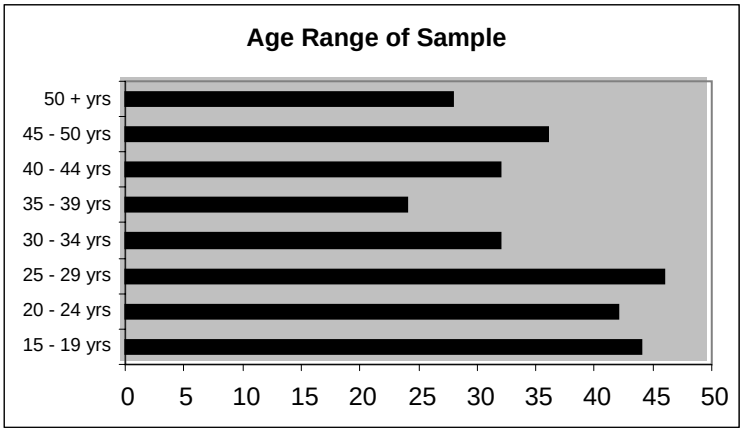


Figure 5.3. Number and age range of students in the final study

The Internet skills of the sample could be considered to be excellent with a significant majority (190) accessing the Internet on a daily basis and the entire sample accessing the Internet at least once a week, see Figure 5.4

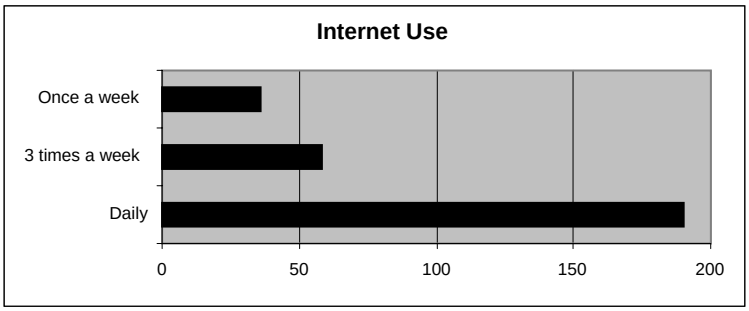


Figure 5.4. Availability and use of the Internet in the final study

Similarly, the computer skills of the sample could be considered to be excellent with a significant majority (222) using computers on a daily basis and the entire sample using a computer at least once a week, see Figure 5.5.

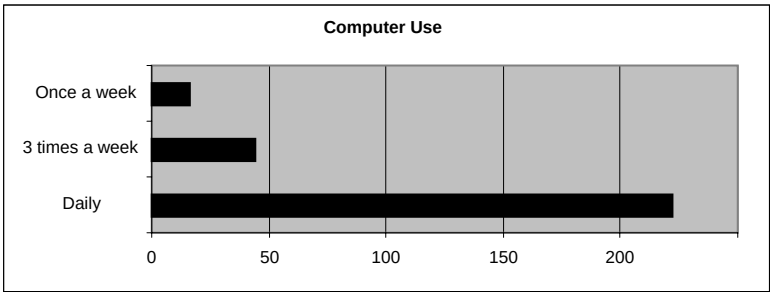


Figure 5.5. Availability and use of computers in the final study

While a significant minority (104) of the sample accessed their course on a daily basis, a similar minority (100) could be considered as infrequent users accessing their course either weekly or monthly, see Figure 5.6. This could be partially attributed to some of the courses being blended offerings (i.e. a combination of face-to-face sessions with block online activities).

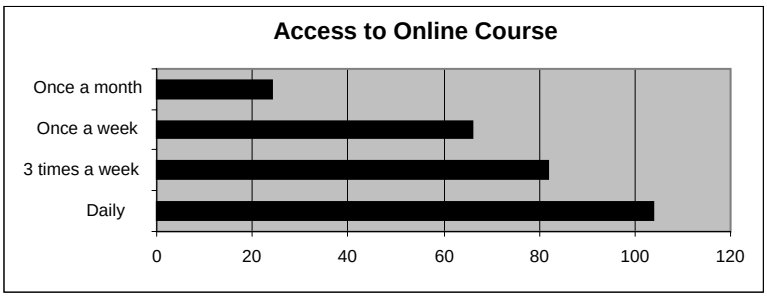


Figure 5.6. Access of learners to online course in the final study

5.2.3 Statistical Procedures

Factor analysis is undertaken to identify and describe the pattern of co-relationships between variables, (i.e. detect structure), and to investigate the reduction of the number of variables and associated data collected (StatSoft, 2003). Principal Components Analysis (PCA), a technique used to transform the number of correlated variables to a smaller number of uncorrelated variables called *principle components*, is a common mathematical procedure used in factor analysis (Visual Statistics, 2006). To increase the interpretability and usefulness of the factors identified, learning environment researchers often *rotate* the axes orthogonally or obliquely. Orthogonal analytic rotation methods, in which the factor axes are kept at right angles to each other (coordinates are equal to 90 degrees), could be regarded as the most common rotational method used. The most popular appears to be varimax rotation (Fisher, et al, 2001; Majeed, Fraser, & Aldridge, 2002; Nix, et al, 2005;

Zandvliet & Fraser, 2005) although equimax rotation has also been used (Dorman & d'Arbon, 2001). Oblique analytic rotation methods, in which the factor axes are not kept at right angles to each other (coordinates are not equal to 90 degrees), are not as common as orthogonal methods but, when used, the most popular appears to be oblimin rotation (Johnson & Stevens, 2001; Trinidad, et al, 2005; Walker, 2003).

As well as selecting the most appropriate factor analytical rotation technique to be used, learning environment researchers also need to clarify the factor loading used in the retention of items and scales. In learning environment research the value of factor loadings used is variable. For example, factor loadings of between 0.30 and 0.35 of items on their *a priori* scale and no other scale were acceptable in some studies (Dorman & d'Arbon, 2001; Johnson & Stevens, 2001; Majeed, et al, 2002), while other studies argued factor loadings below 0.50 were unacceptable (Walker, 2003). It appeared a large number of learning environment studies have worked within these two ranges and regarded a factor loading of 0.40 for an item on their *a priori* scale and no other scale, as acceptable (Dorman, 2003; Fisher, et al, 2001; Nix, et al, 2005; Zandvliet & Fraser, 2005).

As mentioned in section 5.1.4, in checking if firstly, each item within the same scale is assessing a common construct, internal consistency, and secondly, each scale within a measure is assessing a separate construct, discriminant validity, learning environment researchers follow two common procedures. The Cronbach Alpha reliability coefficient is generally used as an index of scale internal consistency and a convenient discriminant validity index (namely, the mean correlation of a scale with other scales) is used as evidence scale measures a separate dimension distinct from the other scales in this measure.

In the analysis of data for the OLLES instrument firstly, two PCA rotational techniques, orthogonal (varimax) and oblique (oblimin), using an identified factor loading of 0.40, are employed and secondly, the internal consistency and discriminant validity of the scales is reported on.

5.2.4 Reliability and Validity of the OLLES Instrument

Because the OLLES instrument had been designed using an eight scale structure, during the initial data analysis an eight factor solution was initially explored. This eight factor solution appeared to be a logical fit to the data investigated. A review of the identical scree plots and eigenvalues, generated by SYSTAT 11 in varimax and oblimin rotation, confirmed this factor solution was acceptable. Factor eight had an eigenvalue of 1.61 and, using the Cattell scree test, was visually above the *factorial scree* or *debris* (StatSoft, 2003), see Figure 5.7.

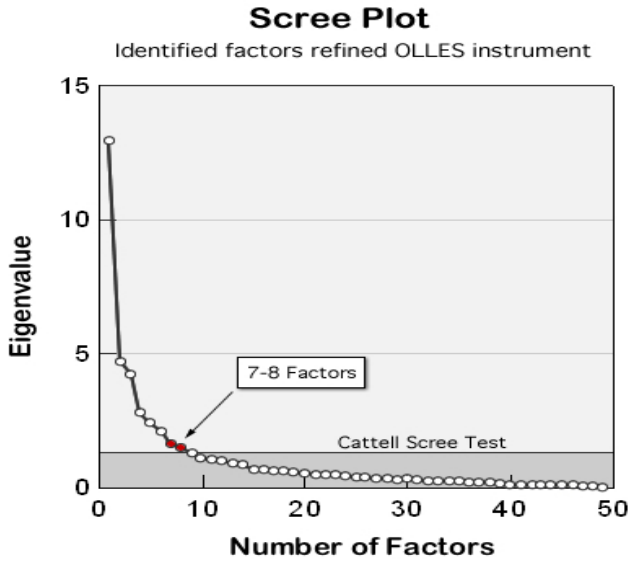


Figure 5.7. Scree plot for varimax and oblimin rotations the refined OLLES

However, when reviewing the factor loadings generated by SYSTAT 11, the loadings for the scale O*rder and Organisation* did not easily or readily group together, instead its loadings appeared to be 'scattered' over a number of factors as well as on its *a priori* factor. While it was possible to retain some identified items (3) it was felt the low number of items would make this scale redundant and the scale was eliminated from future analysis. Further factor analysis was undertaken and since the instrument was re-designed using a seven scale structure, a seven factor solution was explored. The removal of the items of the identified scale Order and Organisation confirmed, in both oblimin and varimax rotations, the refined 49-item instrument was structurally sound, see Tables 5.5

Table 5.5 *Factor loadings (oblimin and varimax rotations) for 49-item OLLES*

TS		**CC**		**SC**		**AL**		**RT**		**ID**		**ME**		
Ob	**Va**	*Ob*	**Va**	*Ob*	**Va**	*Ob*	**Va**	*Ob*	**Va**	*Ob*	**Va**	*Ob*	**Va**	
Ob= Oblimin Rotation				0.80	0.79							Varimax Rotation= **Va**		*SC1*
				0.83	0.82									*SC2*
				0.68	0.68	Student Collaboration (SC)								*SC3*
				0.76	0.75									*SC4*
				0.76	0.75									*SC5*
				0.72	0.73									*SC6*
				0.69	0.70									*SC7*
		0.85	0.85											*CC1*
		0.79	0.80											*CC2*
		0.71	0.73	Computer Competence (CC)										*CC3*
		0.74	0.73											*CC4*
		0.66	0.69											*CC5*
		0.78	0.78											*CC6*
		0.61	0.62											*CC7*
						0.82	0.79							*AL1*
						0.90	0.86							*AL2*
						Active Learning (AL) 0.90	0.86							*AL3*
						0.79	0.76							*AL4*
						0.68	0.69							*AL5*
						0.73	0.73							*AL6*
						0.83	0.81							*AL7*
0.77	0.79													*TS1*
0.63	0.67													*TS2*
0.37	**0.46**	Tutor Support (TS)											**0.46**	***TS3***
0.62	0.65													*TS4*
0.74	0.76													*TS5*
0.53	0.57													*TS6*
0.62	0.64													*TS7*
										0.61	0.61			*ID1*
										0.62	0.61			*ID2*
										Information Design and Appeal (ID) 0.78	0.76			*ID3*
										0.78	0.77			*ID4*
										0.72	0.71			*ID5*
										0.67	0.66			*ID6*
										0.80	0.78			*ID7*
												0.38	**0.45**	***M1***
												0.41	0.43	*M2*
								Material Environment (M)				0.72	0.72	*M3*
												0.42	0.47	*M4*
												0.57	0.59	*M5*
												0.70	0.71	*M6*
												0.52	0.57	*M7*
								0.59	0.61					*RT1*
								0.60	0.61					*RT2*
								0.70	0.71					*RT3*
								Reflective Thinking (RT) 0.61	0.63					*RT4*
								0.79	0.77					*RT5*
								0.80	0.77					*RT6*
								0.66	0.69					*RT7*

The table highlights only two items (M1 and TS3) in which the factor loadings show some discrepancies. M1 in the factor loadings for oblimin rotation is slightly below the threshold of 0.40 but in the varimax rotation is above this threshold. TS3 in the varimax rotation loads highly (0.46) on another factor other than its *a priori* factor, but in oblimin rotation this loading disappears. In order to retain consistency during this phase of the analysis, it was decided to retain both factors. This decision is reviewed in Section 5.4. The factor loadings and percentage of variance for both oblimin and varimax rotations were exactly the same as shown in a single Table 5.6

Table 5.6 *Varimax and oblimin rotation Eigenvalues and percentage of variance accounted by each factor*

Factor	Cumulative EV	Eigenvalue	% of Variance	Cumulative %
1	12.92	12.92	26.36	26.36
2	17.60	4.68	9.55	35.91
3	21.84	4.24	8.66	44.57
4	24.64	2.80	5.70	50.27
5	27.05	2.42	4.93	55.20
6	29.17	2.12	4.32	59.53
7	30.85	1.68	3.42	62.95

The cumulative variance of all of the seven scales is 62.95% and, while 37.05% of the variance is unaccounted, this cumulative variance total is consistent with the reports of variance of other learning environment research studies (Dhindsa & Fraser, 2004; Fisher, et al, 2001; Trinidad, et al, 2005; Walker, 2003). Reducing the instrument to 49-items and 7-scales provides an efficient and economical tool to measure online learning environments. However, it is recommended that a factor analysis is conducted in other studies using the OLLES instrument in order to demonstrate that the findings presented here can be replicated. It is also recommended a review of further tentative modifications to the instrument, outlined in Section 5.4 of this chapter, be undertaken before the instrument is used extensively.

As mentioned in Section 5.1.4 of this chapter, ensuring each item within the same scale is assessing a common construct and each scale within a measure is assessing a separate construct, discriminant validity and Cronbach Alpha scores are recognised

measures in learning environment research. The coefficient and discriminant validity scores for the extensive field testing of the instrument are detailed in Table 5.7

Table 5.7 *Internal consistency and discriminant validity scores for the OLLES*

Scale	**Items**	**Discriminant Validity**	**Alpha Reliability**
Computer Competence	7	0.18	0.88
Material Environment	7	0.38	0.79
Student Collaboration	7	0.10	0.87
Tutor Support	7	0.39	0.89
Active Learning	7	0.37	0.94
Information Design and Appeal	7	0.35	0.89
Reflective Thinking	7	0.38	0.88

(*N= 284)*

The alpha for the scale, Active Learning (at 0.94), could be considered to be excellent. The alpha for the scales Information Design and Appeal, Reflective Thinking, Tutor Support, Student Collaboration, Order and Organisation, and Computer Competence (all above 0.80), could be considered to be good. The remaining scale, Material Environment (alpha above 0.75), could be considered acceptable. The discriminant validity results for two of the scales, Student Collaboration and Computer Competence (all below 0.20), indicate these scales appear to be measuring distinct aspects of the learning environment. The discriminant validity results for the five remaining scales, ranging from 0.35 to 0.39, indicate the scales appear to be measuring distinct but overlapping elements of the learning environment and are considered acceptable (Koul & Fisher, 2005; Zandvliet & Fraser, 2005).

5.2.5 Limitations and Review

In presenting the validation and reliability results for the OLLES instrument it must be acknowledged, as Walker, (2003) has done, that the procedures explained do not exactly match those followed in previous learning environment instrument developments and validations. This is caused in part by the initial collection of data where individual's responses, but not the individuals' responses as part of an identified class group, were captured. In essence, the sample was web-based and, since responses were solicited from a potentially unlimited group, the sample was not

as well-defined as with conventional samples drawn from identified class groups. In previous research, class data have been used to enrich the findings investigating the degrees of similarity and difference between two units of statistical analysis, that of the individual student and that of the class mean. Such analysis was not undertaken in this research. It must also be noted that the responses were from self-selected participants with a potential affinity towards web-based/online learning environments. Those students who might not have the same affinity to web-based/online learning may have chosen not to respond. Therefore, the results of the study should be treated with particular care.

However, the analysis conducted thus far is sufficient to draw tentative conclusions about the reliability and validity of the scales and individual items used in the OLLES instrument and the method of instrument administration and data collection. It would appear from preliminary analysis, the refined 7-scale, 49-item OLLES instrument will allow conclusions to be drawn about student perceptions of the interactions occurring in their online environments, in an economical and efficient manner.

5.3 An Initial Application of the OLLES

This section is divided into nine topics. The first, overview, describes how the individual items and scales that constitute the measure are explored. It also provides statistical details for the measure as a whole, concluding respondents were positive regarding their online experience. Topics two to eight follow an exact pattern, in that a table is presented providing brief descriptive statistics for each individual item and scale and comments on these statistics are made. Topic nine, review, concludes the apparent duplicate investigations of similar interactions by two or more scales that warrant further investigation.

5.3.1 Overview

Structurally, the reporting of this section follows a pattern established by Siragusa, (2005) when reporting on students' perceptions of their course web-site. Siragusa presented a table of brief descriptive statistics for each individual item response, the mean, standard deviation and the value of the Pearson product-moment correlation coefficient between the item and the scale score. A line graph showing the

distribution of means for each question was also produced. This report has attempted to enhance this initial structure by the inclusion of comments on the significance of the data generated and, in this regard, could be seen to be following a reporting pattern used by Chang and Fisher (2001) in the discussion of web-based learning environments.

Generally, in analysing the data, mean scores of greater than 3 should be considered as positive and indicate the majority of respondents' perceived practices to this item to be occurring more than 'Sometimes' and in the positive direction of 'Almost Always'. Conversely, mean scores of less than 3 should be considered to be negative as these practices are viewed as occurring less frequently than 'Sometimes' and in the negative direction of 'Almost Never'. If the scale means are high, and standard deviations are low, there is an indication that the samples responses to the items may not provide sufficient discrimination. Kurtosis indicates the degree of "peakedness/flatness" in the variable distribution, and skewness is a measure of the degree of symmetry in the variable distribution. In essence, negatively skewed scores indicate a positive distribution, in the direction of 'Almost Always'. Positive kurtosis values indicate the degree of 'peakness' in the scale. The average mean, mode, kurtosis, skewness and standard deviation are presented in Table 5.8

Table 5.8 *Scale mean ranges, mean, mode, kurtosis, skewness and standard deviation from field testing of the OLLES*

Scale Name	**Items**	**Low Score**	**High Score**	**Mean**	**Mode**	**s.d.**	**Kurtosis**	**Skewness**
Computer Competence	7	3.60	4.60	4.34	5.00	0.97	3.11	-1.75
Material Environment	7	3.47	4.13	3.77	4.29	1.10	-0.19	-0.63
Student Collaboration	7	2.44	3.35	2.92	3.14	1.17	-0.71	-0.17
Tutor Support	7	3.39	4.15	3.93	4.57	1.06	0.52	-0.94
Active Learning	7	3.50	3.91	3.70	3.57	1.06	0.21	-0.66
Information Design and Appeal	7	3.54	4.09	3.81	4.14	1.02	0.24	-0.67
Reflective Thinking	7	3.06	4.15	3.70	4.14	1.08	0.50	-0.61

The scores for each scale are negatively-skewed, have a positive kurtosis value and have relatively high means. This indicates respondents were positive regarding their online experience and, on average, gave responses of 'Sometimes' to 'Often' in this

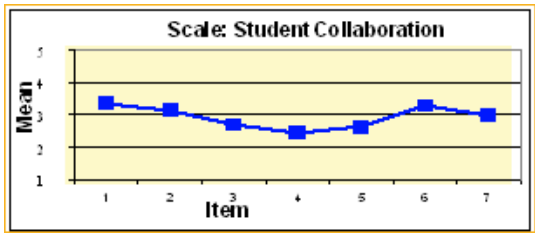
instrument. As mentioned in 5.2.5 these positive responses could be accounted for by respondents having a potential affinity towards web-based/online learning environments. Therefore, the results of the study should be treated with care.

5.3.2 Students' Perceptions of Collaboration

Table 5.9 *Students' perceptions of student collaboration*

Response	**1** = almost never - **to** - **5** = almost always							
Item	**1**	**2**	**3**	**4**	**5**	**Mn**	**s.d**	**Cor**
I communicate regularly with other students in this course.	38	28	84	66	68	3.35	1.31	0.80
Other students communicate with me regularly.	42	42	84	66	50	3.14	1.29	0.82
I often ask other students for help in activities we are doing.	64	54	88	66	12	2.68	1.18	0.69
Other students provide feedback on activities I have done.	72	64	108	30	10	2.44	1.09	0.76
I provide feedback to students on activities they have done.	62	56	112	36	18	2.62	1.14	0.75
I share resources and information with other students.	30	32	82	108	32	3.28	1.14	0.76
Other students share resources and information with me.	40	34	118	80	12	2.96	1.07	0.71

Mn= Mean s.d=Standard Deviation Cor = Correlation (N=284)



The mean scores of responses to items in this scale ranging from 2.44 to 3.35 indicate, on average, students gave responses of 'Seldom' to 'Sometimes' on this scale. The mean score for all items was 2.92 and the mean standard deviation for all items was 1.17. The correlation for all items (all above 0.69) is acceptable.

Discussion

The responses indicate students use the personal and group communication tools within their online course regularly. While they generally communicate well with others in the course and they recognise other students regularly communicate with them, this communication is generally to share information and resources. In general they tend not to ask other students within their online course for assistance in completing specific course tasks and they are reluctant to provide feedback to other students on course tasks undertaken. Tutors, in designing online courses, need to be aware of these trends and incorporate peer review activities within their course.

These peer review activities will help develop a sense of 'community' and 'belonging' potentially increasing student motivation and reducing drop-out.

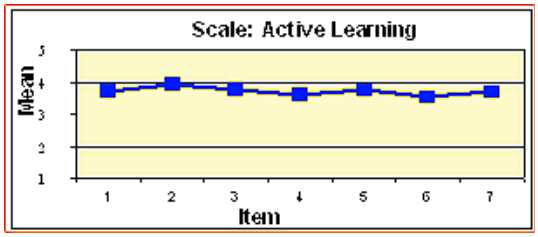
5.3.3 Students' Perceptions of Interactive Material

Table 5.10 *Students' perceptions of active learning*

Response **1** = almost never - **to** - **5** = almost always

Item	**1**	**2**	**3**	**4**	**5**	**Mn**	**s.d**	**Cor**
The feedback I receive from activities / quizzes is meaningful.	18	8	90	90	78	3.71	1.09	0.86
The feedback I receive from activities / quizzes helps me to identify those things I get wrong.	14	8	66	98	98	3.91	1.06	0.89
The feedback from activities / quizzes helps me to locate where I am having difficulties.	12	16	86	86	84	3.75	1.07	0.90
I am motivated by the responses I get from the activities / quizzes included in this course.	16	16	94	96	62	3.61	1.06	0.80
The activities / quizzes provided in the course enhance my learning.	18	10	78	100	78	3.74	1.09	0.79
The responses provided during the activities / quizzes are meaningful to me.	14	10	126	86	48	3.51	0.98	0.84
The responses to the activities help me understand where I am having difficulty.	16	10	98	84	76	3.68	1.08	0.88

Mn= Mean s.d=Standard Deviation Cor = Correlation (N=284)



The mean scores of responses to items in this scale ranging from 3.51 to 3.91 indicate, on average, students gave responses of 'Sometimes' to 'Often' on this scale. The mean score for all items was 3.70 and the mean standard deviation for all items was 1.06. The correlation for all items (all above 0.79) is excellent.

Discussion

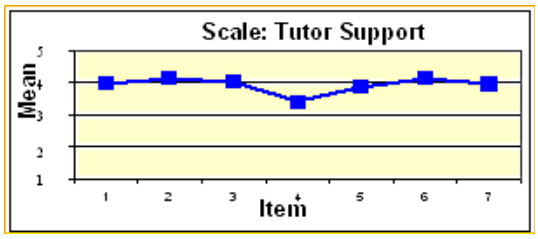
The responses indicate students generally appreciate the feedback generated by online activities and quizzes. As well as being motivated by the feedback they are able to reflect on the activities and increase their understanding of the material presented. Tutors, in the creation of interactive online activities, need to develop activities that provide meaningful feedback to participants, increasing their understanding and improving student satisfaction and achievement.

5.3.4 Students' Perceptions of Tutor Communication

Table 5.11 *Students' perceptions of tutor support*

Response	**1** = almost never -		**to** -		**5** = almost always			
Item	**1**	**2**	**3**	**4**	**5**	**Mn**	**s.d**	**Cor**
The tutor encourages my participation.	12	14	60	78	120	3.99	1.10	0.84
The tutor responds promptly to my queries.	12	14	30	90	138	4.15	1.07	0.82
The feedback I receive from my tutor helps me identify the things I do not understand.	10	4	56	108	106	4.04	0.97	0.73
The tutor regularly sends me feedback on my progress.	26	32	90	76	60	3.39	1.20	0.75
The tutor regularly provides feedback on group progress.	10	20	66	86	102	3.88	1.09	0.84
The tutor addresses group queries promptly.	4	10	48	108	114	4.12	0.91	0.73
The tutor participates regularly in group discussions.	14	12	56	90	112	3.96	1.10	0.72

Mn= Mean s.d=Standard Deviation Cor = Correlation (N=284)



The mean scores of responses to items in this scale ranging from 3.39 to 4.15 indicate, on average, students gave responses of 'Sometimes' to 'Often' on this scale. The mean score for all items was 3.93 and the mean standard deviation for all items was 1.06. The correlation for all items (all above 0.72) is excellent.

Discussion

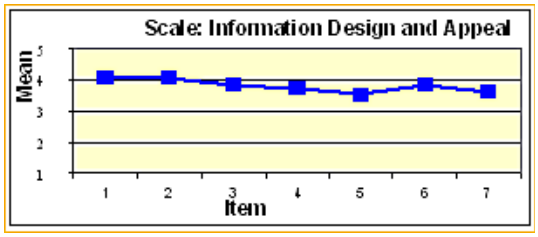
The responses indicate students are appreciative of tutor communication within the course. They feel the tutor actively encourages group and individual participation and provides effective guidance throughout the course. Tutors provide regular feedback to students and are often active participants, co-learners, in the course. Tutors, in the creation of online courses, need to ensure they communicate regularly with their students providing meaningful feedback when appropriate, improving student participation and achievement.

5.3.5 Students' Perceptions of Visual Appeal

Table 5.12 *Students' perceptions of information design and appeal*

Response	**1** = almost never -	**to** -	**5** = almost always					
Item	**1**	**2**	**3**	**4**	**5**	**Mn**	**s.d**	**Cor**
The choice of the text font is good.	6	10	52	104	112	4.08	0.95	0.69
The choice of colours and style used in the text assisted my being able to read clearly.	10	8	44	106	116	4.09	0.99	0.73
The backgrounds used in tables and pages enhance the look of the material.	10	14	74	102	84	3.83	1.02	0.84
The material presented is visually appealing.	14	14	86	94	76	3.72	1.07	0.85
The material shows originality and creativity in the layout.	12	24	118	58	72	3.54	1.09	0.76
I find the graphics (photos, images and graphs) used are appropriate to the text and help me understand.	6	18	86	84	90	3.82	1.02	0.72
I find the graphics (photos, images and graphs) used are well designed and visually appealing.	10	16	108	90	60	3.61	0.99	0.82

Mn= Mean s.d=Standard Deviation Cor = Correlation (N=284)



The mean scores of responses to items in this scale ranging from 3.54 to 4.09 indicate, on average, students gave responses of 'Sometimes' to 'Almost Always' on this scale. The mean score for all items was 3.81 and the mean standard deviation for all items was 1.01. The correlation for all items (all above 0.69) is acceptable.

Discussion

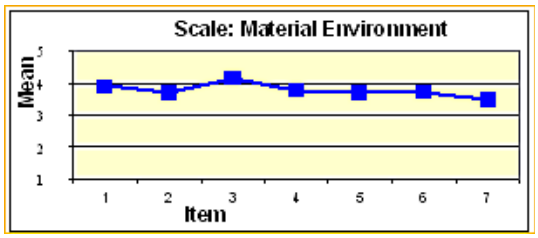
The responses indicate students felt the digital material presented within the course was visually appealing. The choice of colour, style and font for text and backgrounds helped students read the material, reducing screen glare and resultant eye strain. The graphics used within the course were appreciated and aided students' understanding. Tutors, in the creation of digital material, need to be aware of these trends and develop not only visually appealing material but develop material for ease of reading and understanding. These materials will engage learners, increasing their understanding and improving learner satisfaction and achievement.

5.3.6 Students' Perceptions of Course Functionality

Table 5.13 *Students' perceptions of the material environment*

Response	**1** = almost never -		**to** -		**5** = almost always			
Item	**1**	**2**	**3**	**4**	**5**	**Mn**	**s.d**	**Cor**
The instructions provided to use the tools within the site are clear and precise.	6	14	76	98	90	3.89	0.98	0.66
I have no problems in seeking appropriate help files that explain tool use.	12	18	90	90	74	3.69	1.06	0.54
The software I use is suitable for participating fully in the course.	6	12	54	78	134	4.13	1.00	0.73
I am able to install the appropriate software needed to participate in this course with ease.	12	34	62	74	102	3.77	1.18	0.66
All software applications needed to participate in this course are provided.	24	28	68	58	106	3.68	1.29	0.69
There is little delay in opening and using the software applications used in this course.	12	20	82	88	82	3.73	1.08	0.70
All material (photos, images, graphics and multi-media) appear quickly on my screen.	18	24	104	82	56	3.47	1.09	0.69

Mn= Mean s.d=Standard Deviation Cor = Correlation (N=284)



The mean scores of responses to items in this scale ranging from 3.47 to 4.13 indicate, on average, students gave responses of 'Sometimes' to 'Often' on this scale. The mean score for all items was 3.77 and the mean standard deviation for all items was 1.09. The correlation for all items (all above 0.54) is good.

Discussion

The responses indicate students felt they were in control of their online learning environment. They were able to access appropriate support files to use software applications used within the course and they were able to download the appropriate software applications and install them with few problems. The graphics and software applications used did not place unnecessary loading on their computer processor and they were able to complete activities with few problems. Tutors, in the creation of online courses using a range of software applications, need to develop courses

incorporating 'light-weight' (low computer usage) applications if possible. This will ensure students will not be frustrated by low response times from their computers.

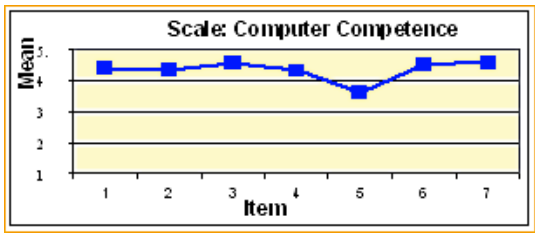
5.3.7 Students' Perceptions of Their Online Competencies

Table 5.14 *Students' perceptions of their computer competence*

Response **1** = almost never - **to** - **5** = almost always

Item	**1**	**2**	**3**	**4**	**5**	**Mn**	**s.d**	**Cor**
I am confident and competent using a computer.	6	8	28	74	168	4.37	0.93	0.85
I am confident in using the World Wide Web to search for information.	4	8	38	64	170	4.37	0.92	0.80
I am confident in using the web-browser tool bar (back, forward, home, search).	8	4	18	40	214	4.58	0.89	0.76
I am able to reconnect to the network if anything goes wrong.	8	8	36	64	168	4.32	0.99	0.76
If necessary I can select and print documents from the Internet.	28	20	82	62	92	3.60	1.28	0.77
If necessary I can electronically store information on my computer or disk.	6	8	28	34	208	4.51	0.93	0.77
I am able to copy selected parts of the documents and save if necessary.	6	4	20	36	218	4.61	0.85	0.66

Mn= Mean s.d=Standard Deviation Cor = Correlation (N=284)



The mean scores of responses to items in this scale ranging from 3.60 to 4.61 indicate, on average, students gave responses of 'Often' to 'Almost Always' on this scale. The mean score for all items was 4.33 and the mean standard deviation for all items was 0.97. The correlation for all items (all above 0.66) is acceptable.

Discussion

The responses indicate students felt they were technologically capable of participating fully in their online learning environment. They were confident and competent using their computers and searching, retrieving, storing and manipulating information from the Internet. Tutors, in the creation of online courses, need to be aware of these trends and during the student enrolment process detail clearly the technical skills learners need to have to fully participate in the course. This will ensure students will not be frustrated by undertaking tasks beyond their technical

competency, increasing a sense of control over their learning environment and increasing satisfaction.

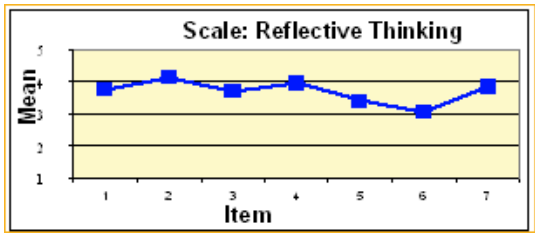
5.3.8 Students' Perceptions of Online Learning

Table 5.15 *Students' perceptions of reflective thinking*

Response **1** = almost never - **to** - **5** = almost always

Item	**1**	**2**	**3**	**4**	**5**	**Mn**	**s.d**	**Cor**
I enjoy using the Internet as a means of accessing information.	14	18	70	106	76	3.75	1.07	0.71
I find using the Internet for learning is stimulating.	10	8	48	80	138	4.15	1.03	0.70
I have no problems accessing and going through the materials on my own.	12	26	86	62	98	3.73	1.15	0.81
I feel I am in control of my learning as I review the material provided.	8	8	70	102	96	3.95	0.98	0.75
I feel the web based learning approach can substitute for, or enhance the normal classroom approach.	16	28	122	60	58	3.41	1.09	0.78
I feel I learn more in the online environment.	32	42	124	50	36	3.06	1.13	0.78
I am satisfied with my experience of using the Internet and learning online.	12	16	74	80	102	3.86	1.10	0.81

Mn= Mean s.d=Standard Deviation Cor = Correlation (N=284)



The mean scores of responses to items in this scale ranging from 3.06 to 4.15 indicate, on average, students gave responses of 'Sometimes' to 'Often' on this scale. The mean score for all items was 3.70 and the mean standard deviation for all items was 1.07. The correlation for all items (all above 0.70) is acceptable.

Discussion

The responses indicate students enjoyed using computers and the Internet for learning. They enjoyed using the internet to access information and were stimulated and motivated by their online course. Although they were satisfied with their online course they recognized there were benefits associated with traditional methods of delivery. Tutors, in the creation of online courses, need to be aware of these trends and during the design of courses ensure communication activities encourage

individual learners to develop a sense of 'belonging' and 'community', thus potentially increasing student motivation and satisfaction and reducing drop-out.

5.3.9 Review

During the above in-depth review of the 7 scales and 49 items of the refined OLLES instrument, it became clear some items appeared to be investigating similar interactions. For example, in the scale Student Collaboration, item 1, *I communicate regularly with other students in this course* and item 2, *Other students communicate with me regularly* are essentially exploring a single interaction, individual student-to-student communication. If this was indeed the case, one or other of the items was essentially redundant. It was also noted some items in separate scales appeared be investigating similar interactions. For example, item 1, in the scale Reflective Thinking *I enjoy using the Internet as a means of accessing information* and item 2, in the scale Computer Competence *I am confident in using the World Wide Web to search for information* are essentially exploring students' satisfaction in using the Internet to gather resources for their online course. A further examination of the relevance and appropriateness of the scales and items within the refined OLLES instrument was warranted. The report of this examination is presented below.

5.4 Tentative Modifications to the OLLES Instrument

This section is divided into three topics. Topic one, overview, explains the underlying basis for undertaking further analysis of the data. Topic two, statistical analysis and results, tentatively confirms the structural validity of a modified 35-item measure. Topic three, review, acknowledges the limitations of the modifications made but concludes that the modified instrument will allow tentative decisions to be made about student perceptions on the interactions occurring in their online environments.

5.4.1 Overview

As mentioned in Chapter 3 (section 3.1.9) the research methodology of this study is significantly shaped by the intuitive-rational approach. This approach involved the instrument developer in the identification of salient dimensions, the selection and/or writing of appropriate items, and the field-testing of those items. A further critical review of the instrument, after significant data analysis and testing by the developer,

could be regarded as perfectly legitimate, fitting within the intuitive-rational approach. However, the potential bias created by the individual researcher's modifications needs to be acknowledged and the resulting modifications and findings should be created with some care.

Recent studies in the validation of learning environment research have noted obtaining satisfactory fit of model with a large number of latent and observed variables is problematic. It has been suggested more than four or five indicators per factor results in an unsatisfactory fit (Dorman, 2003). It has also been suggested, while not necessary, a balanced distribution of items on factors might result in a more efficient instrument (Johnson & Stevens, 2001).

In the re-review of the retention of items within the instrument a set pattern was followed. Firstly, items investigating the same interaction (both within and across scales) were identified. Secondly, scales composition was reviewed and the number of items in each scale was reduced to five based on the researcher's 'intuition' and extensive knowledge of the domain. Finally, factor analysis was undertaken to ensure the structure of the instrument was acceptable. This re-review resulted in a 7-scale, 35-item instrument reported fully in Appendix C. The report on the final statistical procedures is outlined below.

5.4.2 Statistical Analysis and Results

Because the refined OLLES instrument had been modified using a seven scale structure, during this supplementary data analysis a seven factor solution was explored. This seven factor solution appeared to be a logical fit to the data investigated. A review of the identical scree plots and eigenvalues, generated by SYSTAT 11 in varimax and oblimin rotation, confirmed this factor solution was acceptable. Factor seven had an eigenvalue of 1.34 and, using the Cattell scree test, was visually above the *factorial scree* or *debris* (StatSoft, 2003). See Figure 5.8.

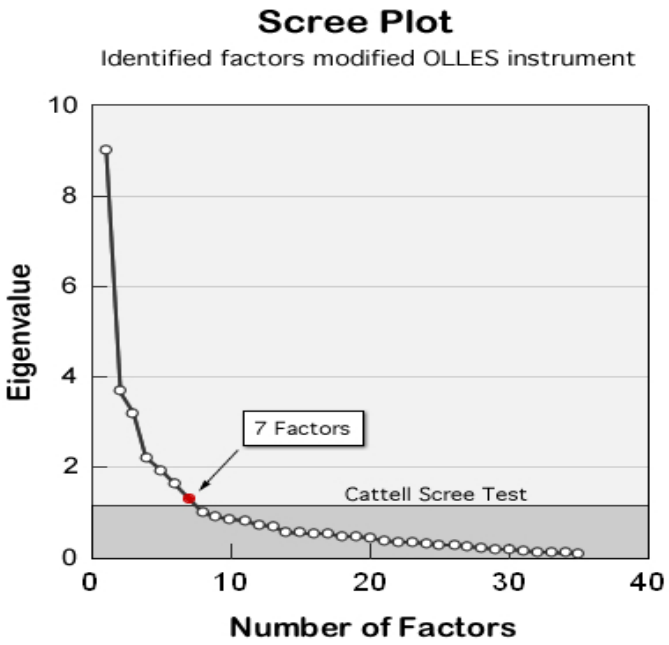


Figure 5.8. Scree plot for varimax and oblimin rotations of the modified OLLES

The removal of two items from each of the seven remaining scales confirmed, in both oblimin and varimax rotations, the modified 35-item measure was structurally sound (see Table 5.16 below). An unusual discrepancy to be noted in the factor loadings on the scales is the apparent 'swap/replacement' of the factors *tutor support* and *material environment* in the oblimin and varimax rotations; they have replaced each other in either column 1 or 7. However, this 'swapping/replacement' does not affect the confirmed scale structure of the instrument and was ignored. Table 5.16 highlights only two items (M3 and ID1) in which the factor loadings show some discrepancies. **M3,** *I am able to install the appropriate software needed to participate in this course with ease,* in the varimax rotation loads highly (0.41) on a factor other than its *a priori* factor but in oblimin rotation this loading disappears. Similarly **ID1,** *The choice of colours and style used in the text assisted my being able to read clearly,* in the varimax rotation loads highly (0.45) on a factor other than its *a priori* factor but in the oblimin rotation this loading disappears. In order to retain consistency of presentation and a balanced distribution of items on factors, it was decided to retain both these items. The factor loadings for the modified 35-item version of shown below in Table 5.16

Table 5.16 *Factor loadings (oblimin and varimax rotations) for the modified 35-item version of the OLLES*

TS	**M**	**CC**		**SC**		**AL**		**RT**		**ID**		**M**	**TS**	
Ob	**Va**	*Ob*	**Va**	*Ob*	**Va**	*Ob*	**Va**	*Ob*	**Va**	*Ob*	**Va**	*Ob*	**Va**	
Ob= Oblimin Rotation				0.75	0.75								Varimax Rotation= **Va**	*SC1*
				0.70	0.71									*SC2*
				0.83	0.82	Student Collaboration (SC)								*SC3*
				0.68	0.69									*SC4*
				0.85	0.84									*SC5*
		0.83	0.83											*CC1*
		0.82	0.83											*CC2*
		0.78	0.78	Computer Competence (CC)										*CC3*
		0.72	0.74											*CC4*
		0.73	0.73											*CC5*
						0.78	0.77							*AL1*
						Active Learning (AL) 0.89	0.87							*AL2*
						0.84	0.81							*AL3*
						0.68	0.69							*AL4*
						0.85	0.83							*AL5*
0.65													0.67	*TS1*
0.73												Tutor Support (TS)	0.75	*TS2*
0.50	Tutor Support (TS)												0.55	*TS3*
0.70													0.70	*TS4*
0.72													0.71	*TS5*
	0.45									0.53	0.54			***ID1***
										0.71	0.71			*ID2*
										0.72	0.72			*ID3*
										0.76	0.75			*ID4*
										0.85	0.84			*ID5*
	0.43											0.37		*M1*
	0.76											Material Environment (M) 0.75		*M2*
	0.49	Material Environment (M)										0.43	**0.41**	***M3***
	0.63											0.62		*M4*
	0.75											0.74		*M5*
								0.60	0.62					*RT1*
								0.73	0.74					*RT2*
								Reflective Thinking (RT) 0.64	0.66					*RT3*
								0.82	0.80					*RT4*
								0.79	0.77					*RT5*

Ob = Oblimin Rotation **Va**= Varimax Rotation

TS=Tutor Support **CC**=Computer Competence **SC**=Student Collaboration **AL**=Active Learning **RT**=Reflective thinking **ID**=Information Design and Appeal **ME**=Material Environment
(N=284)

The Eigenvalues and percentage of variance calculated for the modified version of the instrument was again, in both oblimin and varimax rotations, exactly the same (refer to Section 5.2.4 above) and these are described in the single Table 5.17

Table 5.17 *Varimax and oblimin rotation Eigenvalues and percentage of variance accounted by each factor in the modified OLLES*

Factor	Cumulative EV	Eigenvalue	% of Variance	Cumulative %
1	12.92	9.01	25.75	25.75
2	17.60	3.69	10.55	36.30
3	21.84	3.18	9.09	45.39
4	24.64	2.19	6.27	51.66
5	27.05	1.94	5.55	57.20
6	29.17	1.65	4.72	61.93
7	30.85	1.34	3.82	65.75

The cumulative variance of all the seven scales is 65.75% (approximately 3% higher than the 49-item refined instrument) and, while 34.25% of the variance remains unaccounted, this cumulative variance total is consistent with the reports of variance of other learning environment research studies (refer to Section 5.2.4 above). Reducing the instrument to 35-items and 7-scales provides a more efficient and economical tool to measure online learning environments. However, it would be recommended factor analysis is conducted in other studies using the OLLES instrument in order to demonstrate the findings presented here can be replicated.

The Cronbach Alpha for the scale, Active Learning (at 0.90), continues to be considered as excellent. The alpha for the scales Information Design and Appeal, Reflective Thinking, Tutor Support, Student Collaboration, Order and Organisation, and Computer Competence (all above 0.80), also continue to be good. The remaining scale, Material Environment (alpha above 0.75), also continues to be acceptable. The discriminant validity results for two of the scales, Student Collaboration and Computer Competence (all below 0.16) again indicate these scales appear to be measuring distinct aspects of the learning environment. While the discriminant validity results for the five remaining scales, ranging from 0.32 to 0.37, continue to indicate the scales appear to be measuring distinct but somewhat overlapping elements of the learning environment, they remain acceptable. The Cronbach Alpha

reliability coefficient and discriminant validity scores for the modified instrument are detailed in Table 5.18

Table 5.18 *Internal consistency and discriminant validity for the modified OLLES*

Scale	Items	Discriminant Validity	Alpha Reliability
Computer Competence	5	0.16	0.86
Material Environment	5	0.31	0.75
Student Collaboration	5	0.09	0.83
Tutor Support	5	0.37	0.85
Active Learning	5	0.33	0.90
Information Design and Appeal	5	0.32	0.85
Reflective Thinking	5	0.33	0.84

(*N= 284)*

5.4.3 Limitations and Review

It is acknowledged to reduce the bias of researcher-generated scales and items a review of the items should be undertaken by other experts in the field and learning environment instrument specialists. In this re-assessment of the OLLES instrument this did not occur. The statistical analysis of the instrument should help mitigate any bias. It is also acknowledged the limitations identified in section 5.2.5 above have not been addressed in this re-review of the items.

However, the re-analysis conducted is sufficient to draw tentative conclusions about the reliability and validity of the scales and individual items used in the modified OLLES instrument and the method of instrument administration and data collection. It would appear from the re-review of the data and instrument, a refined 7-scale, 35-item OLLES instrument will allow conclusions to be drawn about student perceptions on the interactions occurring in their online environments, in an economical and efficient manner.

Finally, before the instrument is used extensively, it is recommended a peer review of the items by subject specialists and learning environment researchers is conducted, ensuring all salient aspects of the environment are covered. It is also recommended factor analysis is conducted in other studies using the modified OLLES instrument in order to demonstrate the findings presented here can be replicated.

5.5 Summary of Phase Two

This chapter has reported on the extensive investigations and data analysis undertaken in confirming the validation and reliability of a new perceptual measure, the OLLES. Initial investigations undertaken with 103 respondents confirmed the operational functionality of the instrument. Preliminary investigations of the data generated by these operational tests were pleasing and confirmed more extensive testing could occur. The sample size for the extensive testing of the instrument was relatively small but did fall within the sample size used in the validation of other similar instruments and was deemed acceptable.

Principal components analysis with firstly oblique, oblimin and secondly orthogonal varimax rotations, confirmed the structure of the OLLES instrument of 7-scales and 49-items. The internal consistency, confirmed by Cronbach Alpha coefficients, all above 0.75, is deemed to be acceptable. The discriminant validity scores ranging from 0.10 to 0.38 indicated the scales did overlap but not sufficiently to violate the psychometric structure of the instrument and are small enough to confirm each scale generally measures distinct aspects of the participants' online environment. The cumulative variance of all of the seven scales was 62.95%.

A review of the individual items within the scale indicated respondents were positive regarding their online experience and on average gave responses of 'Sometimes' to 'Often' in the instrument. But, it was acknowledged, these positive responses could be accounted for by respondents having a potential affinity towards web-based/online learning environments. The most significant finding resulting from these investigations was the identification of items, within and across scales, investigating similar dimensions.

Further analysis of the items undertaken in the light of the discoveries made in the investigation of the scales and items, resulted in the creation of a 7-scale, 35-item measure. Principal components analysis with firstly, oblique, oblimin and secondly, orthogonal varimax rotations, confirmed the structure of the modified 35-item OLLES instrument. The internal consistency, confirmed by Cronbach Alpha coefficients, all above 0.75, is deemed to be acceptable. The discriminant validity scores ranging from 0.09 to 0.37 indicated the scales did overlap but not sufficiently to violate the psychometric structure of the instrument and are small enough to

confirm each scale generally measures distinct aspects of the participants' online environment. The cumulative variance of all of the seven scales was 65.75% (approximately 3% higher than the 49-item refined instrument reported above).

Finally, in presenting the validation and reliability results for the OLLES instrument it must be acknowledged the procedures explained do not exactly match those followed in previous learning environment instrument developments and validations. In previous research, class data was used to enrich the findings investigating the degrees of similarity and difference between two units of statistical analysis, that of the individual student and that of the class mean. Such analysis was not undertaken in this research. This is caused in part by the initial collection of data where individual's responses, but not the individuals' responses as part of an identified class group, were captured. Therefore, the results of the study should be treated with caution. However, the analysis conducted thus far is sufficient to draw tentative conclusions about the reliability and validity of the scales and individual items used in the OLLES instrument and the method of instrument administration and data collection. It would appear from preliminary analysis, the refined 7-scale, 35-item OLLES instrument will allow conclusions to be drawn about students' perceptions on the interactions occurring in their online environments in an economical and efficient manner.

Chapter 6: Conclusions, Implications and Recommendations

The technological advances in, and decreasing costs of, computer software applications and related hardware components, have resulted in the increased use of, and confidence in, information and communication technologies by tutors and learners at all levels of education. The perceived benefits of using networked computers, learning management systems, technologically-rich digital content, software applications and computer simulations in learning activities have been exploited within all curricula areas. As web-based and online software applications such as browsers, search engines, communication tools and data-bases mature, so does educators' use of this medium for teaching and learning. How we can efficiently, economically and consistently investigate the impact of these technologies on the learning activities undertaken by students was the key concept addressed in this thesis. This final chapter is divided into six sections. Section one provides a chapter-by-chapter overview of the thesis. Section two reports on the major findings of the study and the contributions the study has made to the areas of electronically-connected learning environments, psychosocial learning environment research and Internet-facilitated research procedures and practices. Section three considers the significance of the study to education in general and learning environment research specifically. Section four identifies how the research was constrained and limited. Section five makes recommendations for future research. Section six concludes with the assertion the development and refinement of learning environment instruments, such as the OLLES, can provide valuable tools in online educational research.

6.1 Overview of Thesis

The first chapter began by noting the use of electronic learning and teaching technologies in formal educational settings, in a variety of formats, is, and has been, a common teaching practice. The chapter then reviewed the growing use of information and communication technologies in educational settings and provided historical overview of how educational institutions have implemented these technologies. Definitions of three common terms, the Internet, the World Wide Web and learning environment, and their particular application to this study, were also provided. The chapter then outlined the theoretical framework underpinning the

research to be undertaken exploring learning environment research, constructivist views of learning and the growing use of the web-based technologies to facilitate research. The purpose of the study - the exploration and investigation of electronically-connected learning environments and how effective measurement of the perceptions of students and teachers operating within these environments - was distilled into three aims. Firstly, the study would review online learning environments and attempt to identify core generic activities undertaken by learners and teachers, within such environments. Secondly, a web-based perceptual measure, the Online Learning Environment Survey, would be developed, field-tested and validated. Finally, the study would identify and validate appropriate procedures and processes in the administration of web-based forms.

Chapter 2 provided a review of the literature in three broad categories; psychosocial learning environments, flexible learning with networked computers, and previous investigations of online learning environments using perceptual measures. The section on psychosocial learning environments reviewed 35 years of development and the use of perceptual measures specifically designed to investigate educational settings. This section highlighted the significance of Rudolph Moos' three social climate dimensions in the creation of measures. It described the levels of analysis, the flexibility and robustness of perceptual measures, and the benefits gained from the use of these measures in refining teaching practice, influencing the design of learning experiences for students and, ultimately improving student achievement. The section on flexible learning with networked computers described the ways educational institutions and tutors have used information and communication technologies to communicate with students and provide learning activities. Five key relationships (student - interface, student - tutor, student - student, student - content and student reflection), occurring in all digital environments were identified for further investigation. The final section described and reported on previous investigations of technology-rich environments using perceptual measures, highlighting in particular eight studies and the nine instruments used.

Chapter 3 outlined the research design and methodology suited to the development of a specific perceptual measure to investigate online learning environments. The chapter began by exploring previous psychosocial instrument development, investigating the process and procedures used in seven previous studies in instrument

development. From these investigations three stages of development and the intuitive-rational theoretical approach, followed in the development of learning environment instruments, were identified and described. A description then followed of how the OLLES psychosocial-instrument was created and administered. The identification of salient scales and items was described and the manner in which web-forms were used in the collection and storage of data was outlined. The chapter concluded by describing the two-phased approach, based on the concepts of content and construct validity, the research study would follow.

Chapter 4 reported on the range of activities undertaken in phase one of the research project; content validity. The chapter began by detailing the three-staged approach used in the identification of specific scales and the creation of individual items for the OLLES instrument. Firstly, the area to be investigated was described and the relevant literature was reviewed. Secondly, previous learning environment studies in the field were explored and appropriate scales and items were identified. Finally, the proposed scales were described and potential items were identified. The creation of dynamic web-pages and the development of an associated, connected database were detailed. Finally, the chapter reported on the significant modifications made to the scales and items, the web-pages and database structure as a result of the feedback received from peers and a limited pilot testing of the instrument.

Chapters 5 contained detailed analysis of the range of activities undertaken in phase two of the research project; construct validity. The chapter began by describing initial field testing of the measure with a limited sample. It summarised the functionality tests undertaken and the reduction of the number of items in the instrument for final testing. The chapter then reported on the field testing of the OLLES. It described the sample and the processes and procedures used in analysing the data. The analysis undertaken confirmed was the structural soundness and reliability of the 49-item OLLES. This analysis was followed by a discussion of the refined version of the OLLES, reviewing identified scales, individual items and comments on the trends the data exposed. During this phase apparent duplicate items, investigating similar interactions within and across scales, were identified. The chapter concluded by confirming a modified 35-item version of the OLLES appeared to be structurally sound and reliable and would allow conclusions to be drawn about student perceptions on the interactions occurring in their online environments in an

economical and efficient manner. However, prior to further extensive use the measure, it was recommended a peer review of the items be conducted and further factor analysis undertaken to demonstrate replication of the findings presented in the chapter.

6.2 Report on the Major Findings and Contributions of the Study

The growing use of computers in education, the creation of virtual learning environments based on web services, and the increased investments by educational institutions (both fiscal, physical and human) in the development of networked environments have impacted on all aspects of education. In these times of educational change, driven by the use of information and communication technologies, it was perceived as timely to explore the development, validation and application of a learning environment measure to investigate the perceptions of participants in the virtual environments created. This study investigated and contributed significantly to three specific areas 1) electronically-connected learning environments, 2) psychosocial learning environment research and instrument development, and 3) Internet-facilitated research procedures and practices.

6.2.1 Contributions to the Field of Electronically-Connected Learning Environments

In reviewing the use of information and communication technologies in educational settings this study was able to distil from a number of previous studies, (refer to Chapter 2.2.1), four distinct levels of Internet use:

1) *Informational*: where institutions provide information on upcoming events, course syllabus, and class notices, tutorial and lecture notes;

2) *Supportive*: where links to supplementary resources, for example, the library, Internet sites, note taking, essay writing and examination preparation is provided;

3) *Blended*: where a number of major course components such as quizzes, chat, messaging and tutorials using threaded discussion are held solely on the web; and

4) *Dependent*: where all course activities such as enrolment, assignments, assessments, and simulations, entire course content and activities are on the web.

Significantly, this study was able to identify five broad categories of electronically-connected learning environment activity for investigation:

1) *Student - Media Interaction*: where student engagement with digitally stored information is explored;

2) *Student - Student Relationships*: where inter-student communicative activities can be reviewed;

3) *Student - Tutor Relationships*: where the student relationships with the tutor, both in textual communication and virtual environments, can be described;

4) *Student - Interface Interaction*: where the students' technological capabilities are investigated; and

5) *Student Reflection Activities*: where students' acceptance of the digital learning environment is reported on.

6.2.2 Contributions to the Field of Psychosocial Learning Environment Research and Instrument Development

In reviewing the administration of learning environment instruments this study was able to demonstrate the benefits of using web-based forms to learning environment researchers. It offered a simpler, more streamlined method for the collection, storage and manipulation of data; it reduced costs by eliminating print and data-entry charges, and did this without reducing the robustness and reliability of the instrument.

In reviewing the research design and methodology of learning environment instrument development, this study was able to refine the three staged pattern employed in learning environment instrument development. This was specifically, firstly, the identification of salient dimensions and items, secondly, ensuring the three social climate dimensions identified by Moos were adequately covered and finally, field testing and analysis of the instrument into a two-phased approach based upon:

1) *Content validity*: where researchers check against the relevant knowledge of the domain and ensure all aspects pertinent to the domain are identified and the social climate dimensions of Moos are adequately covered; and

2) *Construct validity*: where researchers prove there is, firstly, convergent validity (items in a scale measure the construct identified) and secondly, discriminant validity (individual scales measure a single construct).

6.2.3 Contributions to Internet Facilitated Research Procedures and Practices

In reviewing the literature on Internet-based research it was noted while there exists a fairly extensive body of literature on the design and delivery of web-based forms and factors influencing response rates, there was no similar body of literature focused on the ethical issues posed by undertaking Internet based research. The procedures outlined in this study contribute significantly to addressing ethical concerns raised by the use of web-based forms. These procedures included firstly, ensuring in all forms of communication with potential participants the purpose and reason for the study is clearly articulated. Secondly, entry pages of instruments developed need to be separated from the data collection aspects of the form. The initial page should contain a description of the research, a brief overview of the nature of the instrument, the expected time respondents would need to complete the survey and an assurance from the researcher respondents would not be identified in any way. It should seek informed and continuing consent by the use of strategically placed “clickable” button and contain the electronic contact details of the researcher. The data collection page(s) need to once again assure all participants that data collected would only be used for the purposes of the research described and participants would not be publicly identified in any way. It should continue to seek informed consent by the use of a strategically placed “clickable” button and contain the electronic contact details of the researcher.

In reviewing the creation of instruments using dynamic web-pages and associated databases, the study investigated the least technologically-taxing solution, where web-forms using friendly “what you see is what you get (WYSIWYG)” software applications, the collection of data using a form processor to automatically generate the fields in the database, and the storage of data as a comma separated values text

file (csv), increased the instruments' portability (the ability to be re-used in a number of operating environments) and significantly reduced the technological literacy costs for instrument developers. In essence, learning environment research developers with limited technical skills can now easily develop web-based instruments.

6.3 Report on the Significance of the Study

Societal pressure, educational institutional competition nationally and globally, the demand for flexibility in education, student expectations, tutors' increasing technological competence, advances in computer software applications and decreasing costs of associated hardware have resulted in increased use of, and confidence in, networked computer technologies. However, the increased use of technology-rich environments is not cost neutral. There are professional development costs, course material design costs, Internet connection costs, computer hardware costs, student computer charges, library database upgrades and software application costs. Educational institutions are investing large sums introducing digital environments, but, relatively few institutional-specific studies have been undertaken to justify or support continued development or implementation.

In conducting such institutionally-specific studies a number of quantitative measures such as grades allocated, total number of credits earned, participation rates in specified activities, graduation rates, standardized test scores, proficiency in identified subjects and other valued learning outcomes could be used. It is also possible to employ external bodies to observe and report on the impact of these initiatives. However, these investigations are resource-hungry, expensive to conduct, and their findings are not unproblematic. Research measuring student and teacher impressions of the environment in which they operate are just as effective as these more expensive studies. It is well documented that students' reactions to, and perceptions of, their learning environment have a significant impact on their performance. It would appear the 'time-is-ripe' for the introduction of a learning environment measure to investigate the perceptions of participants in the online learning environments.

The field tested version of the OLLES was administered, online, to 284 respondents from the Pacific Rim. The electronic data collected were analysed to review the internal consistency and discriminant validity of the instrument. Principal

components analysis with firstly, oblique (oblimin) and secondly, orthogonal (varimax) rotations, with factor loadings on scales ranging from a low of 0.41 to a high of 0.89, confirmed the structure of a modified 35-item 7-scale measure. The internal consistency, confirmed by Cronbach Alpha coefficients, all above 0.75, is deemed to be acceptable. The discriminant validity scores ranging from 0.09 to 0.37 indicated the scales did overlap but not sufficiently to violate the psychometric structure of the instrument and are small enough to confirm each scale generally measures a distinct aspect of the participants' online environment. The cumulative variance of all of the seven scales of 65.75% is also deemed to be acceptable. The OLLES measure, developed and validated in this study, provides tutors an efficient and economical means of measuring the interactions, and the effect these interactions have, on student' perceptions, occurring in their online classes.

6.4 Constraints and Limitations

In presenting the validation and reliability results for the OLLES instrument it must be acknowledged the procedures explained do not exactly match those followed in previous learning environment instrument developments and validations. This is caused in part by the initial capture of data where individuals, but not individuals' responses as part of an identified class group, were captured. The sample was web-based and, since responses were solicited from a potentially unlimited group, the sample was not as well defined as with conventional samples drawn from identified class groups. This can be seen both to constrain and limit the study. The identified limitations are discussed in the following paragraphs.

Firstly, the one-sample design does not lend itself to cross-validation. In previous learning environment research, class data have been used to enrich the findings investigating the degrees of similarity and difference between two units of statistical analysis, that of the individual student and that of the class mean, such analysis was unable to be undertaken in this piece of research, limiting the generalisability of the study's findings.

Secondly, analysis of the data revealed the scores for each scale were negatively skewed, had a positive kurtosis value and had relatively high means. These indicated respondents were positive regarding their online experience and, on average, gave responses of 'Sometimes' to 'Often'. These positive responses could be accounted

for by the self-selected nature of the sample and by respondents having a potential affinity towards web-based/online learning environments. Those students who might not have the same affinity to web-based/online learning may have chosen not to respond. Therefore, the results of the study should be treated with care.

Thirdly, in the reassessment of the retention of items within the modified 35-item instrument, the scales composition was reviewed and the number of items in each scale was reduced to five based on the researcher's 'intuition' and extensive knowledge of the domain. It would be legitimate to argue that prior conceptions held by the researcher influenced decisions made and, potentially, researchers at different ends of a theoretical spectrum could interpret the scales and items in different ways and thus make modifications to the instrument, in a different manner.

However, the review of the instrument, based on the researcher's 'intuition' and extensive knowledge of the domain can be regarded as perfectly legitimate, fitting within the intuitive-rational approach, where the researcher is regarded as the primary constructor and modifier of the scales and items constituting the instrument. The extensive factor analysis undertaken and the continued consistency of results appear to confirm the underlying structural validity of the instrument. It can be legitimately argued that the analysis conducted thus far is sufficient to draw tentative conclusions about the reliability and validity of the scales and individual items used in the OLLES instrument and the method of instrument administration and data collection. It would appear from preliminary analysis, the refined 7-scale 35-item OLLES instrument will allow conclusions to be drawn about student perceptions of the interactions occurring in their online environments, in an economical and efficient manner.

6.5 Recommendations for Further Research

Despite the limitations identified above, this study has described and addressed new information on a communication technology-based learning environment in education, the online environment. Preliminary investigations of the data-generated by the field testing of the instrument are pleasing and confirm more extensive research in this area using the OLLES instrument, could occur. Some recommendations are made in the following paragraphs.

Firstly, prior to the instrument being used extensively, the 35 items identified for retention in the modified instrument are peer reviewed by subject specialists and learning environment researchers. Such a review should ensure all salient aspects of the described online learning environment remain covered by the modified instrument.

Secondly, the web-form should be modified to include the capture of an individual's course/class details. The capturing of class/course data could then be used to enrich the findings by investigating the degrees of similarity and difference between two units of statistical analysis, that of the individual student and that of the class mean.

Thirdly, the results described here are from the actual version of the OLLES instrument and it is recommended further studies, focused on preferred and tutor versions of the instrument, be undertaken to create a more comprehensive validated instrument.

Fourthly, in order to expand upon the generalisability of the findings reported, it is recommended studies using the OLLES instrument and similar factorial analysis techniques be undertaken targeting different educational levels, (for example, high school and graduate students), in order to demonstrate the findings presented here can be replicated.

Fifthly, it is recommended studies using the OLLES instrument and similar factorial analysis techniques, be undertaken in countries with significant indigenous populations (such as New Zealand) introducing into the analysis a larger variation of learning environment perceptions, expectations, and attitudes.

Finally, it is recommended further research be undertaken in the use of web-forms, form processors and interactive databases to ensure the architectural infrastructure developed addresses ethical issues on informed consent and confidentiality and the data collected from these forms is as reliable as the data collected from 'pencil and paper' methods of data collection.

6.6 Concluding Comments

In the not too distant future, educational activity will no longer be constricted to or confined by text, print based materials, time or space. Educationalists will be challenged to develop appropriate strategies to deal with new information and

communication technology-rich ways of teaching and learning. It appears evident those features explored in learning environment research, the perceptions of students and teachers of the environment, the social and psychological factors, will be equally as important to research in digital environments. The development of a perceptual measure investigating aspects of the online learning environment is timely and can make a significant contribution to teaching, learning and research.

- Firstly, online educators developing courses for online delivery should be careful to ensure participants, both learners and tutors, are comfortable in and benefit from, the learning environment created. The availability of the OLLES instrument, and the data generated by its application, will serve to illuminate those practices which assist learners and tutors to adjust to the online environment and those which create barriers to learning.
- Secondly, the availability of the OLLES instrument illustrates how online learning environments, and the changes that might occur within these environments, can be monitored for effectiveness.
- Thirdly, although the instrument has only been through initial validation procedures it could be viewed as contributing significantly to the larger research field of learning environment studies.

The demand for more flexibility in education, the improvement in information and communication technological capabilities, and the reducing costs of such technologies are making electronically-mediated education increasingly more viable, attractive, cost-effective and valued. This continued growth of online educational activities needs to be matched by a similar growth in educational research focused upon the specific learning environments created in the digital world. The development, validation and refinement of portable web-based learning environment instruments such as the OLLES address these research needs.

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8. Appendices

Appendix A: **Peer review information, scales and items**

Online Learning Environment Survey

DRAFT: Scales and Items

A learning environment could be described as the place where teachers and students gather together to participate in the activity of learning. The essence of a learning environment is the interaction that occurs between individuals, groups and the setting they operate within. The environment created, also referred to as climate, atmosphere, tone, ethos or ambience, during this activity, is regarded as an important component in the learning process. Both teachers and learners hold views on the learning environment they operate within and these views will affect the way they participate in learning activities undertaken. Indeed research appears to indicate that student achievement is enhanced in those environments which students feel comfortable in and positive about.

In the online learning environment there are 5 broad areas of activity that can be identified and described. These are outlined below:

1. **Student - Media Interaction** (How is the student engaged with digitally stored information and how do they relate to the information presented?)
2. **Student - Student Relationships** (How, why and when students communicate with each other and what is the nature of this communication?)
3. **Student - Tutor Relationships** (How, why and when students communicate with their tutor and what is the nature of this communication?)
4. **Student - Interface Interaction** (What are the features of the interface created that enhance / inhibit student learning and navigation?)
5. **Student Reflection Activities**. (How are students encouraged to reflect on their learning, are they satisfied with the environment and how do they relate to the environment created?)

Inventories and surveys that seek the perceptions of the milieu of inhabitants are high inference measures, asking the respondent to make judgments about the meaning of what is going on around him/her or what she/he feels about the environment they are in. They are useful in tapping into what is actually taking place in the environment and have been found to account for considerable variance in student learning outcomes. Reliable instruments and surveys that have been validated can be used with large samples with confidence, and because of this the results provide statistical confidence. Therefore it is hoped the *Online Learning Environment Survey* (OLLES) described in the following pages will be a useful tool in the investigation of the online environment.

To validate the instrument, the scales and items to be used need to be extensively reviewed. This ensures that the dimensions, scales and individual items outlined are what you as tutors see as relevant and meaningful. You are asked to review the scales and items below and comment on the appropriateness of the scales and items listed. Please use the text box provided below each scale to make any comments.

Do not hesitate to contact me if you have any concerns.

John Clayton

Student Reflection Activities

Reflective Thinking

Dimension	Personal Development Dimensions
Scale Name	Reflective Thinking
Scale Description	Extent to which reflective activities are encouraged and how students enjoyed learning and participating in this environment.
Base Identifier	PRRT
Items	

I felt a sense of satisfaction and achievement about this learning environment.	PRRT 1
I enjoy learning and participating in this learning environment and found using the Internet for learning is stimulating.	PRRT 2
I enjoyed using the Internet as a means of accessing information and felt I learnt more in this environment.	PRRT 3
I felt the web based learning approach could substitute the traditional classroom approach.	PRRT 4
I had no problems accessing the materials and going through the materials on my own.	PRRT 5
I felt I was in control of my learning as I reviewed the material provided.	PRRT 6
I felt isolated towards the end of my study and was working very much on my own.	PRRT 7
I felt bored towards the end of viewing the materials presented.	PRRT 8
I would enjoy my learning if more of my courses were offered online.	PRRT 9
I was satisfied with my experience of using the Internet and learning online.	PRRT 10

Your comments and/or suggestions

Student - Media Interaction

Information Design and Appeal

Dimension	System Maintenance & System Change Dimension
Scale Name	Information Design and Appeal
Scale Description	Extent to which class materials are clear, stimulating and visually pleasing to the student.
Base Identifier	SMIDA
Items	

The choice of the text font was good.	SMIDA1
The choice of colours and style used in the text helped me read clearly.	SMIDA2
The backgrounds used in tables and pages enhanced the look of the material.	SMIDA3
The material was visually appealing.	SMIDA4
The material showed originality and creativity in the layout.	SMIDA5
I found the still graphics (photos, images and graphs) used were appropriate to the text and helped me understand.	SMIDA6
I found the graphics (photos, images and graphs) used were well designed and visually appealing.	SMIDA7
The multi media used (animation, sound, or video) was clear to hear and view.	SMIDA8
The multi media used (animation, sound, or video) was well designed.	SMIDA9
The multi-media used (animation, sound, or video) was appropriate to the text and helped me understand the concepts	SMIDA10

Your comments and/or suggestions

Student - Media Interaction

Order and Organisation

Dimension	System Maintenance & System Change Dimension
Scale Name	Order and Organisation
Scale Description	Extent to which class activities are clear, well organized, stimulating and assist student comprehension.
Base Identifier	SMOO
Items	

The links provided in the topic are clearly visible, reliable and are relevant and appropriate to the topic being studied.	SMOO 1
I found the links provided on the pages were useful in my learning and they clearly illustrated main points explained.	SMOO 2
The learning objectives are clearly stated for each topic.	SMOO 3
There was a contents page included that outlined the main points to be presented in each section.	SMOO 4
There was a course guide included that outlined the main points to be presented during the course.	SMOO 5
There was a summary page included for each topic that reviewed the main points presented.	SMOO 6
There was a course guide included that reviewed the main points presented for the whole course.	SMOO 7
The information was appropriate and related to the topic studied.	SMOO 8
The information was well organized and easy to follow.	SMOO 9
The information presented kept me focused on the terms and concepts explained.	SMOO 10
I was able to easily find help on terms or concepts I could not understand.	SMOO 11
There was a glossary included that reviewed key terms and concepts and helped me understand the topic.	SMOO 12

Your comments and/or suggestions

Student - Tutor Relationships

Active Learning

Dimension	Personal Development Dimensions
Scale Name	Active Learning
Scale Description	The extent to which the computer activities support students in they're learning and provide ongoing and relevant feedback.
Base Identifier	PDDAL
Items	

The activities/quizzes included in web-based materials enhance my learning process.	PDDAL 1
The activities/quizzes were placed in appropriate places.	PDDAL 2
The feedback I received from activities/quizzes is meaningful	PDDAL 3
The feedback I received in activities/quizzes helped me identify the things I got wrong	PDDAL 4
The feedback from activities/quizzes helped me to locate where I was having difficulties.	PDDAL 5
I was motivated by the responses I got from the activities/quizzes included in this course.	PDDAL 6
The activities/quizzes provided enhanced my learning.	PDDAL 7
Activities/quizzes appeared to be carefully planned.	PDDAL 8
The responses to my activities/quizzes where meaningful to me.	PDDAL 9
The responses to the activities helped me understand where I went wrong.	PDDAL 10

Your comments and/or suggestions

Student - Tutor Relationships

Affective Support

Dimension	Relationship
Scale Name	Affective Support
Scale Description	The extent to which the tutor guides students in their learning and provides sensitive, ongoing and encouraging support.
Base Identifier	RAS
Items	

I have the autonomy to ask my tutor what I do not understand	RAS1
The tutor responds promptly to my queries.	RAS2
The tutor addresses my queries adequately	RAS3
The feedback I received helped me identify the things I got wrong	RAS4
The tutor sends me feedback on my progress	RAS5
The tutor sends me feedback on assignments.	RAS6
The tutor encourages group activities.	RAS7
The tutor participates regularly in-group discussion.	RAS8
The tutor addresses group queries promptly.	RAS9
The tutor provides feedback on group progress.	RAS10
I have the autonomy to pose questions for the whole group to respond to.	RAS 11
The tutor treats me with respect.	RAS 12
The tutor encourages my participation.	RAS 13
The tutor helps me identify problem areas in my study	RAS 14

Your comments and/or suggestions

Student - Student Relationships

Student Cohesiveness and Affiliation

Dimension	Relationship Dimension
Scale Name	Student Cohesiveness and Affiliation
Scale Description	Extent to which students work together, know, help, support and are friendly to each other.
Base Identifier	RDSCA
Items	

I communicate regularly with other students in this course.	RDSCA 1
Other students communicate with me regularly.	RDSCA 2
I often ask other students for help in activities we are doing.	RDSCA 3
Other students often ask me to help them complete activities.	RDSCA 4
I have plenty of opportunities to work with other students in this course.	RDSCA 5
Other students provide feedback on activities I have done.	RDSCA 6
I provide feedback to students on activities they have done.	RDSCA 7
I share resources and information with other students	RDSCA 8
Other students share resources and information with me.	RDSCA 9
All students in this course get on well together	RDSCA 10
I get on well with students in this course.	RDSCA 11

Your comments and/or suggestions

Student Interface Interaction

Computer Anxiety and Competence

Social Climate Dimension	Personal Development Dimension
Scale Name	Computer Anxiety and Competence
Scale Description	Extent to which the student feels comfortable and enjoys using computers in the online environment.
Database Table Identifier	PDDCAC
Potential Items	

I am confident and competent using a range of computer technologies.	PDDCAC1
I have no problems using a range of computer technologies.	PDDCAC2
I have no problems connecting to the Internet and accessing relevant information.	PDDCAC3
I am confident in using 'search engines' and the World Wide Web to search for information.	PDDCAC4
I am able to locate the web-browser software quickly.	PDDCAC5
I am confident and competent in using the web-browser tool bar (back, forward, home, search).	PDDCAC6
I am able to re-connect to the network if anything goes wrong.	PDDCAC7
I would know what to do if a computer ‘error message’ occurred during my learning.	PDDCAC8
If necessary I can electronically store information on my computer or disk.	PDDCAC9
I am able to copy selected parts of the document and save if necessary. If necessary I am able print documents from the world wide web.	PDDCAC10

Your comments and/or suggestions

Student Interface Interaction

Material Environment and Rule Clarity

Dimension	System Maintenance & System Change Dimension
Scale Name	Material Environment and Rule Clarity
Scale Description	Extent to which behavior in the online environment is guided by formal rules and extent to which the computer hardware and software are adequate and user friendly.
Base Identifier	SMMERC
Items	

The rules on how to navigate the online course are clearly explained.	SMMERC 1
I felt I was in control of the online learning environment.	SMMERC 2
The environment is well structured and I found no difficulty in organizing my self.	SMMERC 3
There are clear rules and explanations to guide me in my online activities.	SMMERC 4
Instruction provided to use the tools within the site were clear and precise.	SMMERC 5
I had no problems in seeking appropriate help files that explained tool use.	SMMERC 6
The software I used was suitable for participating fully in the course.	SMMERC 7
I was able to install the appropriate software needed to participate in this course with ease.	SMMERC 8
All software applications needed to participate in this course were already provided.	SMMERC 9
There was little delay in opening and using the software applications used in this course.	SMMERC 10
All material appeared quickly on my screen.	SMMERC 11

Your comments and/or suggestions

Appendix B: **Refined 49-Item OLLES instrument**

Online Learning Environment Survey (OLLES)

Instructions

This survey contains two sections.

Section one, personal details, contains 5 questions and is used for statistical purposes only. Participants can not be identified in any way.

Section two, scales and items, contains statements about practices which could take place in your 'online' course. You will be asked how often each practice actually takes place in the course.

Once again thank you for your time spent in completing this survey.

Section 1: Personal Details

The personal information requested in this section of the survey is for **statistical purposes only**.

At no stage will this information be used for any other purpose. Your answers to the questions will remain confidential and **you will not be identified** in any way.

Personal Details

Gender

Your Age

Computer Use

I use my computer

I use the Internet

I log on to my online course

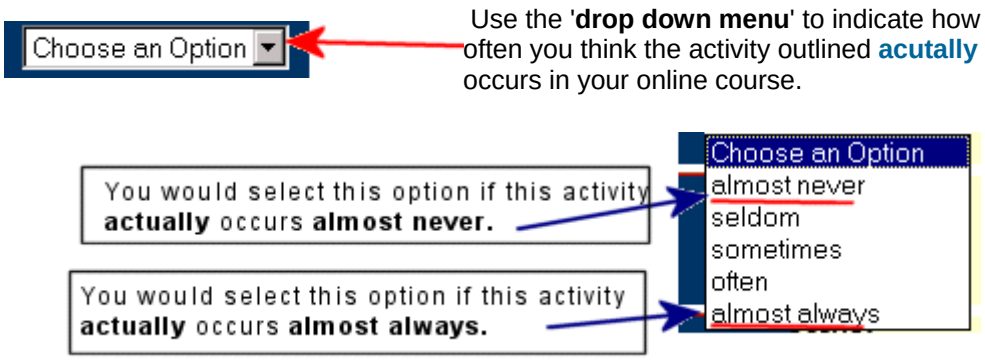
Section 2: Scales and Items

This remaining part of this survey contains statements about practices which could take place in your online unit. You will be asked **how often** each practice ***actually*** takes place in the course. Think carefully on how each statement describes what this unit is **actually** like for you. There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Using 'Drop Down Menus'

As mentioned above the survey contains a number of statements about practices which could take place in your online course. To respond you will be asked to use a

"**drop down menu**" at the right of the statement. Please see the example below.



Some statements in this survey are fairly similar to other statements. Do not worry about this. Simply give your opinion about all statements. This section should take you no more than 15 minutes to complete.

Scale: Student Collaboration **(1st of 8 scales: 8 questions)**

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 I communicate regularly with other students in this course.	**actual**
Item 2 Other students communicate with me regularly.	**actual**
Item 3 I often ask other students for help in activities we are doing.	**actual**
Item 4 Other students provide feedback on activities I have done.	**actual**
Item 5 I provide feedback to students on activities they have done.	**actual**
Item 6 I share resources and information with other students.	**actual**
Item 7 Other students share resources and information with me.	**actual**
Item 8 All students in this course get on well together. ***NB: This Item was removed in the extensive field testing undertaken***	**actual**

Scale: Computer Competence **(2nd of 8 scales: 8 questions)**

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — **actual**

I am confident and competent using a computer.

Item 2 — **actual**

I am confident in using the World Wide Web to search for information.

Item 3 — **actual**

I am confident in using the web-browser tool bar (back, forward, home, search).

Item 4 — **actual**

I am able to reconnect to the network if anything goes wrong.

Item 5 — **actual**

I know what to do if a computer 'error message' occurs during my learning.

NB: This Item was removed in the extensive field testing undertaken

Item 6 — **actual**

If necessary I can select and print documents from the Internet.

Item 7 — **actual**

If necessary I can electronically store information on my computer or disk.

Item 8 — **actual**

I am able to copy selected parts of the documents and save if necessary.

Scale: Active Learning **(3rd of 8 scales: 7 questions)**

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — **actual**

The feedback I receive from activities / quizzes is meaningful.

Item 2 — **actual**

The feedback I receive from activities / quizzes helps me to identify those things I get wrong.

Item 3 — **actual**

The feedback from activities / quizzes helps me to locate where I am having difficulties.

Item 4 — **actual**

I am motivated by the responses I get from the activities / quizzes included in this course.

Item 5 — actual

The activities / quizzes provided in the course enhances my learning.

Item 6 — actual

The responses provided during the activities / quizzes are meaningful to me.

Item 7 — actual

The responses to the activities help me understand where I am having difficulty.

Scale: Tutor Support (4th of 8 scales: 8 questions)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — actual

The tutor encourages my participation.

Item 2 — actual

The tutor responds promptly to my queries.

Item 3 — actual

The feedback I receive from my tutor helps me identify the things I do not understand.

Item 4 — actual

The tutor regularly sends me feedback on my progress.

Item 5 — actual

The tutor encourages my participation.

Item 6 — actual

The tutor addresses group queries promptly.

Item 7 — actual

The tutor participates regularly in group discussions.

Item 8 — actual

The tutor regularly provides feedback on group progress.

NB: This Item was removed in the extensive field testing undertaken

Scale: Information Design and Appeal (5th of 8 scales: 7 questions)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — actual

The choice of the text font is good.

Item 2 — actual

The choice of colours and style used in the text assisted my being able to read clearly.

Item 3 — actual

The backgrounds used in tables and pages enhance the look of the material.

Item 4 — actual

The material presented is visually appealing.

Item 5 — actual

The material shows originality and creativity in the layout.

Item 6 — actual

I find the graphics (photos, images and graphs) used are appropriate to the text and helps me understand.

Item 7 — actual

I find the graphics (photos, images and graphs) used are well designed and visually appealing.

Scale: Order and Organisation (6th of 8 scales: 9 questions)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — actual

The learning objectives are clearly stated for each topic.

Item 2 — actual

There is a course guide included that reviews the main points presented for the whole course.

Item 3 — actual

The information presented in the course is well organized and easy to follow.

Item 4 — actual

The information presented is appropriate and related to the topic studied.

Item 5 — actual

There is a summary page included for each topic that reviews the main points presented.

Item 6 — actual

I am able to easily find help on terms or concepts I do not understand.

NB: This Item was removed in the extensive field testing

undertaken

Item 7

There is a glossary included that reviews key terms and concepts and helps me understand the topic.

NB: This Item was removed in the extensive field testing undertaken

actual

Item 8

The links provided in the topic are clearly visible and are relevant and appropriate to the topic being studied.

actual

Item 9

I find the links provided on the pages are useful in my learning and they clearly illustrate main points explained.

actual

Scale: Material Environment (7th of 8 scales: 7 questions)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1

The instructions provided to use the tools within the site are clear and precise.

actual

Item 2

I have no problems in seeking appropriate help files that explain tool use.

actual

Item 3

The software I use is suitable for participating fully in the course.

actual

Item 4

I am able to install the appropriate software needed to participate in this course with ease.

actual

Item 5

All software applications needed to participate in this course are provided.

actual

Item 6

There is little delay in opening and using the software applications used in this course.

actual

Item 7

All material (photos, images, graphics and multi-media) appear quickly on my screen.

actual

Scale: Reflective Thinking (8th of 8 scales: 8 questions)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1

I feel a sense of satisfaction and achievement about this

actual

learning environment.

NB: This Item was removed in the extensive field testing undertaken

Item 2 — **actual**

I enjoy using the Internet as a means of accessing information.

Item 3 — **actual**

I find using the Internet for learning is stimulating.

Item 4 — **actual**

I have no problems accessing and going through the materials on my own.

Item 5 — **actual**

I feel I am in control of my learning as I review the material provided.

Item 6 — **actual**

I feel the web based learning approach can substitute for, or enhance the normal classroom approach.

Item 7 — **actual**

I feel I learn more in the online environment.

Item 8 — **actual**

I am satisfied with my experience of using the Internet and learning online.

Thank you for the time you have spent in completing this evaluation. Your efforts are much appreciated.

Please click the Submit Responses button below to complete the survey.

Submit Responses

By clicking on the "Submit Responses" button your continuing consent to participate in this survey is assumed.

Once you click on the button your responses to this survey will be saved to the database and you will no longer be able to access or change them.

If you have any queries regarding this survey please contact your course tutor or John Clayton ctjfc@wintec.ac.nz

Appendix C: **Modified 35-Item OLLES instrument**

Online Learning Environment Survey (OLLES)

Instructions

This survey contains two sections.

Section one, personal details, contains 5 questions and is used for statistical purposes only. Participants can not be identified in any way.

Section two, scales and items, contains statements about practices which could take place in your 'online' course. You will be asked how often each practice actually takes place in the course.

Once again thank you for your time spent in completing this survey.

Section 1: Personal Details

The personal information requested in this section of the survey is for **statistical purposes only**.

At no stage will this information be used for any other purpose. Your answers to the questions will remain confidential and **you will not be identified** in any way.

Personal Details

Gender

Your Age

Computer Use

I use my computer

I use the Internet

I log on to my online course

Institutional and Class Details

My institution name (provided by your teacher/tutor)

My course name/code (provided by your teacher/tutor)

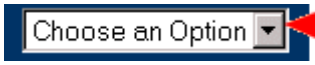
Section 2: Scales and Items

This remaining part of this survey contains statements about practices which could take place in your online unit. You will be asked **how often** each practice ***actually***

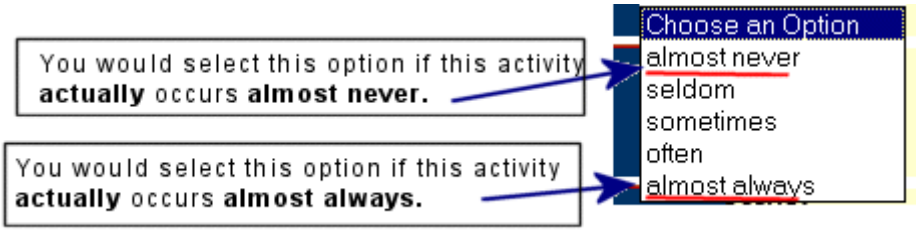
takes place in the course. Think carefully on how each statement describes what this unit is **actually** like for you. There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Using 'Drop Down Menus'

As mentioned above the survey contains a number of statements about practices which could take place in your online course. To respond you will be asked to use a "**drop down menu**" at the right of the statement. Please see the example below.



Use the '**drop down menu**' to indicate how often you think the activity outlined **acutally** occurs in your online course.



Some statements in this survey are fairly similar to other statements. Do not worry about this. Simply give your opinion about all statements. This section should take you no more than 15 minutes to complete.

Scale: Student Collaboration (1st of 7 scales: 5 statements)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — **actual**

I communicate regularly with other students in this course.

Item 2 — **actual**

I often ask other students for help in activities we are doing.

Item 3 — **actual**

Other students provide feedback on activities I have done.

Item 4 — **actual**

I share resources and information with other students.

Item 5 — **actual**

Other students share resources and information with me.

Scale: Computer Competence (2nd of 7 scales: 5 statements)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — **actual**

I am confident and competent using a computer.

Item 2

I am confident in using the World Wide Web to search for information.

actual

Item 3

I am able to reconnect to the network if anything goes wrong.

actual

Item 4

If necessary I can select and print documents from the Internet.

actual

Item 5

If necessary I can electronically store information on my computer or disk.

actual

Scale: Active Learning (3rd of 7 scales: 5 statements)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1

The feedback I receive from activities / quizzes is meaningful.

actual

Item 2

The feedback from activities / quizzes helps me to locate where I am having difficulties.

actual

Item 3

I am motivated by the responses I get from the activities / quizzes included in this course.

actual

Item 4

The activities / quizzes provided in the course enhances my learning.

actual

Item 5

The responses to the activities help me understand where I am having difficulty.

actual

Scale: Tutor Support (4th of 7 scales: 5 statements)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1

The tutor encourages my participation.

actual

Item 2

The tutor responds promptly to my queries.

actual

Item 3

The feedback I receive from my tutor helps me identify the things I do not understand.

actual

Item 4

actual

The tutor addresses group queries promptly.

Item 5 — actual

The tutor participates regularly in group discussions.

Scale: Information Design and Appeal (5th of 7 scales: 5 statements)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — actual

The choice of colours and style used in the text assisted my being able to read clearly.

Item 2 — actual

The backgrounds used in tables and pages enhance the look of the material.

Item 3 — actual

The material shows originality and creativity in the layout.

Item 4 — actual

I find the graphics (photos, images and graphs) used are appropriate to the text and helps me understand.

Item 5 — actual

I find the graphics (photos, images and graphs) used are well designed and visually appealing.

Scale: Material Environment (6th of 7 scales: 5 statements)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1 — actual

The instructions provided to use the tools within the site are clear and precise.

Item 2 — actual

The software I use is suitable for participating fully in the course.

Item 3 — actual

I am able to install the appropriate software needed to participate in this course with ease.

Item 4 — actual

All software applications needed to participate in this course are provided.

Item 5 — actual

There is little delay in opening and using the software applications used in this course.

Scale: Reflective Thinking (7th of 7 scales: 5 statements)

Remember, there are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Item 1

I find using the Internet for learning is stimulating.

actual

Item 2

I have no problems accessing and going through the materials on my own.

actual

Item 3

I feel I am in control of my learning as I review the material provided.

actual

Item 4

I feel the web based learning approach can substitute for, or enhance the normal classroom approach.

actual

Item 5

I feel I learn more in the online environment.

actual

Thank you for the time you have spent in completing this evaluation. Your efforts are much appreciated.

Please click the Submit Responses button below to complete the survey.

Submit Responses

By clicking on the "Submit Responses" button your continuing consent to participate in this survey is assumed.

Once you click on the button your responses to this survey will be saved to the database and you will no longer be able to access or change them.

If you have any queries regarding this survey please contact your course tutor or John Clayton ctjfc@wintec.ac.nz