

**Science and Mathematics Education Centre**

**The Influence of Occupational Therapy Students'  
Characteristics When Learning With Interactive Multimedia**

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## ABSTRACT

This study was undertaken to assist with the development and introduction into the occupational therapy curriculum of an interactive, multimedia learning resource. The radical changes from traditional teaching/learning methodologies, focusing on instructor presentation, to a more learner active role could disadvantage some students. For instance, having to access information independently and problem-solve utilising material presented electronically may add considerable cognitive demands to the learning task. Many factors influence an individual learning in computerised interactive learning situations and these include motivation, previous experience, and a range of learner characteristics. The last factor includes styles of functioning which impact on both the interpretation of processes and the appraisal of performance levels. In many previous studies researching the use of media and learning, these factors have been isolated and their impact on user performance and attitude measured. However, with interactive multimedia, several elements combine to make research concentration on individual variables questionable. These elements include the range and mix of media used, the interactivity possible, and the degree of user control. Therefore, this exploratory study sought to establish some of the learning characteristics which combined to form statistical models in a range of participant navigational tasks. Multiple regression analysis was employed to determine the ways that individuals with differing personal characteristics make navigational decisions while browsing and problem-solving when utilising interactive learning materials. Case studies were employed to illustrate extreme cases. Personal characteristics measured included technological experience, cognitive style, learning style, computer awareness and computer anxiety. This research indicated that significant numbers of occupational therapy students displayed a tendency towards field-independent cognitive style, activist and reflector learning styles, and an aversion to the use of computer technology. Awareness of these strengths and weaknesses and their impact on multimedia navigation can assist both students and educators to plan strategies to maximise the effectiveness of learning materials. Statistically significant models were identified for five of the six dependent navigation variables measured although their predictor strength was low. Of the independent variables, age, cognitive style, computer thoughts, and prior computer experience all occurred in two or more of the statistically significant models for the navigation performance dependent variables. The dependent variable forming the strongest statistical model was attitudes towards the learning package, representing 38% of the variance.

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## Chapter 1

### AN OVERVIEW OF THE STUDY

#### 1.0 Introduction

##### 1.0.1 Information technology

Technological developments in occupational therapy studies and clinical practice increasingly demand the development of computer-literacy and specific learning skills by students and practitioners (Farrow & Sims, 1987; Moge, 1995; Seale, 1997; Toth-Cohen, 1994). Learning in multimedia environments, exploring the Internet through hypertextual links, utilising computer-driven assessment tools and accessing administration software packages are all areas increasingly being employed (Campbell, 1996; Kippen, 1996; Stone, 1996). To perform effectively with computer/telecommunications technology, Schools of Occupational Therapy must ensure that graduates acquire the skills and confidence to utilise it effectively and be prepared to assist and encourage established therapists to utilise the potential of the technology in clinical practice (Koschman, 1995; Moge, 1995).

Interactive information systems, propelled by recent advancements in computer and telecommunication technologies, are introducing new opportunities for students and therapists to conveniently access information independently. Utilisation of these technologies is gaining momentum with the availability of more effective means of transferring data across local and global communication networks. The availability of multimedia CD-ROMs and the growth in the utilisation of the Internet, with the introduction of the graphical interfaced World Wide Web, bears testament to this phenomena. Multimedia learning packages such as *Computer Applications in Therapy*

(Seale, 1997), *Vocational Rehabilitation Learning Resource* (Cameron, 1995b), *The Virtual Teaching Hospital* (Wong, 1994) utilise the interactive capabilities of computer technology to provide occupational therapy students with opportunities to practice clinical reasoning skills in simulated settings through *open learning* strategies.

### **1.0.2 Open learning**

Open learning represents a family of strategies within the spectrum of learning opportunities. It can include amongst its subsets distance and correspondence schemes, modularised learning in which learners can construct an individualised learning program, and multimedia packages (Bailey, 1992, p. 983). Openness and closure is the degree of control that the learner has with these dimensions. Interactive information systems can provide an open approach to learning whereby students can utilise resources at a time, pace, and place of their convenience through CD-ROM and/or network access.

With a general trend towards open learning and life long learning in the tertiary sector of education (Bailey, 1992; Bassett, 1994; Hannafin, 1996), and the current constraints on educational budgets as well as the rapid developments in computer/telecommunication technologies (Laurillard, 1993), it follows that educators and funding providers will increasingly look at employing the capabilities of this technology to meet anticipated demand. Although the provision of learning resources through open learning can provide more choice and control to the learner, it also requires the utilisation of independent learning skills to employ it effectively.

### **1.0.3 Self-directed learning**

This use of technology-driven interactive learning systems introduces new opportunities for students to conveniently access information without the restraints of traditional

teacher-directed instruction (Ebersole, 1997; Gall & Hannifin, 1994). However, there are concerns that not all students will benefit equally from these new learning situations which demand a more self-directed approach than is the case in traditional teaching/learning environments (Kozma, 1991). For instance, student performance may vary significantly in these new learning situations because of differences in motivation, information processing capabilities, information retrieval procedures, knowledge that is stored in long-term memory, self-directed learning skills, and knowledge of when and how to use such procedures and skills. Therefore, focus should be directed into adequately evaluating the educational effectiveness of these innovations to meet the variable needs of all intended learners (Hedberg & Alexander, 1994).

Hooper and Hannafin (1991) suggested that, in the recent past, researchers have applied a technology-driven perspective to the use of interactive learning technologies which focused more on the equipment instead of optimising the capabilities of the learner. The full potential of this technology to the learner, according to Hooper and Hannafin, can only be realised when:

the cognitive requirements of the instruction have been identified; associated strategies prescribed accordingly; and instructional activities developed to maximise those features of the medium that support most substantially the identified processing requirements. (p. 70)

Hooper and Hannafin (1991) and other researchers such as Kozma (1991) and Jonassen, Campbell, and Davidson (1994) have noted that the design of emerging technologies remains comparatively insulated from research and development that might maximise the capabilities of learners through technology-driven instructional manipulations. Kozma argued that instructional media should be more than mere vehicles relaying learning materials, but should combine the technology, task and context to maximise educational

effectiveness. Jonassen et al. agreed with Kozma and believed that the research debate “focuses too exclusively on objectivist and instructionist conceptions of media” (p. 31) and that this focus is inappropriate in the context of contemporary learning theory. Hence, there is a need for research to guide interactive multimedia designers on ways in which users interact with content and the navigation strategies they employ in multimedia environments in order to utilise this technology to maximise its potential.

## **1.1 The Research Problem**

### **1.1.1 Introducing computer-driven self-directed learning into the occupational therapy curriculum**

The range of digitised information resources available to tertiary learners is developing at a significant rate (Ebersole, 1997; Trumbull, Gay, & Mazur, 1992; Wood, Ford, Miller, Sobczyk, & Duffin, 1996). The most obvious resource contributing to this situation is the Internet, where the volume of data is multiplying at an exponential rate. Numerous on-line service providers allow users access to this data, one of the largest being *America On-Line* which has approximately eight million subscribers (<http://www.aol.com/>). For several years, tertiary students have had access to CD-ROM based databases housing references to journals and other subject specific resources, usually available at campus libraries. Recent developments have seen abstracts and complete digitised journals becoming available on-line through the Internet. The National Library of Australia maintains a World Wide Web site containing reference information on over 1,000 Australian electronic journals and magazines (<http://www.nla.jor.au/oz/ausejour/>). These resources have significant relevance to learning, whereby students now have the opportunity to rapidly download information which in the past was available only through teacher-directed learning or through time-consuming manual library searches.



This study was prompted by the planned introduction of an interactive problem-based learning package into the curriculum at the School of Occupational Therapy, Curtin University. A hypermedia system, *Vocational Rehabilitation Learning Resource (VRLR)*, has been developed by the author to facilitate undergraduate students of an occupational health unit practice in the decision making process in which a clinician engages when presented with an injured client. The design and function of this self-paced learning system, and the way in which students engage with it, is presented in Chapter 3. Simultaneously, students are being encouraged to supplement this information on *VRLR* by accessing the World Wide Web and utilising related information located in appropriate sites around the world.

#### **1.1.2 Users' ability to independently access interactive multimedia learning materials and problem-solve**

In an interactive learning situation, such as encountered with *VRLR*, new users may be faced with a number of challenges as they navigate through the system and attempt to make its structure and contents meaningful. Not only must learners gain knowledge of new content matter, but they must also master the interactive technology (Reed, Ayersman & Liu, 1996). Plowman (1996, p. 92) pointed out that "we are not yet accustomed to the new form of text (hypertext) engendered by the combination of media and our narrative expectations can be confused and thwarted". Although we have some familiarity with learning through the use of a range of media, including film, books, and television, the knowledge we have gained is not directly transferable to computer-driven interactive multimedia. Issues surrounding the methods that multimedia information seekers employ are complex as they focus on attention to detail, attempt to make comprehension, and apply long and short-term memory. In some of the tasks, different kinds of learning skills are involved in addition to those of understanding the subject matter. These can include interpreting the computer's 'opaque' interface, interacting with a multimedia format,

database searching, problem-solving, measuring performance, and accessing 'help' features. The varieties of learning employed may include learning by transfer, by doing, and creating hypotheses through a process of acceptance and rejection (Burbules & Callister, 1996; Gall & Hannafin, 1994; Jonassen & Wang, 1993).

## **1.2 Learning With Computers**

Trotter (1989) pointed out that educationally, interactive multimedia provides features which have the potential to contribute to sound learning strategies. These include the learner being in control, thereby permitting opportunities to manoeuvre within the program to suit individual needs. With a variety of media available, the designer can provide the user with a range of approaches to make the material more meaningful to the individual (p. 35). By incorporating reinforcement and feedback features, the designer has the opportunity to enhance the effectiveness of instruction. Hannafin (1985) and Bruder (1991) identified other features which have led to claims of interactive multimedia's superiority over competing technologies as an effective instructional tool. These include rapid access time to material, fidelity of visual and sound production, and the potential to allow students to create what they learn, thereby giving a sense of ownership. However, because of the relatively short history of this technology, researchers are still learning about the cognitive processes that learners engage in as they interact with multimedia. Research on how designers can maximise its effectiveness to cater for users with varying needs is still in its infancy.

Any form of instruction involves numerous variables and interactive multimedia in particular has several complexities due to the media mix, interactivity and degree of user control. Jonassen, Campbell, and Davidson (1994, p. 3) highlighted this problem noting that it was "difficult or impossible to isolate which components of the learning system, the medium, the attributes, the activities, the learner, or the environment affect learning and in

what ways". These authors believed that the focus of research into learning with interactive media should be less on the characteristics and attributes of the various elements for conveying knowledge and more on the role of the learner and the context of learning. Rather than use the traditional research procedure of subjecting learners to different methodologies and comparing results, focus should be more on the role of media in supporting, not controlling, the learning process. Concentration can thereby be directed to capitalising on the media's inherent strengths and minimising its weaknesses.

### **1.3 Purpose of the Study**

Designing and developing educational interactive multimedia can be a challenging task. Apart from the identification, collection, and collation of content materials, the designer must construct a user interface which matches the cognitive abilities of the targeted learners. This design consideration is particularly critical for new users who may seek familiar cues as they attempt to make meaning from computer-learning systems such as *VRLR*. Previous experiences and cognitive processing characteristics are employed by learners as they attempt to make the multimedia structure meaningful (Hockey, 1990). Developers of computer learning packages could benefit from knowledge of the intended users' characteristics that influence learning and the creation of meaningful hypothesis, thereby assisting in selection of features which could be incorporated to promote effective learning. These features may be in the form of overviews or help features.

This research was designed to identify and describe the relationship between specific learner characteristics and navigation performance that new users employ as they interact with the interactive multimedia learning system *VRLR* for the first time and attempt to make the experiences meaningful. This study examined a range of learner characteristics and the navigation strategies employed as each participant explored and completed set tasks within the system. Contributing elements to participants' approach to learning were

investigated and relevant modifications made to *VRLR* in order to enhance the system's educational effectiveness. Recommendations were made on how this information may be applied to the design of other similar interactive learning systems.

#### **1.4 Research Design**

The introduction of *VRLR* into the occupational therapy curriculum was treated as a case study in this research. This approach allowed a comprehensive research strategy to be employed investigating a variety of evidence which would not be available in a more experimental study (Merriam, 1990; Platt, 1992; Yin, 1994). Participants with extreme and average performances on navigation and attitudes variables were selected to provide qualitative support, or otherwise, to the findings. This study had five main stages:

- the design, development and formative evaluation of *VRLR*
- measurement of participants' learner characteristics
- measurement of participants' navigation performance
- measurement of participants' attitudes towards *VRLR*
- identification of relationships between learner characteristics and other variables measured.

##### **1.4.2 Research questions**

The following research questions were investigated:

1. Can an independently accessed, interactive multimedia package be designed and developed to provide case studies which support occupational therapy students learning vocational rehabilitation?

2. What are the learner characteristics (i.e. cognitive style, learning style and degree of technophobia) for the targeted population of occupational therapy students?
3. What is the relationship between learner characteristics and navigation performance for the targeted population of occupational therapy students?
4. What is the relationship between learner characteristics, navigation performance and attitudes for the targeted population of occupational therapy students?

### **1.5 Instrumentation, Data Collection and Analysis**

Instruments employed in this study sought to identify learner characteristics, learners' navigation performance, and their attitudes towards the learning package. In addition, data were collected from questionnaires, field notes, and video recordings. Analysis was conducted through statistical techniques, including variable pairing correlations and multiple linear regression.

#### ***1.5.1 Vocational Rehabilitation Learning Resource***

This interactive multimedia package was designed to provide occupational therapy students with the opportunity to practice making case management decisions in the area of vocational rehabilitation. From a bank of case studies, students link to four separate resource databases to problem-solve by selecting treatment to meet client needs. Details of this learning package are detailed in Chapter 3.

### **1.5.2 Learner characteristics**

Many personal characteristics influence learning and the potential formation of meaningful hypotheses in computerised interactive learning situations. Some of the most recognised influences include cognitive style (Coventry, 1989; Sein & Bostrom, 1989), learning style (Logan, 1990; Sein & Bostrom, 1989; Van der Veer, 1989), and computer experience and computer anxiety (Honeyman & White, 1987; Marcoulides, 1988; Nelson, Wiese & Cooper, 1991).

### **1.5.3 Navigation performance**

A hypermedia system, such as *VRLR* (see Appendix A), consists of a database or series of databases with an interface linking and permitting access to information contained within. The system impacts on information-seeking through its content, organisation, and physical form. Well-designed hypermedia should encourage users to interact with them by readily allowing selection of individual pathways through their internal architectures (Lemke, 1993). A major concern with hypermedia learning systems is that the novice may get 'lost in hyperspace'. The choice of pathways, volume of contents, and mix of media components can all contribute to users becoming confused and frustrated (Burbules & Callister, 1996; Chen, 1989; Cohen, 1984; Vickers & Gaines, 1988). Thus, observation of learners navigating through hypermedia can provide information which can enhance designs to make the system more meaningful for targeted users. Navigation can include the pathways selected by users, help features accessed, and time taken to access specific data (Gall & Hannifin, 1994; Gay, Trumbull & Mazur, 1991; Stanton & Baber 1994).

### **1.5.4 Attitudes towards learning experiences**

Investigators studying the effectiveness of computer-driven learning in the past have mainly focused on the cognitive domain when advising designers on meeting users'

needs, but there is also a need to address the affective domain. Few would disagree that fostering a favourable user attitude towards learning in general is a fundamental goal of educators. For if students develop such attitudes, other objectives often become secondary (Bear, Richards & Lancaster, 1987). One reason why most investigators have not assessed student attitudes towards computer learning is that few psychometrically sound instruments for measuring such attitudes have been developed (Kulik, Bangert & Williams, 1983; Kulik, Kulik & Cohen, 1980; Woodrow, 1994). This study will endeavour to measure users' attitude to one specific computer learning system, *VRLR*, and to establish links with learner characteristics and navigation.

#### **1.5.5 Statistical models**

Many independent variables impact on learning with hypermedia. Selecting appropriate contributing variables can require theoretical knowledge as well as knowledge of their impact on each other. This study measured learner characteristics, navigation performance variables, learners' attitudes, and relationships between these variables utilising statistical tests which included Pearson's correlation coefficients and the development of multiple linear regression models. Details of the application of these measurements and analysis are explained in Chapter 4. The outcome of these measurements and the resulting analyses are described in Chapters 5 to 7.

### **1.6 Organisation of this Study**

#### **1.6.1 Development phase**

Interest in this research topic was kindled during the author's investigations towards a Masters degree (Cameron, 1993). Included in the outcomes of this study into the use of advance organisers in multimedia was the recommendation that designers of multimedia incorporate short tests within learning programs to establish the learning needs of users.

These tests should be employed to identify previous computer experience and learning and this information should be utilised to direct learners “to the most appropriate part of the program to meet their immediate needs” (p. 103).

Subsequently, with the design and development of *VRLR* (see Chapter 3), the author has been concerned that to maximise the learning value of this problem-based learning package, an awareness of users' needs was necessary. This would involve identifying and measuring occupational therapy students' learning characteristics which impact on learning in a hypermedia environment.

The opportunity to investigate the influence of learning characteristics came during formative evaluation of *VRLR* during 1995. Instruments were procured to measure user characteristics and to conduct pilot studies in order to trial routines for tracking navigation (explained in detail in Chapter 3). With the significant effort and cost involved in producing and introducing multimedia learning materials into the curriculum, field-testing is imperative to ensure that they meet the learning objectives. Driver and Scott (1996) advocated that it is no longer sufficient to introduce curriculum innovations by relying on “materials that are well thought through --- and that are presented clearly to students” (p.106). These authors stated that to establish “what is taught is what is learned”, more thorough research should be instigated. The investigations carried out in this research were conducted to provide information to maximise the effectiveness of a major innovation into the occupational therapy undergraduate curriculum.

### **1.6.2 Data Collection**

The participants in this research were the occupational therapy students who would be the first to use *VRLR* as a learning resource. This would ensure that the content material was seen as relevant to their studies; however, it also meant that this research was restricted to



a 'captive audience' where the total number of participants was limited to the total number of students enrolled in the relevant part of the occupational therapy curriculum. All possible candidates agreed to participate in this study, although five dropped out during the course of the investigations.

The data analysis phase involved initially measuring each participant's learner characteristics. A range of measuring instruments/questionnaires was administered to determine demographic data and technology experience, learning style, cognitive style, computer anxiety, computer thoughts and computer attitudes. Each of these constructs and the instruments are described in detail in Chapter 4.

The research then involved observing participants carry out four types of task utilising the CD-ROM *VLLR*. These tasks were:

- carrying out simple searches of the multimedia package
- exploring the package to become familiar with content and structure
- conducting problem-solving exercises
- teaching-back the problem-solving features to the investigator

Participants were permitted up to four minutes to complete each of the above group of tasks with instructions being given by the investigator who was located next to the participant in a small testing laboratory set-up (see Chapter 4, Figure 4D). The participants' actions were recorded by video camera and relayed to a research assistant who was located in an adjacent room. The research assistant viewed the monitored proceedings and assisted with recording of scores on a range of set tasks and observations (see Appendix B). Variables measured by the investigator and research assistant included time spent attempting tasks, screens accessed, successful searches, assistance requested and overviews accessed. Further details on these procedures are provided in Chapter 4.

On completion of the set tasks with *VRLR*, participants were asked to complete a questionnaire assessing their attitude to the learning package. Reliabilities were measured for the learner characteristics instruments. Descriptive statistics for the variables measured by each instrument were obtained, coefficient matrices constructed, and multiple regression analysis conducted to examine if learner characteristics predicted the performance outcomes. Results are reported in Chapter 5-7 and conclusions presented in Chapter 8.

### **1.7 Overview of the Thesis**

In this exploratory study an attempt was made to identify some of the main influencing user characteristics, and their combined effect, on navigation performance in an interactive multimedia learning environment being introduced into the occupational therapy undergraduate curriculum.

Chapter 2 investigates the literature in areas related to this study. It looks at current knowledge on the learning characteristics of occupational therapy students and aspects of learning theory in general with particular relevance to hypermedia and its interactivity.

Chapter 3 includes a description of the learning package *VRLR*, and identifies the need to provide occupational therapy students with learning experiences that reflect clinical practice and can be accessed independently by users. The design, development, and formative evaluation trials of this learning resource are explained in detail. The methodology utilised in this research is discussed in Chapter 4, identifying both the quantitative and qualitative components. It describes the participants in the study, measurement instruments employed, research set-up, and the analysis of data. Chapter 5 reports on the results of the learner characteristics questionnaires/instruments and describes any relationships between these learner variables. Observations from the

participants' navigation components are reported in Chapter 6 with correlation matrices demonstrating any statistically significant pairings of learner characteristics and navigation performance variables. Multiple linear regression analysis is then employed to illustrate statistical models involving combinations of these variables. In Chapter 7, the results of the *VRLR - User Attitude Questionnaire* is reported along with correlations and multiple linear regression analysis to demonstrate any relationships between the attitude, learner characteristics, and navigation performance variables. Finally, in Chapter 8, summaries, limitations, and implications of this study are highlighted and discussed. Some of the limitations identified include the relatively small population size, absence of measurement on effectiveness of *VRLR* on student learning, and investigator's involvement in the design of *VRLR*. Implications discussed include the value of knowledge on user characteristics to both learners and educators, need to develop new instruments to measure characteristics relevant to learning with information technology, strategies which can be employed to minimise user computer aversion, research methodologies which are recommended for future studies in this area.

## Chapter 2

### LITERATURE REVIEW

#### 2.0 Introduction

Although interactive multimedia programs have been presented as new technology, their development has evolved from several diverse areas of educational technology, some of which have been in use for a number of years. For example, the concepts of interactive learning techniques can be traced back to the individualised learning movement pioneered by the behavioural psychologist B. F. Skinner in the 1950s (Skinner, 1968). The development of the microcomputer, the CD-ROM, the World Wide Web, and hypermedia software have all played a part in interactive multimedia reaching its current state of development and consequent potential to enhance and improve the educational process (Astleitner & Leutner, 1995; Burbules & Callister, 1996; Reed, Ayersman & Liu, 1995). A review of these contributing techniques and technologies has therefore been considered as being appropriate to this current study and forms Section 2.1 of this chapter.

Learning theory and the implications for users of new information technologies, such as interactive multimedia, also require scrutiny. Therefore, the behavioural, cognitive and constructivist movements are investigated for research findings that are relevant to learning packages such as *Vocational Rehabilitation Learning Resource (VRLR)*. This investigation comprises Section 2.2 of this chapter. Recent innovations in methodologies of educational delivery, such as open learning, and the potential of on-line availability are investigated in Section 2.3 of this literature review. As *VRLR* involves students working in a self-directed, problem-based learning environment, related research in these areas is also examined. The unique learning environment of multimedia, and its demands on new users as they strive to create a working

hypothesis of their experience, have prompted the review of literature involving some of multimedia's key features such as interactivity, navigation and user control.

One of the major objectives of this study is the investigation of some of the characteristics which influence learning for the occupational therapy students who form the population for this study. Section 2.4 of the review is focused on research involving the learner characteristics of cognitive style, learning style and technophobia. Lastly, an overview of related research in the areas of bibliography searching and interactive multimedia learning is provided.

## **2.1 Individualised Learning and the Computer**

### **2.1.1 Individualised learning**

The move to individualised learning began as a reaction to the problems associated with large group instruction. These problems included instruction proceeding at one fixed rate and teachers spending most of their time imparting information and not having time to spend with individual students with special difficulties (Pearson, 1983). Skinner developed the technique called programmed learning, where teaching materials were carefully structured into a series of statements or frames designed to give feedback to students. Depending on the response to test questions, students were directed to the next frame in the sequence or, if they answered incorrectly, directed to repeat or attempt some remedial work (Skinner, 1968). Frequently, programmed learning material was designed for teaching machines, which could be regarded as non-electronic forerunners to the personal computer. Teaching materials were printed on rolls of paper with a feed mechanism in the machine permitting branching to appropriate sections dependent on student responses. The advantages claimed by programmed learning included active involvement, immediate feedback, and student pacing. Further, low level achievers could achieve as much as high achievers (Goldschmid & Goldschmid, 1974).

It is now 40 years since Skinner first introduced programmed text and teaching machines. Interest has diminished significantly over the past few decades such that today little, if any, reference is made to this work. Student boredom and faulty equipment are two reasons why programmed learning never maintained its popularity as a teaching method (Cohen, 1984). Although the programmed learning model, and its behavioural principles, was a dominant paradigm in the field of instructional technology for three decades, it has been supplemented by cognitive strategies which have become widely accepted in recent years as they make learning more meaningful to the individual. Further, there is a prevalent view that technology has advanced in recent years to a level where computers, and interactive multimedia in particular, are capable of representing knowledge in ways which are more consistent with the ways in which humans learn (Jonassen, 1991; 1996). For instance, Jonassen (1991, p. 86) believed that there is significant potential for hypertext systems (refer to Appendix A), which are frequently used as authoring tools in multimedia, as they have the ability to function as models of supportive networks similar to associated learning theory. Although Jonassen's beliefs have still to be substantiated, the increasing knowledge of cognitive processing and the advances in computer technology have allowed designers to introduce more interactive materials and thereby cater more for the individual's needs.

Several studies have investigated the research into programmed learning. The initial claims that low achievers could learn as much as high achievers through the use of programmed learning materials was not validated when the research was scrutinised (Cronbach & Snow, 1977). In a meta-analysis of studies into programmed learning in higher education, Kulik, Cohen & Ebeling (1980) noted that programmed learning raised student examination scores by a quarter of a standard deviation compared to conventional studies. Although achievement gains by students were small, Kulik, et al. noted a trend to more favourable results as indicated by later studies in the analysis.

In a meta-analytic study of programmed learning in secondary education, Kulik, Schwalb, & Kulik (1982) found a similar improvement in later studies. Although the effect of programmed learning was insignificant (less than one tenth of a standard deviation unit), they speculated that the improvement in results was because "the art or science of programming has improved in recent years and that these later studies used better programs than older studies" (p. 138). The same authors believed that although the use of programmed learning, in the strictly Skinnerian tradition, had diminished, it had a significant impact on improving the quality of teaching. For instance, the approach had made teachers more aware of the importance of system and design in instruction, and has led to them placing increasing value on pedagogical basics such as behavioural objectives, active student response, and positive reinforcement (p. 133). Consideration of many of these principles and strategies is relevant in today's computer-based classrooms and worthy of consideration for incorporation in the design of multimedia.

### **2.1.2 Computers and learning**

The fundamental hardware of interactive multimedia is the computer. It is through the computer that the user can control those media options which may be accessed from the computer's hard disk or from separate linked sources, such as a CD-ROM drive or the World Wide Web. An understanding of the computer's development and abilities as an instructional tool is therefore relevant to multimedia developers and researchers as well as a knowledge of learning theory associated with individualised pacing, branching, immediate feedback on answers, and reinforcement.

Many of the main features of programmed learning have been applied to computer assisted instruction (CAI). In a review, using meta-analytic techniques, Kulik & Kulik (1980) found that computer-based college teaching made a small but significant contribution to student achievement, student attitudes towards instruction and material

being studied, and reduction in time required for instruction. In 37 of the 54 studies reviewed, CAI mean examination performance was superior to mean examination performance in a conventional class with scores being raised by approximately 0.25 standard deviations. Similar results were reported in a later meta-analysis of 51 evaluations of CAI in secondary schools (Kulik, Bangert, & Williams, 1983). This latter analysis showed that computer-based teaching raised secondary school students' scores on final examinations by approximately 0.32 standard deviations. However, results such as these in media research can be confusing as the uncontrolled effects of instructional methods, content differences between treatments, and the novelty effect may influence findings. Clark (1983) believed that these positive findings in achievement and attitude are due to the "--- systematic but uncontrolled differences in content and/or method, contributed unintentionally by different teachers or designers" (pp. 448-449). Indeed, Kulik & Kulik (1980) acknowledged that the positive effect for media more or less disappears when the same teacher produces all treatments. In their study of computer-based college teaching, the average effect size was 0.13 for those studies in which a single teacher gave both computer-based and conventional sections of a course, whereas the effect size was 0.51 when teachers employed for experimental groups were different from those used in control groups (pp. 534-535). Therefore, it appears that different teams of designers or teachers probably gave more varied content and teaching methods to the treatments that were compared.

Clark (1983) also criticised the claim that there was a time savings due to the use of computers over conventional teaching, stating that "a plausible rival hypothesis here is the possible effect of greater effort invested in newer media programs than in conventional presentations of the same material" (p. 449). These findings from meta-analytical research (Kulik & Kulik, 1980; Kulik et al., 1983), generally support the argument that it is not the type of media which improves the effectiveness of one media over another (or conventional teaching), but rather it is the additional time and thought given to the instructional design and development. This observation should be



noted by all developers and researchers of interactive multimedia. However, it is a viewpoint not shared by all in this continuing debate and needs to be subjected to controlled investigation to establish under what conditions media will influence learning. Specifically it requires the need to consider the capabilities of media, and the methods that employ them, as they interact with the cognitive and social processes by which the knowledge is constructed (Kozma, 1994).

Despite the increasing usage of CAI in education over the past two decades, one of the most important limitations has been the reliance upon abstract or verbal teaching. CAI learning materials produced up until recently have not been capable of depicting static or dynamic visual material with the same accuracy as video and have largely been restricted to drill and practice, and tutorial roles (Chen, 1989, p.8). Hypermedia offers the opportunity to address this issue, particularly with the latest technological developments in hardware and software which allow features such as sound, still images and moving images to be readily digitised and stored within the computer.

### **2.1.3 Interactive media: hardware and software**

The advent of the first video disc recording can be traced to 1927 when John Logie Baird developed a technique of storing television images on phonograph records (Bosco, 1984; Smith, 1987). However, it was not until the 1970s, and the development of the laser disc with its high quality sound and video reproduction, that the video recording on disc format began to be appreciated as a rival to tape which was then the standard method of recording.

Consequentially, instructional videotape has been widely used in the classroom for instructional purposes for the past two decades. It has several notable characteristics including the capabilities of including spoken description, instructions, and other sound effects as well as offering good quality visual stimuli. However, the major

disadvantages of video as a *stand alone* instructional tool are that it is non-interactive in format and not capable of providing feedback, remediation, and individualised pacing (Chen, 1989, p. 6).

With the rapid development of the microcomputer in the early 1980s, educationalists began to explore the potential of allowing learners to interact with video through a computer (Bosco, 1984). Graphic capabilities, animation, sound, large memory capacity, and high speed response coupled with peripheral devices such as touch-screens, the *mouse* input device, and high resolution bit-mapped graphic computer screens have added to making video more attractive when part of an integrated, interactive package (Frisse, 1990). This integration has prompted exploration of the process components of this instructional delivery system as well as the media component (Dick, 1987).

In recent times, the term *instructional design* has been applied to this process component of educational technology which endeavours to systematically apply learning theory and empirical findings to the planning of instruction (Merrill, 1991). Instructional design theory and processes are influenced by learning theories, which incorporate principles based upon information processing, memory, retention theory, and related schemata. Knowledge of these principles can assist the developer of interactive multimedia to design with due consideration of the learner's perspective.

Many studies have been conducted into learning by psychologists and educationalists in an endeavour to increase our understanding. Scrutinising the results and determining the implications for the instructional designers of hypermedia can be a daunting task. The topic of *learning* is probably the most researched in the history of psychology but our knowledge is still wanting with many problems remaining to be resolved. Laurillard (1993) illustrates the magnitude of the task when she compares the human mind to being just as complicated as the human body but points out that

“the same amount of time, energy and money spent on medical science will never be spent on instructional science”(p. 4). In recent years, learning research has been revitalised through the introduction of computers (Waern, 1993). A convenient starting point in investigating the impact of learning theory on hypermedia is to trace the development of theories of learning which have had a significant impact on instructional design. These theories have been classified under the philosophies of behaviourism, cognitive processes and constructivism.

## **2.2 Learning Theories**

### **2.2.1 Behavioural theories**

Advocates of behaviourism have taken the view that those who study learning should base their conclusions on observations of the study of individual behaviour as it interacts with the environment (Kratowill & Bijou, 1987, p. 131). Kratowill and Bijou traced behaviourism's empirical foundation to the times of Aristotle, whose major contribution was the attempt to interpret human experience and behaviour in concrete terms. Aristotle argued that individuals remember events due to contiguity, similarity, and contrast (p. 132). Skinner (1968) viewed the modern roots of behaviourism as forming from the experimental analysis of animal behaviour studied in laboratory sessions. It was here that the principles of classical and operant conditioning evolved.

Classical conditioning developed at the turn of the century from the work of a number of Russian scientists, notably Pavlov, who were working in the area of experimental neurophysiology. Their experiments, involving animals, introduced physiological methods of research into the domain of psychology. The outcome of their studies was the description of the nature of conditioned reflex by repeatedly pairing a stimulus that elicited a reflex reaction (labelled an unconditioned stimulus) with a neutral stimulus that did not (labelled a conditioned or reinforced stimulus). This kind of learning is

referred to frequently as classical conditioning, because it is based on classical experiments that are viewed as good examples of scientific methodology (Biehler & Snowman, 1982).

Thorndike (1912) also worked in the area of animal learning, and took the association concept a stage further than Pavlov. Thorndike hypothesised that through repeated trial and error learning, certain connections between stimuli and responses are strengthened or weakened by the consequences of behaviour. These he defined as the Laws of Habit Forming (pp. 95-102). One of these, the *Law of Effect*, states that when a connection between a situation and a response is made and is accompanied or followed by a satisfying state of affairs, that connection's strength is increased. This fundamental principle embodies the same idea as Skinner's statement of conditioning for an operant response which states that if a behaviour is immediately followed by favourable consequences, then that behaviour is engaged in more frequently. Similarly, unfavourable consequences result in less frequent use of the behaviour (Skinner, 1953). Thorndike also explored the role of practice. Prior to his experiments, the act of repeating events in an association was originally considered a condition that would increase *associative strength*, but Thorndike's studies of the *Law of Exercise* led him to the realisation that sheer repetition of an act does not strengthen learning. Practice has its effects only when each repetition of the learned association is carried out with due provision for systematic contiguity and reinforcement. Contiguity is where objects once experienced together tend to become associated in the imagination, so that when one of them is thought of, the others are likely to be thought of also.

Many behavioural concepts and principles such as reinforcement, shaping, and modelling are recognised as being based on empirically established behaviour-environment relationships. In their synthesis of research studies of specific predictor variables on student learning outcomes, Fraser, Walberg, Welch, & Hattie (1987)

established that reinforcement had the greatest effect out of a total of 26 predictor variables explored with the behavioural principles of cues and feedback coming fourth. These behavioural principles therefore continue to be utilised by educators in the design and execution of learning, including that involving hypermedia.

An extreme position based on behavioural principles has assumed that teaching procedures could directly affect achievement with the student being conceptualised as a receptacle capable (or incapable) of profiting by experience (Di Vesta, 1987). According to Di Vesta, the focus was on "drill and practice, rote rehearsal, shaping errorless learning, and sheer transmission of content as reasonable educational practices and goals" (p. 204). Young (1985) put the blame for this attitude on the work of Ebbinghaus, who first published his work on experimental psychology in 1885. In experiments on the effects of practice, Ebbinghaus deliberately minimised the influence of the cognitive processes such as association, which he believed would bias his data. Young believed that this had an unforeseen consequence on the field of educational psychology for a period of nearly 80 years. Because of the superior quality of Ebbinghaus's work in the use of practice, the attention of researchers had been turned away from the question of how to learn more effectively, to the question of how learning takes place (pp. 491-493).

Behaviouralists expected strategies involved in learning, such as encoding, retrieving, or transferring information to problem-solving situations, to be used by students but they were left to engage in these strategies to the best of their ability, rather than under teacher guidance. The aim was to refine the teaching method to produce a universally acceptable behavioural outcome. Thorndike (1912) typifies this attitude when he described "all the changes that are produced in human intellect, character and skill happen in accord with and as a result of, certain fundamental laws of change" (p. 95). For most of this century, educationalists have confined this behaviourist approach to their research into the introduction of diverse teaching aides such as teaching

machines, slide projectors, recorders, films, television, and computers. Each new teaching aide has, in turn, been examined for its potential in the transmission of knowledge (Di Vesta, 1987, p. 205). Although acknowledging the value of the behaviourist contribution to research on learning, Di Vesta saw the extreme behaviourists philosophical view that all students should receive the same input as having the " --- intrinsic weakness of viewing the learner as a passive recipient of instruction, regardless of how active or inactive the teaching situation might be, because the influence of the learner-as-processor has been ignored" (p.205).

A significant reason why the behavioural approach has been so dominant in the past is that these concepts are easily observable. How individuals process information is not so easy to observe. Additionally, behavioural learning theories, particularly pleasurable or painful consequences of behaviour, apply to all forms of life. Therefore, Pavlov and Skinner had been able to carry out experiments on animals, where the results presumably could be transferred to human behaviour. The same experiments carried out on humans would be socially unacceptable.

Considering these issues, and the presumptions of transference to human learning, effective behavioural strategies, such as reinforcement and feedback, can play an important role in the design of hypermedia. They can be incorporated in learning packages such as *VRLR* in a number of ways to assist users to learn its operation and structure. At the beginning, they could be employed by signalling praise when a user new to the system makes correct responses, and giving guidance when he or she errs. Other strategies, calling on ways to make the material more meaningful to individual users, require looking beyond the behaviourist's domain to that of the cognitive scientist.

### **2.2.2 The Cognitive Influences**

During the past two decades, a different set of assumptions about how learners process information has been gaining influence and can be added to that offered by behavioural learning theorists. These principles, based in the field of cognitive psychology, are not new, but have been overshadowed by behaviourism's dominance for a large part of this century. This cognitive approach addresses how incoming information is processed and with what result, rather than solely responding to controls imposed by the instructor (Atkins, 1993; Allen, 1991; Beihler & Snowman, 1982; Di Vesta, 1987; Jonassen, 1988; Slavin, 1991). Unlike behaviourism, it is solely confined to human behaviour.

Cognitive learning examines attending to stimuli, accessing existing knowledge in order to relate to it, realigning the structure of that knowledge in order to accommodate new information, encoding the restructured knowledge base into memory, and motivation (Jonassen, 1988). Meaning is therefore constructed by the learner, using existing knowledge as the foundation for interpreting information and building new knowledge. This meaning is unique to each individual and is not solely a reception of someone else's organisations and abstractions. Instead, it is an active, constructive process.

Cognitive theorists are interested in mental processes. They want to find out how non-observable impressions are recorded and stored in the brain and how these impressions are then used to solve problems. Many cognitive psychologists are primarily interested in information processing theory which includes the ways in which sensory input is transformed, reduced, elaborated, stored, recovered, and used (Allen, 1991; Beihler & Snowman, 1982).

One set of theoretical ideas that are fundamental to modern views of learning pertain to the human memory storage system which is viewed as a three-part information

processing mechanism consisting of sensory register, short-term storage, and long-term storage (Beihler & Snowman, 1982; Di Vesta, 1987; Grabowski & Aggen, 1984). Environmental stimuli, be they visual, auditory, tactile, smell or taste, are initially recorded in the sensory register where they are held for up to three seconds to decide whether the receiver wishes to attend to them further. The process of recognition is interactive, in that it depends partly on information extracted from the stimulus itself and partly on the hypothesis generated from information in long term memory. A large number of experiments have been conducted to improve attention capability (Allen, 1991; Beihler & Snowman, 1982; Green, 1990; Houston, 1986). One approach has been to present stimuli that are known to attract attention such as novel, bizarre, or incongruous events. With hypermedia, the designer has available a variety of cueing features including zooming, flashing, auditory tones, arrows, highlighting and colour. A major element contributing to this media's effectiveness in education is the interactive mode of learning. For instance, cueing can be held back and only applied when the student demonstrates a deficiency or misperception about a concept.

Once information has been attended to and recognised, it is transferred to short-term memory. Single items stored in short-term memory, when further processing is prevented, die away in about 20 seconds. Short-term memory is often referred to as *working* memory since it holds information that we are aware of at a given time. Generally the limit of capacity of this memory store is considered to be five to seven *bits* of information; that is, we can focus on only five to seven things at a time (Slavin, 1991). These restrictions are important considerations for the interactive multimedia designer when planning the amount of information to be presented and its duration on the screen to ensure that the cognitive load expected of the student is not excessive.

On the basis of neurological, experimental and clinical evidence, most cognitive scientists believe that the third memory structure, long-term memory, has unlimited



storage capacity. Two categories of long-term memory are episodic and semantic. Episodic memories always have a particular personal referencing, for instance "I did such and such at such and such time, and at such and such place". Semantic memories refers to a person's abstract, timeless knowledge of the world which he/she shares with others (Tulving & Thomson, 1973). All of a person's semantic memory is originally recorded as an episode. It is through repeated experiences in various contexts that concepts, intellectual rules, facts and so on are formed and integrated into semantic memory.

To incorporate information into semantic memory, the designer of instruction needs to provide a learning environment that stresses mastery, organisation, and encoding strategies. Elaborative encoding enhances the organisation and meaningfulness of materials being learned (Carroll & Olson, 1987; Fischer, 1991; Jonassen, 1991). Jonassen (1988) noted the shortcoming of most existing computer courseware, where the emphasis was on practice of associations in working memory, and advised that designers must make more use of deeper, semantic processing which requires the learner to access prior knowledge in order to interpret new material. Instructional developers of interactive multimedia need to involve strategies which call on the user to employ this deeper processing when undertaking new learning experiences, and also there is a need to consider the limitations of short-term memory. The latter part of our memory system has particular importance with interactive materials on a computer, where users are in control of the direction and pace of their learning. Too much control may overtax their short term memory capabilities.

Educational researchers and theorists continue to debate what it means to know something and how we come to know it. More recent arrivals in this debate are constructivists who form a faction within cognitive psychology. This movement is associated with Piagetian learning theory and is characterised with discovery and experiential learning (Piaget, 1970; Rieber, 1992).

### 2.2.3 Constructivism

The philosophy of *constructivism* is currently prominent in learning theory debate and reflects the self-directed approach required with new interactive technologies. Unlike behaviourism, constructivism holds that meaning is imposed on the world *by us*, rather than existing in the world independently *of us* (Duffy & Jonassen, 1991, p. 8). The constructivist perspective asserts that individuals construct and restructure their schemes of the world, through their own mental activity, as a result of experiences with phenomena and social interaction (Driver & Scott, 1996; von Glasersfeld, 1991). The principles of constructivism assert that knowledge resides in individuals and cannot be transferred intact from the head of the teacher to the head of a student (von Glasersfeld, 1991). Essentially, constructivism is concerned with the process of how learners *construct* knowledge from what they already know. Thus learner's knowledge depends on the kinds of experiences that they have had, how they have organised these experiences into knowledge structures, and the beliefs that they use to interpret objects and events that they encounter in the world (Jonassen, 1996, p. 11).

Key ingredients of constructivism are that learners *actively* engage in interpreting the external world and *reflect* on their interpretations. This experience contrasts to the objectives of direct instruction, which tends to favour the presentational aspects of the process (Duffy & Jonassen, 1991; Laurillard, 1996). Several of the advantages put forward by the advocates of constructivism include:

- Learners actively build up their own interpretations of the world, have more ownership of those thoughts, and so these thoughts are less likely to degenerate over time (Jonassen, 1996, p. 12)
- Traditional instructional tutorials can be monotonous and tend to promote passive learning (Jonassen, 1988; Merrill, 1991)

- Encourages inductive learning based on discovery or learning by inventing (Rieber, 1992, p. 96)
- Incidental learning can occur, that is, learning that otherwise may be missed by an instructivist approach can be attended to by the learner (Rieber, 1992)
- The focus is on the learning and the learning experience, whereas the instructivist approach sees learning as the mastery of one objective serving as the starting point of the next (Rieber, 1992, p. 103)
- Problem-solving as a learning strategy uses a constructivist approach where learning is defined as adaptations made to fit the world we experience and based on prior knowledge (Lorsbach & Tobin, 1992)

Phillips (1995, pp. 6-7) points out that the constructivist approach to learning is still evolving and has many different factions. Although the constructive approach advocates that the ability to learn and otherwise progress in cognitive ways is a natural, innate, and personal process for people, extreme interpretations can lead to instructional chaos. For instance, students may have difficulty adapting to an environment in which they are given responsibility to make sense of certain learning situations. Although incidental learning can be a bonus when using a constructivist approach, it may undermine some learning goals because students can be distracted.

From a constructivist's perspective however, one cannot assume that what is taught is what is learned. Consequently, development of hypermedia learning packages, such as *VRLR*, and their evaluation must consider the understandings that learners are gaining from the experience. Iterative field testing, feedback, and revision should be undertaken to provide evidence of student progression in learning. These issues point to curriculum development as being a legitimate subject for research where careful considerations of proven behavioural, cognitive and constructivist principles are applied and evaluated. Such research should involve cycles of planning,

implementing, and evaluating teaching activities and approaches with a view to maximising the learning achieved (Driver & Scott, 1996, p. 107).

### **2.3 Computer Driven Problem-Based Learning**

Information technology permits the formatting of learning materials into a number of environments which are currently being utilised and investigated by educational technologists and researchers (Allen, 1991; Rowe, 1995). Computer/telecommunications technologies can provide a powerful medium which can enable flexible learning strategies, and the means to connect, link, record, capture and manipulate information (refer to Section 2.1.2). Technology embeds, or can make available, various kinds of advice and/or support such as scaffolding and strategic guidance to aid learners in constructing understanding (Hannafin, 1996). Information technologies are being used in open learning, self-directed learning, and problem-based learning.

#### **2.3.1 Open learning**

Open learning represents a family of strategies within the spectrum of learning opportunities. It can include amongst its subsets distance and correspondence schemes, modularised learning in which learners can construct an individualised learning program, problem-based learning, programmed study courses and computer-assisted learning packages including the use of multimedia (Bailey, 1992, p.983). In this context, openness or closeness is defined as the degree of control which the learner has. According to Hannafin (1996), these learning methods are not designed to teach particular content, but to support learners' attempts to understand for their own purposes. Open learning is designed to enable students to work at their own pace in an environment chosen by themselves, rather than at a pace or environment dictated by the teacher (Bassett, 1994).

Some of the advantages which can be linked to an open learning environment include the availability of learning resources at times to suit the student, individualised to suit specific needs, location other than within an educational institution, active rather than passive, pace to suit student, educators freed up for other duties, and once developed can be used repeatedly with associated cost savings. On the negative side, open learning can be restrictive for learning practical skills where equipment availability and safety issues may be involved. There can be a considerable time and cost associated with development and student feedback can be slow and/or insufficient to modify materials. Difficulty associated with estimation of time requirements and feedback for individual students can frustrate some learners (Bassett, 1994; Taylor, Lopez, & Quadrelli, 1996; Yetton, 1997).

*VRLR* has been made available for open learning. It has been produced on CD-ROM format, with a copy given to each second year undergraduate occupational therapy student enrolled at Curtin University in 1997. Students were instructed on this package's role in supplementing lectures and tutorials in the unit Occupational Health 241. Part of one lecture and one complete tutorial session were devoted to overseeing the introduction of *VRLR* to students in March, 1997. These students can now access this resource at home or in the School of Occupational Therapy's computer laboratory at times convenient to them.

### **2.3.2 Self-directed learning**

*VRLR* is a learning package designed to involve the student with understanding the vocational rehabilitation process rather than recalling facts (refer to Chapter 3). In this type of learning environment, students have to be prepared to direct their own learning by accessing and utilising appropriate features of the program to meet their immediate needs. This type of environment falls into the domain of *self-directed learning* where

students learn to recognise what they need to know, and to use resources effectively (Sadlo, Piper & Agnew, 1994).

Self-directed learning is a particular educational approach which involves the student in the whole process, integrating past experience and present needs (Hollis, 1991).

The recall of facts is not as important as an understanding of ideas and principles in a self-directed learning environment and there is a desire and ability to keep up-to-date with new findings fostered until knowledge and skills are acquired (Sadlo, Piper & Agnew, 1994). According to Hammond and Collins (1987), a self-directed learner is someone who:

with or without the help of others, diagnoses her/his learning needs; sets relevant, feasible and measurable learning objectives; determines generally acceptable standards or criteria which will be applied to assess whether learning has in fact occurred as planned; and finally, formulates a coherent learning agreement or personal curriculum for the course. (p. 254).

Hollis (1991) believed that helping occupational therapy students to develop a self-directed approach to learning encourages motivation, "since it asks the learner to identify his/her needs, both now and as an ongoing process, and then to structure his/her learning appropriately" (p. 46). *VRLR* combines the use of self-directed learning in an open learning situation with problem-based learning. Apart from the immediate benefits to be derived from *VRLR* in assisting with learning in the unit Occupational Health 241, it is believed that it also will assist students to develop a more self-directed learner approach with their studies in general and enhance their skills in formulating for themselves in a clinical setting (Cameron, 1997; Jacobs & Lyons, 1991; Sadlo, 1994).

### **2.3.3 Problem-based learning**

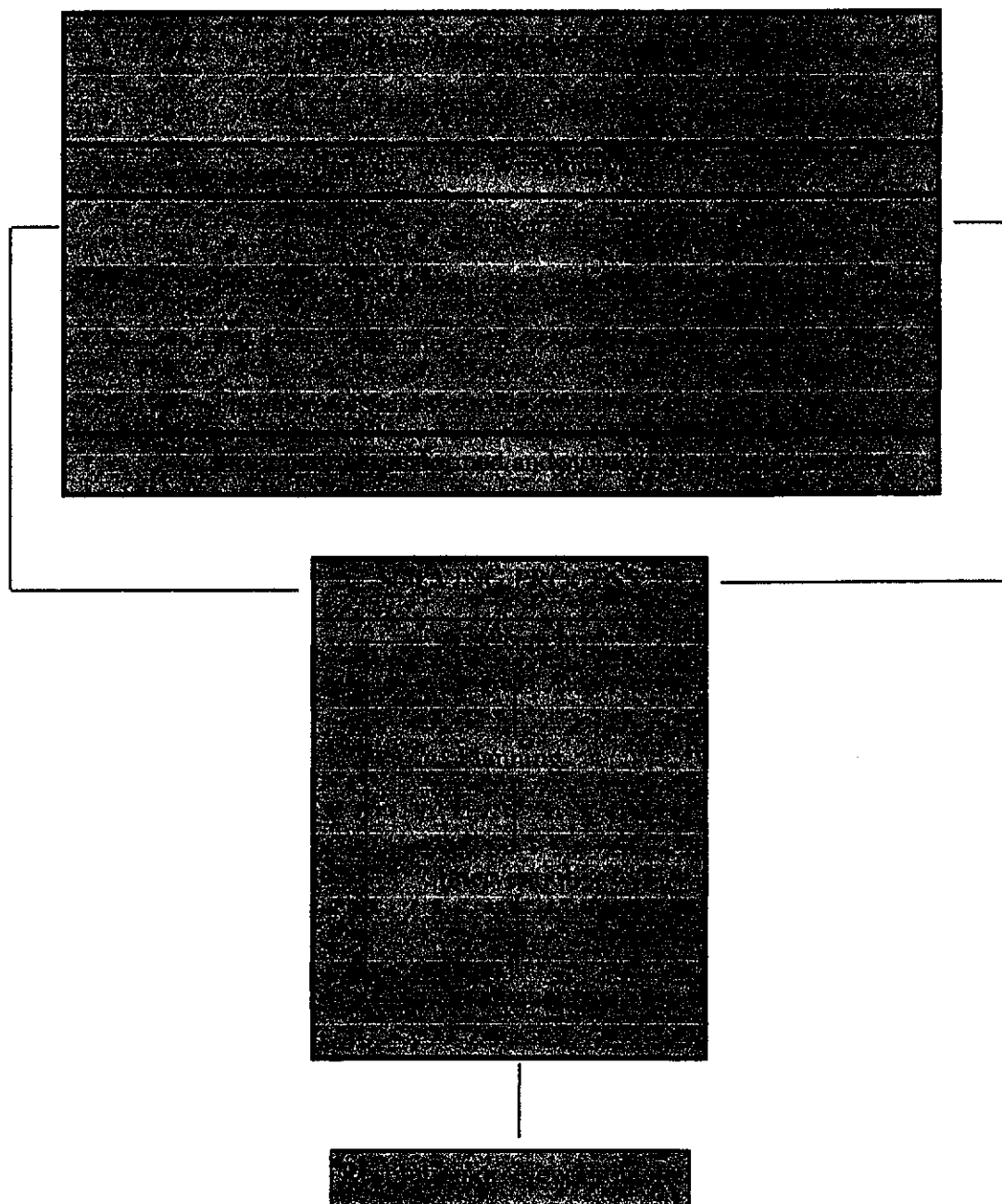
Occupational therapy curricula still follow the traditional format of education designed for medical students in the 19th century (Royeen, 1994; Sadlo, Piper & Agnew, 1994;

Steward, 1996). These traditional methodologies are “structured around separate academic subjects, which are further divided into preclinical and clinical phases. Instruction centres on lectures and tutorial-led seminars or practicals” (Sadlo, Piper & Agnew, 1994, p. 49). Royeen (1994) has called for change in occupational therapy education by suggesting that it be oriented towards development of clinical reasoning and reflective skills. Clinical reasoning is defined by Royeen (1994, p. 338) as a way of thinking about occupational therapy practice in a manner that involves the ability to make rational choices and to assume responsibility for these choices. Problem-based learning (PBL) is a learning process which can address these needs and has been employed in medical education for over 25 years (Barrows & Tamblyn, 1980).

PBL at its most fundamental level is an instructional method characterised by the use of patient problems as a context for students to learn problem-solving skills and acquire knowledge about the basic and clinical sciences. According to Barrows (1985), one of the founding fathers of the use of PBL in medical education, the basic outline of the process is “encountering the problem first, problem-solving with clinical reasoning skills and identifying learning needs in an interactive process, self-study, applying newly gained knowledge to the problem and summarising what has been learned” (p. 15).

PBL enables students to “direct their own learning by using a variety of resources for work-related problems, critical reasoning, managing and solving problems, and applying their knowledge to realistic problems they will encounter in professional practice” (Bruhn, 1992, p. 161). The essential characteristics of PBL should include curricular organisation around problems rather than disciplines, an integrated curriculum rather than one separated into clinical and theoretical components, and an inherent emphasis on cognitive skills as well as on knowledge. Steward (1996) categorised the stages of PBL as problem identification, self-directed study, and analysis of that learning and application to practice. Robertson (1996) illustrated two

central elements, *problem representation* and the *solving process* in a model of PBL (refer to Figure 2.1). The problem representation consists of the goal, the actions and the restrictions. The better the grasp of these elements, the more effective the problem-solving will be. Once an initial situation has been encountered, all subsequent situations that have similarities with the first one will add to the problem solver's understanding of that situation; that is, the internal representation (mental model) is



**Figure 2.1 A Model of Problem-Solving in Occupational Therapy**



modified as more knowledge is added to the problem solver's information base (Robertson, 1996, p. 179).

Several occupational therapy departments in tertiary institutions have recently introduced PBL as a major component of their curricula. These include McMaster University, Canada (Hay, 1995); Shenandoah University, Virginia (Royeen, 1994); University of New Mexico (VanLeit, 1994); University of Newcastle, New South Wales (Jacobs & Lyons, 1991); and Newcastle Upon Tyne Polytechnic, United Kingdom (Lyne & Walton, 1990).

Advocates of PBL cite many advantages for its introduction into the curriculum. For instance, Bruhn (1992) believed that it has a place in preparing future professionals to be able to adapt to change, learn how to reason critically, take a holistic approach to health, and integrate cumulative learning. Knowledge is rapidly changing and skills are dependent upon available and changing technology, therefore emphasis should be on the process of client-care rather than on retention of facts. Sadlo, Piper & Agnew (1994) advocated that vocational activities, which initially motivate students to choose a course such as occupational therapy, can be used as a stimulus for learning with PBL. These authors viewed the principles of PBL and occupational therapy as having similarities. This view was shared by other occupational therapists including (Hollis 1991; Katz, 1990; Royeen, 1994) where PBL allows complete and continuous integration of the basic and clinical sciences. Sadlo et al. (1994, p. 50) held that learning in occupational therapy is most effective through "activity, problems are viewed holistically, independence is the goal; and personal choice of interest is given full play" and that PBL produces superior outcomes in the areas of autonomy, interpersonal skills, satisfaction, deep learning and fieldwork skills.

However, several authors have identified some potentially negative sides to the introduction of PBL into a teaching curriculum. For instance, Sadlo et al. (1994) and

Problem-solving approaches also are controversial in education, because professionals rarely agree on the types of cases that new practitioners should be able to treat, and what represents an acceptable and agreed quality of care (Steward, 1996).

Students may view PBL involving client case studies as irrelevant because they are depersonalised and decontextualised, while they despair of the absence of explicit theorising in clinical case management (Steward, 1996). Also, many students familiar and comfortable with teacher directed learning may find that the learner responsibilities associated with PBL are too much of a challenge. Indeed, Andrews and Jones (1996) claimed that there is little evidence to demonstrate that PBL will result in better real life decision making.

Little known research has been conducted with regards to the effectiveness of PBL in occupational therapy (Hay, 1995). However, results of a meta-analysis of research into the effectiveness of PBL in medical education from 1972-1992 have been released (Albanese & Mitchell, 1993). On the positive side, this research found that generally PBL was a more enjoyable experience for both teachers and students. Graduates performed as well as, and sometimes better, on clinical assessments and faculty performance compared to students taught by traditional, teacher directed learning. On the negative side, some students did not perform as well on the basic sciences and viewed themselves as being less well prepared in the basic sciences than their conventionally trained counterparts. PBL students tended to engage in *backward reasoning* which relies on comparing patient's presenting signs and symptoms with those that occur for a list of illnesses, gradually narrowing the choices to those that match. Experts, on the other hand, engage in *forward reasoning*, which is a schema-driven process working forward from the pattern recognition or illness-script, with the solution available as a goal state. Backward reasoning demonstrated gaps in the user's cognitive knowledge base that could effect practice outcomes. Albanese and Mitchell noted that PBL has a limited research base and recommended caution in making

solution available as a goal state. Backward reasoning demonstrated gaps in the user's cognitive knowledge base that could effect practice outcomes. Albanese and Mitchell noted that PBL has a limited research base and recommended caution in making comprehensive, curriculum-wide conversions to this methodology. These authors identified several areas where PBL research should initially focus. They include investigations into the extent that teaching staff should be involved in directing students, minimising high resource usage, and overcoming cognitive-processing weaknesses such as backward reasoning.

Many other teaching/learning innovations which have been successful in a small scale with dedicated teachers fail when implemented on a large scale with teachers who are less dedicated (Clark, 1983; Kulik, Bangert & Williams, 1983; Kulik, Kulik, & Cohen, 1980; Laurillard, 1993). As Laurillard pointed out, "the implementation of new technology methods cannot take place without the system around it adjusting to the intrusion of the new organism" (p. 223). Therefore, caution is advisable with the introduction of PBL without the support of teaching staff involved.

In their concluding comments, Albanese and Mitchell (1993) espoused the merit in employing instructional methodologies that can capture some of the benefits of both PBL and conventional curricula. In medical education, according to these authors, this could be a program that develops students' basic science framework in teacher-directed study for a portion of the first part of the curriculum, coupled with a parallel and integrated PBL thread that allows students to explore clinical cases in increasing complexity, commensurate with their developing understanding of basic science. This approach can allow teaching staff, with some perceived loss of control accompanying the introduction of PBL, to still maintain a teacher-directed component. The introduction of *Vocational Rehabilitation Learning Resource (VRLR)* at the School of Occupational Therapy, Curtin University of Technology, represents only a small component of the curriculum. In addition, this application of PBL also differs from

the above in that it involves the use of interactive media in a self-directed learning mode to supplement traditional lecture and tutorial coverage of vocational rehabilitation. This is the direction chosen at the School of Occupational Therapy in that the introduction of *VRLR* is linked to the traditional lecture and tutorial coverage of vocational rehabilitation.

#### **2.4 Interactivity, navigation and learner control**

The constructivist stance places the learner in an active role. Given the same teaching method, this perspective implies that students of "equal intellectual ability and motivation do not receive the same instruction, even when inputs are standardised" (Di Vesta, 1987, p. 205). Student control of the content sequence is an important issue for the designer of interactive multimedia. It is possible to allow users freedom to all materials, at any time, in any order that they choose. Alternatively, the designer may lock the material into a branching format, whereby the route taken is determined by the user's response. With the potential variety of media formats employed, the volume of information stored, plus the interactive nature of the learning process, the user can be faced with what may be perceived to be either a challenging experience or alternatively one that is overpowering (Chen, 1990; Gaines & Vickers, 1988).

On first impression, the provision of learner control should allow students to tailor their instructional experiences to suit personal needs and interests, thus increasing instructional relevance and continuing motivation and assisting in development of instructional strategies, thereby also promoting perceptions of personal control (Kinzie, 1990, p. 10). Most writers support the concept of user control in interactive multimedia, but also warn of the dangers to designers in allowing "free scope" to all learners in this environment. For instance, Marchionni (1988) advised that freedom can be confusing because it increases decision-making load. Another warning has

been that the less the student's prior knowledge, the less effective learner-control tends to be (Ross, Morrison, & O'Dell, 1989, p. 678).

Balajthy (1988) explored research which had investigated learner control in a range of teaching areas and concluded that there are serious questions about its effectiveness in instructional materials. Studies into the use of learner control of computer-assisted instruction (CAI), according to Balajthy, have shown some less than promising results. For instance, in a study by, (1977), it was concluded that motivation increased, but that learner control does not necessarily result in improved learning in CAI. Rubincan and Oliver (1985), surveyed eleven studies and found that only two indicated superior performance by groups who were under learner-control, whereas five studies indicated superior performance by groups who were not under learner control. In another study investigating learner control in vocabulary learning with college students, the researcher noted that students using learner-controlled instructional formats were unable to accurately monitor the success or failure of their own learning Balajthy, (1988).

Several studies have suggested that low ability students perform poorly when allowed freedom of control (Balajthy, 1988; Chen, 1989; Kinzie, 1990). Chen warned of this possible negative aspect of learner control (p.10), citing other researchers who fear that this 'free-learning' format might interfere with achievement of less competent, less confident students. Learners may opt to skip important material or quit too soon. Chen believed that learner control may only be effective with high ability learners, or with those who have some prior knowledge of the content. Kinzie (1990) also expressed concern with the use of some interactive learning systems where inexperienced users can find learner control to be confusing. She believed that in learning modes such as this, it is critical that instruction include information about learner control options and permit practice in exercising them (p.12).

Hannafin and Colamaio (1987) argued that providing learners with some guidance is superior to giving them total control and results in enhanced performance. Learner control studies in general support the view that the amount of additional guidance provided could be adjusted according to learner sophistication. This can be provided to give some control and self-determination and thereby act as motivating activities. (Allred & Locatis, 1988, p. 4). For high-ability learners such modifications may be minimal. The designer of interactive multimedia could then permit degrees of user control to be varied, thus maximising an individual's motivation to the learning materials.

The concept of interactivity needs to be thought of in terms of quality and context, not just quantity of response. Cohen (1984) suggested three important techniques for enhancing quality of interactivity when designing interactive materials; the provision of non-linear pathways allowing users to choose direction depending on needs; feedback, including locating errors and informing learners why it is wrong and how it can be corrected, which ensures remediation; and permitted options allowing content, pace, and instructional strategies to be controlled.

Gaines and Vickers (1988) acknowledged the quandary facing designers of interactive multimedia systems, where permitting the user the freedom to 'navigate' at will may sometimes conflict with usability. However, they believed that this should be overcome through guidance not through restriction. Provision should be made for a range of different forms of guidance that do not restrict choice but indicate the basis of choice, the most likely choices, and the reason for these. Some of these can be embedded within the system that provides the local context, but other guidance is essentially global and needs to minimise the risk of him or her becoming disoriented (p. 13). One way of assisting the new user of an interactive multimedia system is to provide advance organisers as a linkage between existing knowledge and material to be learned. However, this has limited benefits as indicated in recent research where

advance organisers may conflict with individual's learning style and/or previous experiences (Cameron, 1993; Gay, Tripp & Roby, 1990; Trumbull, Gay, & Mazur, 1992).

## **2.5 Mental models**

Since the early 1980s, the term *mental model* has been increasingly used to describe the internal representations that users employ when interacting with devices. Carroll and Olson (1987) defined a user's mental models of a system as "a rich and elaborative structure, reflecting the user's understanding of what the system contains, how it works, and why it works that way" (p. 12). It is the conception of a system which a user has sufficiently formed to permit him/her to mentally trial actions before choosing one to execute. Research in this area indicates that there are a number of key issues still to be addressed (Allen, 1991; Bodner, 1995; Jih & Reeves, 1993; Payne, 1991).

Mental models are related to user learning, performance and system design and represent a substantial problem for researchers to identify and measure (Staggers, 1993). For instance, as learners navigate through a computer package, their mental models are changing when the system responds differently to expectations. Users may hold different mental models at different times as they gain competency in using the system.

The development of a mental model may be regarded as a more or less explicit hypothesis-testing procedure. The mental model can be regarded as the generator of hypotheses that concern the characteristics of objects and operations in the system. The model is dynamically changed when these hypotheses fail.

(Waern, 1993, p. 328)

In an interactive learning situation such as with *VRLR*, new users may be faced with a number of challenges as they navigate through a system and attempt to make its structure and contents meaningful (Jih & Reeves, 1993). Assuming that all students have had some previous computer experience, it raises the question of how this knowledge will be transferred to the new learning experience. In some of the tasks involved, such as database searching, problem-solving, measuring performance, accessing 'help' features, different kinds of learning skills are involved in addition to those of understanding the subject matter and navigating through the interactive multimedia format. The varieties of learning may include learning by transfer, learning by doing and creating mental models.

Many factors influence an individual learning and the potential formation of mental models in computerised interactive learning situations. These factors include motivation, previous experience, and a range of learner characteristics. Some of the most recognised learner characteristics which influence successful mental model formation include cognitive style and learning style (Coventry, 1989; Logan, 1990; Sein & Bostrom, 1989; Van der Veer, 1989; Wood, Ford, Miller, Socbezyk, & Duffin, 1996) and computer experience and computer anxiety (Honeyman & White, 1987; Marcoulides, 1988; Nelson, Wiese & Cooper, 1991). In the following sections an overview is presented of our knowledge of these learner characteristics.

## **2.6 Individual Style and Learning**

All individuals display a range of styles of functioning which impact on both the interpretation of processes and the appraisal of performance levels. Several kinds of styles have been identified by Messick (1994), including expressive styles, response styles, defensive styles, cognitive styles, and learning styles.



The terms cognitive style and learning style have been used frequently by learning theorists in the past, but what they mean can still remain confusing (Allen, 1991; Hockey, 1990; Riding & Cheema, 1991, Riding & Douglas, 1993). Some researchers, notably Entwistle (1981), have referred to cognitive and learning styles to be the same thing. Historically, learning style seems to have emerged as a more common term in the 1970's with the rise in interest in individualised learning (see section 2.1.1). Amongst the problems in this field is the fact that no definitions have been agreed upon for these concepts (Bonham, 1988).

Increasingly, researchers are distinguishing between these two types of style (Hayes & Allison, 1993; Wood et al. 1996). Cognitive style can be considered a concept which is concerned with individual differences in cognitive functions that are the product of rather permanent dispositions like intelligence, problem solving and relating to others (Van der Veer, 1989). Riding and Cheema (1991) believed that the impression that is formulated in the usage of the terms has been that:

those working under the umbrella of 'learning style', take cognitive style into consideration, but would probably describe themselves as interested in more practical, educational or training applications and are thus more 'action-oriented', whilst the term cognitive style has been reserved for theoretical, academic descriptions. (p.194)

Witkin (1962) stated that cognitive styles concern the form rather than the content of activity when he developed the theory of 'psychological differentiation'. In other words, cognitive styles reflect differences in the extent to which individuals make perceptual decisions independently of the context or background provided. New users of a computer system bring unique compilation of these abilities which will influence the capability to absorb knowledge.

Learning styles are consistent orientations towards learning and studying, such as comprehension-learning versus operation-learning and deep-processing versus shallow-processing styles (Messick, 1994, pp. 121-122). The focus of cognitive styles can be viewed as more on the organisation and the control of cognitive processes whereas that of learning styles is on the organisation and the control of strategies for learning and knowledge acquisition. The learning style dimension of individual cognition can be defined as the way people absorb and retain information, which is sometimes referred to as subset of cognitive style (Ford, Wood & Walsh, 1994; Hayes & Allison, 1993). One main difference between cognitive and learning style, is the number of style elements considered, that is, whilst cognitive style is a bipolar dimension, learning style entails elements and are usually not 'either - or' extremes (Riding & Cheema, 1991, p. 194).

A number of studies have investigated instruments which have been developed to measure individual's cognitive style and learning style. Messick (1984) identified 19 cognitive style measurements whereas, almost a decade later, Riding and Cheema (1991) revealed 30 labels referred to as cognitive/learning styles. Murray-Harvey (1994) referred to the daunting task facing educators wishing to apply research from these areas into their own educational context, partially due to the "fragmentation of research that has resulted in a confusion of definitions" (p. 374). Some of the most popular instruments for measuring cognitive style and learning styles are identified in Table 2.1 and Table 2.2.

The *Embedded Figure Test* developed by Witkin, Oltman, Raskin and Karp (1971) is the best known assessment instrument of individual's cognitive style (Hockey, 1990). The *Embedded Figure Test* measures the individual's degree of field-dependency/field-independency. People who are significantly influenced by the surrounding field are called field-dependant whereas those who are relatively

uninfluenced are referred to as field-independent. A description of Witkins, et al, *Embedded Figure Test* is detailed in section 4.3.1.

**Table 2.1. Cognitive Style Measuring Instruments**

Instrument	Author(s)	Measurement
Group Embedded Figures Test	Witkin, Oltman, Raskin, & Karp (1971)	Field dependence independence
'free learning situations'	Pask & Scott (1972)	Holist -serialist
Sigel Cognitive Style Test	Sigel, Jarman, & Hanesian (1967)	Analytical - nonanalytical
Multidimensional Academic Locus of Control Scale	Palenzuela (1988)	Internal -external locus of control

Pask and Scott (1972) developed a measure of cognitive style based initially on problem-solving abilities of learners learning keyboard tasks. Learners who displayed intention to search for specific data were labelled 'serialists', whilst those who test a large predicate or relational hypothesis are considered to be 'holists'.

Sigel, Jarman, & Hanesian, (1967) developed an instrument, *Sigel Cognitive Style Test*, where cognitive style is determined by analysing the rationale for choices of grouping from a series of pictures/line diagrams. Subjects are invited to select any two out of three which belong together or are alike in some way and to state why. Analytical individuals are defined as those who score above the median on descriptive-analytical responses, but below the median on relational-contextual responses and inferential-categorical responses. Nonanalytical individuals are defined as those who score above the median on relational responses, but below the median for descriptive-analytical and inferential-categorical responses.

Based on a reconceptualisation of Rotter's (1966) construct of locus of control, Palenzuela (1988) derived an operational domain-specific instrument *Multidimensional Academic Locus of Control Scale* for use with undergraduate students. The general

trend in the literature has suggested an advantage of holding internal rather than external locus of control beliefs with respect to academic performance (Millar & Irving, 1995).

The *Learning Style Inventory* described by Kolb (1985) is a self-scoring questionnaire which measures individuals' reliance on four different learning dimensions. These are concrete experience, reflective observation, abstract conceptualisation, and active experimentation. By plotting scores for each dimension, learners can determine which learning style type they prefer and thereby increase awareness of strengths and weaknesses. Some of the main attractions of the inventory are that it is short, easy to administer and score (Hayes & Allison, 1993).

**Table 2.2. Learning Style Measuring Instruments**

Instrument	Author(s)	Measurements
Learning Style Inventory	Kolb (1976)	Concrete experience Reflective observation Abstract conceptualisation Active experimentation
Learning Style Questionnaire	Honey and Mumford (1992)	Activist Reflector Theorist Pragmatist
Myers Briggs Type Indicator	Myers (1985)	Extroversion/introversion Sensing/intuition Thinking/feeling Perception/judgement

A measure of learning style, which is based largely on Piaget's work, is Honey and Mumford's (1992) *Learning Styles Questionnaire*. By combining the characteristics of learning and the problem-solving processes, Honey and Mumford suggest that individuals learn in four modes through active experimentation, reflective observation, adaptive observation, and pragmatic involvement. The choice of learning mode is governed by each individual's goals and his or her objectives. Because individuals

have different goals, their learning modes become highly individualised (Sein & Bostrom, 1989).

The *Myers Briggs Type Indicator* measures learners ways of taking in information, processing and outputting it (Briggs Myers, & McCaulley, 1985). Four scales of learning style are measured. Extroversion/introversion focuses on preferences for outer world or inner world application of personal energy. Sensing/intuition relates to perception of information. Thinking/feeling refers to the way in which decisions are made, either by logical thought or by using values. Perception/judgement measures attitudes to situations. These preferences influence the way decisions are made, approached and solved (Bokoros, Goldstein, & Sweeney, 1992; MacKenzie, 1997).

## **2.7 Technophobia**

Global competition in the information age requires a workforce that is comprised of well informed individuals who can screen and use information and relate it effectively. Members of society at every level are being asked to demonstrate advanced levels of problem-solving skills to retain their level of employment (Harper, 1997; Moge, 1995; West, 1997). The rapid development of computer/telecommunications technologies is providing vehicles for today's tertiary students to access and utilise information speedily through on-line catalogues available in CD-ROM disks and the Internet. Increasingly, these information platforms are utilising the capabilities of the technology and presenting material in multimedia formats.

High levels of computer awareness and aptitude provide many students with opportunities to gain ascendancy over their less computer literate peers. Large numbers of otherwise competent students experience varying degrees of aversion to the use of computers (Marcoulides, 1988; Rosen & Weil, 1990, 1995a; Temple &

Gallivet, 1990; Woodrow, 1994). This experience can be particularly debilitating as computers become more and more a crucial component of the educational process.

While the opportunities for computer exposure in the educational system and the work environment gain momentum, the need for confidence in the use of computers becomes more pressing, particularly for special populations such as the elderly and disabled (Temple & Gallivet, 1990). Computer technology can enhance the quality of life of these special population groups in daily living and for entering the workplace in a more competitive basis. Occupational therapists have a responsibility to assist clients drawn from these special populations to be aware of the advantages of this technology and to assist them in its use (Farrow & Sims, 1987; Mogey, 1995; Toth-Cohen, 1994). Rosen & Weil (1995a) indicated that teachers with aversion to computer technology can pass on these negative traits to their students. Aversion to the use of computers by therapists can have similar results on their clients.

A variety of terms are used in the literature to describe the state of negative affective reactions to computers experienced by some individuals. These include computer aversion, computer resistance, computerphobia, computer anxiety, technostress, cyberphobia or technophobia (Weil & Rosen, 1995). Computer anxiety is the most widely used term, but there is little common psychological or sociological theory which underlies the literature in this area (McInerney, McInerney, & Sinclair, 1994). Igarria & Parasuraman (1989) defined computer anxiety as "the tendency of an individual to be uneasy, apprehensive, or fearful about current or future use of computers in general" (p. 374).

Bloom (1983) identified some of the factors which are associated with computer anxiety as fear of damaging the computer, looking stupid, coping with documentation, losing control, lack of time, disappointment, futility (p. 90). Typical reaction to this anxiety is avoidance of computers or to problems learning about them. Simonson,

Maurer, Montag-Torardi, and Whitaker (1987) also identified that people with negative psychological reactions to computers tend to be excessively cautious with their use, make negative remarks about computers and attempt to shorten periods of time when computers are used.

Several common beliefs about computer aversion have been questioned in research, much of which is confined to operational and validation of the anxiety or apprehension constructs and instrumentation to measure it, with little information on the underpinnings of this apprehension (Crable, Brodzinski, & Scherer, 1994). Several studies have challenged the belief that increased computer exposure minimises computer aversion, with several reporting increased anxiety, negative beliefs, and avoidance after compulsory computer interaction (McInerney, McInerney, & Sinclair, 1994; Rosen & Weil, 1995a). Temple and Gavillet (1990) found that age, education, or previous exposure to computers did not have any significant influence on anxiety scores and that attempts to decrease computer anxiety and increase computer literacy among seniors taking a computer confidence course were only partially successful. These authors pointed out that it is important to note that computer aversion may play a role in who enrolls in computer courses.

Many instruments have been developed to measure aversion to computers, but, as Rainer and Miller (1996) observed, this “plethora of instruments and constructs have made it difficult to interpret, compare, and integrate across multiple studies” (p. 95). This view is understandable as many of these instruments have been developed for specific populations with specific intents. Some of these instruments are identified in Table 2.3.

Among the most comprehensive and widely used instruments to measure aversion to usage of computers are those developed by Rosen and Weil (1992). These instruments, *Computer Anxiety Rating Scale*, *Computer Thoughts Survey* and

**Table 2.3. Instruments for Measuring Computer Aversion**

<b>Instrument</b>	<b>Authors</b>	<b>Date</b>	<b>Measures</b>
Computer Anxiety Index	Simonson, Maurer, Montag-Torardi, & Whitaker	1987	Achievement test and anxiety index
Computer Attitude Scale	Nickell & Pinto	1986	Positive and negative attitudes towards computers
Attitude Towards Computers Scale	Kjerulff & Counte	1984	General attitudes towards computers
Computer Aversion Scale	Meier	1987	Efficacy, outcome, and reinforcement expectations
Computer Anxiety Rating Scale	Heinssen, Glass, and Knight	1987	Anxiety towards computers
Computer Confidence Survey	Poages	1991	Computer confidence
Computer Concern Questionnaire	Crable, Brodzinski, & Scherer	1991	Concerns about computer usage
Computer Anxiety Rating Scale	Rosen & Weil	1992	Anxiety about computers or computer-related technology
Computer Thoughts Survey	Rosen & Weil	1992	Negative attitudes towards computers
General Attitudes Towards Computers	Rosen & Weil	1992	Negative cognitions towards computers

*General Attitudes Towards Computers*, have been administered to thousands of participants drawn from tertiary institutes in different countries (Rosen & Weil, 1995a; 1995b). Rosen and Weil developed these instruments to measure an individual's degree of comfort with computer technology, referred to as 'technophobia', which consists of :

- anxiety about current and future interactions with computers or computer-related technology
- negative global attitudes about computers, their operation or societal impact



- specific negative cognitions or self-critical internal dialogues during actual computer interaction or when contemplating future computer interaction. (Rosen & Weil, 1992, p. 11)

Technophobes, according to Rosen and Weil (1990), experience actual or imagined interaction with a computer that may cause anxiety reactions typical of other phobias or trigger a negative internal dialogue that belittles their ability and undermines their confidence. These authors referred to surveys showing that 25% to 55% of university students display computer anxiety (p. 276). Technophobes, according to Rosen and Weil, are not more anxious in general than other people, but are slightly more anxious about mathematics and have shown to be “more alienated, more intolerant of ambiguity and less persistent” (p. 277).

## **2.8 Research on Occupational Therapy Students' Characteristics**

A literature search failed to uncover reported research investigating occupational therapy students' computer-related performance. However, several authors have examined cognitive style and learning style dimensions of occupational therapy students. Most of these studies took place from 1975 to 1985 and concentrated on students' learning style preference which refers to a preferred mode of obtaining knowledge. Rezler and French (1975) developed an instrument, *Learning Style Preferences Instrument (LPI)*, which measures affinity for different modes of learning. Recent research has tended to focus more on learning style; that is, the manner in which an individual perceives and processes information in the learning situation (Breines & Avi-Itzhak, 1991; Cunningham & Trickey, 1983; Esdaile & Madill, 1993; Katz, 1990; Katz & Heimann, 1991).

In comparing personality types and learning styles preferences of occupational therapists with other health professionals, Rezler and French (1975) indicated that

students exhibit higher motivation and achievement level if they are allowed to learn according to their preferences. The six preferences measured with the *LPI* instrument are concrete, individual, interpersonal, student-structured, and teacher-structured. These authors cautioned that there was a need for longitudinal studies to test the *LPI* and consider alternative methods to the use of the lecture in tertiary learning. In a later review of the *LPI*, Rezel and Rezmovic (1981) explained that although learning preferences ought to be considered, teachers should expose students to new ways of learning. This was particularly critical because students become practitioners and take on responsibility for self-education for which they have not been prepared (p. 33).

Several occupational therapy researchers have administered Rezler and French's *LPI* to students. Rogers and Hill (1980) compared the preferred mode of obtaining knowledge with undergraduate and postgraduate occupational therapy students before and after clinical practice. There were no significant differences between the two population groups prior to clinical practice and only little difference at the post-test. All subjects preferred learning experiences that were teacher-structured, concrete, and interpersonal. Cahill and Madigan (1984) employed Rezler and French's *LPI* and Kolb's *Learning Style Inventory (LSI)* to measure the learning preference and the learning style of undergraduate students at the beginning of their course work and again one year later. No significant differences between the pre and post-test scores were found on any of the 10 dimensions of the two instruments. These authors argued that these results were consistent with other studies using the *LSI*, but that educators should develop and implement diverse methods of instruction to cater for varying needs of individuals. Barris and Kielhoffner (1985) also employed the *LPI* as well as an instrument developed for the study which they titled the *Occupational Education Values Instrument*. They found evidence of differences between graduate and undergraduate occupational therapy students in a number of dimensions relevant to learning, including differences in attitudes and learning preferences. While all occupational therapy students were frequently found to be similar in their values and

learning styles, therapists with graduate qualifications displayed an increased tendency to value theory and abstract concepts. Graduate students tended to think in a more conceptual manner and employed theory more in their practice.

Other researchers in the occupational literature have employed another learning style preference instrument, the *Canfield Learning Styles Inventory* (1974). Llorens and Adams (1978) believed that educators require knowledge of their students' individual learning characteristics as well as knowledge of them as a group to plan effective learning experiences. Subsequently, they measured the learning style preferences of undergraduate and graduate occupational therapy students with the *Canfield Learning Styles Inventory* which focuses on affective components of teaching-learning situations. The results indicated that this population of therapists had a high preference for informal teaching conditions which promoted the personal relationships with faculty and permitted independence of action and goal-setting. In a study designed to see if learning preference and cognitive style can predict success in graduate allied health program, Blagg (1985) also used the *Canfield Learning Styles Inventory* as well as part one of the *Group Embedded Figures Test* (Witkin, Oltman, Raskin, & Karp 1971). In finding no significant difference between academic success and field-dependency/independency, but a relationship between academic success and learning preference, Blagg recommended that faculty be counselled to adapt their teaching styles to match that of their students or use a variety of teaching styles to reach a larger proportion of learners.

Several occupational therapy researchers have employed Kolb's *LSI* apart from Cahill and Madigan (1984). In an examination of the relationships between occupational therapy students' learning styles and clinical performance, Stafford (1986) employed the *LSI* and measured field-work performance. This researcher also measured participants' style of processing information, employing the instrument *Your Style of Learning and Thinking* (Torrance & Reynold, 1980). There were significant

correlations between scores from the two learning styles instruments and field-work performance which the authors suggested could identify a profile of predictors of clinical performance outcomes. An investigation of the interaction between occupational therapy students' learning styles and teaching methods on their problem-solving ability and the amount of time needed to learn was conducted by Katz (1990). Participants in 'matched' conditions performed better in problem-solving measures and needed less time to learn outside class than those in the opposite 'mismatched' conditions. Using Kolb's *LSI*, Katz and Heimann (1991) investigated the learning style of students and practitioners in five health professions. Occupational therapy students were found to be the least abstract among all groups and displayed an accommodator type of learning style.

In a recent study, MacKenzie (1997) employed the *Myers Briggs Type Indicator* to identify relationships between the four personality variables and occupational therapy students' learning performance in fieldwork settings. Findings showed a relationship between performance in some settings and clinical practice preference.

With the growth of the use of the case method of developing clinical reasoning skills in problem-based learning (Royeen, 1994; Van Leit, 1994), increased computer-assisted learning and computer/telecommunications usage in general (Mogey, 1995; Toth-Cohen, 1994) and the need to develop autonomy and flexibility (Gosselin & Dutil, 1995), it is important for educators to be aware of occupational therapy students' ability to meet these challenges. Identifying the influence of key learning characteristics is a start in this direction.

## **2.9 Overview of Related Research with Interactive Computer Driven Systems**

Research into relationships between students' characteristics and performance when working on computers is still in its infancy, particularly with hypertext linked learning

materials presented through a range of media and permitting the user to control pace and content (Atkins, 1993; Burbules & Callister, 1996; Hannafin & Rieber, 1989; Plowman, 1996). An area with some relationship to interactive learning with the multimedia computer is bibliography searching where users browse through information retrieval systems in a non-sequential fashion (Jonassen, 1991). This section therefore, examines the related literature in computer bibliography searching and also the emerging field of multimedia learning.

### **2.9.1 Computer bibliography searching**

This associated area to multimedia navigation has an established history of over 30 years. Although it has many similar characters, initially searches were conducted by specialist librarians rather than directly by students (Bellardo, 1984). Some areas in the bibliography searching literature, which are also applicable to multimedia navigation, include users' computer anxiety, navigating through materials where it may be difficult to visualise content structure and volume, and related problems with users' cognitive style and learning style. The study of linkages between user characteristics and bibliographic retrieval was a promising and convenient starting point for the investigation of navigation in a multimedia environment.

In Table 2.4, brief details are given of research into computer bibliography searching. Investigations are identified in chronological order by author, year, number of participants, statistics used, and independent/ dependent variables.

Some of the recent research into computer bibliography searching has indicated that differences in user cognitive style and learning style can significantly influence search performance. Ford, Wood, & Walsh (1994) studied the performance of students

**Table 2.4. Review of Computer Bibliography Searching**

Author	Year	Pop.	Statistics	Independent Variable	Dependent Variable
Brindle	1981	31	correlational matrix, analysis of variance	cognitive style, system familiarity, subject area	interaction patterns between user and system
Woelfl	1984	44	correlational matrix, case studies	learning style, remote associates, symbolic reasoning	search related effort, search results
Bellardo	1984 1985	61	factor analysis, multiple regression analysis	creativity perception, interpersonal disposition, intelligence	recall proficiency, precision & unit cost scores
Borgman	1984	32	analysis of variance	conceptual model, gender, procedural instruction	benchmark test
Saracevic, Kantor, Chamis, & Trivison	1988	40/39	multiple regression & log. cross ratio analysis	learning style, remote associates, symbolic reasoning	search performance
Borgman	1989	64	correlation matrix, multiple regression	learning style, Myers-Briggs, remote associates, symbolic reasoning	academic orientation
Logan	1990	76	multiple regression	learning style, remote associates, symbolic reasoning	search cycles, commands, descriptors, references, connect time
Kerr	1990	99	analysis of variance	navigation cues (i.e. icons, headers, fancy, colours, simple)	search speed, efficiency, & accuracy; user aptitude/perception
Fidel	1991	47	correlations, analysis of variance	subject area, environment	search performance
Rauterberg	1993	12	analysis of variance	novices, experts	search performance
Wood, Ford, & Walsh	1994	67	Mann-Whitney, Wilcoxon Rank Sum Test	posting information, cognitive style, approaches to study	search performance, behaviour, attitudes
Wood, Ford, Miller, Sobczyk & Duffin	1996	105	Correlation coefficients	cognitive style, approaches to study	search quality & satisfaction

accessing information from a bibliographic CD-ROM. Using field-dependency/independency measures of cognitive style and the *Lancaster Short Inventory Approaches to Learning* which measures versatile, operation, and comprehension dimensions of learning style, this research recorded statistically significant differences in both searching behaviour and search outcomes. In a later study, Wood, Ford, Miller, Sobczyk, and Duffin (1996) also measured participants for field-dependency/independency dimensions of cognitive style and versatile, operation, and comprehension dimensions of learning style, as well as holistic/analyst dimensions of cognitive style. These researchers found that holistic learners used more new terms per search, performed a higher number of searches, and retrieved more relevant references, but were less satisfied with their search results than analyst participants. High scoring holistic, field-dependent participants tended to use fewer new terms per search, to retrieve a relatively high number of relevant references, to consider their searches successful and to rate the level of their own knowledge highly. They also reported frequent use of computer-based information systems.

Several authors in the bibliography searching literature have, however, referred to the 'puzzling' findings that appear repeatedly in studies of lack of similarity demonstrated by searchers in both process and outcome of on-line searches (Bellardo, 1985; Logan, 1990; Saracevic et al. 1988). Despite numerous investigations, there has been a notable lack of definitive results identifying the characteristics associated with these differences. An exception to this trend has been the recent work of Wood et al. (1994) and Wood et al. (1996). Fidel (1991) pointed to a drop in interest investigating on-line searching in recent years because most experimenters have failed to provide conclusive results. A common explanation is that this failure is due to individual styles overriding most measured attributes of searching behaviour, but Fidel indicated that "although the term searching styles is freely used in the literature about on-line searching, it is not clear what the term embodies" (p. 515). With this unresolved issue

of identification of user characteristics which impact on bibliography search performance, multimedia researchers must be cautious about readily identifying characteristics which impact on navigation performance in multimedia.

### **2.9.2 Interactive multimedia learning research**

While information retrieval systems, including electronic bibliography programs such as ERIC, are generally designed to enable the learner to quickly access specific information, learning materials presented in multimedia format are frequently more complex as they attempt to cater for a range of user needs. For instance, the design of *Vocational Rehabilitation Learning Resource* (refer to Chapter 3) allows the user to either employ it as an electronic retrieval system or as a problem-based learning system where the risk of learning difficulties increase. These difficulties include problems with navigation, difficulties in integrating information into personal knowledge structures, and cognitive overload. Jonassen (1991) also compared this comparatively unstructured learning environment to traditional instructional designs and design models where users' applications are more predictable. Users' interactions in multimedia learning are not "based on convergent, object-referenced purposes (but rather) are minimally intervening and are predicated upon cognitive activity instead of the behavioural outcomes that drive instructional design processes" (pp. 84-85). Thus, knowledge of cognitive learning theories is becoming increasingly important to assist designers of multimedia learning systems in producing products to meet the various needs of users.

While there has a great deal of speculation in the literature on the educational potential of interactive multimedia, comparatively few reports on research into its effectiveness have been conducted, particularly investigating linkages between user characteristics and performance. Table 2.5 lists research to date in areas close to those examined in this study. Independent variables measured includes stages of concern, attitudes,



Table 2.5. Review of Multimedia Research

Author	Year	Pop.	Statistics	Independent Variable	Dependent Variable
Tripp & Roby	1990	60	factor analysis	advance organisers, visual metaphor	recognition & recall of vocabulary
Gay, Trumbull & Mazur	1991	41	multiple regression	browse, time and index time; concentration; study aids; anxiety; motivation	relevant events found
Trumbull, Gay & Mazur	1992	41	simple statistics	browse, time and index time; perceptions of enjoyment; ease of use; system control; search strategies	patterns of navigation
Qiu	1993	61	log linear	gender, search task, search experience, academic background	search processes used
Cameron	1993	53	analysis of variance	flow chart and animated advance organisers	knowledge of structure, content and categories of information
Ellis, Ford & Wood	1993	not given	Chi square, cross tabulations, analysis of variance	prior knowledge, cognitive style, holism/serialism	test of knowledge
Liu & Reed	1994	63	simple regression, analysis of variance	patterns of learning, type of assistance	patterns of learning, type of assistance
Reed, Ayersman & Liu	1995	15	simple regression, analysis of variance	prior experience with hypermedia and authoring language	attitudes to hypermedia
Repman, Rooze & Weller	1991	33	mean, standard deviation	cognitive style, advance organiser, structural organiser	knowledge of topic
Schroeder & Grabowski	1995	113	Pearson's correlations	navigation aids, prior knowledge, attitudes	navigation patterns
Sharp, Bransford, Goldman, Risko, Kinzer & Vye	1995	18	analysis of variance	helpful video, no video, minimum video	comprehension and memory of mental models
Melara	1996	40	analysis of variance	reflector and activist learning style	performance on hypertext structures
Leader & Klein	1996	75	analysis of variance	cognitive style; search tools: map, browser, index/find, all tools	effectiveness in finding information, tool use during search, learner attitude

anxiety, cognitive strategies, novice learners, advance organisers, learning style, and cognitive style.

Reed, Ayersham and Liu (1995) looked for a significant relationship between users' attitude and prior experience with hypermedia. Using the *Information about Stages of Concern Instrument* developed by Hall, George, and Rutherford (1977), these researchers demonstrated that users with less prior hypermedia experience had significantly more concerns about hypermedia technology than those participants with more hypermedia experience. However, with the small population in this study, the analyses involved very small cells and therefore the results are questionable. Schroeder and Grabowski (1995) investigated navigation techniques employed by novice and expert users of hypermedia. They noted that novice users tended to have a fairly passive strategy for selecting their movement through the system which was based more on screen position rather than deliberate conceptual choices. No one technique proved best for all participants, but generally those participants not used to a degree of learner control often felt lost and confused.

A number of researchers have investigated the influence of advance organisers in assisting users navigate successfully, but as indicated in Section 2.3.5, there have been limited benefits found in research to date (Cameron, 1993; Leader & Klein, 1996; Repman, Rooze, G. E., Weller, H. G. 1996; Tripp & Roby, 1990). In an investigation by this researcher, new users were divided into three random groups before exploring a multimedia database. The first group was initially given an animated overview of the database, the second a flowchart overview, and the third entered the database directly without the assistance of an advance organiser. There were no significant differences between the groups in performance measures nor in attitudes towards the database. Similarly, Tripp and Roby (1990) demonstrated no improvement with groups using advance organisers and, like Cameron (1993), warned of the dangers of selecting organisers which may conflict with individual's

learning style and/or previous experiences. Tripp and Roby noted that a combination of orienting devices used in a multimedia database, such as literal description and graphical metaphor, can put an additional load on users' mental resources as they are forced to negotiate between two differing representations.

Gay, Trumbull, and Mazur (1991) examined the influence of affective and motivational dispositions and cognitive strategies on users' search strategies. These researchers noted that participants with lower anxiety about academic tasks were able to focus more on the task and made more effective use of guidance tools in a multimedia learning program. A stepwise regression analysis was used to clarify possible relations between search mode, cognitive and affective measures, and location of material in the program. The results of the analysis, with eight independent variables in the equation and relevant events as the dependent variable, showed that time in browse mode accounted for 29 percent of the total variance. Concentration accounted for five percent, information processing for eight percent, and time in the guide mode for only three percent. All other variables accounted for eight percent in total of the variance. Gay, et al. stressed the necessity of continuing to examine the interactions among motivational, affective, and cognitive measures in multimedia learning research. They pointed out that traditional text-based, alphabetical indexing features may not be helpful to users for navigating through large hypermedia, but that if access is flexible and effective, motivation is enhanced and anxiety reduced.

Melara (1996) noted that in the literature to date, no experimental study had been reported examining the effect of learning styles on multimedia performance using the 'activist' and 'reflector' components of the Learning Style Inventory (Kolb, 1985). Melara's results indicated that there was no significant difference between the two learning styles when it came to time spent accessing two multimedia instruction applications.

A number of investigations from the limited research in this area has measured the field-dependent/independent dimension of cognitive style of participants and sought to assess linkages with multimedia performance. Repman (1991) found that field-independent students learned computer ethics via hypermedia software more effectively than did field-dependent students, regardless of whether or not advance organisers or structural organisers were present. Leader and Klein (1996) investigated the effects of search tools and learner cognitive styles on performance in searches for information within a hypermedia database. Results revealed a significant interaction between search tool and cognitive style. Field-independent learners performed significantly better than field-dependent learners for achievement and accessed more screens. These authors also found that cognitive style was significantly related to attitude, but that contrary to what these investigators expected there was an absence of any benefit from advance or structural organisers on the field-dependant learners. Jonassen and Wang (1993) observed that field-independent participants did better than field dependants in treatments which either did not identify the semantic structure of hypertext links or required participants to classify the link types themselves. The performance of the field independent learners was impeded in the treatment that identified the semantic structure of the links. The authors suggested that this result reflected the preference of field-independent learners for restructuring information rather than accepting the structure provided by materials.

In examining the different types of media, tools, and learning aids chosen by the field-independent and field-dependent learners, Liu and Reed (1994) suggested that different learning style groups employed different learning strategies in accomplishing the same task. Field-dependent learners used the courseware more, accessed more videos, but used less index tools than the field-independent learners. These researchers found that all learning styles performed equally well on achievement, yet approached learning quite differently. They believed the results of their study provided

some evidence to the assumption that hypermedia-assisted instruction could fulfil its promise of accommodating learners with different needs.

Related to this outcome was the research by Ellis, Ford and Wood (1993) that set out to produce a learning package able to accommodate two measures of cognitive style of student participants, namely holism/serialism and field-dependence/independence. Serialists consistently scored a higher number of correct answers than those defined as holistic. There was a clear tendency for serialists to show more confidence in being able to recall answers from the learning package, but these authors noted that this confidence may be misplaced as serialists also scored a greater mean number of incorrect answers. Holists, in contrast, answered fewer questions more accurately, and were more prepared to admit a lack of knowledge. There was no statistically significant difference between field-dependants and field-independent learners in producing correct responses. A predisposition towards field-independence appeared to require a larger number of accesses to information modes (documents) to achieve the same degree of accuracy of response. Preliminary analysis of the detail of logged usage appeared to indicate that this group also returned to previously accessed modes via structural loops. Ellis et al. (1993) found no evidence to connect different approaches to learning patterns with subsequent performance and stated that it may be possible to assume that holism/serialism and field-dependent/independent factors are not absolute or directive in their influence. These researchers noted, however, that in the initial phases of adjusting to the system, these predispositions affect the mechanics of navigation and searching; all users appeared to create individual strategies successfully using tools with which they were comfortable to achieve largely similar end results. The largely successful completion of the open-ended tasks by all groups indicated the adoption of successful strategies. In the briefing sessions, individual differences were manifested more in terms of the interpersonal dynamics of the situation than in the content and cohesion of the presentation.

## **2.10 Computers in the occupational therapy curriculum**

Comprehensive searches of the English language, occupational therapy published literature found limited descriptions of the application of computers as learning tools in the occupational therapy curriculum. One of the earliest reported applications was by Dengler (1983) where occupational therapy students at the University of Illinois used computer-assisted-learning in parts of a neuroscience course. In a self-study approach, students using computers accessed learning objectives, reading assignment information, and practical activities information. In South Australia, Farrow and Sims (1987) described the use of a video tape being linked to a computer to learn about back care. This arrangement permitted therapy students to enter responses on the computer to cues presented in the video tape. Toth-Cohen (1994) examined the learning achieved by occupational therapy students using a computer-assisted-learning program *An Illustrated Guide to Applied Anatomy and Kinesiology* which focused on the musculoskeletal anatomy of the elbow. In this pilot study, the author found that there was no statistically significant difference between learning outcomes for students who completed the computer-assisted-learning program before attending a lecture and laboratory on this topic, to those who completed the program after attending the lecture and laboratory.

With the availability of hypermedia authoring software, which can be employed by non-programming designers, there has been several recent developments with problem-based-learning computer programs. Tomlin (1988; 1996) has used interactive videodisk at the University of Puget Sound, where client simulation packages have been developed in order to measure the ability of therapy students to make informed, effective decisions about the evaluation of clients and to observe and interpret client responses correctly. In these applications, clinical reasoning skills are developed as students focus on the client evaluation phase of the clinical process. In a case involving a person who had suffered a cardiovascular accident, video tape

sequences are displayed showing a therapist evaluating the client. Students are required to select assessments to perform, answer questions about preparatory procedures, and observe the client's responses on video. Periodic prompts are used to direct students to answer questions about the summary appraisal of the client's performance up to that point.

Seal (1997), at Southampton University, has developed a hypermedia system *Computer Applications in Therapy* which allows therapy students to choose a patient/client case history from a list of sixteen. The case histories are divided into four categories: learning difficulties; physical difficulties; cognitive/perceptual difficulties and sensory difficulties. Once students have chosen a case history they can then browse through the resource information in order to find out as much as they can about whether or not the client in the case history would benefit from using a computer and if so how an occupational therapist might use a computer with that client. This program's learning materials include lecture notes, extracts from the newsletters and magazines, scanned images of equipment and links to Web pages, all of which can assist students prepare a written report.

A number of hypermedia learning systems have been developed at the School of Occupational Therapy, Curtin University of Technology. A hypermedia database *Activities Bank* was developed by Cameron (1990) which features arts and crafts activities used by clients in therapeutic settings. Students practicing these activities can access information on individual projects including task analysis, dimensioned illustrations, tools and equipment requirements, materials used, and variations in design. This project was followed by a more sophisticated hypermedia database *Recreation Perth* (Cameron, 1993) which was designed for students and therapist use in leisure settings. Information in this program includes needs for special group clients, maps showing locations, task analysis, equipment needs, and short video segments illustrating key aspects of each leisure activity. As with *Vocational*

*Rehabilitation Learning Resource*, occupational therapy students were involved during the design and development phase with *Activities Bank* and *Recreation Perth*. Students compiled prototype versions, assisted with evaluation trials, and helped collate data for entry into the programs. This input contributed to making the programs more meaningful to student users, but also provided valuable learning experiences to the student participants. A more recent development at Curtin University is the hypermedia system *Human Activity Investigator* (Passmore, Cameron, & Yeo1997) where occupational therapy students view video sequences of clients participating in activities of work, leisure, and daily living. Students have access to a large range of on-screen help features to assist them in preparing a detailed analysis covering physical and psychosocial dimensions. These help features include definitions and their categorisation, and an on-screen note book where students can record their analysis.

Mogey (1995) has also involved students in the design of hypermedia at Glasgow' Caledonian University. Occupational therapy students have used an authoring system to create simple hypermedia programs for use in clinical settings with relevant supporting documentation which includes some self-evaluation of their product. Mogey claims that these experiences, as designers of hypermedia, maximise students' awareness of the therapeutic potential of information technology and also develops practical, transferable information technology skills.

### **2.11 Summary of Chapter**

This chapter reviewed the literature in a number of areas related to the research questions raised in this study. First of all, it explored the historical origins of the use of multimedia in learning by looking at related areas, including the use of programmed learning and hardware/software developments of this technology. The major theoretical positions or tenets of behaviourism, cognitive psychology, and



constructivism were investigated to demonstrate their relevance to learning with interactive multimedia.

This review of literature investigated the educational concepts of open learning, self-directed learning and problem-based learning because they represent some of the learning strategies which users of *VRLR* employ. Key features of multimedia are the type and degree of interactivity, navigation, and learner control and how these relate to the formation of mental models. Relevant student characteristics and their measurement including cognitive style, learning style and technophobia, were studied and later sections of this review looked at related research in the areas of bibliography searching and interactive multimedia. The final section in this chapter investigated the limited references to the use of computers in the occupational therapy curriculum. In the next chapter, a review is conducted of recent changes underway in tertiary education which have potential impact to the design and development of interactive learning packages utilising computer/telecommunications technology. A chronological description is given of the design and development phases of *VRLR*.

## Chapter 3

### DEVELOPMENT OF THE *VOCATIONAL REHABILITATION* *LEARNING RESOURCE CD-ROM*

#### 3.0 Introduction

Education and training are currently undergoing change in the Australian tertiary sector brought about by a number of forces that include reduction in funding, increased student enrolments, increased diversity of student population, increased range of topics being introduced into the curriculum, accountability pressures on teaching services offered, and the information explosion brought about by the recent advances in computer and telecommunications technologies (Laurillard, 1993; Vanstone, 1997; West, 1997). Concurrent with these pressures are the potential of these technological advances in offering alternative means of delivery of learning materials which may help to meet these challenges.

This chapter initially looks at some of the changes currently impacting on tertiary education and suggests ways that packages such as *Vocational Rehabilitation Learning Resource (VRLR)* can assist in meeting some of the challenges arising by following the self-directed approach of constructivism (refer to Chapter 2, Section 2.2.3). The first research question, *Can an independently accessed, interactive multimedia package be designed and developed to support occupational therapy students learning vocational rehabilitation*, is then addressed by a description of VRLR's evolution, design, development, and evaluation trials, followed by a discussion of the planned advantages and limitations.

### 3.1 Current Changes Impacting on Tertiary Education

Federal government funding of Australian universities has remained at approximately \$11,100 per student since 1994 (West, 1997), but with universities having to fund recent staff wage increases there has been a significant shortfall on budgets to meet projected teaching services offered. At the School of Occupational Therapy, Curtin University, this has amounted to a reduction of 14% in operating funds available between the years 1996 to 1997 (see Table 3.1) (Millsted, 1997).

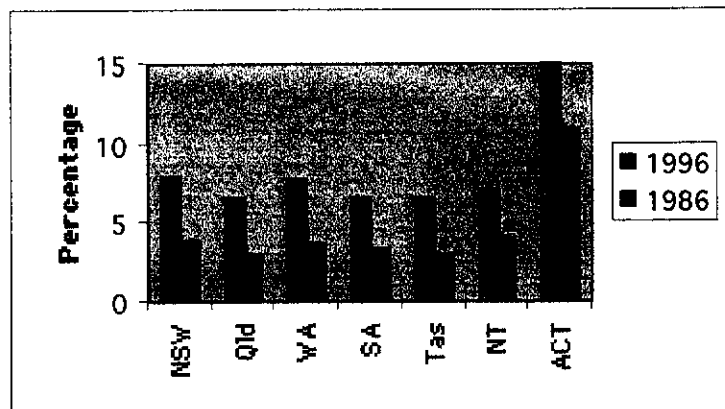
**Table 3.1. School of Occupational Therapy Funding (1995-1997)**

Item	1995	1996	1997
Commonwealth Grant	\$1,467,848	\$1,782,466	\$1,535,247
Overseas Student Fees	\$43,289	\$50,844	\$43,928
Total Income	\$1,511,137	\$1,833,310	\$1,617,528
Expenditure	\$1,733,413	\$1,569,629	\$1,460,893

This decrease in operating funding is forcing university administrators to review the range and type of courses offered. Labour costs, which make up the most significant component of total costs, is approximately 85% of total costs at Curtin's School of Occupational Therapy (Millsted, 1997). This financial predicament is compelling many universities to critically examine their operating costs and resulting in several seeking to offload salaried and academic staff by offering redundancy packages (Illing, 1997; Spencer, 1997; Windsor, 1997).

Most undergraduate and graduate tertiary courses have undergone a significant increase in student enrolments in recent times. Nationally, over the ten years from 1985 to 1995, the number of people holding university degrees has almost doubled (see Figure 3.1). In 1995, there were 604,000 higher education students in Australia (including overseas students and students attending institutions funded by other

Federal Government departments). This amounts to an increase of 65% from 1985 to 1995 (Department of Employment, Education, Training, and Youth Affairs, 1996b).



Source: Australian Bureau of Statistics

**Figure 3.1. Percentage of Australians Over the Age of 15 With a Bachelor Degree (Victorian figures not available)**

Tertiary teaching staff today are facing the challenges of meeting an increasingly diverse student population with varying learning needs (Laurillard, 1993; West, 1997). This is due to more school leavers coming directly into tertiary education, in many instances at lower entrance standards than previously, and others returning to university studies in order to upgrade or supplement their qualifications to meet the needs of modern society. Simultaneous with this increase in local student numbers, most Australian tertiary institutions have experienced a phenomenal rate of increase in overseas student enrolments in the past decade. In 1985 there were 16,075 overseas students enrolled in Australian tertiary institutions and by 1995 this had risen to 51,944 overseas participants (Department of Employment, Education, Training, and Youth Affairs, 1996b). The cultural and educational background of most of these students, from predominantly Asian countries, differs from local students and consequently their learning needs and expectations of teaching staff also differ (Laurillard, 1993).

Curriculum content is another area undergoing change. With the rapidly changing demands of the workplace and the information technology explosion, there has been an increasing pattern of curriculum review and change. Teaching staff have little time to consolidate, but must continually be updating and upgrading their own knowledge to select and develop appropriate related learning materials for their students.

In recent years, federal funded tertiary institutions have experienced significant pressures of public accountability into their programs. These have included Department of Education, Employment, Training, and Youth Affairs investigations which have scrutinised and reported on the quality of teaching and research within each institution and across institutions (Department of Employment, Education, Training, and Youth Affairs, 1993). Students no longer are provided with 'free' tertiary education in Australia, but must pay on average one third towards the total costs (Department of Employment, Education, Training, and Youth Affairs, 1996a). Teaching staff, therefore, cannot expect an unchallenged right to the content delivery of their subject matter, but can anticipate increased scrutiny from Government departments and their representatives as well as 'fee-paying' students who want value for their contributions towards the cost of their education.

Traditionally, academic learning has depended upon reading and teacher-directed instruction by means of lectures, tutorials and practical sessions (Hannafin, 1992; Laurillard, 1993). The information explosion is bringing about change as students have convenient access to vast quantities of information related to their chosen discipline through CD-ROM literature databases and more recently through the Internet. This positive advancement in provision of academic knowledge is having considerable impact on teacher/student relationships. No longer can teaching staff expect their role in the relationship to be the key providers of knowledge as more and more information is readily accessed through means over which they do not have direct control, such as the Internet (Bias & Carey, 1996; Jonassen, 1996; Lombardo,

1995). Subsequently, teachers are having to take up the challenge of re-thinking their role in the teaching/learning process.

### **3.2 Computer/Telecommunications Developments and Their Impact on Learning**

The introduction of teaching packages, such as *VRLR*, offers some indication of how traditional teaching may be supplemented in future years by academic staff designing and/or overseeing learning materials for delivery by computer/telecommunications technology. The advantages of tailoring learning materials for individual needs and the convenience of open access to self-paced learning can help meet some of the needs brought about by the situations identified above (Reynolds & Ehrlich, 1992).

Lectures have been employed as the primary method of communication between teacher and student in academic education for over 800 years (Laurillard, 1993). In the past, with the limited knowledge of learning, the uniformity of student population in culture and academic capabilities, society's promotion of conformity as opposed to individualism, and the convenience to institutional organisation, this method of pedagogy may have been defensible. With the trend towards open access and catering for the individual, lectures are a grossly inefficient way of engaging with academic knowledge (Bailey, 1992; Laurillard, 1993; Lee, 1996).

Teacher-directed lectures put a tremendous burden onto the student as they fail to allow engagement in the full range of these activities. Although some lecturers may be effective motivators, educational research has shown that lectures cannot be considered efficient in the stimulation of student learning (Hestenes, Wells, & Swackhamer, 1992; Lee, 1994; Redish, Wilson, McDaniel, 1992; Stone & Scott, 1996). Lee, (1996) illustrated the uncertainty surrounding the effectiveness of lectures when he pointed out that:

Irrespective of the quality and skill of the lecturer, the effectiveness of the outcome is determined by the vagaries of the lecture situation and the ability of its audience to sustain a high rate of concentration throughout periods of up to two hours. (p.1)

Laurillard (1993) has argued that academic learning is discursive, adaptive, interactive and reflective. Laurillard described the *discursive* category of academic learning as being met by the provision of an environment within which students can act on, generate, and receive feedback. *Adaptive* conditions can be achieved when students' conceptions are realised and are the focus of continuing dialogue. Students must act by *interacting* to achieve goals and *reflect* on feedback on their action to topic goals. Laurillard viewed the traditional lecture as failing on all four of these categories because:

Lectures are not discursive as only the teacher can communicate his/her conception, and it is neither adaptive nor interactive, and it does not encourage reflection as it does not allow practice in the interpretation and manipulation of the formal representations found in academic subjects.

(Laurillard, 1993, p. 107)

Another learning medium utilised over a number of centuries is print. Like the lecture, the dependency on any one medium, however useful, fails to solve fundamental educational problems (Ramsden, 1992, pp. 159-161). Consequently, print also has the disadvantage of failing to be interactive, adaptive or reflective. However, it does have the key advantage that, like most educational media, it is controllable by the student. They can control the topic focus: they can re-read, skip, browse, go on to another topic via the index or contents page, and in doing so control the delivery of the material (Laurillard, 1993, p.109).

For groups of students with contrasting cultural and academic backgrounds, traditional teacher-directed instruction has difficulty in meeting students' varying needs. In situations such as this, self-paced study can assist as well as ease the effects of the diminishing ratio of teachers to students brought about by increased student numbers and reduced staffing (Laurillard, 1993; West, 1997). However, stand-alone media-based packages will never be sufficient on their own because none of the media can adequately support the discursive activities that are essential for academic learning. By integrating a range of media, in order to best exploit the strengths of each, assistance can be rendered in meeting most of the discursive, adaptive, interactive and reflective needs of students provided it is supplemented by teacher-student dialogue to provide the debate and discussion around academic ideas.

With shrinking revenues and rising costs for campuses, there is a critical need to reassess productivity levels and increased competition for student enrolments (Mahoney, 1997). Use of self-paced learning packages such as *VRLR* can free-up lecturers' time to devote to these discursive elements of the learning process. Such a situation is in operation in the School of Engineering at the University of Western Australia, where first and second year students are introduced to mechanical concepts through accessing self-paced learning packages in the School's World Wide Web site. Teaching staff have, consequentially, significantly reduced lecturing loads and, as a result, they have an 'open-door' policy which allows staff to be more available for discussions with individuals and small groups of participants to focus on special needs areas of the curriculum (Stone & Scott, 1996). Similarly, Lee (1996) has shown that anatomy lectures to physiotherapy students can be substituted with self-paced multimedia learning packages resulting in equally successful learning. The cost effectiveness of the multimedia system is realised with its consistency in delivery and repeatability for minimum financial outlay.



Teachers need to know more than just their subject matter. They need to know the ways that it can come to be understood, the ways it can be misunderstood, what counts as understanding: in other words, they need to know how individuals experience the subject (Laurillard, 1993). To achieve this need, research should be conducted to investigate how students come to learn (or fail to learn) through both traditional and non-traditional learning environments.

The research reported in this thesis is exploratory in that it investigated ways that student participants attempt to learn in a multimedia environment. It focused on the introduction of a self-paced learning package into the occupational therapy undergraduate curriculum, and sought to understand how participants with different learning characteristics navigate the multimedia package and carry out problem-solving exercises in occupational therapy.

### **3.3 Curriculum Development as Research**

In the recent past, as indicated in Chapters 1 and 2, researchers have applied a technology-driven perspective to the use of interactive learning technologies which have focused more on the equipment instead of optimising the capabilities of the learner (Hooper & Hannafin, 1991; Jonassen, Campbell, & Davidson, 1994; Kozma, 1991; Laurillard, 1993). These authors pointed out that the full potential of this technology to the learner can only be realised when the design of emerging technologies is researched to maximise the capabilities of targeted learners.

Research and development funding bodies have focused almost exclusively on the development of the use of a particular medium or method and comparison studies with other forms of media/method usages. Laurillard (1993) indicated that:

As a result of irrational funding, we have studies that tell us that computers, video, etc. can be effective and can also fail utterly, but we have very little idea

of how they might work in combination, or how design relates to the content being taught. (p.7)

The character of student learning is dependent on former experiences of the world and of education, and on the nature of the current teaching situation. Laurillard (1993) believes that the design of information technology-based, interactive learning materials over the past 20 years has been based on an over-simplified understanding of student learning which fails to account for the range of variables involved. This author points out that the implementation of new technology methods cannot take place without the system around it adjusting accordingly. She advocates that academics involved in teaching and design should be able to conduct longer-term research projects to develop the necessary knowledge about teaching and learning in their subject, as an alternative to research in the subject itself. Laurillard stated that unless funding is earmarked for basic research prior to the development, and to evaluation, during and following development, the knowledge base will remain inadequate (p. 223).

In a similar vein, Driver and Scott (1996) suggested that commonalities exist in the ideas that students generate across a range of domains so that it is feasible and important to consider ways of taking them into account in preparing curriculum materials. These authors suggested that in the past, 'good' curriculum materials were those that have been well thought through from the point of view of the scientific ideas they present, and were presented clearly to students. From a constructivist's perspective, however, we cannot assume that what is taught is what is learned. The issues, according to Driver and Scott, point to curriculum development as being a legitimate subject for research (p. 106). These authors explained that research of this nature involves cycles of planning, implementing, and evaluating teaching activities and approaches in order to maximise learning.

This study takes up the above challenges and is an attempt to broaden the research base by introducing interactive learning materials into a curriculum. It is exploratory in nature, and comes from a constructivist perspective which asserts that individuals construct and restructure their schemes of the world, through their own mental activity as a result of experience with phenomena (Duffy & Jonassen, 1991; Waern, 1993). It investigates the characteristics of the learners using an interactive learning package, studies their navigation patterns as they explore and problem-solve, and measures their attitude towards it. From the results of this study, it is planned to execute changes to *VRLR* for a scheduled World Wide Web version, ensure that its introduction into the curriculum is readily accepted by students and staff to maximise its effectiveness, and to use the shell of *VRLR* as a template to compile similar packages to meet the needs of the occupational therapy student population in other curriculum areas. To illustrate *VRLR*'s construction and functions, the remainder of this chapter is devoted to its evolution, design, development and highlights some of the limitations and advantages.

### **3.4 The Design and Development of *VRLR***

#### **3.4.1 Vocational rehabilitation in the curriculum**

Vocational rehabilitation is the process within occupational health aimed at restoring function to the injured or sick worker and assisting the individual to return to work at a suitable level of gainful employment (Barrett, 1995). Occupational therapists are involved in the rehabilitation process with the design and implementation of client programs which include work-capacity assessment, off-the-job training, and job placement. Increasingly, therapists are expected to take on a case management role in the treatment of injured workers seeking to re-enter the workplace. This entails objectively co-ordinating, evaluating, referring and monitoring all services to the client (Dufresne, 1991). In this additional role, the therapist co-ordinates the process and

communicates with other case team members, including other health professionals, employers, insurance company representatives, and family.

Vocational rehabilitation of injured workers is undergoing rapid growth nationally at a considerable cost (Worker's Compensation and Rehabilitation Commission, 1993). It is an area providing an increasing number of openings for occupational therapists, yet in the past there has been a resistance by many students to focus in this area as a potential career option (Cameron, 1994; 1995a; 1995b; 1995c). This resistance may have been due to the belief that vocational rehabilitation is less attractive than other career options and/or that instructional methods employed in this subject have been inappropriate. *VRLR* seeks to address these issues by presenting validated materials attractively and meaningfully, plus giving students the opportunity to assess their knowledge by applying the appropriate management decisions to the case study examples. A major advantage in the development of this resource is that it permits students to practice clinical reasoning skills and make case management decisions before they are required to do so as qualified therapists on 'real' clients.

An additional need for this learning resource has been the limited amount of textual sources of information and the confusing range of terminology used within these limited references (Borst & Nelson, 1993). The latter is, understandably, particularly perplexing to students.

Information on standardised work assessment tools has generally been restricted to user manuals produced by the manufacturer. Information on job analysis and the case management of vocational rehabilitation has depended largely on individual teaching staff producing lecture notes to describe the occupational therapy perspective (Barrett, 1995). In the past, limited numbers and types of standardised work capacity assessment tests have been available within the School of Occupational Therapy to enable students to gain 'hands-on' experience. This situation has been due to the

significant cost of many of these standardised assessments. The few vocational rehabilitation assessment tests owned by the School were generally in the inexpensive range and relatively simple to apply.

### **3.4.2 Evolution of *VRLR***

To address some of the above shortcomings in meeting the curriculum requirements in the area of vocational rehabilitation, the design and development of *VRLR* were proposed for consideration by the School. The initial objective of the introduction of *VRLR* into the occupational therapy undergraduate curriculum was to significantly improve students' understanding of the vocational rehabilitation process. In the longer term, the introduction of *VRLR* has the goal of providing more effective rehabilitation and hence reducing the increasing, substantial cost to the nation of paying employees while absent from work through injury. This figure was \$91 million in 1993 for Western Australia alone (Worker's Compensation and Rehabilitation Commission, 1993).

*VRLR* is modelled on the initial stage of the rehabilitation process. This is, the point where the therapist has been appointed as the case manager and has received referral information from the authority recommending vocational rehabilitation, such as a medical practitioner. Referral information normally includes personal details of the client and details of the injury and medical treatment. At this stage, the therapist plans to conduct an interview with the client and would be starting to consider a plan for rehabilitation therapy. This would include the type and range of work-assessment tools to employ, selection of possible case team members, and the likely impact of the injury on key tasks of the client's occupation. Subsequently, *VRLR* was employed in the teaching unit Occupational Health 241 to enable occupational therapy undergraduate students practice making case management decisions. This educational package is intended to increase future rehabilitation clinicians' awareness and

competency in methods where instruction is currently restricted. That this can occur is due to the practicality of providing students with exposure to clients and clinical applications using specialised equipment in a simulated environment.

A feature of the development of this learning package has been the substantial input by students in a number of capacities, including prototyping, research assistance, graphic art, and evaluation (Cameron, 1994; 1995c; 1997). Early input was conducted by third year undergraduate occupational therapy students in 1993 and 1994 producing 'stand-alone' prototype versions of component parts of *VRLR* (see Section 3.4.3). Fourth year students have been employed as research assistants gathering and collating data for input and assisting with evaluation trials (see Section 3.4.4). Twenty five students volunteered their services as participants in formative evaluation trials.

*VRLR* was developed in two phases, which are described in detail in the next sections of this chapter, and supported by funding from the Committee for the Advancement of University Teaching (CAUT) in 1994 and 1995. Initially, in 1994, funding was sought to develop a self-paced learning package on work capacity assessment tools. These instruments are standardised methods of assessing clients' physical and psychological capabilities for particular vocational tasks. The learning materials developed through this funding were produced for delivery as a computer-driven, multimedia database allowing students to independently access information and test their understanding by attempting self-assessment components. A cross-section of work-capacity evaluation methods available to occupational therapists are featured, with detailed information on the key elements and clinical administration of each.

Funding was approved by CAUT to extend the project in 1995 into a second phase that included problem-based learning materials featuring case management in vocational rehabilitation (Sadlo, Piper, & Agnew, 1994). Eighteen case studies, based

on a range of client criteria, were entered into this extended self-assessment computer resource, allowing students to practise making management decisions. These included selecting appropriate work assessment methods, compiling a job analysis of a range of occupations and identifying key players and their roles in the rehabilitation process.

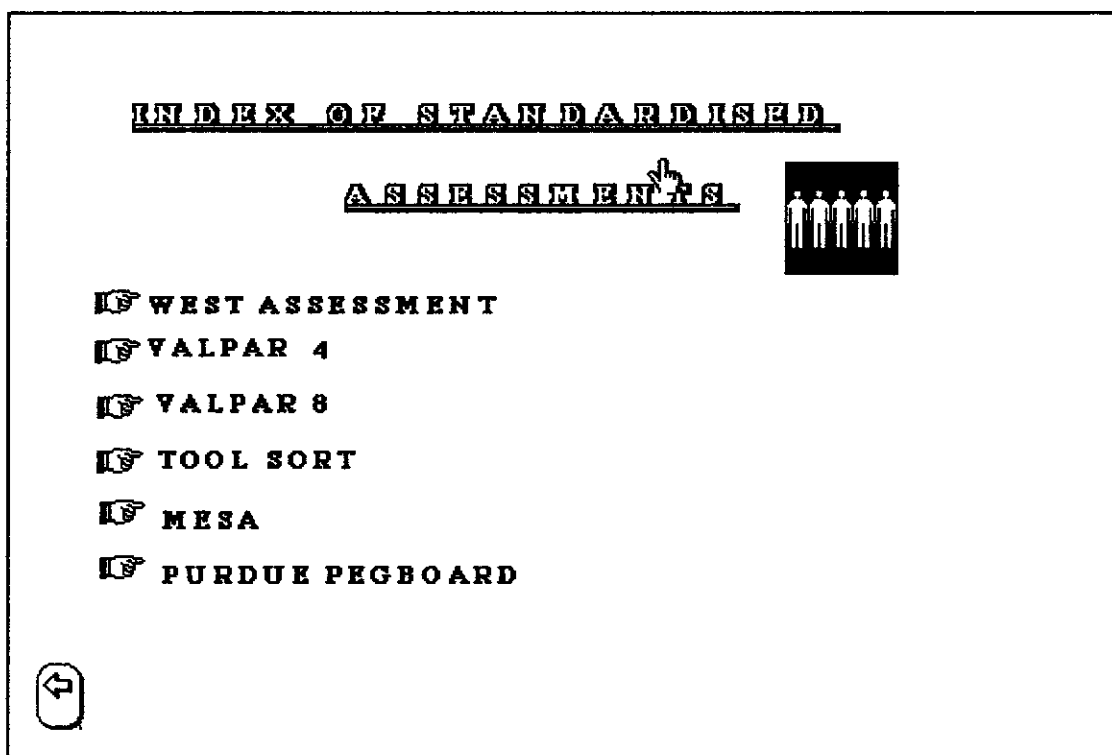
During 1995 and 1996, formative and summative evaluation trials were conducted with participants drawn from students studying Occupational Health 241, the introductory unit to vocational rehabilitation in the occupational therapy undergraduate curriculum. Considerable modifications were made as a consequence of these trials and the learning package was produced on CD-ROM for distribution to students in June 1996. In March 1997, all students studying Occupational Health 241 were briefed on the uses of *VRLR* during the third week of semester and its part in supplementing the lectures and tutorials in this unit. A questionnaire was designed to evaluate students' perception of the value of the learning package on completion of the unit Occupational Health 241. Copies of the CD-ROM *VRLR* have been distributed to all Australian and New Zealand universities that teach undergraduate occupational therapists. In addition, copies have been requested and dispatched to universities in United States, Canada, United Kingdom, Hong Kong, Taiwan, and Singapore. A World Wide Web version of *VRLR* is currently undergoing testing which when completed, can allow this package to be more widely available than at present (<http://www.curtin.edu.au/curtin/dept/therapy/otrcwa/vrlr.html>).

### **3.4.3 Design - Phase 1**

The first phase of this project was focused on the development of an interactive multimedia database covering a range and application of standardised work-capacity evaluation tools as required in the syllabus for occupational therapy undergraduate unit, Occupational Health 241 (Barrett, 1995). These evaluation methods are employed, in a clinical setting, to determine an individual's suitability for particular


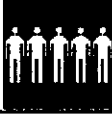


work activities, and are used frequently with employees after injury to determine progress to recovery and suitability to return to work.

Three prototype databases were produced at Curtin University's School of Occupational Therapy in 1993/94 by 3rd year undergraduate occupational therapy students under the direction of the researcher. Software used was Hypercard© version. 2.1 (Apple Computers, 1988) and Filemaker Pro© version. 2.0.4 (Claris Corporation, 1993). One of these databases, *Work Capacity Evaluation Tools*, focused on an overview of some of the standardised work assessment tools being used by therapists in Western Australia. This database was designed to give brief information, including purpose and procedures for six assessment tools (see Figures 3.2 and 3.3).



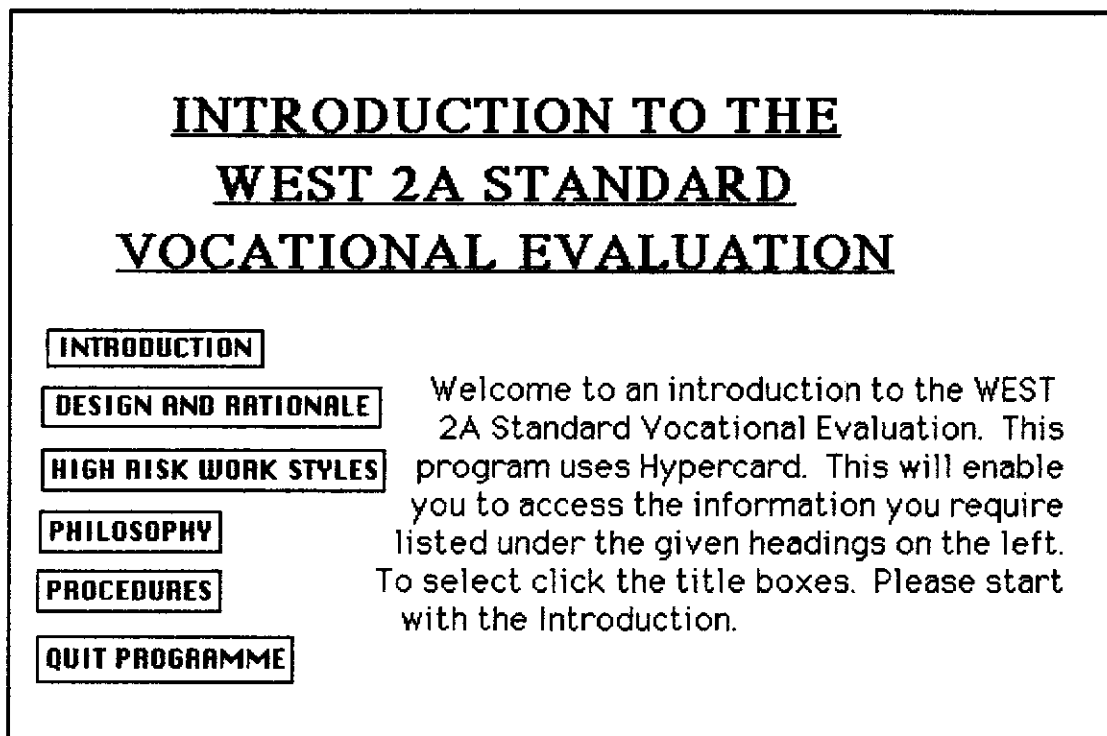
**Figure 3.2. *Work Capacity Evaluation Tools* Prototype Database Main Menu**



 index	<b>Name</b> <span style="border: 1px solid black; padding: 2px;">Valpar 4</span>	
<b>Purpose</b>	Measures person's range of motion and work tolerance in upper torso. Assesses reaching, handling, finger grip, sensation, vision, motor coordination and manual dexterity.	
<b>Procedure</b>	Equipment - a manual, stop watch, pencil, upper extremity body charts, coloured pencils and scoring sheet. Administered in standing unless client is disabled. Two parts - assembly and disassembly.	
	<b>Features</b>	May also be used for work hardening. Functions related to mobility and use of arms and hands.
		

**Figure 3.3. Valpar 8 Information From *Work Capacity Evaluation Tools***

The other two databases, the *WEST 2A* (see Figure 3.4) and *WEST TOOL SORT*, featured more detailed coverage on two of the assessments overviewed in *Work Capacity Evaluation Tools* (Ogden-Niemeyer, 1989; Work Evaluation Systems Technology, 1989). Information covered in these two databases included an overview in the *Introduction* section, with more specific information in the *Design and Rationale*, *Philosophy*, and *Procedures* sections. Students worked in small groups of three or four persons to develop these databases with guidance on authoring and formatting multimedia learning programs with non-linear linkages between related information.



**Figure 3.4. WEST 2A Prototype Database**

The value of having fully developed packages on work assessment tools available to students at their convenience in the Occupational Therapy School's Computer Laboratory was viewed as a positive step to address the shortcomings in the literature in this area (Borst & Nelson, 1993) and the absence of appropriate equipment for participant use as highlighted above. The production of a database modelled on the above prototypes would make available information on the function and application of some of the more widely used methods currently employed in clinics. Student access to information on these methods was only available through catalogues, textbooks, and rare visits to clinics. The information on each standardised test would include its function, general description, component parts, procedure of application and client reporting format. The latter, through the video sequences, would permit students to view the clinical administration of tests, which would include the occupational therapist's role and client performance.

With funding secured by the CAUT grant, a project team was formed with the author as leader/co-ordinator and including the other two academic staff members from the School of Occupational Therapy who assisted with the application for funding. Also included in the team were a graphic artist, computer programmer and an occupational therapy fourth year undergraduate student. Meetings were conducted to determine software selection and design issues.

It was decided to develop *Work Capacity Assessment Tools* using the authoring software package, SuperCard® 2.5 (Allegiant Technologies, 1995). This software had been used by the author to develop *Recreation Perth* (Cameron, 1993) the previous year. This multimedia database had also been funded by CAUT as part of the project *An Investigation of Strategies to Provide Pathways for Learners in a Computer-Managed Learning Environment* (Lee & Cameron, 1994). SuperCard® was designed for development of multimedia courseware on Apple Macintosh computers, the system used in the School's computer laboratory. With Allegiant Technologies committed to developing a Windows version of SuperCard®, it was anticipated that *Work Capacity Assessment Tools* could be used in the future by students using IBM compatible computers at home.

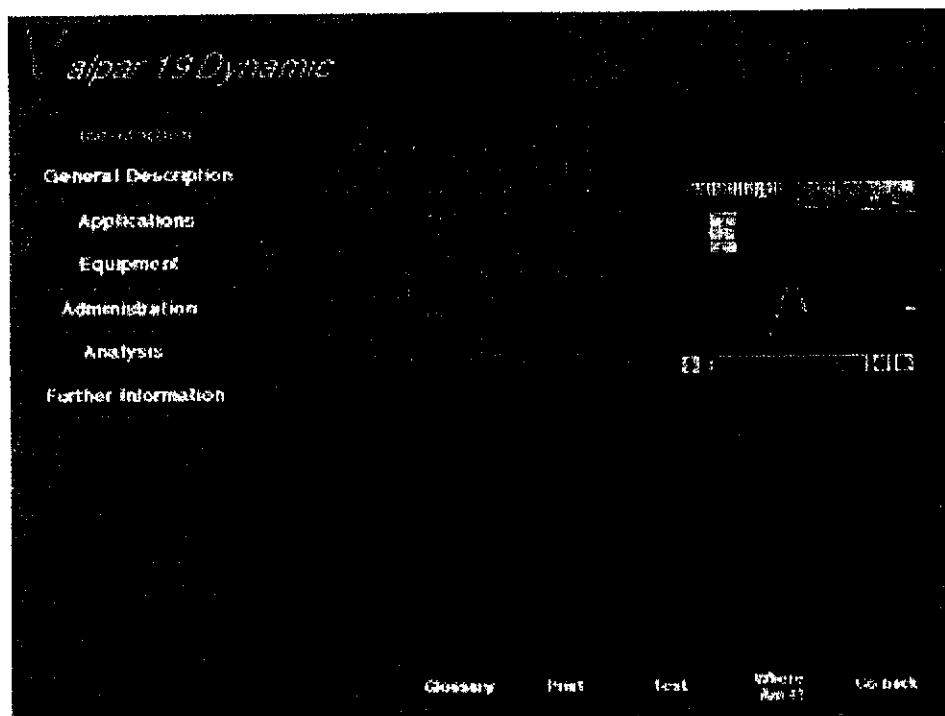
Information on a total of 20 work-capacity tools was entered into the database. The choice of tools was determined by their availability locally and therefore convenient for accessing for research and video recording for the learning package. In addition, these are the vocational rehabilitation assessments that Curtin University occupational therapy students would most likely come across in local practice, and therefore some familiarity with their characteristics also would be of benefit. The Main Menu Screen (see Figure 3.5) includes access to an Overview of *Work Capacity Assessment Tools*, which is an animated sequence accompanied by a commentary.



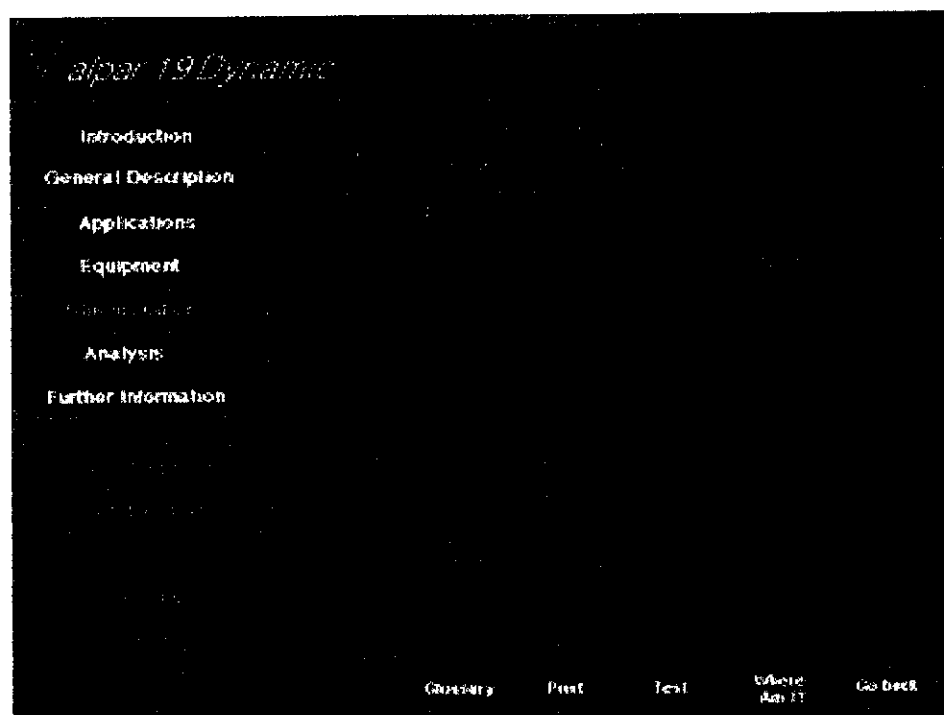
**Figure 3.5. Main Menu of *Work Capacity Assessment Tools***

Coverage of each standardised method includes details on seven main categories of information plus a video recording illustrating key aspects of its use with a client being assessed by a therapist. The main categories of information for each of the 20 entries are *Introduction*, *General Description*, *Application*, *Equipment*, *Administration*, *Analysis*, *Further Information* (see Figure 3.6).

Windows with information on sub-categories of the above were made available as illustrated for *Administration* in Figure 3.7. A full list of sub-categories is illustrated in the *Where Am I?* Screen (see Figure 3.8).

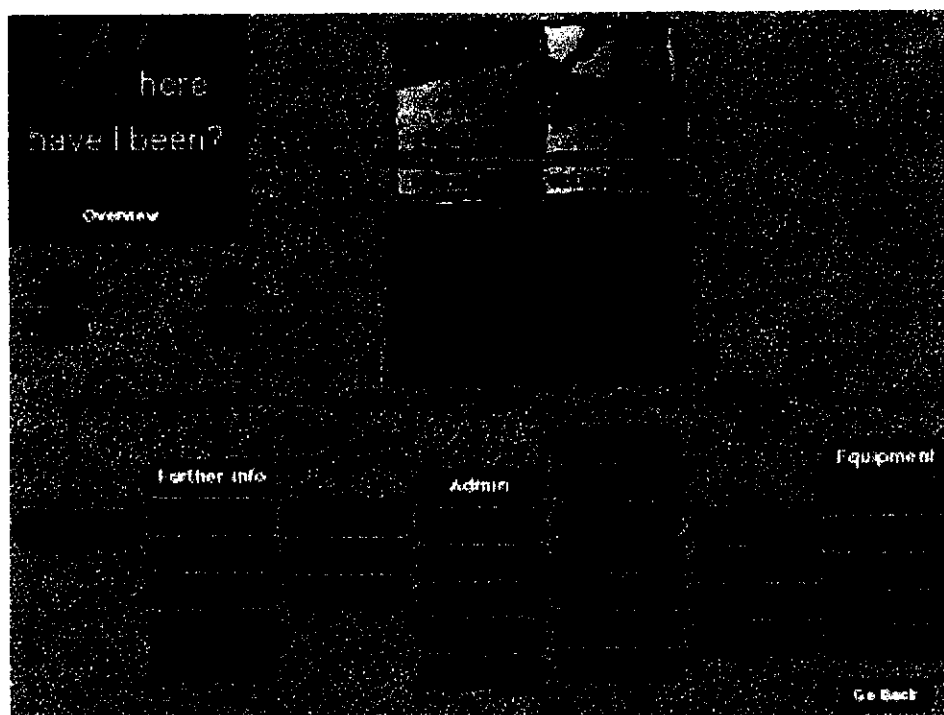


**Figure 3.6. Introduction Screen for the Valpar 19**



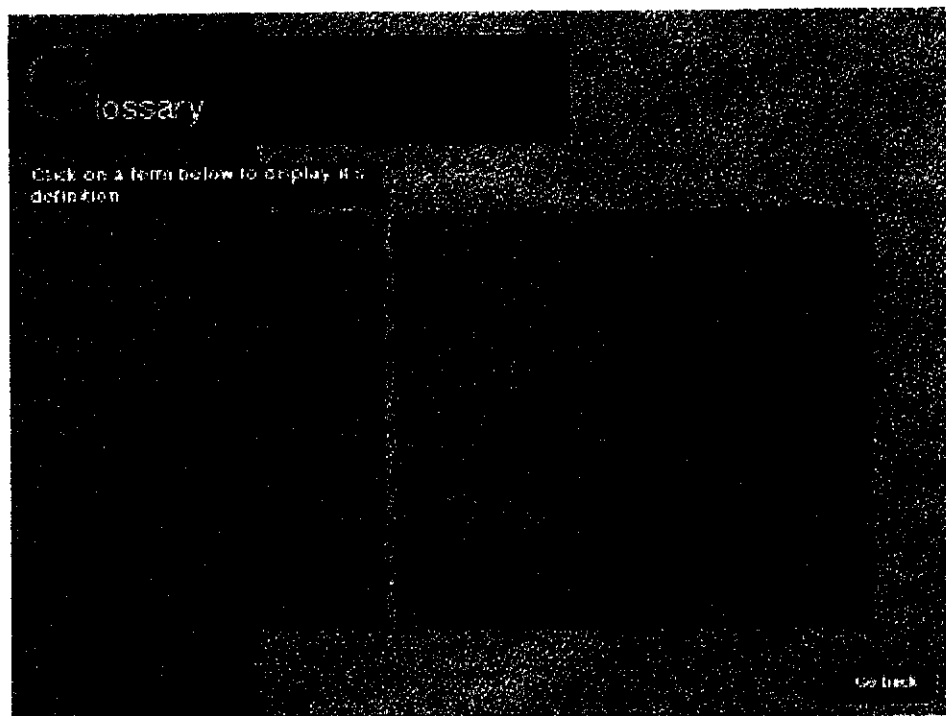
**Figure 3.7. Procedures Sub-Category in the Administration Window**

The guide and 'help' techniques developed and evaluated in the 1993 CAUT project *An Investigation of Strategies to Provide Pathways for Learners in a Computer-Managed Learning Environment* (Cameron, 1993; Lee & Cameron, 1994) were incorporated in this project where appropriate, to simplify usage and increase flexibility to cater for the diverse needs of individual users. For instance the *Where Have I Been?* feature (see Figure 3.8) was developed to allow users to conveniently check which sections of the database they had accessed and thereby minimise user disorientation.



**Figure 3.8. *Where Have I Been?* Navigational Aid to Allow Ready Tracking of Previous Screens Accessed**

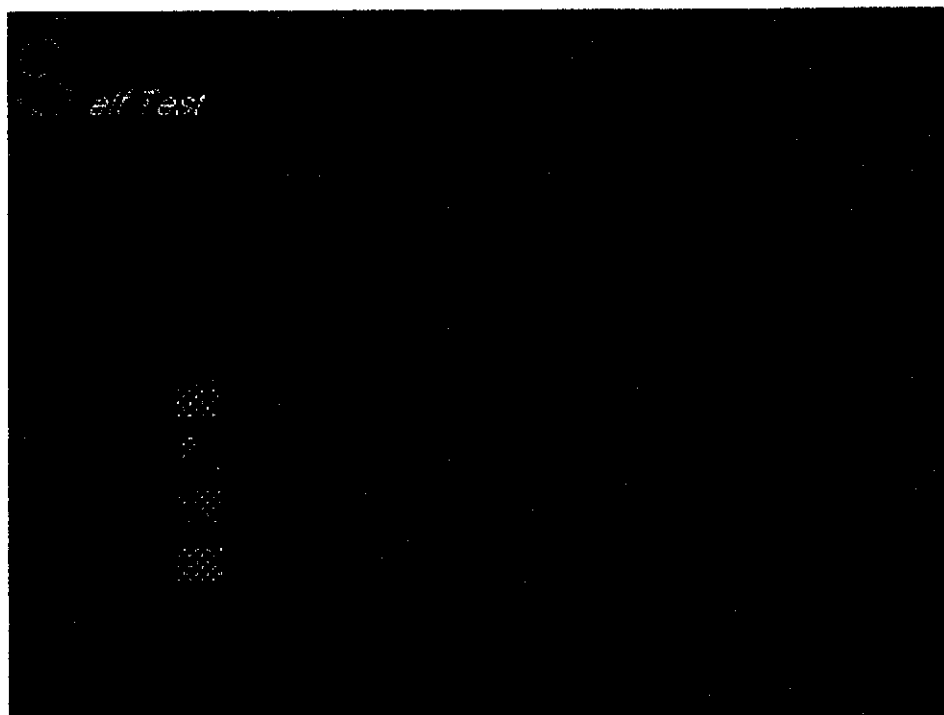
A glossary of terminology used with work assessment tools was compiled and can be accessed from any screen within the package (see Figure 3.9). Variations in terminology used in vocational rehabilitation is a major problem in communications (Borst & Nelson, 1993) and this part of the resource was viewed as being essential to define the usage of terms employed in this resource.



**Figure 3.9. Work Assessment Tools Glossary**

Student self-assessment exercises for each work-capacity method are available within the package so that students can administer these assessments independently, at any time, to allow them to monitor their progress. Where results indicate lack of understanding, the student has the opportunity of branching within the package to appropriate remedial work. The self-assessment section is a multi-choice objective test with ten questions set for each assessment tool. Each question is accompanied by five possible responses which are scored automatically and results presented allowing students to compare their response to the 'correct' answer (see Figure 3.10).

An occupational therapist working in the area of vocational rehabilitation was employed, one day a week during the duration of this package's development, to research information for entry into the database. Contact was made with assessment tools manufacturers, or their agents, to request their support for the inclusion of information on their product from their user manuals. Similarly, contact was made



**Figure 3.10. Self-Assessment Showing Student's Response and the Correct Answer**

with local vocational rehabilitation providers, requesting their assistance with the use of their assessment tools to be used for videotaping.

This database was planned to be utilised as a supplement to traditional lectures, laboratories and tutorials in a foundation undergraduate occupational health unit. Its primary function is to provide students with the opportunity to independently access information on the range, features, and clinical application of work-capacity evaluation methods used in vocational rehabilitation. It is currently available to all undergraduate participants studying Occupational Health 241. With a simplistic and attractive design, optional user help features, and self-assessment routines within the database, the multimedia potential of the computer was utilised to enhance students' understanding and motivation to this topic (Cameron, 1995b). Additionally, individual audio-visual materials produced for the database are available as teaching support materials during lectures/tutorials/laboratories.



### 3.4.4 Design-Phase 2

Early in the development of *Work Capacity Assessment Tool's* it was realised that there were educational advantages to developing other databases covering related topics in Occupational Health 241. These could be linked into a problem-based learning system to incorporate a large section of the Occupational Health 241 syllabus. During 1994, third year occupational therapy students working in small groups piloted this idea as part of a computing unit (Cameron, 1995c). Pilot programs, developed using the database program FileMaker Pro© (Claris, 1993), were produced on a number of topics including introductory information on typical case studies in vocational rehabilitation, the case management process, and a guide to worker compensation legislation issues.

The pilot version of *Case Studies* was developed giving the range of information that occupational therapists would expect from the referral information forwarded to them. Information included was client personal information and details of the injury and medical treatment (see Figure 3.11).

The case management prototype database was designed to give students an overview of the process involved when therapists are called upon to manage a rehabilitation case (see Figure 3.12). This approach was designed to give students a readily accessible, brief coverage of the rehabilitation process, as required in the unit Occupational Health 241. Both state and federal legislation covering areas related to vocational rehabilitation was another topic which it was believed would benefit from the construction of a database of information. Workers' compensation legislation was chosen as the topic to pilot this area (see Figure 3.13).

A successful application was submitted to CAUT for funding of \$31,355 to extend the interactive multimedia learning resource *Assessing Client Capabilities in Vocational*

surname	<input type="text" value="surname"/>	Title	<input type="text" value="Title"/>	Primary Therapist	<input type="text" value="Primary Therapist"/>
names	<input type="text" value="names"/>	D.O.B	<input type="text" value="D.O.B"/>	G.P.	<input type="text" value="G.P."/>
home Address	<input type="text" value="home address"/>	City	<input type="text" value="City"/>	State	<input type="text" value="State"/>
Home Ph.	<input type="text" value="Home Ph."/>				
Injury	<input type="text" value="Injury"/>	Date of Injury	<input type="text" value="Date of Injury"/>		
Details of Injury	<input type="text" value="Details of Injury"/>				
Client History	<input type="text" value="Client History"/>				
-medical	<input type="text"/>				
-work	<input type="text"/>				
-education	<input type="text"/>				
-financial	<input type="text"/>				
-social	<input type="text"/>				
Employer	<input type="text" value="Employer/phone"/>	Insurer	<input type="text" value="Insurer"/>		

**Figure 3.11. Case Studies Prototype Typical Entry**

*Rehabilitation* in 1995. This request was to develop the areas being piloted in 1994 as described above. The proposed design would allow students to access any one of 4 databases: *Work-Capacity Assessment* (i.e. the 1994 project), *Case Team, Legislation*, and, *Case Studies*. The team of designers/developers were retained to provide continuity and the project was titled *Vocational Rehabilitation Learning Resource*.

Work commenced in early 1995 to design *VRLR*. The services of the occupational therapist researching information for the 1994 project were retained to collect data and check that *VRLR* was based on realistic situations faced by clinicians working in vocational rehabilitation. Work progressed on all four new databases simultaneously.

## **CASE MANAGEMENT IN OCCUPATIONAL HEALTH**

### **WHAT IS IT?**

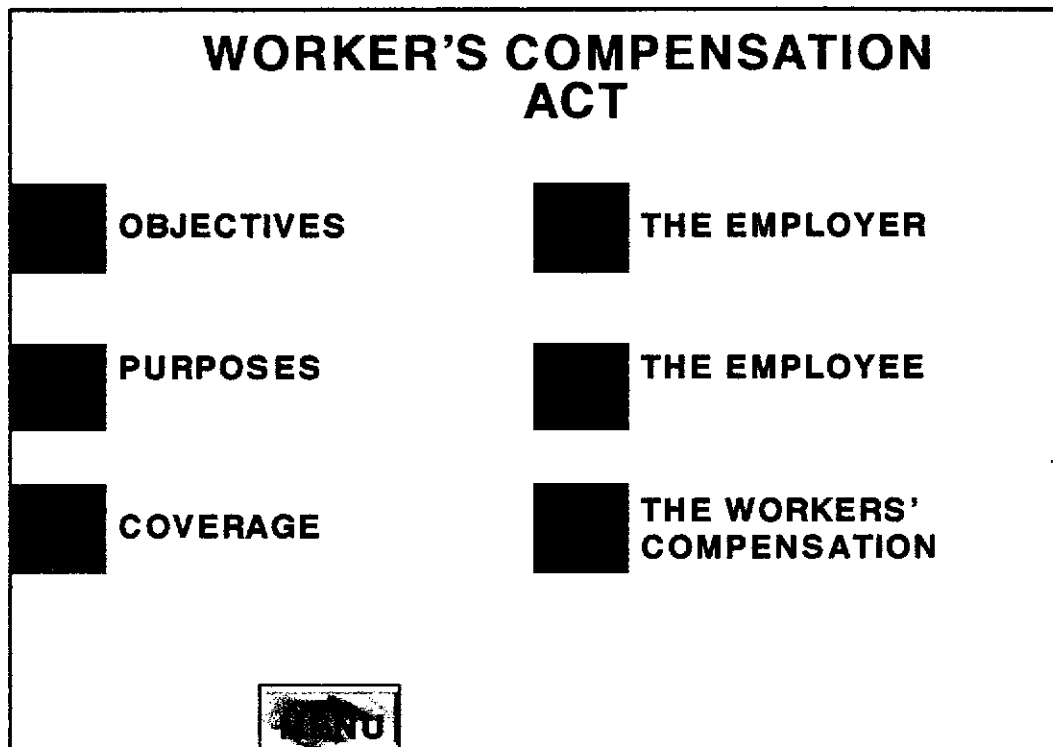
Case management in Occupational Health oversees the whole rehabilitation programme; co-ordinating the services provided by a multi-disciplinary team of professionals.

Case management analyses financial outcomes of the rehabilitation, monitors the use of resources and provides advice for the client, their family, and their employer. The case manager acts as an advocate for the client, taking physical and psychological aspects into consideration.

This programme will outline the roles and skills of the case manager in occupational health and rehabilitation, review the process of case management, and focus on the unique skills of the occupational therapist as a case manager.

The second part of this programme will provide a profile of the professionals and participants in the case management process. These profiles will be organized under the areas of health/medical, rehabilitation/workplace and legal/support.

**Figure 3.12. Case Management Prototype: Screen 1**



**Figure 3.13. Worker's Compensation Legislation Prototype Database - Main Menu**

The legislation database posed two major problems which quickly became apparent. One of these was that state and federal legislation relevant to occupational health is subject to frequent changes, which would mean this database would require regular updating. The other problem was that each state within Australia has its own legislation covering vocational rehabilitation issues such as workers' compensation. As it was requirement of CAUT funding to circulate a CD-ROM version of the completed *VRLR* to all Australian universities with occupational therapy schools, this would mean it would be quickly dated unless new versions were produced at regular intervals.

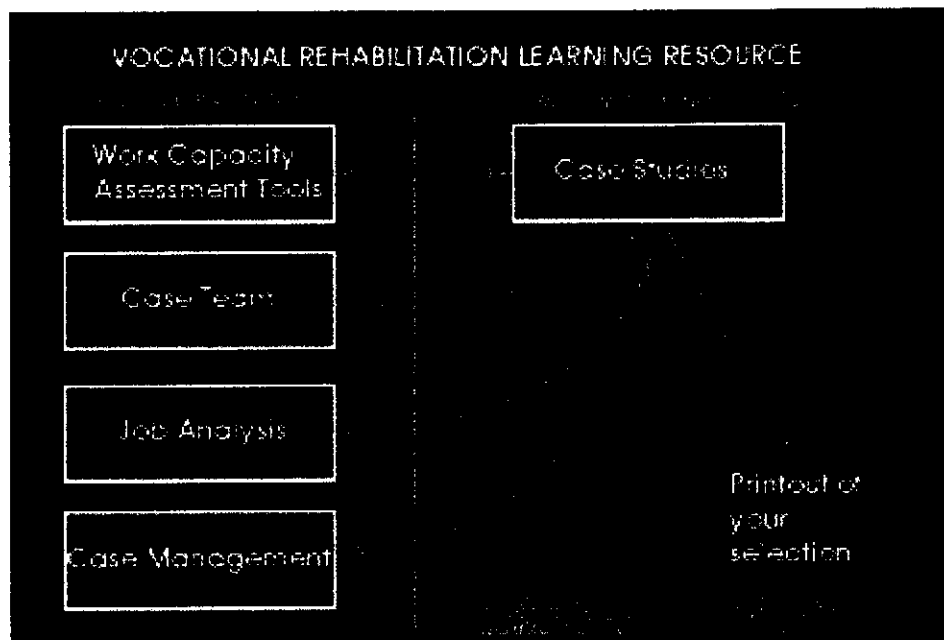
At the time when the design team were considering this issue, the Department of Occupational Health, Safety, and Welfare (1997) in Western Australia were designing *SafetyLine*, a World Wide Web site on occupational health issues. This site includes a comprehensive coverage on all state legislation relevant to vocational rehabilitation and

was viewed as a useful supplement to *VRLR* to cover state legislation issues for local occupational therapy students. It was therefore decided not to proceed with the planned legislation database for *VRLR*.

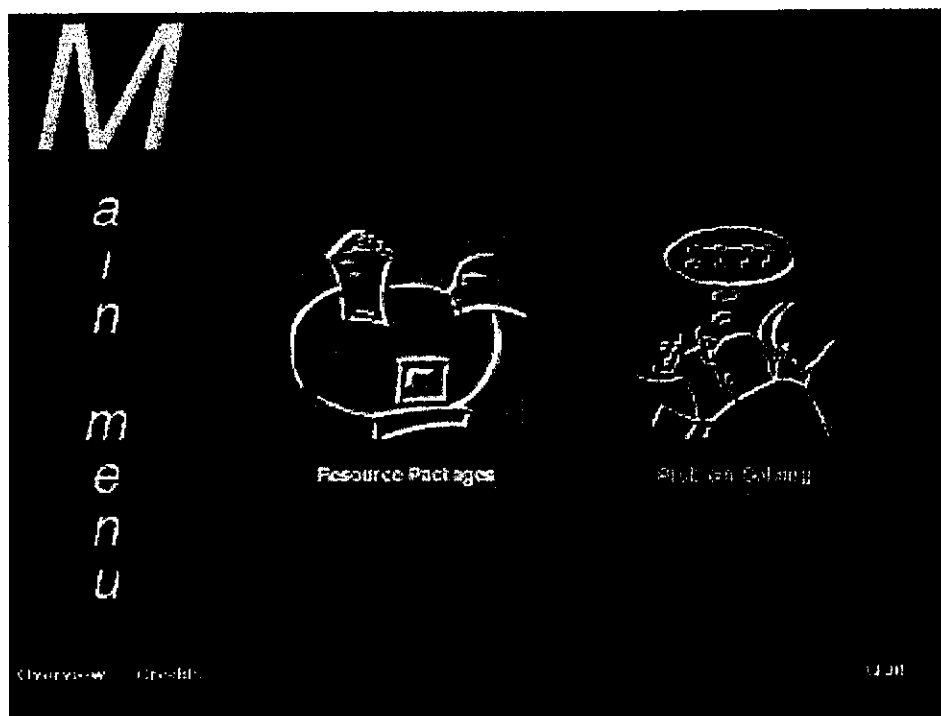
As a replacement to the proposed legislation database, the design team explored the development of a database on occupations of injured clients. It was becoming apparent that information on the occupation of the injured worker would be very useful to students' problem-solving with *VRLR*. A comprehensive coverage on a database of the worker's occupation would allow students to conduct a job analysis, a key process carried out by therapists during rehabilitation. Additionally, it would allow students to search details of other occupations within the database to investigate alternative employment for their client should the extent of the client's injury dictate that they would be unable to return to their previous occupation.

Consequently, it was decided to replace the proposed legislation database with one giving a comprehensive coverage of the workers' occupation. The structure of the amended *VRLR* would be designed with four databases which could be accessed individually by students as convenient references. These would be *Job Analysis*, *Case Team*, *Case Management* and *Work Assessment Tools*. For the problem-solving component, *Case Studies* would be constructed, which would allow students to select a client and then proceed to carry out the early stages of the rehabilitation process by interacting with the other databases (see Figure 3.14). This would involve conducting a job analysis of the client's occupation, selecting case team members, selecting appropriate assessment tools, and selecting alternative employment. *Case Management* could be referred to if necessary to guide students throughout the problem-solving process.

When opening *VRLR*, students have access to two menu options apart from the *Overview* and *Credits* (see Figure 3.15). These are *Resource Packages* and *Problem*

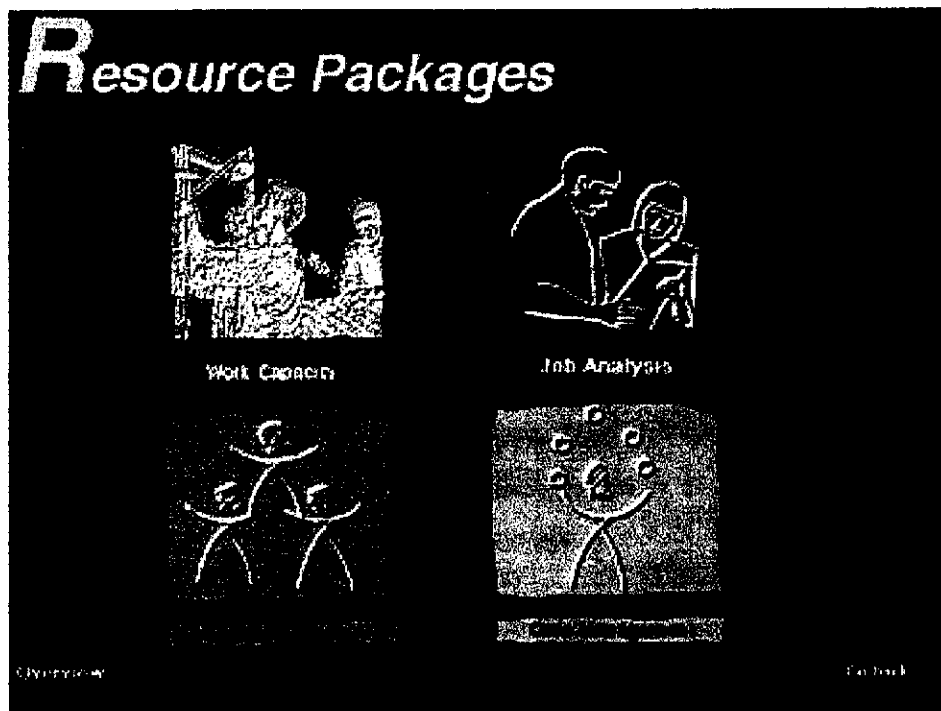


**Figure 3.14. VRLR Designed Layout**



**Figure 3.15. Main Menu of VRLR**

*Solving*. The former permits access to the four databases *Work Assessment Tools* (as described above), *Job Analysis*, *Case Team*, and *Case Management*. (see Figure 3.16).



**Figure 3.16. Resource Packages Menu**

*Job Analysis* covers descriptions of 18 occupations, such as truck driver, nurse, welder, receptionists. The opening screen of each occupation provides a general description of the occupation listing the main duties (see Figures 3.17 and 3.18).

From the opening screen, students can access other screens giving more specific details of the occupation. The *Video* screen focuses on elements of the job where the student can quickly identify problem areas with function due to the injury. The *Physical/Temperament* screen lists demands in areas such as lifting and stress likely to be encountered by the worker. *Aptitude* and *Education/Training* screens list expected performance ratings in these areas.

Details of 19 individual team members are housed in the database *Case Team* (see Figure 3.19). Potential team members include a range of health professionals (e.g., physiotherapists and occupational health physicians) and others including social workers, family members, and workplace representatives who may contribute to

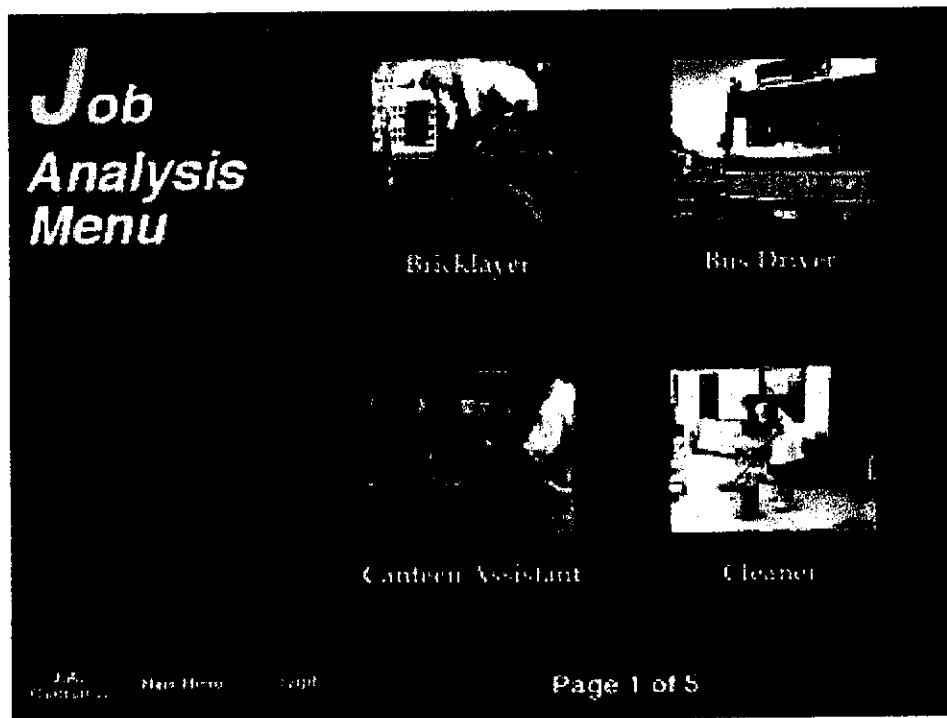


Figure 3.17. Job Analysis Main Menu

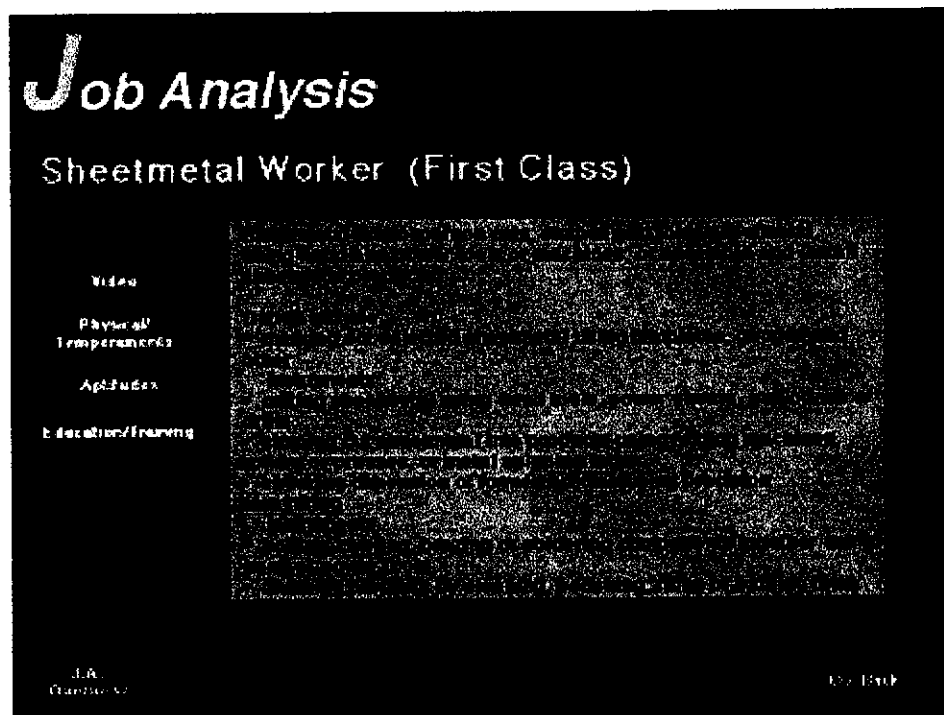
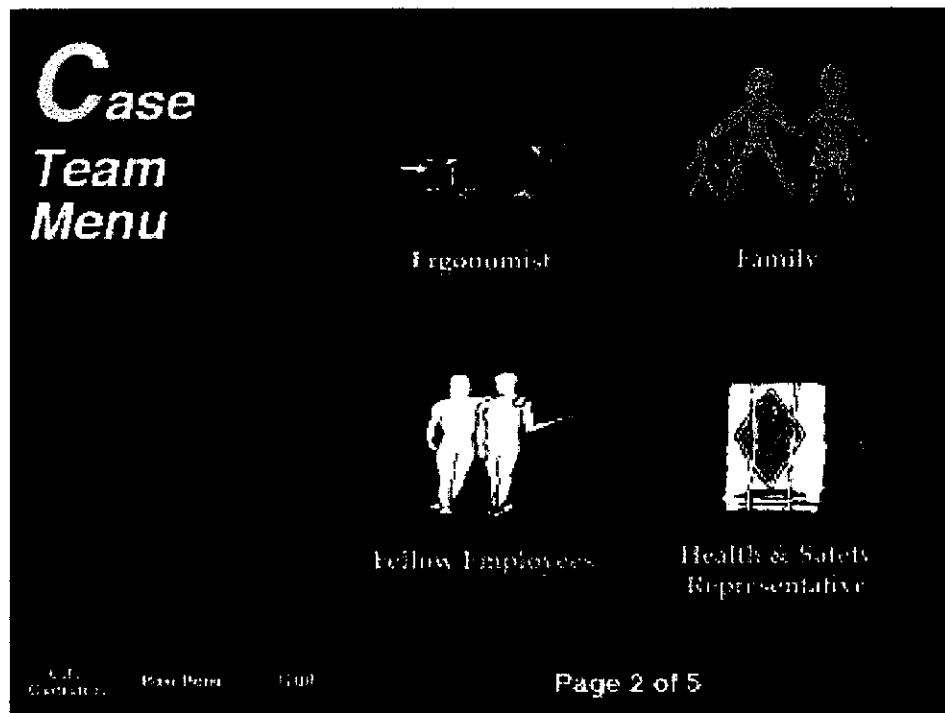


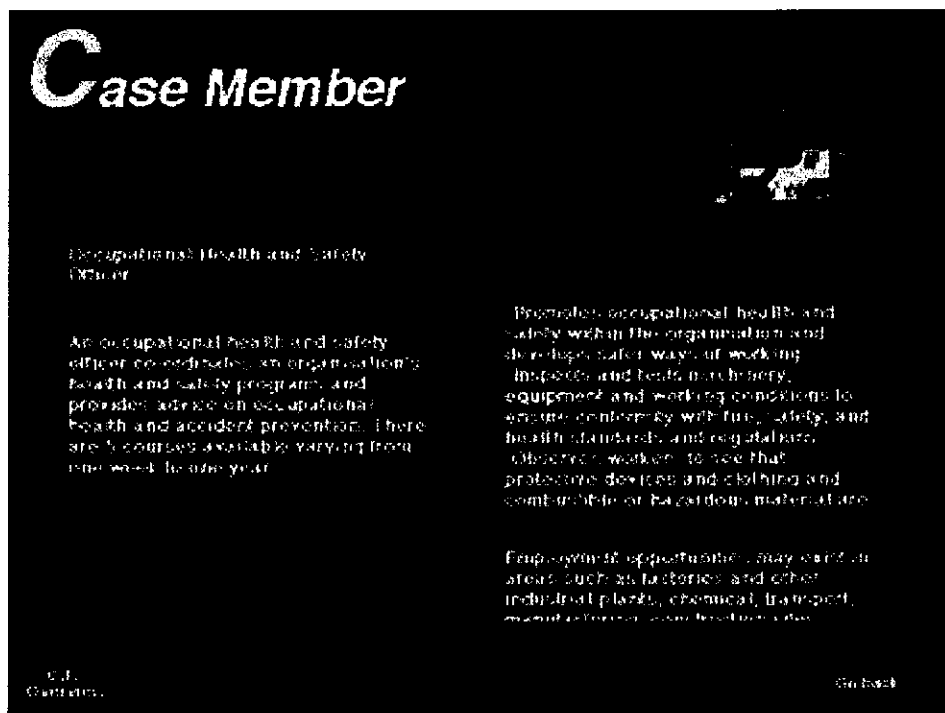
Figure 3.18. Job Analysis Descriptions/Duties Screen



successful rehabilitation of the client. Details of each includes title, occupation description, responsibilities, and employment environment (see Figure 3.20)

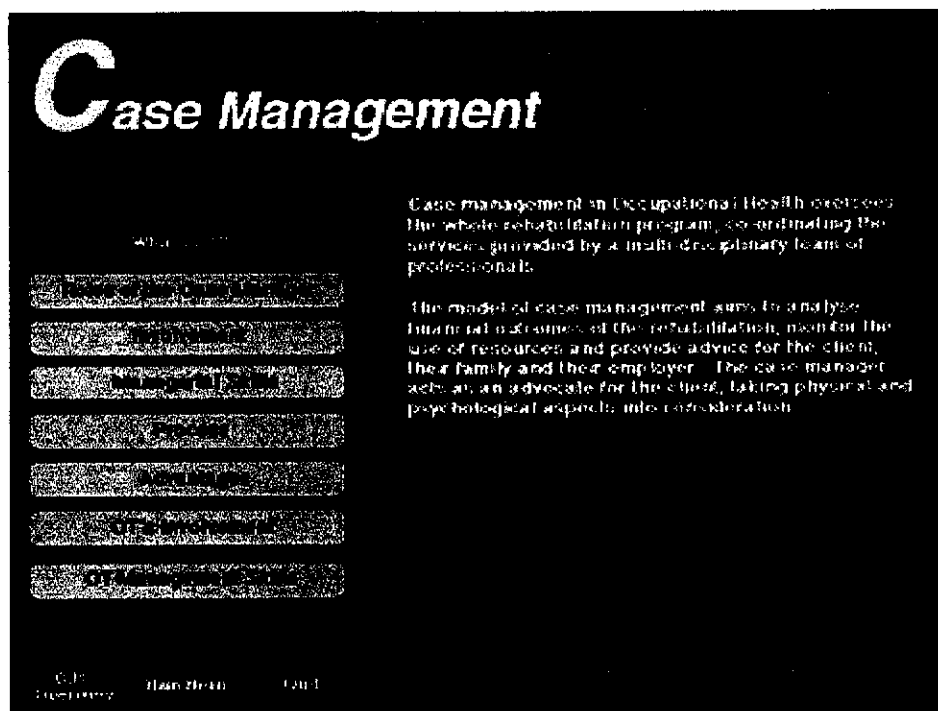


**Figure 3.19. Case Team Main Menu**



**Figure 3.20. Details of the General Information Screen from Case Team Database**

*Case Management* has eight screens of textual information which can be used as a reference on the rehabilitation process by the student using *VRLR* (see Figure 3.21). The opening screen, *What is it?*, gives an overview of the case management process with more detailed information found in the screens *Roles of Case Manager*, *Involvement*, *Managerial Skills*, *Process*, *Advantages*, *OT's Involvement*, and *OT Management Skills*.



**Figure 3.21. Case Management Database Opening Screen**

When the *Problem Solving* option is chosen from the main menu (see Figure 3.15) users are provided with the option of selecting a client by injury type (see Figure 3.22) or by name. The latter was included as a more random method of case selection if desired. The *General* screen in the *Case Studies* database provides some demographic data on the client and his/her injury (see Figure 3.23).

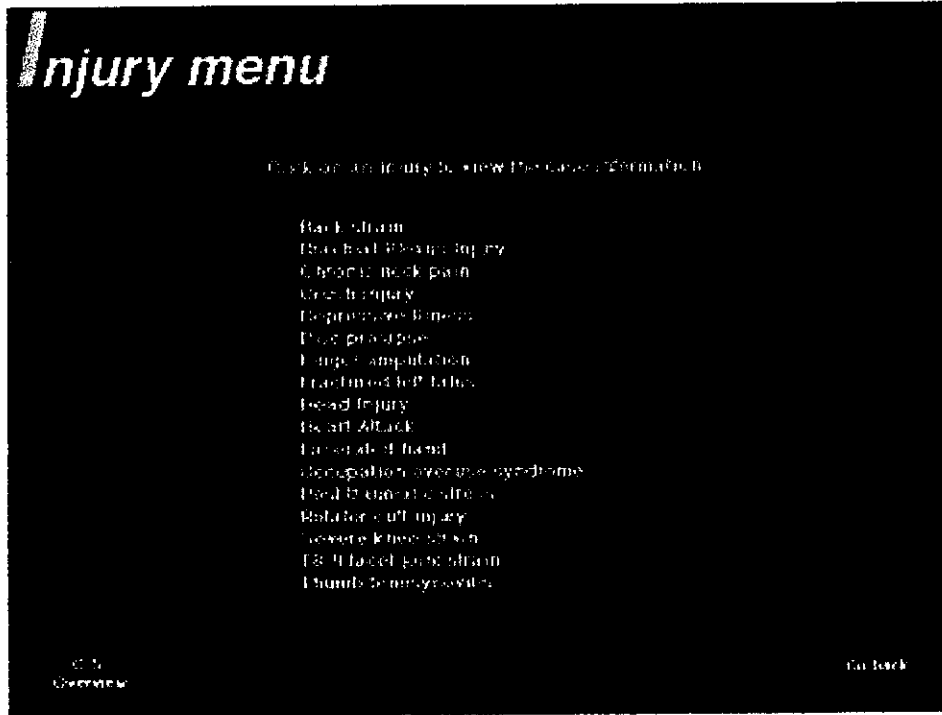


Figure 3.22. Client Injury Screen in Problem Solving

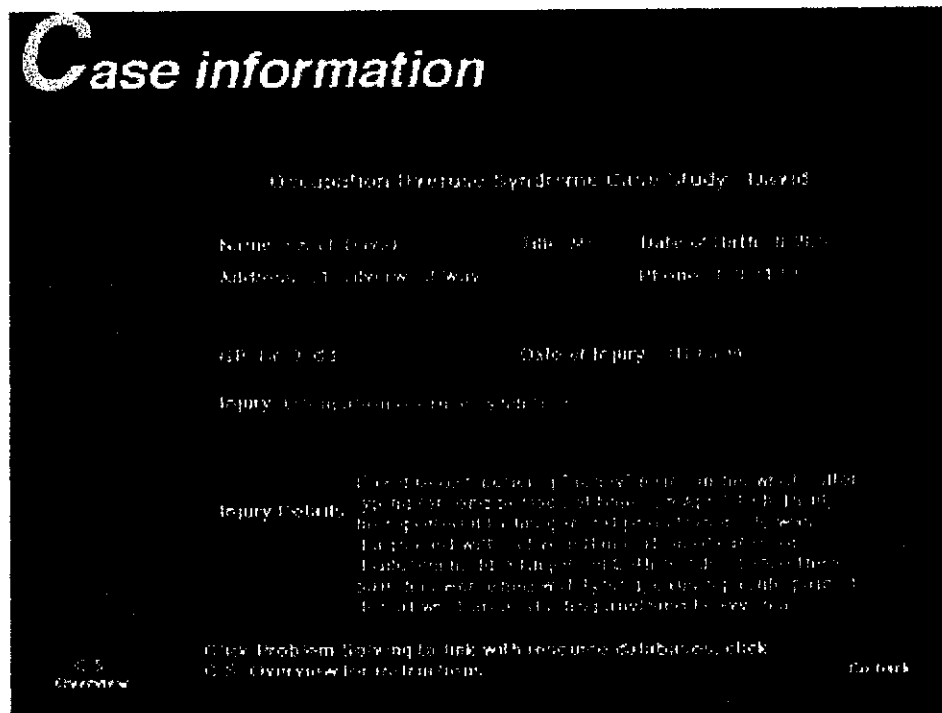
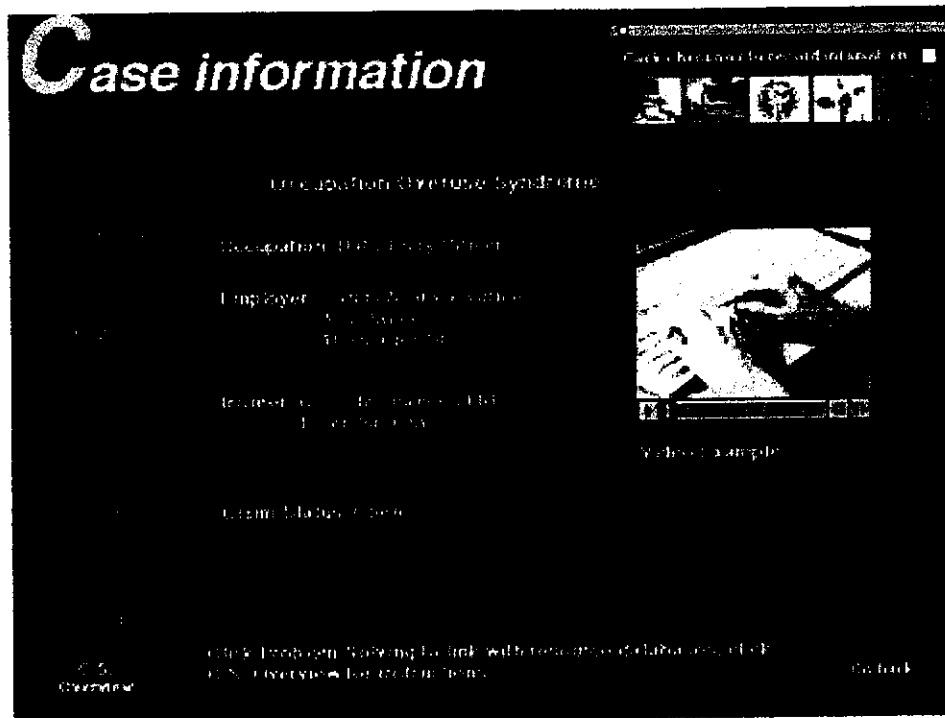


Figure 3.23. General Information on Client Screen in Problem-Solving

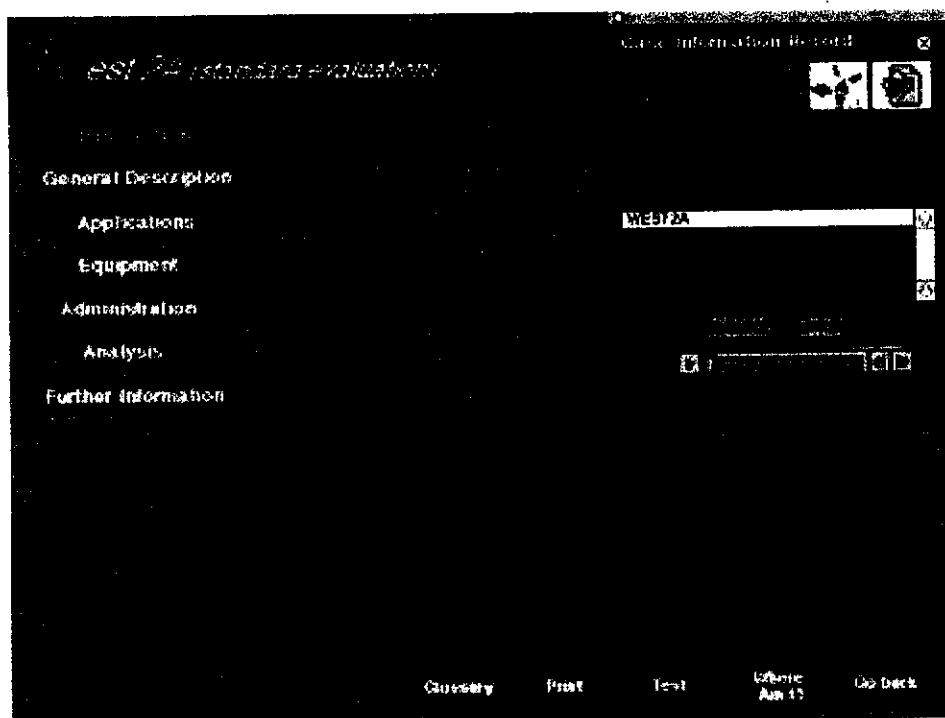
The *Employment* screen provides work related information, including a video showing key aspects of the client's job. *History* provides information on medical, work, education, financial, and social aspects of the client. From any of these screens students can click on the *Problem-Solving* button to access the button palette enabling access to the four resource databases (see Figure 3.24). This palette remains on the screen and allows students to record their selection from the *Work Assessment Tools* and *Case Team* as they move from database to database (see Figure 3.25). At any time, students can return to *Case Studies* to refer to referral information.

### 3.4.5 Evaluation of VRLR

A range of steps have been executed during and after production of *VRLR* to assess its potential effectiveness in achieving learning goals. This has included presentations at conferences, reporting to CAUT, informal feedback from education professionals, and trials with targeted students. *VRLR* has been demonstrated at national conferences and feedback received from professional educators and clinicians working in the area of occupational health (Cameron, 1995b; 1995c; 1997). A condition of the award of a CAUT teaching grant is that recipients must submit interim and final reports plus present their work at a state conference, where representatives of CAUT are present. *VRLR*'s development was presented at a CAUT funded conference in February 1995 (Cameron, 1995a). In addition, four referees from Curtin University were nominated to oversee the project's development. Two of these were Professor Andrew Harper, Director of the HBF Research Centre and Professor Josephine Barker, Head, John Curtin Centre who was formally the Head of the Occupational Therapy School. Robert Fox, Senior Lecturer, Teaching Learning Group was the referee who advised on educational technology matters and Robin Phillips, Computing Centre advised on software issues. Referees were informed of project developments and were given a demonstration of the proposed structure and a copy of the completed CD-ROM version. Frequent feedback on *VRLR* was received informally throughout 1994/95



**Figure 3.24. Button Palette to Link with Resource Databases**



**Figure 3.25. Button Palette Showing On-Screen Note Pad to Record Student Selections From Resource Databases**

during the development phase, both from health professionals and experts in computing and educational technology. Copies of the CD-ROM were dispatched to manufacturers of work assessment tools whose product(s) were entered into the *Work Assessment Tools* section of *VRLR*.

The most systematic and comprehensive evaluations were conducted with second year occupational therapy undergraduate students who are the targeted main users of *VRLR*. During April and May 1995, a series of formative evaluation trials were conducted with a population of 25 second year undergraduate students. In March 1996, during the pilot study of the data collection stage of this research, monitoring of *VRLR*'s function and effectiveness was conducted and steps taken to make modifications where necessary. Summative evaluations continue with the introduction of *VRLR* into the undergraduate curriculum and steps are underway to launch a World Wide Web version.

The formative evaluation trials carried out in April/May 1995 were conducted by fourth year undergraduate occupational therapy students. All students studying the unit Occupational Health and Management 341 were given the choice of working on one of four group projects as their major assignment. All projects focused on the use of media in occupational therapy. Thirteen students chose the option of designing and executing formative evaluating trials with *VRLR* under the supervision of the author. Four groups of evaluators were formed, one with four students and the others with three each.

All four evaluator groups were given access to *VRLR* and were advised to initially become familiar with its functions and structure. They were then instructed to produce and administer a participant consent form, compile a task analysis for all user operations, designate roles for each team member during evaluation trials, compose and administer a usability specification table and user satisfaction questionnaire, and

compile a report on their findings (Bevan & Mcleod, 1994; Hix & Hartson, 1993; Reeves, 1990 & 1992).

Twenty five volunteers from the second year students studying Occupational Health 241 in 1995 were allocated in approximately equal numbers to each of the four fourth year evaluator groups. The School's Occupational Health Laboratory was used as a location for the trials and a separation screen installed partitioning the room in two. Each group had a primary evaluator whose duties included giving instructions and prompting the participant. The primary investigator sat beside the evaluatee facing the computer and a video camera was used to relay events to the other evaluator team members located at the other side of the partition. The other team members had allocated duties which included welcoming participants, administering questionnaires, recording times, note-taking recording events, and arranging video recording. This set-up also served as a model for that used subsequently by the researcher for data collection during the formal evaluation of *VRLR* described in Chapter 4 ( see Figure 4.3).

Although *VRLR* was still at the prototype stage, the design was sufficiently advanced to allow entry of data into the *Work Assessment Tools* and the *Case Studies* databases. This permitted testing of the two main functions of *VRLR*, which are searching a resource database on vocational rehabilitation materials (e.g., work assessment tools) and problem-solving by selecting a client and choosing appropriate assessment tools. The investigator team of fourth year students were advised to select browsing tasks using *Work Assessment Tools* and to ask participants to select three assessment tools to meet the needs of a client from *Case Studies*.

After each evaluator group selected browsing and problem-solving tasks for the trials to follow, they were asked to compile a task analysis of each. Task analysis involved breaking down each browse/search operation to small, measurable components. Task

and activity analysis are key procedures which occupational therapists use when treating clients and this process forms a significant component of the first year undergraduate course (Lampert, Coffey, & Hersh, 1989).

With the analysis of each browse and search task completed, evaluator groups were required to produce usability specification tables (Hix & Hartson, 1993). These measuring instruments are used during the development phase of computer software to determine if the interface is meeting the program's objectives. Usability attributes are operationally defined target specifications which may cover features such as users' initial and long-term performance. In choosing the breakdown of specific benchmark tasks, students were advised to focus on single interface features or small groups of features so that problems identified during evaluation trials could be more easily traced to specific parts of the design.

Values to be measured and entered into usability specification tables can include time to complete tasks, number or percentage of errors, percentage of tasks completed in a given time, frequency of use of help features, and the number of times that users express frustration (Hix & Hartson, 1993). Against each usability attribute, evaluator groups were required to record a range of values: task measured, functions to be measured, current level, worst acceptable level, planned target level, best possible level, and observed result (see Table 3.2).

'Current level' was set by evaluator groups and based on their own initial performance for each attribute and helped to determine realistic measures for the other values. The 'worst acceptable level' was the lowest performance acceptable set. If participants performed below this level for any attribute, then design changes were called for. The 'planned target level' was the usability goal for each attribute and results with participants suggested no further work was required. The 'best possible level' was set at an obtainable level and was seen as a target for designers/developers in future



**Table 3.2. Usability Specification Table - VRLR Evaluation Trials Set By Investigator Group A.**

<b>Usability Attribute</b>	<b>Initial Performance</b>	<b>Learnability</b>	<b>Retainability</b>	<b>First Impression</b>
<b>Task Measured</b>	Task 1: Find out how long it takes to administer the Valpar Component Work Sample #19	Task 2: Find the Work Capacity Evaluation Pact Spinal Sort. Locate Test Question 4 and find current answer from within description Task 3: Find your way back to the Main Menu	Task 4: Find out how much it costs to purchase the West Standard Vocational Evaluation #2A	User Interface Rating Instrument (Modified)
<b>Functions to be Measured</b>	Time Taken/No of Screens Used	Time taken/No of Screens Used	Time Taken/No of Screens Used	Average Score (1-5)
<b>Worst Acceptable Level</b>	175 secs/15 screens	Task 2: 192 secs/ 15 screens Task 3: 28 secs/ 7 screens	185 secs/13 screens	3
<b>Planned Target Level</b>	110 secs/12 screens	Task 2: 126 secs/ 14 screens Task 3: 25 secs/ 5 screens	110 secs/11 screens	4
<b>Best Possible Level</b>	45 secs/9 screens	Task 2: 60 secs/ 13 screens Task 3: 22 secs/ 3 screens	35 secs/9 screens	5

versions. 'Observed results' were the actual values obtained from observing users performing prescribed tasks during formative evaluations (refer to Appendix C).

A user satisfaction questionnaire was administered during trials by the evaluator teams to measure a subjective usability metric. The reason for employing an user attitude instrument was based on the logic that "the better the users like the system, the more likely they are to have good performance with it over the long term" (Hix & Hartson, 1993, p. 227). These instruments were derived from the work of Chin, Diehl and Norman (1988) and were based around screen terminology and system information, learning, and system capabilities (Hix & Hartson, 1993, p.227). The instruments developed used a Likert scale and were similar to the *User Attitude Questionnaire* to formally evaluate participants' characteristics (refer to Appendix D). Dimensions measured included users' attitude to screen design, navigation, ease of use, cognitive load, and aesthetics.

Apart from providing valuable feedback on the usability of *VRLR*, these evaluation trials served a useful role in providing challenging learning experiences to those fourth year students who took an active role in research to supplement their theoretical education. The interaction with participants provided a setting similar in many ways to that experienced by therapists dealing with clients in a therapy clinic. This exercise also served to pilot study many of the strategies planned for the research study which followed.

After completion of formative evaluation trials with the 25 participants, the results were scrutinised and collated by the researcher. This involved formatting all recommendations by the four evaluator groups under eight categories of changes: buttons and icons, graphics, additional icons required, additional screens and information required, text, sound, links, other screen features. Discussions with members of the design team identified a priority list of changes to be made to *VRLR*

based on maximising the educational value of *VRLR*. The programmer and graphic artist then executed these changes prior to the implementation and formal evaluation of *VRLR*.

#### **3.4.6 Perceived advantages of VRLR**

The best source of information on the pedagogical value of the learning materials used will come from the way students carry out assignments based on them (Laurillard, 1993, p. 252). Therefore, evaluation of *VRLR* continues with a view to improvements being made for the package's educational effectiveness.

A significant educational advantage expected from the development of this resource is its availability to students in CD-ROM format. Students can access it at the school's computer laboratory between the hours of 8am -10pm, six days a week. Students can therefore preview material prior to lectures/laboratories/tutorials or review it later during revision or assignment preparation. Students who miss key classes in this area, perhaps through ill-health, have the opportunity to access material independently, rather than rely on colleagues to pass on copies of material missed. The database's convenient, readily accessible format will be of benefit in building students' independent learning skills and allow them experience with information technology applications relevant to their chosen discipline.

Integration into the teaching program has been implemented at the beginning of 1997 with undergraduate students of Occupational Health 241, where the process of vocational rehabilitation forms a significant part of the unit. In week three of the first semester, a demonstration of the resource's accessing and operational functions was given. Students are expected to become familiar with this resource by independently accessing and utilising it to assist with their major assignment in Occupational Health 241.

Positive impact on student learning can be expected through both the development and implementation of this project. Involving students in the design and development process proved successful in a 1993 CAUT project in not only making the product more meaningful to the users, but it opened up a whole range of new participant learning experiences (Cameron & Marquis, 1994). Strategies which proved successful in that exercise were employed in the *VRLR* project. Apart from student involvement in design and evaluation, these included simplistic and attractive design; optional user help features; self-assessment routines, utilising the multimedia capabilities of the computer to enhance individual students' understanding and motivation (Cameron & Marquis, 1994).

Dissemination to the academic community has been implemented through papers submitted for occupational therapy conference presentations (Cameron, 1994; 1995b; 1997) at state, national and international levels. A paper outlining the work completed and currently underway from the two previous successful CAUT awards to the School of Occupational Therapy was presented at the 11th World Congress of Occupational Therapists in London, April 1994 (Cameron & Marquis, 1994).

#### **3.4.7 Advantages and limitations of interactive learning packages**

The results from this particular use of interactive technologies is anticipated, in the short-term, to significantly improve students' understanding of the rehabilitation process, in particular work-capacity evaluation and case management. For the longer term, it can contribute to providing more effective client rehabilitation and hence reducing the increasing, substantial cost to the nation of paying employees while absent from work through injury.

Learning packages such as *VRLR* can assist teaching staff in providing opportunities for their students to access a range of multimedia databases and explore large volumes of attractively presented, relevant information. By incorporating problem-solving exercises, using case studies, students can practice making the types of decisions faced by professionals in their chosen discipline area. By making these packages available to student on CD-ROM format or on computer networks, be they local or international, students can have access at times and places convenient to them. Material presented, unlike lectures, can be repeated in a consistent form time and again, therefore 'repeatability' is guaranteed and once the initial cost of development is met additional costs should be minimal.

However, access to information databases provides students a wealth of material to work from, but this is of no value to them if they are not able to make selective judgements about what to use, and critical judgements about the content of what they find (Cameron & Treagust, 1997; Jonassen, Campbell & Davidson, 1994; Laurillard, 1996; Smith & Curtin, 1997). Additionally, the implementation of new technology methods cannot take place without the system around it adjusting to maximise its potential (Laurillard, 1993, p. 223). Many students do not easily learn with new technologies, especially when they find the subject matter difficult. As learning from new technology is relatively unfamiliar, they may have to develop new learning techniques. It is important that the design of the learning materials is structured to support them in this capacity as much as possible and an awareness of students' learning characteristics is an obvious priority in executing this. Students have to be advised in a number of areas to assist with effective integration with innovations into the curriculum. This includes being informed why the topic is important and interesting, its relation to other topics of the course, what they need to know already, the learning objectives in view, and how to approach them.

Media-based materials are generally too expensive to be developed for use by individual students at only one institution. To be economically feasible, such materials must be made available and used by a larger number of students across a range of institutions. However, campus-based teaching institutions cannot turn themselves overnight into media-based teaching institutions under existing funding arrangements (Laurillard, 1993, p.182). Staff involved with the teaching unit where the innovation is being introduced need to be supportive and preferably should share ownership in its development (Fardon & Kinder, 1997; Knight, 1992). Training may have to be introduced to assist staff to develop suitable ways of integrating new technologies into their courses and to develop their formative evaluation skills so that they can monitor and improve their use of the technologies (Laurillard, 1993, p. 244). Provision of lecturer's and student's guides can be useful tools to assist with this (Laurillard, 1993, pp. 249-250).

Similarly, the teaching that surrounds students' use of such interactive multimedia packages will need to address the above issues. This makes it essential that academics taking on new teaching technologies be clear about the learning objectives, and the prerequisite skills entailed. In addition, the learning that students achieve in relation to a package should be followed through in subsequent teaching, so that it is not isolated from the rest of the course (Laurillard, 1993, p.213). *VRLR* has been designed to be an integral part of the undergraduate course unit Occupational Health 241 at Curtin University and therefore these issues have been addressed. However, *VRLR*'s adoption by another teaching institution may not be successful unless these integration issues are resolved.

### **3.5 Summary of Chapter**

This chapter initially looked at some of the changes currently impacting on tertiary education such as funding cuts, increased student numbers, increased diversity of

students, increased topics, performance accountability, and the information explosion. Learning packages such as *VRLR* can assist in meeting the challenges brought about by these changes using a constructivist approach. The first research question was addressed by detailing a description of the evolution, design, development, and evaluation trials of *VRLR*, followed by a discussion on planned advantages and limitations.

## Chapter 4

### METHODOLOGY

#### 4.0 Introduction

This phase of the research focuses on the introduction and evaluation of a problem-based learning package into the occupational therapy undergraduate curriculum at Curtin University. The package, *Vocational Rehabilitation Learning Resource (VRLR)*, employs the use of interactive media and represents a substantial innovation into the curriculum (Cameron, 1995b). In the past, Curtin's School of Occupational Therapy, as is the case with other therapy schools, has depended mainly upon conventional, instructor-led learning methods of lectures and tutorials (Jacobs & Lyons, 1991; Sadlo, Piper & Agnew, 1994).

With self-paced learning packages such as *VRLR*, and the consequential absence of direct instructor assistance, educational designers/developers are responsible for catering for individual user needs as explained in Chapter 2. A logical first step in this curriculum development is to establish the characteristics of the user population (Hedberg & Alexander, 1994; Kozma, 1991). To this end, this phase of the research investigated some of the user characteristics which could influence performances and attempted to establish linkages between those and the navigation patterns used by student participants as they accessed *VRLR*; in addition users' attitude towards the learning package was similarly investigated.

#### 4.1 Research Design

The introduction of *VRLR* into the occupational therapy curriculum was treated as a case study in this research. The investigator was exploring the 'how' and 'why'



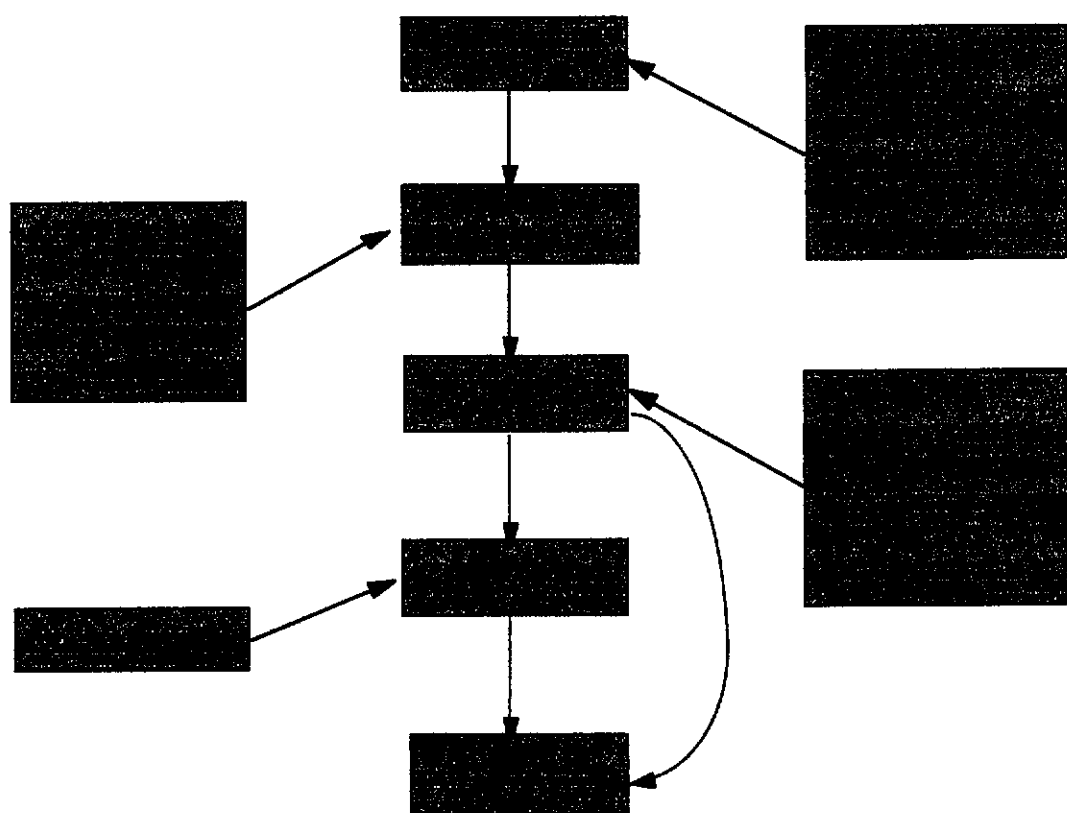
questions regarding the relationship between subjects' reactions to new teaching methodology and the subjects' characteristics. This 'case study' approach allowed a comprehensive research strategy to be employed that investigated a variety of evidence which would not be available in a more experimental study (Merriam, 1990; Platt, 1992; Yin, 1994). Both quantitative and qualitative data collected were triangulated (Yin, 1994, p.13).

The design of this study is *ex post facto* as the causative relationship between the variables being measured was not clear (Merriam, 1990; Tuckman, 1978). A correlational approach was employed, involving the collection of multiple sets of data from a group of subjects in an attempt to determine subsequent relationships between these sets of data. There was no control group. The variables measured included participant characteristics, attitudes, and computer navigation patterns (refer to Appendices E, O, M).

This study had five main stages (see Figure 4.1). The first stage, the design, development and formative evaluation of the instrument *VRLR*, was described in Chapter 3. Stage two focused on the collection of data on participants' learner characteristics which was followed by stage three in which observations of participants' navigation patterns were made as they explored and problem-solved with *VRLR*. The fourth stage assessed the attitudes of users towards *VRLR* after they had completed some searching, browsing and problem-solving tasks. The last stage, as described in Chapters 5, 6 and 7, comprised an analysis of these data in an attempt to identify statistical models which could identify relationships between the participants' learner characteristics and other variables measured. Case studies, selected to show extreme and average performers in dependent variables, were investigated in detail to provide qualitative support, or otherwise, of the findings.

## 4.2 Participants

All first year Bachelor of Health Sciences (Occupational Therapy) undergraduate students (n = 74) at Curtin University enrolled in *Occupational Health 241* during first semester 1996 were invited to participate in this research project. *Occupational Health 241* focuses on an introduction to vocational rehabilitation, which is the subject matter of *VRLR*.



**Figure 4.1. Five Main Stages in Research Study Showing Sources of Evidence**

Participants were initially asked to complete a range of written questionnaires and instruments to establish their learner characteristics. This component of the research took place at the completion of a weekly tutorial class during the first two weeks of the first semester. Questionnaires and instruments for assessing learning style, computer

anxiety, computer thoughts and computer attitudes were chosen for their reported reliability and validity with usage covering a large number and range of participants, in particular university students. These instruments were administered in week one and cognitive style during week two to the 74 participants. Time taken to administer these instruments per group totaled approximately 60 minutes. Following the analysis of the data, the student participants were given the results of these questionnaires in the form of a booklet (refer to Appendix E) with indicators of their scores in relation to the norms. This information was considered to be of benefit in assisting students with future studies by identifying their strengths and weaknesses. The content of these questionnaires also was relevant to course-work on learning theory covered in the foundation unit *Occupational Therapy 148* (Passmore, Barrett & Cameron, 1995) which these participants had completed during semester two in 1995. A third benefit to participants was experiencing assessment procedures from a client's viewpoint; this experience is of value to participants as a significant part of a qualified therapist's role is administering assessment instruments to clients. Indeed, some of the instruments employed in cognitive rehabilitation of clients by practising therapists are similar in structure and application to the *Group Embedded Figures Test* which was employed in this study and described in the next section.

### **4.3 Measuring instruments**

#### **4.3.1 Cognitive style**

Cognitive style is a concept which is concerned with individual differences in cognitive functions that are the product of rather permanent dispositions like intelligence, problem solving and relating to others (Van der Veer, 1989). When he developed the theory of 'psychological differentiation', Witkin (1962) stated that cognitive styles concern the form rather than the content of activity, that is, cognitive styles reflect differences in the extent to which individuals make perceptual decisions independently of the context or background provided. The *Group Embedded Figure*

**Table 4.1. *Group Embedded Figures Test - Number of Correct Tracings* (from Witkin, Oltman, Raskin & Karp, 1971, p. 28)**

Quartiles	Men	Women
1	0-9	0-8
2	10-12	9-11
3	13-15	12-14
4	16-18	15-18
N	155	242
Mean	12.0	10.8
S.D.	4.1	1.4

*Test (GEFT)* developed by Witkin, Oltman, Raskin and Karp (1971) was used in this study as it is the best known assessment of an individual's cognitive style (Hockey, 1990). It has a reported reliability of .82 when scores from the first and second of its two parts are corrected and computed by the Spearman-Brown prophecy formula (Witkin, et al, 1971, P. 28). *GEFT* measures individual's degree of field-dependency/field-independency; people who are significantly influenced by the surrounding field are called field-dependent whereas those who are relatively uninfluenced are referred to as field-independent (refer to Appendix F).

Field-dependent people react to the situation as a whole without analysing it, responding on the basis of what it does rather than what they do with it. On the other hand, field-independent people keep the individual parts of the situation separate from one another, ignoring those parts which are irrelevant to their purpose. People with a tendency towards field-dependency are likely to exhibit a passive approach to problem-solving, relying on guidance and external referents, whereas field-independent people may adopt a hypothesis-testing approach, actively exploring the situation (Coventry, 1989). This personal characteristic can be measured by the

*GEFT* which is a perceptual test where the subject's task is to locate and trace a previously seen simple figure within a larger complex figure. There are 18 complex figures which have been arranged to obscure or embed the sought-after simple figure and it can take approximately 20 minutes to complete. The score assessed is the total number of simple figures correctly traced onto the complex figures. A scoring key is provided with the simple figure traced over each complex figure. Subjects whose total score falls in the first quartile have the strongest leaning towards field dependency, whereas those in the 4th quartile are strong in field independency. Norms have been developed based on the results of *GEFT* administered to college students in the United States (refer to Table 4.1 where men performed slightly, but significantly, better than women).

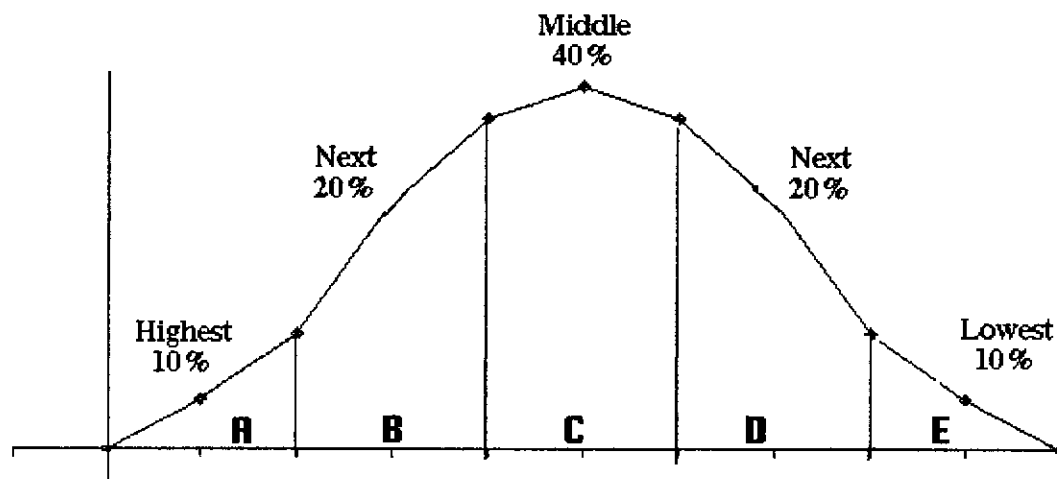
#### **4.3.2 Learning style**

Another dimension of individual cognition is learning style which is sometimes referred to as a subset of cognitive style and is defined as the way people absorb or retain information (Hayes & Allison, 1993). A measure of learning style, which is based largely on Piaget's work, is Honey and Mumford's (1992) *Learning Styles Questionnaire (LSQ)*. By combining the characteristics of learning and the problem-solving processes, Honey and Mumford suggest that individuals learn in four modes: through active experimentation, reflective observation, adaptive observation, and pragmatic involvement (refer to Appendix G).

*Activists* tend to act first and consider consequences afterwards and involve themselves fully and without bias in new experiences. They are open-minded and enjoy the challenge of new experiences. *Reflectors* are thoughtful, cautious people who like to consider all angles and implications before acting or reaching a conclusion. They prefer to delay action until they have considered the past as well as the present and others' observations as well as their own. *Theorists* adapt and integrate

observations into complex, but logically sound theories. They tend to be detached, analytical and dedicated to rationale objectivity rather than anything subjective or ambiguous. They prefer to maximise certainty and feel uncomfortable with subjective judgments. *Pragmatists* positively search out new ideas and take the first opportunity to experiment with applications. They are essentially practical, down-to-earth people who like making practical decisions and solving problems which they see as a challenge.

The choice of learning mode is governed by each individual's goals and his or her objectives. Because individuals have different goals, their learning modes become highly individualised (Sein & Bostrom, 1989). The *LSQ* lists 80 short statements, 20 of which are associated with each of the above four styles. There are no right or wrong answers. Subjects are asked that if they agree more than they disagree with a statement, then enter a tick in the box alongside. If they disagree more than they agree then they have to enter a cross in the box. Participants take between 15 and 20 minutes to complete this questionnaire. A scoring key was used to identify the items linked with each of the four, resulting "raw" scores for learning styles. Results were then



**Figure 4.2. Learning Style Questionnaire Categories (from Honey & Mumford, 1992, p. 10)**

compared to norms which Honey and Mumford (1992) have estimated for a population of 3,500 people from commerce and industry (See Figure 4.2 & Table 4.2). Reliability reported by these authors was high with Pearson product moment of correlation being .89 when the same population completed the questionnaire twice within a two week period (Honey & Mumford, 1992, p. 79).

**Table 4.2. Learning Style Questionnaire Norms (from Honey & Mumford, 1992, p. 10)**

	Very strong preference (A)	Strong preference (B)	Moderate preference (C)	Low preference (D)	Very low preference (E)
Activist	13-20	11-12	7-10	4-6	0-3
Reflector	18-20	15-17	12-14	9-11	0-8
Theorist	16-20	14-15	11-13	8-10	0-7
Pragmatist	17-20	15-16	12-14	9-11	0-8

The actual scores recorded can be plotted for each participant on a profile chart which shows the general norms established. For example, in Table 4.3, if the participant had scored 11 for *Activist* they would fall in the 'Strong Preference' according to the general norms. A score of 11 for *Reflector*, *Theorist* and *Pragmatist* would fall in the 'Moderate Preference', 'Very Low Preference' and 'Low Preference' categories respectively. Honey & Mumford (1992) measured the consistency of this instrument with a population of 50, twice within a two week period. On that occasion, these authors found the Pearson's product-moment coefficient of correlation was *Theorist* (.95), *Reflector* (.92), *Pragmatist* (.87) and *Activist* (.81). However, most users of the *Learning Style Questionnaire* do not report reliabilities for the four components, but appear to rely on the high levels reported by the developers of the instrument.

### 4.3.3 Technophobia

High levels of computer awareness and aptitude provide many students with opportunities to gain ascendancy over their less computer literate peers. Large

**Table 4.3. Learning Style Questionnaire Profile Chart (from Honey & Mumford, 1992, p.11)**

Activist	Reflector	Theorist	Pragmatist	
20	20	20	20	Very Strong Preference
19				
18		19	19	
17	19			
16		18	18	
15				
14		17		
13	18	16	17	
12	17	15	16	Strong Preference
11	16			
	15	14	15	
10	14	13	14	Moderate Preference
9				
8	13	12	13	
7	12	11	12	
6	11	10	11	Low Preference
5	10	9	10	
4	9	8	9	
3	8	7	8	Very Low Preference
	7	6	7	
	6	5	6	
2	5	4	5	
	4	3	4	
1	3	2	3	
	2	1	2	
0	1	0	1	
	0		0	

numbers of otherwise competent students experience varying degrees of anxiety when exposed to computers. This experience can be particularly debilitating as computers become more and more a crucial component of the educational process. Computer anxiety can be defined as an affective response of apprehension or fear of computer



technology accompanied by feelings of nervousness, intimidation, and hostility (McInerney, McInerney & Sinclair, 1994). Negative cognitions and attitudes towards computers may also accompany such feelings of anxiety and include worries about embarrassment and looking foolish. To measure an individual's degree of 'technophobia', i.e., their comfort with computer technology, Rosen and Weil (1992) developed three instruments which can be employed to measure the multidimensional aspects of this phenomena. These instruments, which are employed in this study, are the *Computer Anxiety Rating Scale (CARS)*, *Computer Thoughts Survey (CTS)* and *General Attitudes Towards Computers Scale (GATCS)*. Each instrument has been administered to thousands of student participants drawn from tertiary institutes from around the world (Rosen & Weil, 1995a). The reliability of these instruments reported by Rosen and Weil (1992, p. 20) was alpha coefficients of above .80 for the CARS and CTS and .60 for the GATCS.

The *CARS* comprises a list of 20 statements related to technological anxiety about machines, their role in society, computer programming, computer use, consumer uses of technology, problems with computers and technology, and technology in the media. Participants have to rate each statement on a five-point Likert scale indicating how anxious or nervous the item makes them feel (refer to Appendices E and H).

The *CTS* and the *GATCS* are both modeled after the *CARS* with each containing 20 statements which participants are asked to rate on a five point scale. *CTS* focuses on technophobics' cognitions and feelings about their abilities with technology rather than on their anxieties about computers and technological devices (refer to Appendix I). *GATCS* features statements addressing general attitudes towards computers and technology (refer to Appendix J). The order of administering the three instruments to participants was counterbalanced with each appearing, first, second and third equally often. It took participants between 20-25 minutes to complete all three technophobia instruments.

For *CARS*, a higher score indicates more computer anxiety. Although the response scale for *CTS* is similar to *CARS*, 11 items are phrased in the negative direction and 9 items in the positive direction. Higher *CTS* scores indicate more positive cognitions and feelings towards computers. The *GATCS* has ten items phrased in the positive direction and 10 in the negative direction. Higher *GATCS* scores indicate more positive general attitudes towards computers and technology. Based on distributional characteristics of each measure, the designers of these three technophobia instruments partitioned each into three levels of participant performance: No Technophobia, Low Technophobia and Moderate/High Technophobia (Rosen & Maguire, 1990; Rosen & Weil, 1995b; Weil, Rosen & Sears, 1987) (refer to Table 4.4).

**Table 4.4. Scores on Technophobia Scales Showing Identified Levels of Technophobia (from Rosen & Weil, 1992, p. 30)**

Technophobia Levels	Instrument		
	CARS	CTS	GATCS
None	20-41	69-100	64-100
Low	42-49	61-68	56-63
Moderate/High	50-100	20-60	20-55

According to the criterion of these technophobia instruments, any participant with scores of *Moderate/High* on any one instrument is considered to possess moderate or high technophobia. Any participant with scores of *None* on all measures is considered to have no technophobia. Any participant with scores of *Low* on one or more measures, but does not have a score of *Moderate/High* on any measure is considered to have low technophobia (Rosen & Weil, 1992).

#### 4.3.4 Demographic data and technology experience

An instrument, *Demographic and Technology Experience Questionnaire*, was specifically developed to gather demographic data (gender and age), prior computer/technology experience, computer availability, and perception of computer knowledge (refer to Appendix K). This questionnaire, a modified version of a questionnaire developed by Weil and Rosen (1995b), was administered to participants after completion of the technophobia instruments, *CARS*, *CTS* and *GATCS*.

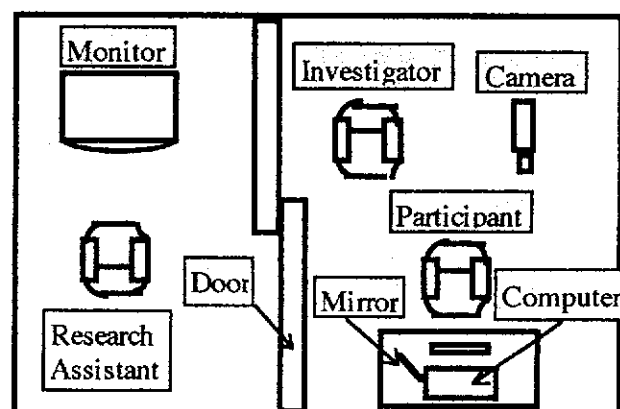
A prior computer/technology experience section examined where subjects gained their greatest amount of computer experience prior to entry into tertiary education. It also examined experience in a number of areas involving computers, including automatic banking, word processing, accessing the World Wide Web, library searches, School's computer laboratory, video arcade games, computer games and computer programming. One question was set to examine computer availability at home and another asked subjects to rate their computer knowledge compared to their peers.

Eleven of the 15 questions on the questionnaire were answered on a 1 to 4 scale to reflect how often each item was used in the past (1 = never, 2 = 1-2 times, 3 = 3-5 times, and 4 = 6 or more times). The remaining questions sought details of the participants' gender, age, where the greatest computer experience was gained, and rating of their perceived computer knowledge. The age of participants was set with four options (under 20, 20 -25, 26 -30 and over 30). Location of computer experience had six options (school years 1-10, school year 11, school year 12, TAFE, home, and other). Self-rated computer knowledge was on a 5 point scale (1 = much lower than average, 2 = below average, 3 = average, 4 = above average and 5 = much higher than average). The *Demographic and Technology Experience Questionnaire*, which took approximately 5 minutes to complete, was administered immediately prior to the participants accessing *VRLR* for the first time.

#### 4.3.5 Performance using *VRLR*

All 74 participants were invited to individually access the problem-based learning package *VRLR*, described in Chapter 3, and attempt several set tasks. This part of the study was conducted in a temporarily isolated section of the Heavy Activities Laboratory at the School of Occupational Therapy, Shenton Park in Perth (Refer to Figure 4.3), comprising an office and an adjoining screened area. Scheduled times for these sessions were Mondays (9am-5pm), Tuesdays (9am-5pm) and Wednesdays (1pm-5pm) of weeks 4-8 of 1st Semester, 1996. This schedule was arranged to fit within the non-class contact time of participants. Total time per participant was 45 to 60 minutes which allowed up to 15 subjects per week to be observed conducting the requirements of this part of the study.

In the interests of obtaining data in an effective manner, a research assistant helped with administration and monitoring. A protocol document (refer to Appendix L) was produced to assist with consistency and precision of data collection during each session. Participants were invited to be seated facing the monitor with the investigator sitting behind to the right. A video camera was focused on the monitor and adjacent mirror recording the participant and his/her navigation pathway through *VRLR*. The research assistant sat in the adjoining area and observed proceedings on a remote monitor (refer to Figure 4.3).



**Figure 4.3. Plan View of the Investigation Laboratory**

The investigator's role in this section of the study included welcoming each participant, explaining the proceedings that would take place, giving instructions, stating questions, operating the video, responding to subject's requests, and recording field notes on the prepared form *Observations Recorded* (refer to Appendix M). The research assistant measured participant's times with a stop watch, recorded these times and the number of features accessed on a copy of *Observations Recorded*, as well as filing field notes and video tapes.

As participants progressed through the assigned tasks with *VRLR*, they were asked to 'think-aloud'. The goal of this verbal protocol technique was for participants to describe the thought processes that they engaged in while problem-solving (Stone, 1990, p. 326). This procedure was accomplished by having participants talk about what they were doing, as they were doing it. Ideally, participants should say everything they are thinking, no matter how trivial, while solving a problem. This verbalisation of subjects' thinking was recorded to facilitate analysing of each participant's problem-solving strategies (Afflerbach & Johnston, 1984; Ericsson & Simon, 1980; Meyers, Lytle, Palladino, Devenpeck, & Green, 1990).

There are several advantages of using this verbal protocol, according to Afflerbach and Johnston (1984). Firstly, validity relies on a different set of assumptions from those of most other methods investigating cognitive processes and therefore serves as a cross-check. Under certain circumstances, thinking-aloud provides veridical descriptions of cognitive processes which otherwise could only be investigated indirectly, allows access to the reasoning processes underlying higher level cognitive activity, and permits an analysis of the affective components of an individual's performance.

Four groups of exercises involving *VRLR*, which participant's were invited to attempt, were accessing data, exploring *VRLR*, problem-solving and teach-back to the

investigator. The investigator read the instructions for each exercise to the participant at the same time as placing a card with a transcript of the exercise alongside the monitor. These four exercises are displayed in Figure 4.4. This 'teach-back' method was employed by asking the participant to instruct the investigator.

This technique requires participants to explain, to a hypothetical 'new' learner, how a program works and non-directive questions can be used to encourage participants to

---

**Exercise 1: Accessing data from VRLR**

---

Open *Vocational Rehabilitation Learning Resource* and enter the *Work Assessment Tools Database*. Select the Valpar #19 assessment tool and answer the following three questions:

- What is the full title of the Valpar #19 assessment tool?
  - How long does it take to administer?
  - Name one of the three objectives in using this tool
- 

**Exercise 2: Exploring VRLR**

---

I'd like you now to spend 4 minutes exploring *Vocational Rehabilitation Learning Resource*, thinking aloud while you are working. Feel free to open and close screens at will and move between connecting links.

---

**Exercise 3: Problem-solving**

---

Imagine you are a Case Manager and have just received referral information on a client named "Susan White". Access the problem-solving section of *Vocational Rehabilitation Learning Resource* and answer the following questions:

- What was Susan's injury?
  - What is her occupation?
  - Why would a Social Worker be a useful member of your case team?
  - Which three physical demands of this job are most likely to aggravate this type of injury?
- 

**Exercise 4: Teach-back**

---

Now I am going to ask you to imagine that I am new to using *Vocational Rehabilitation Learning Resource* and invite you to instruct me on accessing and using the problem-solving component of this package. Please demonstrate and verbally describe accessing procedures, format and uses of the various components as you proceed.

---

**Figure 4.4. The Four Groups of Exercises attempted by each VRLR Participant**

explain the structure of a computer program and to identify the functions of icons and menus (Reeves, Ellis, Ring, Ring, Oliver, 1993; Van der Veer, 1989). From their verbal performance, an assessment can be made of the participant's level of skill

and/or knowledge. In the case of *Exercise 4* shown in Figure 4.4, participants were expected to demonstrate and explain the problem-based learning component of *VRLR* using the teach-back method. Finally, participants' attitudes to the problem-based learning package was assessed when they completed the *VRLR-User Attitude Questionnaire* (refer to Appendix D).

#### **4.4 Pilot Study**

During the evaluation of *VRLR* in 1995, as described in Chapter 3, the evaluation setups used were viewed as an opportunity to trial this part of the research. The use of the test laboratory, video camera, participants' learner characteristics instruments/questionnaires were employed as a means of assisting in creating a research environment that could operate effectively. Pilot studies employing these participant learner characteristics instruments and questionnaires were administered to 25 occupational therapy student participants in 1995. This volunteer group, drawn from second year undergraduate students, were involved in a comprehensive evaluation of *VRLR*. This led to some modifications to the package's design and functionality as well as gaining considerable knowledge to be used in the design of this research including setting appropriate exercises with *VRLR* and estimating an approximate time for each to allow navigation performance of participants to be observed during their initial experiences with the package.

With changes to *VRLR* made and the research design complete, two subjects from the intended population from this study were randomly chosen to assist as participants in a final pilot testing. These tests were conducted in the Investigation Laboratory described in Section 4.3.5. Feedback from these pre-test sessions led to further minor changes in the planned data collection exercises, including allocated times for each of the four exercises. In this pilot study, time allowed was up to 5 minutes each to Exercises 1, 2, and 4 and 15 minutes for Exercise 3. These times were considered too

generous and it was judged that sufficient information on participant navigation performance could be determined by setting a standard time of 4 minutes for each of the four exercises (see Figure 4.4).

#### **4.5 Data Analysis**

The key questions being investigated in this research were:

1. Can an independently accessed, interactive multimedia package be designed and developed to provide case studies which support occupational therapy students learning vocational rehabilitation?
2. What are the learner characteristics (i.e. cognitive style, learning style and degree of technophobia) for the targeted population of occupational therapy students?
3. What is the relationship between learner characteristics and navigation performance for the targeted population of occupational therapy students?
4. What is the relationship between learner characteristics, navigation performance and attitudes for the targeted population of occupational therapy students?

A triangulation approach was taken in this study by utilising a combination of quantitative and qualitative data analysis methodologies. This was employed in a number of ways to minimise the problem of relying too much on any single data source or method and undermining the validity and credibility of the research investigation (Patton, 1990, p. 193). Data were collected and analysed on participants' characteristics and performance through a range of instruments and questionnaires,



observation of navigation employing two observers allowing for cross-checking, teach-back method of checking understanding, and use of case studies to illustrate extreme performances.

In Chapter 2, Section 2.1.2, reference was made to the widely reported criticism in recent years that traditional, comparative studies investigating the use of educational technology have failed to show significant differences in student performance (Clark, 1983; 1994; Lee, 1996; Reeves, 1993). Also, Oliver (1994) has warned designers that “many potentially useful forms of technology can fail to deliver when the development (of the technology) is not matched by the development and application of the appropriate instructional components” (p. 381). This study seeks to identify influencing factors impacting on performance which are worthy of further investigation to aid designers of interactive, problem-based learning.

The major effort in this analysis went into the quantitative aspects of the investigation involved in measurement of participant learner characteristics, navigation performance, attitudes and achievement and the relationship between them utilising statistical tests including the Pearson correlation coefficient, factor analysis and multiple regression. After *VRLR* was produced, descriptive statistics were used to seek information on the learner characteristics required for the second research question. Data were collected from the instruments described earlier in this chapter, namely *Learning Styles Questionnaire*, *Group Embedded Figure Test*, *Computer Anxiety Rating Scale*, *Computer Thoughts Survey*, and *General Attitudes Towards Computers Scale*.

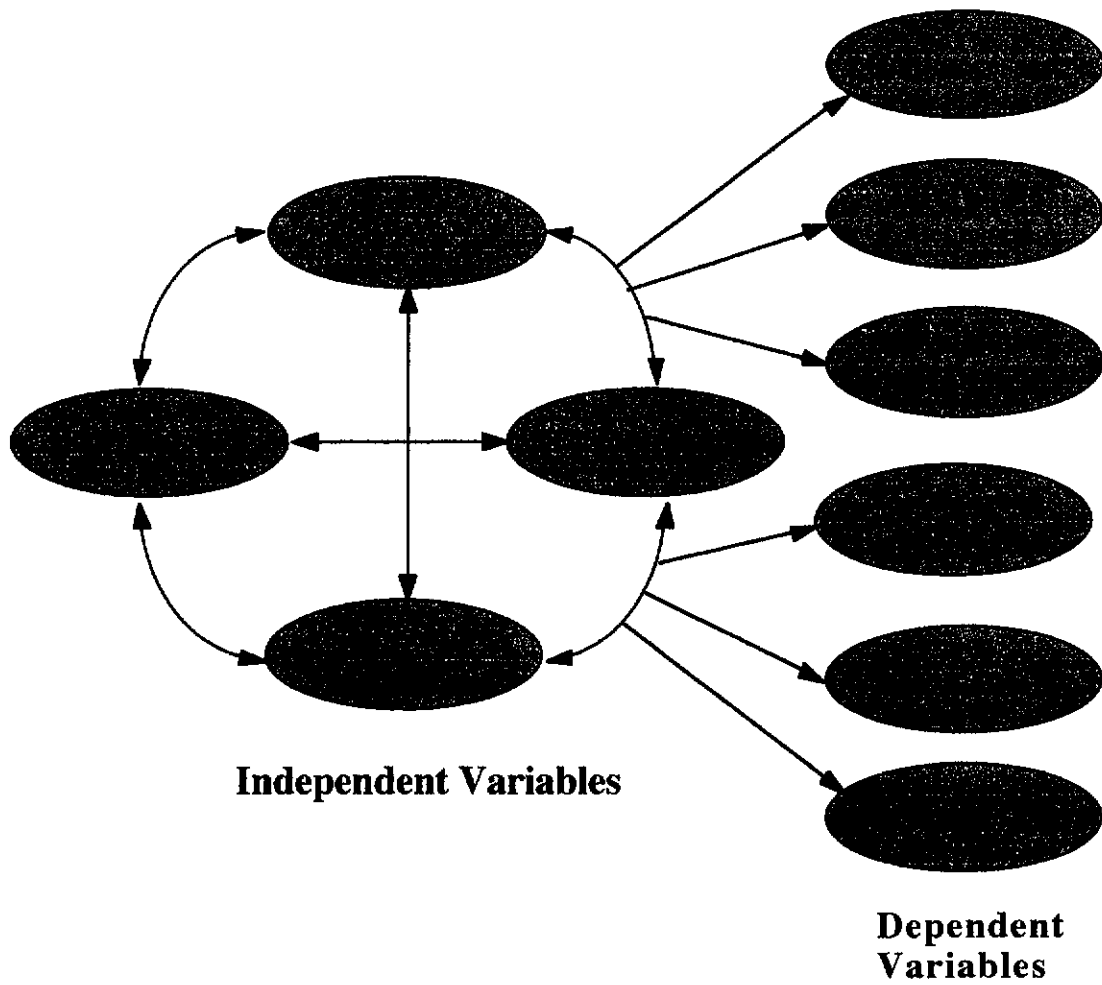
For the third and fourth research questions, attempts were made to identify statistical models of relationships between variables. In the third research question, relationships were explored between participants’ learner characteristics and navigation performance with *VRLR*. Navigation was initially grouped into five sub-categories *number of screens opened*, *times that assistance was requested*, *overviews accessed*, *time to*

*complete searches and successful searches* variables (see Figure 4.5). For the fourth research question, relationships were explored between users' attitude towards *VRLR* and learner characteristics/navigation performance (see Figure 4.6). With each of these two research questions, correlation matrices were initially constructed to assist with identification of significant relationships between variables.

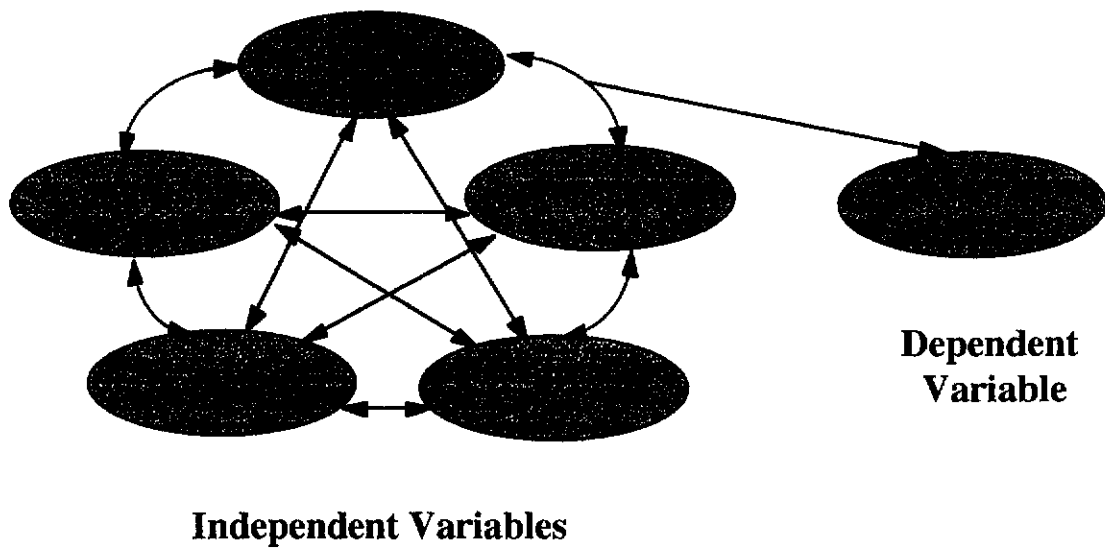
#### **4.5.1 Correlations Analysis**

Measurements for all 12 learner characteristics variables were recorded and arranged into ordinal scale groupings after collection of raw scores. The groupings for cognitive style, computer thoughts, computer anxiety, and learning style were determined according to the scoring instructions in the respective manuals for users (Honey & Mumford, 1992; Rosen & Weil, 1992; Witkin et al., 1971). This categorical presentation of the results of measurements allows for a convenient focus on displayed patterns within a study population and on comparisons with other groups. In addition, participants' scores recorded from the *Demographic/ Technological Experience Questionnaire* (see Appendix K) and navigation patterns (see Appendix M) were initially arranged categorically in this study for use in constructing log-linear models (see Section 4.5.2).

The measure of linear association between pairs of variables employed in this study were investigated using correlation functions of the statistical package SPSS version 6.1.1 for Apple Macintosh computers. This type of analysis can provide useful indicators of the strength of association or independence of variables. However, correlational analysis does not provide estimates of the effects of the variables on each other or other complications in analysing data with more than two variables (Ihlenfeld,



**Figure 4.5. Exploring those Variables Impacting on Navigation**



**Figure 4.6. Exploring those Variables Impacting on User Attitude**

1988; Kennedy, 1988; Norusis, 1992c). Options for exploring the potentially complex relationships among the variables in this exploratory study included the following methods of statistical analysis methodologies: log-linear models, canonical correlation analysis, factor analysis, and regression analysis. Because the data collected in this study had been formatted categorically, the use of log-linear analysis was initially investigated (Ihlenfield, 1988).

#### **4.5.2 Log-linear analysis**

The log-linear statistical method allows analysis of contingency table data for goodness of fit of a model and tests whether the expected frequencies of given variables approximate the observed frequencies of the variables in the collected data (Ihlenfield, 1988). The base system SPSS software package did not include log-linear capabilities and therefore the additional module *Advanced Statistics* was installed (Norusis, 1992a).

One limitation of this method is that the current version of SPSS can only accept a limited number of variables. The user manual claims that a maximum of 10 variables can be entered (Norusis, 1992a), but after a number of trial attempts to run log-linear models, it was established that the program could not cope with more than seven of the variables used in this study at any one time. When the number of variables was increased beyond this, the load on the computer led to slowing down of processing and eventual crashes. Alternative computers were tested, with this latest version of SPSS, but similar limitations occurred resulting in the computer crashing when more than seven variables were loaded simultaneously. As a consequence of this, it was decided not to proceed with the use of log-linear models, but to investigate other statistical means of generating statistical models representing the variables identified and measured in this study.

### **4.5.3 Canonical correlation analysis**

In order to investigate the relationships between the navigation variables in combination with the learner characteristics, canonical correlation analysis (CCA) was conducted. This was carried out using the data as collated in its original ordinal format in order to investigate the limits or patterns of interdependency that joined the two sets and the number of significant links (Norusis, 1992a).

CCA provides the opportunity to investigate the possibility that combinations of dependent variables relate to combinations of independent variables. CCA is accomplished by replacing the original variables in the dependent and independent sets by pairs of linear combinations of the original variables. Of the infinite number of possible linear combinations for each set, coefficients are chosen where the resultant linear combination of the dependent set variables is maximally correlated with the linear combinations of the independent set variables. As there is no assurance that there is only one pair of linear combinations which are highly correlated to one another, the CCA process seeks out others. Each new combination of sets is uncorrelated with the former (Cohen & Cohen, 1983; Levine, 1997; Thompson, 1991). Although canonical correlations analysis appears suited to studies investigating multidimensional phenomena such as multimedia navigation, no reference to its use was made in the related literature (section 2.5.4). A comprehensive search of the canonical literature discovered a serious limitation with its use. Unless sample size is large relative to the number of variables, both the standardised coefficient and the correlations are unstable (Stevens, 1992). Stevens indicated that unless the ratio of sample size to number of variables was in the region of 20 to 1, then researchers cannot confidently predict results will accurately transfer to another sample. This limitation therefore led to the abandonment of the use of canonical correlations in this study and concentration on the use of factor analysis and multiple regression analysis. However, as the technique of CCA shows promise in multimedia navigation studies,

provided that the minimum conditions are met, a section of the concluding chapter is devoted to suggestions on the use of CCA in future studies.

#### **4.5.4 Factor analysis and multiple regression**

Factor analysis was employed in an attempt to identify groupings of the independent variables measured within the study which formed a strong relationship. The basic assumption of this statistical technique is that underlying dimensions, or factors, can be used to explain complex phenomena. The objective in using this strategy was therefore to identify any non-directly observable factors based on the set of observable independent variables. To employ factor analysis with the current version of the statistical software SPSS entails loading the *Professional Statistics* module to the base module (Norusis, 1992b).

Multiple regression statistical models were then employed to investigate research questions three and four of this study (refer to section 4.5.1). In other words, attempts were made to establish any statistically significant relationships between the independent and dependent variables. By studying observed values of the correlation coefficients and degrees of variance, prediction models can be identified (Cohen & Cohen, 1983; Jaccard, Turrisi, & Wan, 1990; Montgomery & Peck, 1992; Sen & Srivastava 1990). The factorial analysis groupings identified were initially used to represent groupings of independent variables in multiple regression models attempted with the dependent variables. This was followed by a comparison of the strengths of models derived when the independent variables were entered in their original 'ungrouped' form.

To investigate further the relationships between variables, qualitative examination of these data was explored in the next section. Case studies of both high and low

performers for the navigation features measured in this research were utilised to demonstrate linkages with learner characteristics.

#### 4.5.5 Qualitative components

Qualitative methods were used to permit the evaluator to study issues related to the statistical models generated above in depth and detail. Direct quotations, facial expressions and mannerisms were recorded for a selective sampled population to reveal respondents' depth of emotion, their thoughts about what is happening, their experiences, and their basic perceptions. The qualitative-naturalistic-formative approach is especially appropriate for developing, changing, or innovative programs where the focus is on program improvement, facilitating more effective implementation, and exploring a variety of effects on participants (Patton, 1990, pp. 130-131). This approach can be particularly important early in the life of a program or at major points of transition. Additionally, case studies become particularly useful where there is a need to understand some special people, a particular problem, or unique situation in great depth, and where the investigator can identify cases rich in information pertaining to the investigation question (Patton, 1990, p. 99).

In order to focus on the impact of *VRLR* on specific participants, case studies of six subjects were made up from both extreme and typical results for the navigation and attitude variables that were selected and scrutinised. The 'navigation' score was the sum of the dependent variables *times that assistance was requested*, *overviews accessed*, *time to complete searches*, and *successful searches* as described in Chapter 6, Section 6.1. This score was used only as a measure of participants' performance for selection of case studies. For instance, those who would be considered a good 'navigator' would tend to score low for *times that assistance was requested*, *overviews accessed*, and *time to complete searches* and tend to score higher for number of *successful searches*. The 'attitudes' score was the total score for the *VRLR*-

*User Attitude Questionnaire* (see Appendix D). The case studies were designated as follows:

- Case Study #1 was the top scoring participant for navigation
- Case Study #2 was the average scoring participant for navigation
- Case Study #3 was the bottom scoring participant for navigation
- Case Study #4 was the top scoring participant for attitude
- Case Study #5 was the average participant for attitude
- Case Study #6 was the bottom scoring participant for attitude

#### **4.6 Facilities and Resources**

The development of the problem-based software *VRLR* (Cameron, 1995b) was funded by a Committee for the Advancement of University Teaching (CAUT) grants in 1994 and 1995. The School of Occupational Therapy provided the use of the laboratory for observing participants (Figure 4.3) and all hardware required.

#### **4.7 Ethical Issues**

All participants were fully informed about the context of the study, its purpose, its confidential nature, its potential advantages, and possible use of the data. They had the right to decline being involved in the study at any time. On agreeing to participate they were asked to sign a consent form (refer to Appendix N).

#### **4.8 Summary of Chapter**

In this ex-post-facto quantitative study supported by qualitative case studies, the investigator employed a range of strategies to determine statistical models that indicate linkages between users' characteristics accessing information in a multimedia learning package and users' attitude to that package. Users' characteristics measured were



cognitive style, learning style, degree of technophobia and demographic information such as computer experience and age. Strategies employed to collect data in this quantitative and qualitative study were the use of questionnaires and instruments to measure participants' learner characteristics and attitudes. Users' navigation performance was monitored by the use of a video camera and two observers recording field notes. Each participant was requested to 'think-aloud' and also instruct the investigator on the application of part of the learning package, i.e., 'teach-back'.

In Chapter 5, results of participants' learner characteristics are reported. Chapters 6 and 7 report on the results of participants' navigational performance and attitudes towards *VRLR* respectively. In each of these chapters, case studies are employed to illustrate performance of participants who measured at the average and extreme points for navigation performance and attitudes.

## Chapter 5

### PARTICIPANTS' LEARNER CHARACTERISTICS

#### 5.0 Introduction

This chapter focuses on the results of the second question posed in this research, *What are the learner characteristics for the targeted population of occupational therapy students?* In Chapters 6 & 7 the results are discussed in relation to the remaining research questions. Participants' learner characteristics explored in this chapter include demographic data, technology experience, cognitive style, learning style and technophobia. Results from each questionnaire/instrument are reported, reliabilities of the instruments noted where appropriate, and the relationships between variables are examined by correlations.

Of the original participants ( $n = 74$ ) who agreed to take part in this research in 1996, two were employed in the pilot study for the navigation component of the study reported in Chapter 6 and five participants either left the course or were unavailable to complete all components of the study. In Sections 5.1 to 5.4 of this chapter the results of the *Demographic/Technological Experience Questionnaire* are reported for the remaining 67 participants who completed the entire study. In Sections 5.5 to 5.7, results from the *Learning Style Questionnaire*, *Group Embedded Figures Test*, *Computer Anxiety Rating Scale*, and *Computer Thoughts Survey* are noted for the same population. The results for the learner characteristics instruments for the additional seven participants who did not complete the entire study, as well as the results for the 23 participants involved in the 1995 pilot studies (refer to Chapter 4, Sections 4.3 and 4.5) also are reported in Sections 5.6 to 5.7 of this chapter. This serves as a comparison group to strengthen, or otherwise, the findings of this research.

### 5.1 Demographic Data

As expected from the pool of available participants, there was a predominance of female students ( $n = 57$ ) enrolled in the second year unit, Occupational Health 241. Most participants were under 25 years of age (92.5%), with only one being over 30 (see Table 5.1).

**Table 5.1. Age Ranges of Occupational Therapy Student Participants (n = 67)**

Age	Number	Percentage
under 20	46	68.7
20-25	16	23.9
26-30	4	6.0
over 30	1	1.5

### 5.2 Computer/Technology Experience

Eleven questions in the *Demographic/Technological Experience Questionnaire* (refer to Appendix K) focused on the participant's prior experience with computers and related technologies (see Table 5.2). A significant number of participants (62.7%) had used computers at home to assist with their tertiary studies on six or more occasions in the past, but 79.1% had never accessed the World Wide Web. This pointed to participants being unaware of the wealth of material related to occupational therapy now available through this medium and/or a lack of awareness how to access it (Campbell, 1996; Stone, 1996).

The School of Occupational Therapy's computer laboratory had been used during the first year of the occupational therapy course by 90% of participants, although 58.2% had only used it once. This minimum usage can partially be explained by students only attending the School of Occupational Therapy two days a week during the first year of their course. The remainder of their studies were in subjects common to health science

courses in general and conducted by other Schools on the university's main campus. The popularity of the use of computerised literature searches was revealed with only 3% of participants having never utilised this facility.

**Table 5.2. Descriptive Statistics for Prior Experiences with Computers and Related Technologies of Occupational Therapy Student Participants (n = 67)**

Computer/Technology Experience	(1) never %	(2) 1-2 times %	(3) 3-5 times %	(4) 6 or more %	Mean	Std. Dev.
Use computer at home	10.5	11.9	14.9	62.7	3.3	1.05
Accessed WWW	79.1	13.4	4.5	3	1.3	.70
Used computer lab.	10.4	58.2	19.4	11.9	2.3	.82
Literature searches	3	17.9	19.4	59.7	3.4	.88
Word processing	3	1.5	13.4	82.1	3.8	.64
Computer games	0	16.4	13.4	70.1	3.5	.77
Arcade games	19.4	26.9	17.9	35.8	2.7	1.16
Computer programs	79.1	11.9	3	6	1.4	.81
Programmed VCR	13.4	10.4	11.9	64.2	3.3	1.11
Microwave oven	6	0	9	85	3.7	.75
Auto. bank teller	4.5	0	1.5	94	3.8	.63

Raw scores from Table 5.2 were added together to give a prior computer/technology experience total score for each participant (Rosen & Weil, 1992). The higher the score, the more computer/technology experienced by the participant. The mean, standard deviation, maximum and minimum for these scores are provided in Table 5.3. The participant total scores were used later in this chapter (see Table 5.12) to compare with other learner characteristics, and in Chapters 6 and 7 to compare with participant navigation performance and attitudes to *Vocational Rehabilitation Learning Resource (VRLR)* and (see Table 6.9 and Table 7.2 respectively).

**Table 5.3. Range of Scores for Prior Computer/Technology Experience of Occupational Therapy Student Participants (n = 67)**

Variable	Mean	Std. Dev.	Minimum	Maximum
Prior Computer/ Technology Experience	32.5	4.19	23	42 *

\* Maximum score possible = 44

### 5.3 Learning about Computers

As indicated in Table 5.4, almost 39% of the population attributed their most significant learning experiences with computers to have been obtained at home. This could suggest that these participants have largely developed their computer skills to date without the direct teacher feedback experienced in formal learning situations. It indicates that it is likely that this participant group is generally prepared to take a self-directed approach when working with problem-based learning packages such as *VRLR*. A further 34% of participants indicated that their most significant learning experiences with computers had occurred in the final year of secondary schooling as opposed to only 3% who attributed it to Year 11 and 14.9% at their school prior to that time. These data suggest that approximately one half of this group viewed computer experiences gained in areas other than their secondary schooling as more educationally rewarding.

### 5.4 Computer Knowledge

The data in Table 5.5 illustrate that over 96% of the participants indicated that they perceived themselves as average, or below average, in their level of computer knowledge when compared to their peers. This response displays either a lack of confidence in this area or a lack of awareness of the ability of their peers. Occupational therapy students, at the beginning of the second year of their undergraduate course generally, will have had little opportunity to test their computer knowledge against that

of their colleagues. Exposure to learning packages such as *VRLR* can provide situations where these students can compare their computer skills.

**Table 5.4. Sources of Learning about Computers Prior to University Studies for Occupational Therapy Student Participants (n = 67)**

Most Significant Computer Learning	Number of participants	Percentage of participants
Year 12	23	34.3
Year 11	2	3
Years 1-10	10	14.9
TAFE	1	1.5
Home	26	38.8
Other	5	7.5

**Table 5.5. Self-Perception of Computer Knowledge by Occupational Therapy Student Participants (n = 67)**

Perception of computer knowledge	No. of participants	% of participants
Much lower than average	9	13.4
Lower than average	17	25.4
Average	38	56.7
Above average	2	3
Much higher than average	1	1.5

### 5.5 Cognitive Style

The results of the *Group Embedded Figures Test*, which are summarised in Table 5.6, illustrate the degree of field-dependency/field-independency cognitive style for participants. The Cronbach alpha reliability of this instrument was measured as .85. It will be noted that apart from the 67 participants who went on to complete the computer

navigation and attitude towards *VRLR* parts of this research, the results displayed in Table 5.6, include the cognitive style scores for the remainder of participants involved in this study to serve as a comparison. As previously indicated, the 'Other Participants' group ( $n = 30$ ) was made up of the two participants in the pilot study and the five who did not complete the study in 1996, and the 23 participants involved with the pilot study in 1995 (see Chapter 4, Sections 3 and 5).

**Table 5.6. Percentage of Field-Dependency/Field-Independency for Two Groups of Occupational Therapy Student Participants**

Cognitive Style	Completed Study ( $n = 67$ )		Other Participants ( $n = 30$ )	
	n	%	n	%
High Field-Dependency	8	11.9	5	16.7
Moderate Field-Dependency	4	6	4	13.3
Moderate Field-Independency	10	14.9	9	30
High Field-Independency	45	67.2	12	40

A comparison of the percentage of participants scoring at each of the four categories of field-dependency cognitive style illustrates that there is a tendency towards field-independency in these occupational therapy participant groups and that the 'Completed Study' group were more field-independent than the 'Other Participants' group. Only 14.9% of the 'Completed Study' group scored in the moderate field-dependency category compared to 30% of 'Other Participants', but this trend was reversed for the high field-independency where 67% of the 'Completed Study' participants scored compared to 40% for the 'Other Participants'. There was little difference between the mean (1.72) and the standard deviation (.24) for the field-dependency/field-independency scores for these two groups are shown in Table 5.7. As there was a difference in sample size between the *Completed Study* and the *Other Participants*

groups, the differences between the means was tested using a two-tailed, Mann-Whitney U-test (Norusis, 1992c) and found not to be statistically significant ( $p = .54$ ).

**Table 5.7. Descriptive Statistics of Completed Study Group with Other Participants Group for Mean of Field-Dependence/Field-Independence Scores**

Population	Number	Mean	Standard Deviation
Completed Study	67	14.82	3.52
Other Participants	30	13.10	3.76

Field-independent individuals tend to be more analytical, impose their own structuring more on a situation, and be relatively less passive and global in their behaviour (Ford, Wood, & Walsh, 1994). Occupational therapists using information technology, and with a relatively high degree of field-independency, can expect to do better in tasks that require them to restructure information rather than accepting the structure provided by the materials (Jonassen & Wang, 1993). In a hypertext-linked database for conducting on-line searches, a field-dependent user may perform better when provided with a clearly identified semantic structure whereas the field-independent user may perform better if required to classify the link types. Davis (1991) found there was little or no difference when a limited amount of information was processed, but that field-independent participants were consistently more efficient in situations with high information-processing demands.

## 5.6 Learning Style

Participants' learning style was measured using the *Learning Style Questionnaire* developed by Honey & Mumford (1992). The Cronbach alpha reliability indices for the four components of the *Learning Style Questionnaire* were measured at .67 for *Activists*, .54 for *Pragmatist*, .69 for *Reflector*, and .73 for *Theorist*. (refer to Chapter



4, Section 4.3.2). Scoring for each of this instrument's four scales ranged from zero (very low preference) to 20 (very strong preference). The weighting allocated to numerical scores varies between each of the four scales (see Chapter 4, Table 4.2).

The population in this study displayed a significant preference for Activist and Reflector learning styles with totals of 85% and 78% recording moderate, strong, or very strong respectively (see Table 5.8). There was a significant lower preference for the other two measures of learning style, that is Pragmatist and Theorist, with a total of 59.7% and 47.8% measuring low or very low, respectively. A comparison of the mean and standard deviations from the 'Completed Study' and 'Other Participants' groups is shown in Table 5.9. The difference in the means was tested using the Mann-Whitney U-test for equality of means, two-tail significance (Norusis, 1992c) and recorded  $p = .55$  for Activist,  $p = .08$  for Pragmatist,  $p = .39$  for Reflector, and  $p = .37$  for Theorist. These scores indicated that Activist, Pragmatist, Reflector, and Theorist learning styles were relatively consistent in not being significantly different for the two groups of occupational therapy undergraduates at  $p < .05$  level.

**Table 5.8. Number and Percentage of Learning Styles for Occupational Therapy Student Participants Who Completed the Study (n = 67)**

Rating	Activist		Pragmatist		Reflector		Theorist	
	n	%	n	%	n	%	n	%
Very strong preference	17	25.4	2	3	11	16.4	7	10.4
Strong preference	15	22.4	7	10.4	25	37.3	14	20.9
Moderate preference	25	37.3	18	26.9	16	23.9	14	20.9
Low preference	8	11.9	29	43.3	11	16.4	20	29.9
Very low preference	2	3	11	16.4	4	6	12	17.9

**Table 5.9. Descriptive Statistics of ‘Completed Study’ and ‘Other Participants’ for the *Learning Styles Questionnaire***

Variable	Group	Number	Mean	Stand. Dev.
Activist	Completed Study	67	10.28	3.28
	Other Participants	30	10.03	3.93
Pragmatist	Completed Study	67	11.07	2.85
	Other Participants	30	11.82	3.17
Reflector	Completed Study	67	14.12	3.15
	Other Participants	30	13.20	4.20
Theorist	Completed Study	67	11.01	3.80
	Other Participants	30	11.33	3.27

The identification of learning style preference can help with planning and preparing appropriate learning experiences to meet students' needs. Similarly, students who are aware of their learning strengths and weaknesses can plan strategies to cope in differing learning environments. With more and more information being accessed through computers and telecommunications technology, there is an advantage to develop learning skills that can access information quickly. This study suggests that *Activist* learners, with their enthusiasm to be dominated by immediate experiences, can benefit in an information technology environment. However, Koschmann (1995) explained that by providing access to diverse and potentially conflicting information, information technologies require users to be more reflective about their sources of knowledge. Therefore, the development of *Activist* learning styles may have some initial benefits in the accessing of data, but *Reflector* styles should be developed to assist with making sense and assessing implications of the increasing quantity of information becoming available.

Kolb (1985) and Honey and Mumford (1992) have suggested that although an individual may have a preferred way of learning, different situations and problems require different cognitive strategies. Therefore, flexibility, or an ability to alternate learning styles, is advantageous to both an individual and a professional group (Barris, Kielhofner, & Bauer, 1985a; 1985b).

### **5.7 Technophobia**

Cronbach's alpha reliability for the instruments to measure technophobia were measured as .91 for *Computer Anxiety Rating Scale*, .91 for *Computer Thoughts Survey*, and .32 for *General Attitudes Towards Computers Scale*. Based on the low reliability of the general attitudes towards computers instrument, a decision was made not to use the data for analysis in this study.

The results of the *Computer Anxiety Rating Scale* and the *Computer Thoughts Survey* were scored according to the criterion set by the developers of these technophobia instruments (Rosen & Weil, 1992, p. 30), where participants scoring 'Moderate/High' on any one instrument were considered to possess moderate or high technophobia. Any participant with scores of 'None' on all measures was considered to have no technophobia. Any participant with scores of 'Low' on one or more measures, but does not have a score of 'Moderate/High' on any measure was considered to have low technophobia (refer to Table 5.10 and Appendix E).

When the mean and standard deviation of the above scores representing the 'Completed Study' group of occupational therapy student participants (n = 67) were compared with the 'Other Participants' occupational therapy student participants (n = 30), again there was little difference in the measures (see Table 5.11). The difference in the means, tested using the Mann-Whitney U-test for equality of means, two-tail

significance (Norusis, 1992c) indicated no statistical significance for the two measures of technophobia with  $p = .29$  for computer anxiety and  $p = .53$  for computer thoughts.

**Table 5.10. Number and Percentage of Levels of Technophobia for Computer Anxiety and Computer Thoughts Scores for Occupational Therapy Student Participants (n = 67)**

Levels of Technophobia	Computer Anxiety		Computer Thoughts	
	n	%	n	%
No technophobia	36	53.7	26	38.8
Low technophobia	20	29.9	20	29.9
Med./high technophobia	11	16.4	21	31.3

**Table 5.11. Comparison of Scores between 'Completed Study' with 'Other Participants' for Two Scales of Technophobia**

Variable	Group	Number	Mean	Stand. Dev.
Computer Anxiety	Completed study	67	40.12	12.48
	Other Participants	30	40.40	13.73
Computer Thoughts	Completed study	67	65.25	13.13
	Other Participants	30	67.53	13.23

As indicated in Table 5.10, a majority of the 'Completed Study' participants scored no technophobia for computer anxiety (53.7%), but a majority (61.2%) scored low to high technophobia for computer thoughts. This significant number of participants experiencing computer anxiety and negative thoughts about computers is cause for concern. Rosen & Weil (1995b, p. 26) warned of the dangers of technophobic teachers translating this fear onto students. Occupational therapists with technophobic tendencies may also translate this fear onto their clients or avoid using computers

altogether. If this is the case, it is of concern because computer/telecommunication technology is widely accepted as offering significant improvements to the quality of life of populations with special needs (Browning, Nave, White, & Barking, 1985; Browning & White, 1986; Malouf, MaCarthur, & Radins, 1986; Sims, 1988; Walberg, 1990). Therefore, tertiary institutions educating and training therapists have a responsibility to ensure that new graduates are at ease with this technology.

With increased exposure to computer technology at home, school and work, it may be presumed that computer anxiety and thoughts will diminish. However, several studies have noted that an individual's anxiety about computers and technological devices does not necessarily decrease with computer exposure and that changes may be insignificant (Dimock & Cormier, 1991; Rosen & Weil, 1995b). For example, Honeyman and White (1987) found that anxiety levels showed little change over the first 30 hours of exposure to computer technology in an undergraduate introductory computer applications course, although beyond the 30 hours exposure time, there was a significant drop in computer anxiety. These results suggest that many occupational therapists, with little opportunity to increase exposure to this technology, may continue to experience computer anxiety.

### **5.8 Relationships Between Learner Characteristics**

A preliminary exploration of any relationship(s) between the above learner characteristics was conducted using the *Correlations* procedure of the statistical package SPSS (Norusis, 1992a). This allowed Pearson's product-moment correlations to be calculated for each pairing of variables (refer to Chapter 4, Section 4.5.1). Detection of any linear association(s) between the participant learner characteristics could provide useful information in the design and preparation of learning materials employing computer/telecommunications technology. For instance, there was interest to ascertain if there is a relationship between age and computer

experience, gender and computer anxiety, activist learners and computer thoughts. All variables identified and measured above were included in the pairings (see Figure 5.1). Scores for prior computer/technology experiences were the total score for Questions 4-14, *Demographic/Technological Experience Questionnaire* (refer to Appendix K).

The coding for the learner characteristics variables used in the analysis which follows and which were acceptable for entry by the statistical package SPSS® are presented in Figure 5.1 with a complete list of coding for this research found in Appendix Q. From an examination of Table 5.12, several statistically significant correlations were evident. Honey & Mumford (1992, p. 80) noted that scoring from previous studies using the *Learning Style Questionnaire*, and involving a range of participants from differing occupational groups, indicated several combinations of correlations. These are illustrated in Table 5.13 and comparisons are made with the present study.

ACTIVIST	Activist score from the <i>Learning Style Questionnaire</i>
AGE	Age
ANX	Computer Anxiety Rating Scale score
COGSTYL	Cognitive style score ( <i>Group Embedded Figures Test</i> )
COMEXP	Prior computer training (refer to Table 5B)
COMKNOW	Perception of computer knowledge (refer to Table 5E)
GEN	Gender
PRAG	Pragmatist score from the <i>Learning Style Questionnaire</i>
PRIOREXP	Total prior computer/technology experience (refer to Table 5B)
REFL	Reflector score from the <i>Learning Style Questionnaire</i>
THEO	Theorist score from the <i>Learning Style Questionnaire</i>
THOUGHT	<i>Computer Thoughts Survey</i> score

**Figure. 5.1. Labels for Learner Characteristic Variables Used in Table 5.12**

Several of the four *Learning Style Questionnaire* components had statistically significant positive correlations where  $p < .001$ , namely Reflector/Theorist, Theorist/Pragmatist, and Reflector/Pragmatist. These particular combinations were also significantly correlated in the basic statistical data chapter in the *Manual of Learning Styles* (Honey and Mumford, 1992, p. 80).

**Table 5.12. Learner Characteristics Correlation Matrix for Occupational Therapist Student Participants (n = 67)**

Variable	ACTIVIST	AGE	ANX	COGSTYL	COMEXP	COMKNOW	GEN	PRAG	PRIOR:EXP	REFL	THEO	THOUGHT
ACTIVIST (1)	1.00	.00	-.09	.06	-.26 *	.08	.12	-.13	.14	-.52 ***	-.40 **	-.06
AGE		1.00	-.08	.08	.29 *	.16	.24	.27 *	.10	.23	.07	.25 *
ANX (2)			1.00	-.07	-.11	-.39 **	-.23	-.24 *	-.48 ***	.05	-.02	-.55 ***
COGSTYL				1.00	.05	.02	.07	-.01	.15	.03	-.06	-.07
COMEXP					1.00	.28 *	.02	.09	.21	.20	.12	.27 *
COMKNOW						1.00	.19	.15	.66 ***	.03	.04	.62 ***
GEN							1.00	.08	.20	.02	.02	.14
PRAG (1)								1.00	.08	.43 ***	.57 ***	.08
PRIOR:EXP									1.00	.01	.06	.47 ***
REFL										1.00	.63 ***	.01
THEO (1)											1.00	.03
THOUGHT (2)												1.00

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$  (Tuckman, 1978)

Note: 1 ACTIVIST, PRAG, REFL, & THEO refer to the Honey and Mumford's (1992) *Learning Style Questionnaire* which measures four dimension of learning style, i.e., Activist, Pragmatist, Reflector & Theorist

2. ANX and THOUGHT refer to Rosen & Weil's (1992) *Measuring Technophobia* dimensions of computer anxiety and computer thoughts

**Table 5.13. Statistically Significant Correlations for Components of the *Learning Style Questionnaire* (Honey & Mumford, 1992)**

Components	Reflector	Theorist	Pragmatist
Activist	-0.01	0.10	0.30
Reflector		0.70	0.42
Theorist			0.54

In addition, this current study involving occupational therapy students also detected Activist/Reflector and Activist/Theorist as being statistically negatively correlated (see Table 5.12). The former negative correlation can be explained by the characteristics associated with active learners being dominated by immediate experiences whereas reflective learners are more likely to ponder these experiences and observe them from different perspectives (Honey & Mumford, 1992). Curiously, Honey and Mumford found a positive, though minimally significant relationship between Activist and Theorist (see Table 5.13). The negative relationship between Activist learners and Theorist learners in this study could possibly be due to Theorists investing more time maximising their certainty before taking action.

There were no statistically significant correlations between learning styles and the gender of participants, a finding similar to that of Honey and Mumford (1992, p. 70) with a random sample of males and females from a cross-section of occupations. However, statistically significant correlations ( $p < .05$ ) were detected between age and Pragmatist learning styles, computer experience, and computer thoughts. Although there was only a small range of age groups in this study, the indication was that as occupational therapy students move from their teenage years through into their twenties they increasingly try out ideas, theories and techniques (pragmatic), develop greater computer experiences, and have more positive thoughts about computers.



Participants' perception of their computer knowledge was, as expected, statistically significantly correlated to computer anxiety (negatively,  $p < .001$ ), computer thoughts ( $p < .001$ ), prior computer experiences ( $p < .001$ ), and computer training ( $p < .05$ ). Computer training correlated negatively with activist learning style ( $p < .05$ ), and positively with computer thoughts ( $p < .05$ ).

In addition to being negatively correlated to computer knowledge, computer anxiety was also negatively correlated to pragmatist ( $p < .05$ ), prior computer experience ( $p < .001$ ) and computer thoughts ( $p < .001$ ). Computer thoughts was correlated positively with prior computer experience ( $p < .001$ ) as well as being correlated with age ( $p < .05$ ), computer anxiety ( $p < .001$ ), computer training ( $p < .05$ ) and computer knowledge ( $p < .001$ ) as identified above.

Two significant findings from these correlations are: 1) the absence of variables combining significantly with cognitive style; and 2) participants scoring high in the Pragmatist dimension of the *Learning Style Questionnaire* have relatively low computer anxiety. The former finding suggests that the field-dependency/field-independency aspect of learners' cognitive style is independent of all the other learner characteristic variables employed in this study. The latter finding suggests that occupational therapy students who score highly on the pragmatist dimension of learning have a low level of computer anxiety.

In Chapter 6, the results of participants' navigation performance is reported and implications discussed. Factor analysis and multiple regression statistical techniques were employed in an attempt to determine relationships between the learner characteristics examined in this chapter and navigation performance variables. In addition, qualitative analysis is employed with special cases from the participant population to assist with explanation of these relationships.

### **5.9 Summary of Chapter**

Sixty-seven occupational therapy students participated in a series of assessments to determine their learning characteristics before preceding to the computer navigation activities associated with this study. Instruments used included the *Learning Style Questionnaire*, *Group Embedded Figures Test*, *Computer Anxiety Rating Scale* and *Computer Thoughts Survey*. Additional information was identified from the *Demographic Data and Technology Experience Questionnaire*. Scores were recorded and compared to the scores for occupational therapy student participants from a previous year referred to as *Other Participants* (n = 30). Analyses of all scores were conducted to investigate correlations amongst the variables.

Evidence from this research was that second year undergraduate occupational therapy students have distinctive characteristics which can impact on learning. Sixty nine percent were under 20 years of age and sixty three percent had used computers at home to assist with their tertiary studies. Very few had accessed the Internet, but almost all had used computers for literature searches and word processing. They had a low perception of their computer knowledge with only 4.5% ranking themselves as above average, but 39% ranking themselves below average. As a measure of cognitive style, this group of occupational therapy student participants demonstrated field-independency and thereby have a tendency to be analytical and impose their own structure on a situation. Both activist and reflective learning styles were prominent in this group and a substantial number displayed low to high technophobia for their thoughts and anxieties about computers. Awareness of these occupational therapy students' attributes can be of benefit to occupational therapy educators, course material designers, and occupational students.

## Chapter 6

### **PARTICIPANTS' NAVIGATION OF THE VOCATIONAL REHABILITATION LEARNING RESOURCE PACKAGE**

#### **6.0 Introduction**

This section reports on the outcomes for the third research question being investigated, *What is the relationship between learner characteristics and navigation performance for the targeted population of occupational therapy students?* This part of the research involved observing participants' navigation patterns as they worked with the computer learning package *Vocational Rehabilitation Learning Resource (VRLR)*. The four groups of exercises observed were categorised as accessing data, exploring *VRLR*, problem-solving and teaching-back to the investigator. These four exercise groups were discussed in detail in Section 4.3.5.

Sixty seven occupational therapy students participated in all four groups of exercises and their navigational responses were recorded on the pre-prepared form, *Observations Recorded* (refer to Appendix M). Measurements were recorded for the number of screens opened and the number of times that assistance was required for all four groups of exercises. In the accessing data and problem-solving exercises, the number of overviews accessed, successful searches, and time for searches also were recorded. With the exploring and teach-back exercise, the variables successful searching and time for searches were not relevant and the number of overviews accessed could be interpreted as participant curiosity rather than seeking help. Video-taping of participants' navigating *VRLR* was conducted as a record of participants' performances, particularly to assist in monitoring information on the range of variables required for the qualitative component of this study. These variables included verbal comments, facial expressions, and any unusual behaviour.

Results of the four groups of exercises are discussed in Sections 6.1.1 to 6.1.4, with the totals for the five navigation variables described in Section 6.2. Section 6.3 displays and describes the correlation matrix for the navigation variables, and in Section 6.4 a matrix is used to display the relationship between the navigation variables and the learner characteristics. Statistical models employed to allow more complex relationships between all of the variables measured are described in Section 6.5. The case study results are reported in Section 6.6.

## **6.1 Navigation Performance Exercises**

### **6.1.1 Exercise 1 - Accessing data from *VRLR***

After the initial introduction to this stage of the research, as described in Chapter 4, all participants were invited to attempt the following exercise utilising *VRLR*:

Open *Vocational Rehabilitation Learning Resource* and enter the *Work Assessment Tools Database*. Select the Valpar 19 assessment tool and answer the following three questions:

- What is the full title of the Valpar #19 assessment tool?
- How long does it take to administer?
- Name one of the three objectives in using this tool

Responses were recorded against five variables for each of the three questions listed above. These were the times taken for searches and the number of successful searches, number of screens opened, number of times the overview sequence was accessed, and the number of times direct assistance was requested.

Just over half the participants (51%) completed all of the searches successfully with only 7% being unsuccessful in completing at least one of the three searches (see Table 6.1). However, a large number of participants (43.5%) failed to complete the

questions within the allocated time. The total number of screens accessed ranged from one participant who opened seven to another who opened 36 screens; over 50% of participants accessed less than a total of 14 screens. The overviews were accessed by nine participants, each on only one occasion. Assistance was requested from the investigator by 35 participants, three of whom made a second request. The mean, standard deviation, maximum and minimum for the 67 participants are presented in Table 6.2.

**Table 6.1. Successful Searches of Occupational Therapy Student Participants Conducted During Accessing Data from VRLR Exercises (n = 67)**

No Searches		One Search		Two Searches		Three Searches	
n	%	n	%	n	%	n	%
5	7.5	10	15	14	21	38	56.5

**Table 6.2. Descriptive Statistics for Variables Measured During Navigation Performance to Access Data from VRLR Exercises (n = 67)**

Navigation Performance	Group Mean	Std. Dev.	Minimum	Maximum
SUCSEAR (successful searches)	2.27	.98	0	3
NOS (number of screens opened)	14.49	5.13	7	36
TIMES (time taken in seconds)*	192.45	53.19	72	240
OVERVW (overviews accessed)	.13	.34	0	1
ASSIST (assistance requested)	.57	.58	0	2

\* 240 seconds maximum time permitted (refer to Chapter 4).

### 6.1.2 Exercise 2 - Exploring VRLR

The second exercise invited participants to browse through VRLR. The duration of

this exploratory exercise was set for four minutes as determined during pilot tests (refer to Chapter 4). The instructions were as follows:

Now spend 4 minutes exploring Vocational Rehabilitation Learning Resource, thinking aloud while you are working. Feel free to open and close screens at will and move between connecting links.

The total number of screens opened ranged from six to 43 (see Table 6.3) with 50% percent of participants opening 24 or less. Only 46% of the participants opened an overview during this exercise and none of these accessed this help feature on more than one occasion (see Table 6.3). All participants had been exposed to the general overview, which serves to explain the overall function of *VRLR*, immediately prior to tackling these exercises as part of the introductory explanation of the research (refer to Appendix L - *Data Collection Protocol*). For those participants who did not access an overview when browsing, the initial (introductory) overview may have served its purpose as an advance organiser or cognitive map showing relationships in the new learning scenarios about to be attempted (Cameron, 1993; Hooper & Hannafin, 1991). Secondly, other participants may have felt it was a useful feature and were curious to explore overview sequences peculiar to specific components of the learning package as part of their *browsing* time allocation devoted to exploration. Thirdly, some participants may have sought help by opening overviews when they were uncertain of the structure and content of component parts of *VRLR*.

**Table 6.3. Descriptive Statistics for the Number of Screens and Overviews Opened Exploring *VRLR* (n = 67)**

No. Accessed	Group Mean	Std. Dev.	Minimum	Maximum
Screens	23.88	8.05	6	43
Overviews	.46	.5	0	1

### 6.1.3 Exercise 3 - Problem-solving

The third exercise involved the use of the problem-solving features of *VRLR* and the questions posed were as follows:

Imagine you are a Case Manager and have just received referral information on a client named 'Susan White'. Access the problem-solving section of *Vocational Rehabilitation Learning Resource* and answer the following questions:

- What was Susan's injury?
- What is her occupation?
- Why would a Social Worker be a useful member of your case team?
- Which three physical demands of this job are most likely to aggravate this type of injury.

All participants successfully completed the first two questions of this problem-solving component of the investigation, but only 25% completed all four questions successfully. Forty eight per cent of participants were successful with three questions and 27% were successful with only two (see Table 6.4).

**Table 6.4. Descriptive Statistics for the Number of Correct Responses When Problem-Solving with *VRLR* for Occupational Therapy Students (n = 67)**

Two Correct		Three Correct		Four Correct	
n	%	n	%	n	%
18	27	32	47	17	25

Fifty two participants took the maximum time or did not complete questions within the four minutes set time for this group of problem-solving exercises. All of these participants were recorded with the maximum time allocation of 240 seconds. Generally, participants did not have any difficulty solving the first two questions, the answers to which were in the first screen accessed when the client's name was selected in the *Case Studies* database of *VRLR* (refer to Chapter 3, Figure 3.23). Questions 3 and 4 required participants to link with the *Job Analysis* database, and to return to *Case Studies* to determine connections between aspects of the job and the

client's history. The total number of screens accessed ranged from two participants who opened eight screens to another who opened 35 screens (see Table 6.5). Fifty percent opened 19 screens or less. Several participants ( $n = 17$ ) accessed the overviews on one occasion each, none viewed the overviews on more than one occasion. Assistance was requested on one occasion each by 27 participants.

The linking between different databases required in Questions 3 and 4 posed problems for some participants and could largely be explained by their limited knowledge with *VRLR* and hypermedia in general. The expectations with these questions was that students would not be expected to retain all the case study details in their heads, but have to move back to the *Case Studies* database periodically to make associations as they browsed the *Job Analysis* database. Additional time allocated to this exercise may have permitted more successful responses.

**Table 6.5. Descriptive Statistics for the Variables Measured During Problem-Solving with *VRLR* ( $n = 67$ )**

Navigation Performance	Mean	Std. Dev.	Minimum	Maximum
SUCSEAR (successful searches)	2.46	.94	2	4
NOS (number of screens opened)	19.64	6.45	8	35
TIMES (time taken in seconds)*	229.25	25.67	139	240
OVERVW (overviews accessed)	.25	.44	0	1
ASSIST (assistance requested)	.40	.49	.00	1

#### 6.1.4 Exercise 4 - Teach-back

In the fourth exercise, participants were requested to demonstrate their knowledge of *VRLR* by instructing the investigator on using the problem-solving features of the program. At the outset, the investigator made the following request:



Now I am going to ask you to imagine that I am new to using *Vocational Rehabilitation Learning Resource* and invite you to instruct me on accessing and using the problem-solving component of this package. Please demonstrate and verbally describe accessing procedures, format and uses of the various components as you proceed.

**Table 6.6. Descriptive Statistics for the Teach-Back of Problem-Solving Component of VRLR (n = 67)**

Number	Mean	Std. Dev.	Minimum	Maximum
Screens	19.51	7.25	2	51
Databases	2.96	1.02	1	5
No. of overviews	.27	.45	0	1

Several participants (27%) accessed one overview while demonstrating, but none accessed an overview more than once (see Table 6.6). Seventy three percent of the participants opened three or less databases during the teach-back session whereas nine percent opened five databases. The number of screens accessed ranged from a total of two screens for one participant to 51 screens for another, with 48% of participants opening a total of 19 screens or less.

With previous exercises, participants had to be mostly prompted to communicate verbally to the investigator what they were doing in attempting to respond to the set questions. This had only limited success which could be explained by any one of the following reasons, either individually or in combination as identified and discussed in Chapters 2 and 4. Many participants started off explaining what they were doing, but gradually forgot to continue talking. Others could have felt uncomfortable speaking their thoughts to the investigator. The degree of cognitive load of grasping the function and content of *VRLR* could limit the ability to also communicate thoughts to the investigator. In this last exercise, teaching-back to the investigator, participants were asked to explain verbally. Although some participants displayed discomfort with this

reversal of teacher/student roles, generally participants communicated understanding of the function and operations of the problem-solving component of *VRLR*. As they were attempting to explain key features, many participants who had been unsuccessful with the previous problem-solving component expressed that they now understood what they should have done to answer the problem-solving questions. This could be explained by the increased contact time with *VRLR*. Another set of problem-solving questions coming after this teach-back session would probably have shown that most participants would have had more successful results with the navigation performance measures used for this feature of *VRLR*. A further reason for participants' generally communicating understanding of the function and operations with teach-back may be explained by participants having to think deeper about the material in order to teach it to the investigator.

## **6.2 Descriptive Statistics for the Summation of Four Exercises for Navigation Performance**

The performance levels of participants on all four groups of navigation exercises are displayed in Table 6.7. Entries are accumulations of successful searches, screens opened, times taken, and number of times overviews and assistance requested. Measurements were totaled for the number of screens opened and the number of times that assistance was required for all four groups of exercises. In the accessing data and problem-solving exercises, the number of overviews accessed, successful searches, and time for searches also were totaled.

The quickest participant at searching took a total of 211 seconds to complete the search questions in the exercises. A substantial number ( $n = 25$ ) used up all the allocated time in their endeavour to successfully complete the exercises. Twenty seven percent of participants never used the overview features in the exercises, whereas nine percent used the overviews on four or more occasions. The number of screens opened varied

**Table 6.7. Descriptive Statistics for the Summation of Four Exercises for Navigation Performance for Occupational Therapy Students(n = 67)**

Navigation Performance	Totals for All Four Groups of Exercises			
	Mean	Std. Dev.	Minimum	Maximum
SUCSEAR (successful searches)	5.25	1.36	2	7
NOS (number of screens opened)	77.52	17.29	41	121
TIMES (time taken in seconds)*	421.70	65.56	211	480
OVERVW (overviews accessed)	1.16	.93	0	3
ASSIST (assistance requested)	1.15	.80	0	3

\* Time recorded for accessing and problem-solving exercises only (480 seconds maximum time permitted).

from a total of 41 to 121. Fifty one percent of participants opened 78 screens or more. Twenty two percent of participants never asked for assistance from the investigator with only three percent asking for assistance on three or more occasions. Fifty percent of participants were successful with five or more searches, with 18% of participants being successful with all seven search tasks. Three participants only managed two successful searches each in this exercise.

The four groups of exercises were designed to cover the range of operations that occupational students would execute, or attempt to execute, using *VRLR* as a learning support tool for the teaching unit Occupational Health 241. With the exception of questions 3 and 4 in the problem-solving group of exercises, as new users, participants were mostly able to find their way around *VRLR* and utilise its key operations with reasonable ease. From a design point of view, the problem-solving component could be better handled by new users if they are advised to access the *Case Studies* overview sequence before attempting investigations. Currently, there is a message on the screen when users open *Case Studies* advising them of the overview

feature and how to access it (refer to Chapter 3, Figure 3.23). This message could be extended and highlighted to recommend that all new users access this help feature before attempting problem-solving tasks.

### 6.3 Correlations Between Navigation Performance Variables

As a preliminary investigation to exploring relationships with learner characteristics, measurement of linear association between the navigation variables was conducted using the *Correlations* procedure of the statistical package SPSS (Norusis, 1992a). All totals of variables identified and measured in Table 6.7 were included in the pairings and illustrated in a matrix of all these correlations (see Table 6.8). The labels used in this table are as specified in Table 6.7.

**Table 6.8. Correlations Matrix for Five Navigation Performance Variables for Occupational Therapy Student Participants (n = 67)**

Variable	SUCSEAR	NOS	TIME	OVERVW	ASSIST
SUCSEAR	1.00	.31 **	-.70 ***	-.34 **	-.30 *
NOS		1.00	-.07	-.21	-.14
TIME			1.00	.21	.30 *
OVERVW				1.00	-.05
ASSIST					1.00

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

Overall, correlations detected were in the directions expected. As illustrated in Table 6.8, there were statistically significant correlations between the number of successful searches and the other four variables. Successful searchers, compared to less successful searchers, accessed more screens ( $p < .01$ ), took less total time to complete searches ( $p < .001$ ), opened less overviews ( $p < .01$ ) and requested less assistance ( $p < .05$ ). There was also a statistically significant positive relationship between the total

time taken and number of times that assistance was requested ( $p < .05$ ). These patterns demonstrate differences in navigation confidence between successful searchers of *VRLR* and their less successful peers.

#### 6.4 Correlations Between Learner Characteristics and Navigation for Occupational Therapy Student Participants

Table 6.9 is a correlation matrix of the 12 learner variables and the five variables of navigation performance shown in Table 6.8. The labels used for the 12 learner variables in Table 6.9 are identified in Chapter 5, Figure 5.1.

**Table 6.9. Correlations Between Learner Characteristics and Navigation for Occupational Therapy Student Participants (n = 67)**

Variables	ASSIST	NOS	OVERVW	SUCSEAR	TIME
ACTIVIST	.12	.24	-.13	.05	.05
AGE	-.09	-.19	-.11	-.22	.22
ANX	.13	-.24	.03	-.05	-.02
COGSTYL	-.28 *	.12	-.16	.23	-.17
COMEXP	-.26 *	-.07	-.17	.03	.06
COMKNOW	-.22	.10	.12	-.02	-.02
GEN	-.18	.04	.06	-.17	.22
PRAG	.01	-.11	.00	-.15	.17
PRIOREXP	-.06	.23	.11	-.11	.17
REFL	-.02	-.15	.22	-.24	.15
THEO	-.08	-.20	.17	-.16	.16
THOUGHT	-.26 *	.10	-.02	.10	-.05

\*  $p < .05$ .

There was a statistically significant relationship ( $p < .05$ ) between the number of times that assistance was requested and cognitive style, computer experience, and computer thoughts. As expected, participants with a tendency towards field-dependent cognitive style were more likely to require assistance at the early stages of working with a learning package such as *VRLR*. Similarly, those with less computer experience and/or negative thoughts on computers were more prone to require assistance. There was no statistically significant differences recorded between any of the four learning style preferences and the five navigation performance variables. Participants with strong preference for activist learning style could have been expected to open more screens as they attempted to perform the four groups of exercises as they “tend to act first and consider the consequences afterwards” (Honey & Mumford, 1992, p. 5). Those with a strong preference for reflector learning style could have been expected to open less screens in the limited time available, as they ponder experiences and delay consequences before acting.

## **6.5 Regression Models**

### **6.5.1 Factor analysis to reduce number of variables**

All but two of the twelve learner characteristics variables were initially collected as interval scales (refer to Chapter 5, Sections 5.1 to 5.7) and therefore were suitable for establishing potential statistical models using multiple regression analysis. The two remaining characteristics of gender and source of learning about computers were excluded from the regression analysis on the grounds that their scores were categorical (see Table 5.12). Because of the large number of learner characteristics, factor analysis techniques were employed in an attempt to simplify description and understanding by reducing the data to a more manageable number of variables. This statistical technique is employed to identify a relatively small number of factors that can be used to represent relations among sets of many variables which may not be observably related (Norusis, 1992c). To enable factor analysis to be conducted, the

additional SPSS module *Professional Statistics* was loaded onto the computer used in this study. Three factors with eigenvalues greater than one were identified and these explained 62.8% of the total variance (see Table 6.10).

**Table 6.10 Eigenvalues and Contributed Variance for the Factor Analysis (Varimax Rotated) of Learner Characteristics for Occupational Therapy Student Participants (n = 67)**

Factor	Eigenvalue	Percentage Of Variance	Cumulative Percentage Of Variance
1	2.82	28.2	28.2
2	2.36	23.6	51.8
3	1.10	11.0	62.8

The results of the factor analysis after rotation and sorting are displayed in Table 6.11 with variable groupings selected shown in bold. The three factors derived contained all of the ten learner characteristics measured in this research and were given the mnemonic labels of *computer confident*, *learning style*, and *cognitive demograph* to describe their component variables.

**Table 6.11. Rotated Factor Matrix of Learner Characteristics with Three Factors Varimax Rotation (n = 67)**

Factor Labels	Variables	Factor Loadings		
		Factor 1	Factor 2	Factor 3
Computer Confident	Comknow	<b>.85</b>	.03	.05
	Thought	<b>.82</b>	.06	-.10
	Priorex	<b>.82</b>	-.04	.18
	Anx	<b>-.74</b>	.00	-.10
Learning Style	Refl	-.04	<b>.85</b>	.12
	Theo	.03	<b>.85</b>	.00
	Prag	.17	<b>.67</b>	.29
	Activis	.10	<b>-.66</b>	.30
Cognitive Demograph	Cogstyl	-.04	-.11	<b>.81</b>
	Age	.19	.25	<b>.53</b>

A correlation matrix presented in Table 6.12 illustrates the relationship between the attributes derived by factor analysis and the navigation variables. The only correlation significant above the .05 level was for number of screens opened (NOS) and *learning style* (FACTOR 2) which was negative. Although none of the contributing variables of FACTOR 2 were individually statistically significantly correlated to the number of screens opened (see Table 6.9), activist learning style was almost significantly correlated at the 0.05 level. The other three contributing variables (i.e., pragmatist, reflector, and theorist learning styles) were all negative in their relationships suggesting that individuals with low combined scores for these learner characteristics were likely to open many screens.

**Table 6.12. Correlation Matrix of Learner Characteristics Factors and Navigation Performance (n = 67)**

Variables	ASSIST	NOS	OVERVW	SUCSEAR	TIME
FACTOR 1	-.17	.19	.06	-.01	.05
FACTOR 2	.16	-.25*	.18	-.23	.16
FACTOR 3	-.16	.04	-.19	.02	-.05

\*  $p < 0.05$

The last step in the analysis was to relate the three derived factors to the dependent variables, the navigation performance scores, in a multiple linear regression analysis. This procedure was to see which, if any, of the four learner characteristics factors predicted the five navigation variables scores for the number of successful searches, number of screens opened, time taken, number of times assistance requested, and number of overviews opened.



### 6.5.2 Multiple Linear Regression Analysis

Multiple linear regression analysis is possible with SPSS using alternative methods of entering the variables. According to Norusis (1992a) “none of these variable selection procedures is ‘best’ in any absolute sense; they merely identify subsets of variables that --- are good predictors of the dependent variable” (p. 329). Attempts were made with stepwise, forward selection and backward elimination procedures and acceptance into the regression analysis was set so that only these factors which fell within a probability tolerance range of F-to-enter value of .05 and F-to-remove value of .10.

The only correlation coefficient significant above the .05 level for all three methods of entry attempted was for the independent variable, number of screens opened (NOS) and the factor *learning style* which is consistent with the correlation matrix (see Table 6.12). This correlation provided a small degree of prediction in a backward regression, explaining four percent of the variance (adjusted R-squared value = .04). The F-ratio of 4.46 was statistically significant ( $p < .05$ ) giving a predictor equation of:

$$\text{NOS} = 77.52 - 4.40 (\text{Learning Style}).$$

Stepwise and forward selection methods of variable entry were attempted and the models derived for NOS were almost identical to the above. Because of the low percentage of variance explained by these models, it was decided that this use of factor analysis could not provide meaningful clusters of variables which could be used to usefully describe and understand users’ navigation of *VRLR*.

To investigate potentially more significant regression models, it was decided to attempt entering all variables into a multiple regression analysis. This was justified by the significant relationships between variables demonstrated in the correlation matrices above (see Tables 5.12, 6.8, and 6.9). All of the five dependent navigation variables (see Table 6.2) were in turn entered into backward elimination multiple regression

with the ten independent learner characteristic variables (refer to Section 6.5.1). The same criteria of entering variables into the regression was applied as above. Table 6.13 illustrates the results.

**Table 6.13. Best Predictors of Occupational Therapy Student Participants' Navigation Performance Using Multiple Regression Analysis (n = 67)**

Dependent Variable	Independent Variables	Beta-Standardised Regression Coefficient	Adjusted R-Squared	F Ratio	Significance (F)
ASSIST	COGSTYL	-.29	.14	5.68	.005 **
	THOUGHT	-.27			
NOS	ACTIVIST	.21	.10	3.58	.019 *
	AGE	-.21			
	ANX	-.24			
OVERVW	REFL	.22	.03	3.33	.073
SUCSEAR	AGE	-.25	.17	3.69	.006 **
	COGSTYL	.32			
	PRIOREXP	-.19			
	REFL	.31			
	THOUGHT	-.28			
TIME	AGE	.26	.14	3.70	.009 **
	COGSTYL	-.26			
	COMKNOW	-.41			
	PRIOREXP	.49			

\* p < .05, \*\* p < .01, \*\*\* p < .001

The analysis in Table 6.13 identified statistically significant models for four of the five dependent navigation variations. Of the independent variables, age, cognitive style, computer thoughts, and prior computer experience all occurred in two or more of the statistically significant models. The model equations were as indicated in Figure 6.1, each of which is discussed in turn below in sections 6.5.3 to 6.5.7 and tested with actual participant results (refer to Appendix P).

- ASSIST = 4.24 - .07 COGSTYL - .02 THOUGHT
- NOS = 86.62 + 1.13 ACTIVIST - 5.34 AGE - .33 ANX
- SUCSEAR = 6.16 - .49 AGE + .12 COGSTYL -.08 REFL +  
.03 THOUGHT -.09 PRIOREXP
- TIME = 294.21 + 25.17 AGE - 4.81 COGSTYL - 33.06 COMKNOW + 7.59  
PRIOREXP

**Figure 6.1. Multiple Linear Regression Models for Learner Characteristics and Navigation of Occupational Therapy Students (n = 67)**

### **6.5.3 Number of Times Assistance Requested Model (ASSIST)**

The independent variables, cognitive style and computer thoughts in combination explained 14% of the variance for the number of times assistance was requested. These two variables, each of which correlated significantly with the number of times assistance was requested in the correlational matrix (see Table 6.9), appeared as the main effect (Katz, 1990). When these two learner characteristic variables were examined separately for correlations (see Table 5.12) there were no statistically significant relationships. It therefore appears that there is a spurious relationship between these variables, that is they are related, but only through a common cause (Jaccard, Turrisi, & Wan, 1990).

The model suggests that occupational therapy student users of the *VRLR* learning package, who have a combination of the learner characteristics of field dependency cognitive style (-.07COGSTYL), and negative thoughts about computers

(-.02THOUGHT) will require more assistance, at least during the early stages of usage.

#### **6.5.4 Number of Screens Opened Model (NOS)**

Activist learning style, age and computer anxiety in combination explained 10% of the variance for the number of screens entered. Comparisons with the correlation matrix (see Table 6.9) illustrate that none of these three learner variables are significantly related to the number of screens opened, but that activist learning style appears as the main effect ( $p = .06$ ). When these three learner characteristic variables were examined for correlations (see Table 5.12) there were no statistically significant relationships, again suggesting that they come together only under a common cause. The strength of the above multiple regression model (10% of the variance) suggests that younger, more activist learners with less computer anxiety are liable to open more computer screens.

#### **6.5.5 Number of Overviews Opened Model (OVERVW)**

The best model achieved for the number of overviews opened explained only 3% of the variance and was not statistically significant. This independent variable in this model was Reflector learning style. With only four minutes allocated to each group of navigation tasks, it is likely that some participants were hesitant in accessing the *Overview* button through lack of confidence or alternatively, some may have felt there was no need to access it.

#### **6.5.6 Number of Successful Searches Model (SUCSEAR)**

Age, cognitive style, reflector learning style, computer thoughts and prior computer experience in combination explained 17% of the variance for the number of successful searches. Reflector learning style appeared to be the main effect in this model

(according to the correlation matrix Table 6.9), with a negative correlation of  $p = .050$  (just outside the significance level) with the number of successful searches. Correlations within the learner characteristics identified only one significant pairing, age and computer thoughts. Older participants had less negative computer thoughts ( $p = .041$ ). The analysis of this model appears more complex, with a direct causal relationship apparent between low reflector learning style and successful searches. The relationship between age and negative thoughts about computers may demonstrate a moderating influence on reflector learning style (Jaccard, Turrisi, & Wan, 1990). This model generated by backward elimination multiple regression suggests that younger students, with positive thoughts about computers, field independent cognitive style and scoring low in reflective learning style perform well with search and problem-solving tasks using *VRLR*.

#### **6.5.7 Total Time Taken Model (TIME)**

Age, cognitive style, computer knowledge and prior computer experience in combination explained 14% of the variance for the time taken for searches. No significant correlations were determined between these learner characteristics and time taken to complete search and problem-solving exercises with *VRLR* (see Table 6.9), although there was a positive relationship between the learner characteristics of perceived computer knowledge and prior computer experience. This relationship may act as a moderating influence on the other variables which together influence the time taken to successfully search and problem-solve with *VRLR*.

### **6.6 Case Studies and Navigation**

Selection criteria for case studies were described in Chapter 4, section 4.5.4. Three of these cases, based on navigating performance with *VRLR*, were chosen for demonstrating differences reported in this chapter.

- Case 1 was the top scoring participant for navigation
- Case 2 was the average scoring participant for navigation
- Case 3 was the bottom scoring participant for navigation

In Table 6.14 scores for these three cases are presented for comparisons for learner characteristics with navigation performance. The most effective navigator, Case 1 (top navigator), completed all seven searches successfully in 279 seconds, opening 93 screens without asking for assistance or using the overviews. The least effective navigator, Case 3, in contrast successfully completed 2 searches, opened 79 screens using the maximum time set (480 seconds). This participant asked for assistance on 5 occasions, twice during the first part of question one where she also opened the overview sequence on two occasions.

The bottom three rows of Table 6.14 state the maximum, minimum, and mean scores for the *Completed Study* group ( $n = 67$ ) as a whole. Learner characteristics profiles are summarised below of the two extreme cases for navigation performance, Case 1 and Case 3, and the participant nearest the mean, Case 2:

#### CASE 1

This participant was female, aged between 20-25, with her greatest amount of computer experience being gained through technical and further education. She scored high for the Activist dimension of the *Learning Style Questionnaire*, but was below average for the group for Pragmatist, Reflector and Theorist dimensions. Her field dependency/field independency score was on the group mean for the *Group Embedded Figures Test*. She recorded no technophobia on the measuring instruments used (Rosen & Weil, 1992), scored highest, of the participants as a whole, for positive thoughts about computers and below average for computer anxiety. Her perception of her computer knowledge and her previous computer experiences rated her amongst the highest scoring.

## CASE 2

This participant was aged between 20-25, female, and selected the 'Other' category for where her main computer learning experiences had been developed. She had the lowest score for prior computer experience and scored in the lowest category for self-perception of her knowledge of computers compared to her peers. In addition, Case 2 demonstrated a significant amount of technophobia, particularly computer anxiety. This indicates that her previous computer experience had been minimal. She scored above the mean for Reflector and Theorist learning style, but marginally below the mean for Activist and Pragmatist learning style and demonstrated a high degree of field-dependency cognitive style.

## CASE 3

This participant was female, aged 20 or under, whose experience with computers had mostly occurred at home. On the *Participant Style Questionnaire*, she scored above average for reflector and theorist, average for activist, and below average for pragmatist. Her field dependency/field independency score was on the group mean for the *Group Embedded Figures Test*. She had a low level of technophobia for computer anxiety and a moderate to high level for computer thoughts. Her perception of her computer knowledge compared to her peers was above average, being only one point below Case 1, the best navigator. For level of previous computer experiences, Case 3 rated above average for the group.

Interestingly, Cases 1 and 3 both scored the same or almost the same for the field-dependency/field-independency measure of cognitive style, perceived computer knowledge and pragmatist measure of learning style. Case 1 had low computer anxiety and scored high for positive computer thoughts, the highest score of all participants. On the other hand, Case 3 registered technophobic scores for both of

Table 6.14. Learner Characteristics Scores and Navigation Performance of Case Studies (n = 3)

CASE No.	Learner Characteristics											Navigation						
	ACTIVIST	AGE	ANX	COGSTYL	COMEXP	COMKNOW	GEN	FRAG	PRIOREXP	REFL	THEO	THOUGHT	ANSTT	POS	MOV	ST	CL	EXP
1	15	20-25	29	15	TAFE	37	fem.	9	4	10	10	99	3	93	1	1	1	279
2	9	20-25	60	8	other	23	fem.	10	1	16	14	78	2	51	1	1	1	380
3	10	<20	46	15	home	36	fem.	9	3	16	13	49	3	70	2	2	2	360
max*	18		80	18		42		18	5	19	19	99	3	93	1	1	1	380
min*	4		20	5		23		4	1	4	2	34	0	0	0	0	0	211
mean*	10.3		40.1	14.8		32.6		11.1	2.6	11.1	11	65.3	2.3	70.5	1.3	1.3	1.3	301.7

Note \* indicates group score



these measures. Case 1 had a very strong preference for activist learning style and a low preference for reflector learning style. The reverse was the situation for Case No. 3 who had a strong preference for reflector learning style, but a moderate preference for active learning style. Case 2 demonstrated considerable low esteem in perception of computer knowledge, moderate to high technophobia, and limited experience with computers, but scored the nearest to the mean for navigation. In addition, this participant scored 24 for attitude towards VRLR, which was close to the group mean (refer to Chapter 7, Figure 7.9). These somewhat conflicting results for Case 2 indicate the value of in-depth qualitative studies in our quest for understanding of interactive multimedia learning and are discussed in Chapter 8, Section 8.7.4.

In Chapter 5, it was noted that there appeared to be two distinctive learning styles which were strongly represented within the student therapist population in this study. These were *activist* and *reflector* and this is highlighted in the two case studies illustrating extremes of navigation performance. From the models developed and illustrated in Table 6.13, activist or reflector learning styles were evident as a variable in three of these: number of screens opened, number of successful searches, and number of overviews opened. However, these two variables were also significant, or near significance in the correlation matrix as shown in Table 6.9. Activist learners tended to open more screens in general, but use less overview screens than reflective learners. Case 3 asked for assistance on five occasions whereas Case 1 never asked for assistance, but there did not appear to be any general significance between these two learning style groups for number of times assistance requested.

## 6.7 Summary of Chapter

Sixty seven participants were observed as they proceeded through a series of exercises navigating *VRLR*. These four exercises involved accessing data, exploring, problem-solving and teaching-back. Totals for these exercises were recorded for the number of

successful searches, number of screens opened, time taken, number of times assistance requested, and number of overviews opened. The number of successful searches was significantly correlated with 1) number of screens opened, 2) total time taken, 3) number of overviews accessed, and 4) the number of times assistance was requested (refer to Table 6.8).

Multiple regression analysis was conducted and five statistical models produced which can provide assistance in explaining relationships between learners' characteristics and navigation performance with interactive multimedia packages such as *VRLR*. Four of these models were statistically significant accounting for between 10% and 17% of variance. Particularly interesting is activist and reflective learning styles, both being prominent in this study's population, and their influence on navigation. Information from case studies was collated to allow qualitative analysis to be conducted on special cases.

Chapter 7 investigates relationships between attitude towards *VRLR*, learner characteristics and navigation performance. Correlation matrices are initially employed to identify significant pairs of variables before investigating multiple linear regression models between the learner characteristics and navigation performance as independent variables and the attitude towards *VRLR* as the dependent variable.

## Chapter 7

### **PARTICIPANTS' ATTITUDE TO THE VOCATIONAL REHABILITATION LEARNING RESOURCE PACKAGE**

#### **7.0 Introduction**

This chapter reports on the outcomes for the fourth research question being investigated, *What is the relationship between learner characteristics, navigation performance and attitudes for the targeted population of occupational therapy students?* This research involved collating the results of the *VRLR - User Attitude Questionnaire* (refer to Appendix D) and comparing them with results from the learner characteristics and navigation components previously measured and reported in Chapters 5 and 6.

In Section 7.1 of this chapter, the results from the *VRLR - User Attitude Questionnaire* are tabulated and discussed. A correlation matrix is used in Section 7.2 to show any significant relationships between participants' learner characteristics and attitudes to *VRLR*. This is followed, in Section 7.3, by a report and discussion on participants' navigation performance variables and their attitudes towards the learning package. Multiple regression analysis was employed to report significant statistical models, in Section 7.4 which may predict relationships between participants' attitudes and their learner characteristics and navigation performance variables. Qualitative results are reported, in Section 7.5, on attitudes and their relationship to the other variables measured in this research by displaying and discussing the detailed data from the population of six case studies.

#### **7.1 Results from Participants' Attitude Questionnaire**

The *VRLR - User Attitude Questionnaire* asked six questions relating to participants' perception of the *user friendliness* of *VRLR*. Participants were asked to rate each

response on a nine-point Likert scale, with a comments box underneath where they were invited to elaborate. The questions related to the following features: ease of use, navigation, cognitive load, screen design, video sequences, and media integration. The Cronbach alpha reliability index for the six-question instrument was .47. In the response box to question six on media integration, the scoring options were laid out with the most negative rating at the extreme left hand side with the most positive at the extreme right hand side (see Appendix D). This was the reverse of the scoring options with the other five questions and as a consequence some participants may have incorrectly responded to this question. The Cronbach alpha reliability index for this instrument, minus the question on media integration, was .68. When question 5, video sequences, was also removed from the instrument further improvements to reliability were achieved with Cronbach alpha index measuring .78. In order to minimise the risk of the instrument unreliability, it was decided to count only the responses to the first four questions in the *VRLR - User Attitude Questionnaire*.

**Table 7.1. Descriptive Statistics for the Attitudes to the VRLR Survey of Occupational Therapy Student Participants (n = 67)**

Ques. No.	Feature	Mean	Std. Dev.	Max.	Min.
1	Ease of use	6.28	1.61	9	2
2	Navigation	6.24	1.60	9	3
3	Cognitive load	6.58	1.34	9	3
4	Screen design	7.45	.96	9	4
Total		6.64	1.34	9	3

Generally, attitudes were positive towards the *usability* of the package *VRLR*. The question which elicited the highest response score was Question 4 (*Screen Design*), where 91% of participants scored seven or more on the Likert scale. The least positive

response was to Question 2 (*Navigation*) where 50.8% of participants scored seven or more on the Likert scale (see Table 7.1).

## 7.2 Correlations Between Attitudes to *VRLR* and Learner Characteristics

Table 7.2 is a correlation matrix of the twelve learner characteristics variables and the variable, attitude to *VRLR*. The attitude score (ATTITUDE) is the sum of the scores to Questions 1-4 in the *VRLR - User Attitude Questionnaire* (see Appendix D). The labels used for the 12 independent learner characteristics variables are described in Chapter 5, Figure 5.1.

**Table 7.2. Correlation Matrix of Attitude to *VRLR* and Learner Characteristics (n = 67)**

Dependent Variable	Learner Characteristics					
	ACTIVIST	AGE	ANX	COGSTYL	COMEXP	COMKNOW
ATTITUDE	-.24 *	-.08	-.24 *	.18	.19	.24 *

Dependent Variable	Learner Characteristics (Cont.)					
	GEN	PRAG	PRIOREXP	REFL	THEO	THOUGHT
ATTITUDE	.06	-.16	.24 *	.01	.05	.37 **

\* p <.05, \*\*p <.01

Participants' attitude having a significant negative correlation with activist learning style (p < .05) was not expected as activists were anticipated to be more enthusiastic.

According to Honey & Mumford 1992, activist learners:

involve themselves fully and without bias in new experiences. They enjoy the here and now and are happy to be dominated by immediate experiences. They

are open-minded, not sceptical, and this tends to make them enthusiastic about anything new. (p.5)

Participants scoring highly for *Activist* could have been expected to have an advantage when working with *VRLR* for the first time, where the learning material is largely self-explanatory. One possible explanation for this result was the fact that the investigator was largely directing the sequences to be used and the times set, thereby frustrating the activist who would prefer to investigate using his/her own inclinations.

Positive computer thoughts ( $p < 0.01$ ) and low computer anxiety ( $P < .05$ ) were also significantly related to attitude. This response is more or less what would be expected with those participants who are at ease with this technology being more positive in their attitude towards *VRLR*. Participants' perception of their computer knowledge and prior computer experience also were statistically significantly related to attitude ( $P < 0.05$ ).

### 7.3 Correlation Matrix Between Attitudes and Navigation

The labels used for the five navigation variables are described in Chapter 6, Table 6.2. Three navigation procedures were statistically significantly correlated to attitude to *VRLR*, one of which at a probability level less than .01 (see Table 7.3). Attitude was

**Table 7.3. Correlation Matrix of Participants' Navigation Performance and Attitudes Towards *VRLR* (n = 67)**

Dependent Variable	Navigation Procedures				
	ASSIST	NOS	OVERVW	SUCSEAR	TIMES
ATTITUDE	.27 *	.09	-.12	.35 **	-.31 *

\*  $p < .05$ , \*\*  $p < .01$

significantly correlated to the number of successful searches ( $p < 0.01$ ), time taken for searching ( $p < .05$ ) and number of times assistance requested ( $p < 0.05$ ).

During the navigation of the *VRLR* phase of this research, participants' success in searching and problem-solving was acknowledged by the timer being stopped and a verbal response by the investigator of 'Yes' and/or a nod of the head. This feedback, given when participants' search or problem-solving produced the correct result, would serve to impact on participants' attitude to *VRLR*. This outcome emphasises the importance, especially when introducing new teaching technologies, to structure early exercises so that students have the opportunity of being successful and be acknowledged as being successful (Fraser, Walberg, Welch & Hattie, 1987; Skinner, 1984). The number of times assistance was required was correlated negatively to attitudes ( $p < 0.05$ ), implying that participants who asked more for assistance were likely to have a less positive attitude towards *VRLR*.

#### **7.4 Regression Models With Participants' Attitude Variable**

Attempts were made to establish if there were any significant relationships between participants' attitude to *VRLR* and groupings of learner characteristics variables and navigation variables. Multiple regression models were attempted, firstly using the factor analysis as described in Chapter 6. The learner characteristics of gender and source of learning about computers were excluded from the regression analysis on the grounds that their scores were categorical and in addition there was no statistical significant correlations between them and attitude towards *VRLR* (see Table 5.12). Fifteen variables, comprised of 10 learner characteristics and the five navigation measurements, were entered into a factor analysis in an attempt to reduce the number of variables. Six factors with eigenvalues greater than one were identified by varimax rotation (see Table 7.4).

**Table 7.4. Factor Analysis (Varimax Rotated) of Learner Characteristics and Navigation for Occupational Therapy Student Participants (n = 67)**

Factor	Eigenvalue	Percentage Of Variance	Cumulative Percentage Of Variance
1	2.96	19.7	19.7
2	2.88	19.1	38.8
3	1.88	12.5	51.4
4	1.27	8.5	59.9
5	1.12	7.5	67.4
6	1.03	6.9	74.2

The results of the factor analysis after rotation and sorting are displayed in Table 7.5. The six factors derived contained all of the 15 variables entered and were given the mnemonic labels of *computer confident 2*, *learning style 2*, *navigator*, *overview*, *screen age*, and *cognitive*. A correlation matrix presented in Table 7.6 illustrates the relationship between the attributes derived by factor analysis and learner and navigation variables. The only correlation which was statistically significant was for attitudes towards *VRLR* and *navigator* (FACTOR 3). The variables which make up FACTOR 3 were all statistically significantly correlated (see Table 7.3).

When attitude towards *VRLR* was entered into a multiple regression analysis with these six factors, a weak model was derived for the *navigation* factor (FACTOR 3). The adjusted R squared value was 0.31 with a significance  $F < .001$ . The three variables which make up FACTOR 3 were all statistically significantly correlated with attitude towards *VRLR* (see Table 7.3) and there was also significant correlation between them (refer to Table 6.8). These results suggest that the three navigation variables impact both as *direct* and *indirect* effects (Cohen & Cohen, 1983).



**Table 7.5. Rotated Factor Matrix of Learner Characteristics and Navigation with Six Factors Varimax rotated (n = 67)**

Factor Labels	Var.	Factor Loadings					
		FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6
COMPUTER	COMKNOW	<b>.84</b>	.003	-.01	-.15	-.07	.05
CONFIDENT 2	THOUGHT	<b>.82</b>	.01	-.22	.02	-.25	-.15
	PRIOREXP	<b>.81</b>	-.01	.24	-.10	.17	.20
	ANX	<b>-.74</b>	-.07	-.002	-.21	-.15	-.01
LEARNING	THEO	.02	<b>.87</b>	.10	-.05	.05	-.07
STYLE 2	REFL	-.02	<b>.82</b>	.09	-.19	-.14	.12
	PRAG	.19	<b>.71</b>	.19	.32	-.09	.02
	ACTIVIST	.11	<b>-.60</b>	-.30	.35	.19	.12
NAVIGATOR	TIME	.05	.09	<b>.86</b>	-.07	-.09	-.04
	SUCSEAR	.01	-.12	<b>-.81</b>	.28	.24	.12
	ASSIST	-.24	.01	<b>.51</b>	.24	.20	-.49
OVERVIEW	OVERVW	.08	.11	.24	<b>-.83</b>	.04	-.04
SCREEN AGE	AGE	.20	.12	.22	.30	<b>-.77</b>	.22
	NOS	.26	-.14	-.09	.27	<b>.64</b>	.23
COGNITIVE	COGSTYL	-.20	.01	-.10	.10	.05	<b>.89</b>

**Table 7.6. Correlation Matrix - Learner Characteristics/ Navigation Performance and Attitude Towards VRLR (n = 67)**

VARIABLE	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6
ATTITUDE	.15	.05	-.57 ***	-.11	.02	.06

\*\*\* P < .001

FACTOR 3 was compiled of the navigation variables time to search, number of successful searches, and number of times that assistance was requested. As it did not include any of the learner characteristics measured in Chapter 5, it can be presumed that performance navigating can have a stronger influence in forming a statistically significant model for attitude to VRLR than learner characteristic variables measured in this research.

As with the statistical models developed in Chapter 6, it was decided to investigate other potential regression models which related to the learner characteristics and navigation performance variables. This was attempted firstly by investigating for any significant statistical models between attitude to VRLR and the 10 learner characteristics variables employed in Section 6.5. These were entered independently into a multiple regression analysis (see Table 7.7).

**Table 7.7. Learner Characteristics/Attitude Towards VRLR Regression Model (n = 67)**

Dependent Variable	Independent Variables	Standardised Regression Coefficient (Beta)	Adjusted R Squared	F Ratio	Significance (F)
ATTITUDE	ACTIVIST	-.32	.22	5.52	.0007 ***
	COGSTYL	.18			
	PRAG	-.29			
	THOUGHT	.28			

The independent variables activist learning style, cognitive style, pragmatist learning style, and computer thoughts in combination explained 22% of the variance for participants' attitude to *VRLR* (see Table 7.7). The predictor equation was:

$$\text{ATTITUDE} = 26.99 - .43\text{ACTIVIST} + .21\text{COGSTYL} - .43\text{PRAG} + .09\text{THOUGHT}$$

Both activist and computer thoughts were significantly independently correlated to attitude (see Table 7.2), although cognitive style and pragmatist were not. This suggests that low activist learning style and positive computer thoughts have both *direct* and *indirect* impact on attitudes with additional *spurious* interactive effects of field independency and low pragmatist learning style (Cohen & Cohen, 1983).

The navigation performance variables were added to the learner characteristic variables and subjected to multiple regression analysis in an attempt to create a predictor combination of variables which formed a statistical model explaining (or partially explaining) attitude to *VRLR*. The independent variables activist learning style, pragmatist learning style, computer anxiety, and number of successful searches in combination explained 38% of the variance for participants' attitude to *VRLR* (see Table 7.8). All other variables were not accepted into the regression analysis under the probability tolerance range of F-to-enter value of .05 and F-to-remove value of .10. The predictor equation was:

$$\text{ATTITUDE} = 31.39 - .52\text{ACTIVIST} - .37\text{PRAG} - .07\text{ANX} + 1.43\text{SUCSEAR}$$

The number of successful searches (SUCSEAR) was highly significant within this model, but none of the other navigation performance variables were included. None of the three learner characteristics in this model were correlated to the number of successful searches (see Chapter 6, Table 6.9). Activist and pragmatist learning styles were both negatively related as was computer anxiety (see Table 7.3). In the

correlation matrix in Chapter 5, computer anxiety was significantly correlated with pragmatist learning style (see Table 5.12).

**Table 7.8. Learner Characteristics, Navigation Performance Predictors With Attitude Towards *VRLR* Regression Model (n = 67)**

Dependent Variable	Independent Variables	Standardised Regression Coefficient (Beta)	Adjusted R Squared	F Ratio	Significance (F)
ATTITUDE	ACTIVIST	-.39	.38	11.07	.000 ***
	PRAG	-.25			
	ANX	-.20			
	SUCSEAR	.45			

### 7.5 Case Studies and Attitude Towards *VRLR*

The six case studies were selected as described in Chapter 4, with Case 4 being the highest, Case 5 being the mean, and Case 6 the lowest scoring participants respectively in their attitude scores towards *VRLR* (see Table 7.9). Table 7.1 illustrates the range of attitudes towards *VRLR* scores for the entire group.

Case 6 scored 30 (the minimum) out of a possible maximum of 54 for positive attitude towards *VRLR*. This was a similar score to four other participants, but Case 6 scored lower than these four others in an attitude questionnaire for a concurrent study introduced in Chapter 8 and described in Appendix O that involved the same participants (n = 67) carrying out a number of tasks accessing material related to occupational therapy on the World Wide Web.

When attempting the exercises involving *VRLR*, Case 6 had four successful searches completed within the time limit and opened a total of 50 screens. Case 6 requested

**Table 7.9. Learner Characteristics Scores, Navigation Performance, and Attitude Towards VRLR of Case Studies (n = 3)**

Case	LEARNER CHARACTERISTICS														NAVIGATION					ATTITUDE
	ACTIVIST	AGE	ANX	COGSTYL	COMEXP	COMKNOW	GEN	PRAG	PROBEXP	REFL	THEO	THOUGHT	ASSIST	NOS	OVERVW	SUCSEAR	TIMES			
4	9	<20	41	15	home	3	F	10	34	16	11	75	1	120	0	7	474			
5	13	<20	30	18	year 12	2	M	8	35	11	9	49	2	89	0	6	480			
6	12	<20	46	16	year<11	24	F	12	33	14	15	65	4	50	4	4	480			
Max.*	18		80	18		42		18	5	19	19	99	4	121	4	7	480			
Min.*	4		20	5		23		4	1	4	2	34	0	41	0	2	211			
Mean*	10.28		40.12	14.82		32.55		11.07	2.57	11.07	11.01	65.25	2.16	77.52	2.16	5.25	421.7			

Note \* indicates group scores

assistance and opened overviews on four occasions each, which was the maximum scored for both of these navigation performance measures for the entire participant group ( $n = 67$ ). Case 4, the highest scoring for positive attitude towards *VRLR*, completed all seven searches successfully in 474 seconds and opened 120 screens. This participant did not open any overviews and requested assistance only once. The participant scoring closest to the mean for attitude to *VRLR*, Case 5, completed six successful searches and did not open any overviews. He requested assistance twice and opened 89 screens, which was 11 more than the mean score for this feature.

The contrast between the two extreme participants for attitude towards *VRLR* can be further examined by comparing the *Observation Fieldnotes* (Appendices X & Y). Case 6 displayed what appeared to be several negative reactions, such as shaking her head, head scratching, touching her face with her hand, raising eyebrows, sighing, and hesitant mouse movements. She had to be prompted throughout, failed to verbalise her actions as requested, and displayed a lack of understanding of buttons and functions. For instance, on several occasions she double clicked the mouse button which caused the program to jump ahead one screen further than intended. The lack of confidence displayed and lack of apparent familiarity with basic computer functions did not equate with this participant's perception of her own computer knowledge and prior computer experience where she scored just above the group mean for both of these measured variables (see Chapter 5, Table 5.13).

Case 4 also scored just above the group mean for participant's perception of computer knowledge and prior computer experience, but in contrast appeared to quickly grasp the function and navigation operations of *VRLR*. She initially asked the investigator several questions and frequently nodded her head to responses and prompts with only occasional signs of negative reactions such as shaking her head and scratching her eyebrows. Her degree of verbalisation explaining her actions was limited and took the form of a range of questions which was difficult, in many instance, to ascertain if they

were self-directed or aimed at the investigator. Typical of these questions were “Can you access these (*Resource Databases*) without going through the Case Studies?” In most of these occasions she solved her immediate dilemma herself, before the investigator had a chance to respond, by responding to these ‘prompts’ either verbally or in actions which demonstrated her understanding. The improvement in her understanding was very marked during the final Teach-Back scenario where she confidently displayed a high level of understanding by her quick and thorough demonstration of the problem-solving section of *VRLR* to the investigator. She also demonstrated her enthusiasm during this last section when she asked if *VRLR* would be available for participants to use.

Both of the extreme cases for attitude towards *VRLR* displayed a tendency towards field-independence cognitive style. Case 6’s learning style score was above the group mean for all four measures. She displayed strong preferences towards activist (12) and theorist (15), and moderate preference for pragmatist (12) and reflector (14) learning styles (refer to Table 4.2). These scores display a balanced range of learning preferences with the potential to utilise a range of learning strategies to suit different situations (Honey & Mumford, 1992). Case 4 had a strong preference for reflector learning style (16), moderate for activist (9) and theorist (11), and low for pragmatist (10) (refer to Table 4.1). Case 6 displayed low technophobia for both computer anxiety (46) and computer thoughts (65), whereas Case 4 displayed no technophobia for either computer anxiety (41) or computer thoughts (75) respectively (see Table 4.4).

## **7.6 Summary of Chapter**

In this research, all 67 participants completed the *VRLR - User Attitude Questionnaire*, which was designed to elicit information on users’ perception of the design and ease of use of *VRLR*. The results of this questionnaire were examined in this chapter and

statistically significant relationships investigated between these and participants' performance with other activities associated with this research and reported in Chapters 5 and 6. These other activities included technological experience, learner characteristics, degree of technophobia, and navigation patterns using *VRLR*.

Generally, the participants demonstrated a positive attitude towards this interactive, problem-solving package. On a nine-point Likert scale, the mean score for all questions was 6.64 (refer to Table 7.1 and Appendix D). Correlations were scrutinised for significance between attitude, navigation performance and learner characteristics variables. Participants' attitude had a significant negative relationship with activist learning style and was positively correlated with computer thoughts, low computer anxiety, prior computer experience and perception of computer knowledge.

Multiple regression models were developed which indicated that activist and pragmatist learning styles, computer thoughts, computer anxiety, and number of successful searches all play an interactive part in influencing attitude towards *VRLR*. Information from case studies was collated to allow qualitative analysis to be conducted on special cases. In the next chapter the entire study will be reviewed, conclusions drawn and recommendations made.



## Chapter 8

### SUMMARY AND CONCLUSIONS

Section 8.1 of this chapter is a recapitulation of the rationale, methodology, and goals of the study. In Sections 8.2 to 8.4, discussions on the results and interpretations of the findings that were presented in Chapters 5 to 7 are overviewed. Section 8.5 critically examines the research reported in this thesis, identifies limitations, and briefly reports on a follow-up study with the same participants ( $n = 67$ ), investigating their navigation performance accessing the World Wide Web. Section 8.6 looks at the implications of this study and makes some recommendations in regard to the general direction of future research in this area.

#### 8.1 Summary of the Study

This study was prompted by the planned introduction of an interactive, problem-based multimedia learning package into the curriculum at the School of Occupational Therapy, Curtin University of Technology. In a self-directed, interactive learning situation, new users may be faced with a number of challenges as they navigate through the system and attempt to make its structure and contents meaningful. Not only must learners gain knowledge of new content matter, but they must also master the interactive technology.

As individuals initially access and use multimedia learning systems, they strive to understand its structure, content and function based on their previous experience and their cognitive processing characteristics. Consequently, developers of multimedia learning packages could benefit from knowledge of the intended users' characteristics that influence learning, thereby assisting in selection of features which could be incorporated to promote effective learning.

The introduction of the learning package *Vocational Rehabilitation Learning Resource (VRLR)* into the occupational therapy curriculum was treated as a case study in this research. The investigator examined the relationship between subjects' performance with this new teaching/learning initiative and the subjects' characteristics which impact on learning. This 'case study' approach allowed a comprehensive research strategy to be employed investigating a variety of evidence. Predominantly quantitative methodologies were used with purposeful sampling utilised to illustrate qualitative information on the characteristics and performances of some of the participants.

The design of the study was *ex post facto* as the causative relationship between the variables being measured was not clear. A co-relational approach was employed, involving the collection of multiple sets of data from a group of subjects in an attempt to determine subsequent relationships between these sets of data. There was no control group. The variables measured included learner characteristics, their navigation performance, and their attitudes.

The processes of iterative field testing, feedback, and revision have been undertaken in developing the interactive media learning package *VRLR*. This has been implemented as part of curriculum development with careful considerations of proven behavioural, cognitive and constructivist principles with a view to maximising the learning achieved.

This study had five main stages (refer to Figure 4.1). Firstly, the design, development and formative evaluation of a problem-based learning package (*VRLR*) as described in Chapter 3. The second stage was the collection of data on learner characteristics and stage three was the observation of participants' navigation patterns as they explored and problem-solved with *VRLR*. The fourth stage was determining the attitudes of users towards *VRLR* after they had completed searching, browsing, problem-solving tasks, and teach-back tasks. Lastly, as described in Chapters 6 and 7, analysis of these

data was conducted in an attempt to identify statistical models which could identify relationships between learner characteristics and other variables measured. Case studies, selected to show extreme and average performers for dependent variables, were investigated in detail to provide qualitative support to the findings.

Previous research studies in the areas of on-line literature searches (Bellardo, 1984; Brindle, 1981; Coventry, 1989; Fidel, 1991; Ford, Wood, & Walsh, 1994; Logan, 1990; Wood, Ford, Miller, Sobczyk, & Duffin, 1996) and multimedia navigation (Ellis, Ford, & Wood, 1993; Gay, Trumbull, & Mazur, 1991; Honeyman & White, 1992; Liu & Reed, 1994; Marcoulides, 1988; Melara, 1996; Messick, 1994; Nelson & Wiese, 1991; Repman, Rooze, & Weller, 1991; Sein & Bostrom, 1989; Van der Veer, 1989) had generally observed a variation in the level of searcher performance, even with groups of the same amount of training and experience. Effective design of learning packages such as *VRLR* should consider these variations in navigation procedures adopted by targeted users and assess their effectiveness. A logical first step in this procedure is to look for variations in learner characteristics of the user population and explore how these impact on navigation performance. This research set out to identify some of the key learner characteristics of the study participants, the occupational therapy students, who would be using *VRLR* as a learning resource in an introductory occupational health unit. Observations were then conducted of participants' navigational procedures adopted and their attitude towards the package was measured. The relationships between these three sets of variables were then analysed. The research was guided by the following four research questions were explored:

1. Can an independently accessed, interactive multimedia package be designed and developed to support occupational therapy students learning vocational rehabilitation?

2. What are the learner characteristics for the targeted population of occupational therapy students?
- 3 What is the relationship between learner characteristics and navigation performance for the targeted population of occupational therapy students?
- 4 What is the relationship between learner characteristics, navigation performance and attitudes for the targeted population of occupational therapy students?

A problem-based, interactive learning program was designed and developed as a resource for occupational therapy students studying vocational rehabilitation. This was titled *Vocational Rehabilitation Learning Resource (VRLR)* and mounted on CD-ROM. All first year Bachelor of Health Sciences (Occupational Therapy) undergraduate students (n = 74) at Curtin University of Technology enrolled in *Occupational Health 241* during first semester 1996 were invited to participate in this research project. An instrument was developed to measure participants' demographic data and technological experiences (refer to Appendix K). The *Group Embedded Field Test* (Witkin, Oltman, Raskin, & Karp, 1971) was employed to measure field-dependency/independency dimensions of cognitive style and the *Learning Style Questionnaire* (Honeyman & Mumford), 1992 investigated the activist, reflector, theorist and pragmatist elements of student's learning style. Computer anxiety, computer thoughts and attitudes to computers were measured as three elements of technophobia (Rosen & Weil, 1992).

## **8.2 Results From Learning Characteristics Instruments**

The population in this study was predominantly female (92.5%) and under 25 years of age (92.5%). Their experience with computer technology demonstrated that a significant number used computers at home to help with their studies (63% on six or

more occasions) and 90% had conducted on-line computer literature searches. This familiarity with computers did not, however, extend to the use of the Internet, where 79% had never accessed the World Wide Web. The increasing information related to occupational therapy available on the World Wide Web (Stone, 1996) makes it imperative that students are aware of this vast source of information, how to access it, and how to apply it. It is the author's contention, and an important purpose of this thesis, that experience with multimedia software related to occupational therapy, such as *VRLR*, can assist students in gaining confidence and familiarity with this technology and thereby making them more liable to investigate other applications of information technology, such as the World Wide Web. Of some concern was the low level of perception that participants had of their computer knowledge compared to their peers; only 4.5% indicated that they considered themselves above average. The *Demographic/Technological Experience Questionnaire* was employed recently to see if there was any difference in results with later entrants into the occupational therapy course. A comparison was made between first year students in 1997 and the participants in this thesis using the Mann-Whitney U-test (Norusis, 1992c) and a statistically significant difference was found ( $p < .001$ ) for students' perception of their computer knowledge compared to their peers. Of the 1997 entrants into the course, 16.5% perceived themselves as being above average in computer knowledge compared to only 4.5% of the 1996 second year students who were the participants in this study. When the computer/technology experiences questions for the 1997 first year students were totalled (see Appendix K and Chapter 5, Tables 5.3 & 5.4), there was no statistically significant difference with the second year student participants in this study ( $p = .71$ ). However, there was a statistically significant difference in students' use of the World Wide Web. Only 16.2% of first year students in 1997 had never accessed the Web compared to 79.1% for participants in this study, who were second year students in 1996. This difference can at least be partially explained by a new curriculum being introduced this year, where first year occupational therapy

students are encouraged to use electronic mail as part of an introductory health studies communications unit.

A significant number of participants in this study displayed a tendency towards high field-independency cognitive style (67%) with a further 15% recording moderate field-independency. Although the authors of the cognitive style instrument used in this research warn of the dangers of assigning positive value judgements generally to one or the other dimensions (field-dependent/field-independent) of cognitive style, there are learning environments where strength in one style may be an advantage depending on "the precise situational factors involved" (Witkin, Oltman, Raskin & Karp, 1971, p.13). Awareness of differences and strengths in learners' cognitive style, such as the ability to think more globally (field-dependent) or more analytically (field-independent), can assist designers of hypermedia materials to structure content in a way which is most meaningful to students with different needs.

The population in this study displayed a significant preference for *Activist* and *Reflector* learning styles (85% and 78% measuring moderate to very strong respectively). There was a significant low preference for the other two measures of learning style, i.e. *Pragmatist* and *Theorist*, with 59.7% and 47.8% measuring low and very low respectively. It is intended to monitor these characteristics in future intakes of occupational therapy students by applying the *Learning Style Questionnaire* (Honey & Mumford, 1992) and reporting the findings. Awareness of these characteristics can be of benefit to both educators and the individual students. If this pattern of learning style is repeated in future student populations, then occupational therapy course content and delivery should be directed to both utilise the *Activist/Reflector* strengths and develop the weaker *Pragmatist/Theorist* dimensions.

Although the majority of participants (53.7%) scored "no technophobia" for computer anxiety, there was a substantial majority (61.2%) who experienced low to high

technophobia with their computer thoughts. With the advantages of familiarity and confidence in the use of information technology becoming more relevant, there is a need to address these negative cognitions and feelings held by this substantial representation from the undergraduate occupational therapy student population.

### **8.3 Results of Navigation Performance**

Five measures of participants' navigation performance were observed during a series of learning scenarios using the learning package *VRLR*. Navigation performance for each participant was assessed for the number of successful searches, number of screens opened, time taken, the number of overview screens accessed, and the number of times assistance was requested.

All participants had at least some success with this group of navigation exercises, with the minimum number of successful searches recorded being two from a possible total of seven. The best results were scored in the first two questions of the problem-solving section (refer to Chapter 4, Figure 4.4) where 90.5% of participants were successful. Successful answering of these two questions could be achieved by navigating through two direct links each (opening a minimum of two screens in each case). The final question had the lowest successful response rate in the problem-solving section, where only 27% of the participants completed it successfully within the allocated time. The navigational links were less obvious in this section to new users and required moving from the *Case Studies* database to the *Case Team* database and perhaps back again to check information before making a decision.

There was a significant correlation between the number of successful searches and the other four navigation variables. Generally, the more successful the searcher, the less time taken, more screens and less overviews opened, and less number of times that assistance was requested.

There were three significant correlational pairings between participants' learner characteristic and their navigation performance; all of these related to the number of times that assistance was requested. One pairing was associated with field-dependency and the others were negative computer thoughts and low scoring of previous computer experience. It appears that field-dependent occupational therapy students can perform equally well with field-independent students when coping with searching and problem-solving exercises with multimedia packages such as *VRLR*, with the exception that they may require more personal assistance, at least at the early stages of use. This would be in accord with field-independent participants' reliance more on social interaction (Witkins, Oltman, Raskin, & Karp, 1971).

When all of the independent (learner characteristic) variables were aligned with each of the dependent (navigation performance) variables in multiple linear regression analysis, five statistically significant models were generated. These displayed significant interaction relationships, although their predictor strength was low. The degree of variance explained was 3% for number of overviews opened, 10% for number of screens opened, 14% for number of times assistance requested, 14% for time taken for searches, and 17% for number of successful searches. This indicates that other variables, not measured in this research, also influence navigation patterns.

The low predictor strength of these statistical models generated by multiple regression are somewhat similar to those achieved in the few studies to date involving this statistical process in bibliographic searching and multimedia navigation research. In bibliographic searching research, Bellardo (1984) used factor analysis to reduce the 12 independent variables measured (refer to Chapter 2, Table 2.4) to four major clusters of variables. Multiple linear regression analysis resulted in two of these clusters being statistical significant, but only predicting a small percentage of the variance in participants' ability to recall information. One cluster of variables, made up of mainly verbal and quantitative scores from the Graduate Record Examination (GRE), a



general intelligence test which was is in United States to predict scholastic success (Bellardo, 1984, p. 56), accounted for 6% of the variance. The other cluster, which accounted for 7% of predictor variance in recall of information, comprised of a group of variables which included preference to work alone, being analytical and critical of other's work, and liking to deal with theoretical concerns and complex situations.

Logan (1991) used multiple linear regression analysis in an attempt to establish statistical models involving five measures of bibliographic searching behaviour. The independent variables were cognitive styles and learning styles characteristics of participants. Although none of the relationships derived were statistically significant with this population, who were new to bibliographic searching, this author demonstrated that there was consistent relationships with the *Learning Style Inventory* (Kolb, 1985) and search performance. Individuals who displayed an assimilator learning style scored statistically significantly higher on all five searching measures, whereas those who displayed an accommodator learning style scored statistically significantly lower on four of these five measures.

In a similar research approach, Borgman (1989) used multiple linear regression analysis in an attempt to predict that participants' choice of academic discipline was influenced by a range of technical aptitudes and personality characteristics such as measured by the *Learning Style Inventory* (Kolb, 1985) and the *Myers-Briggs Type Indicator* (1962). Borgman believed that academic orientation is a transient measure and useful primarily as a pointer to underlying characteristics that may have some influence on bibliographic retrieval performance. Although this research produced relatively strong predictors (12% to 61% of variance), it did not relate these variables to search performance and therefore the author indicated that these findings must be only viewed as a 'pointer' to assist with further research.

Gay, Trumbull, and Mazur (1991) examined the influence of eight independent variables on users' successful searching in a multimedia environment. These were time in browse mode, time in guide mode, time in index mode, concentration, information processing, study aids, anxiety, and motivation. In this, the only multimedia research study found to date which has employed multiple linear regression analysis to explore statistical models relating performance to user characteristics, Gay, et al. produced a model predicting 53% of the variance. However, by stepwise inclusion, these researchers established that time in browse mode, time in guide mode, and information processing strategies were the only three variables which were significant from the eight independent variables. Information processing strategies, the only non-time related variable, accounted for 8% of the predictor variance. Time spent on browsing and searching can be related to a range of reasons, such as motivation and distraction, and can prove difficult to relate to user characteristics. The interesting outcome of this study was that the learner characteristics of anxiety, motivation, and concentration proved to be not significant in the model derived.

#### **8.4 Attitude Towards *VLLR***

A statistically significant predictor model was developed in this research when attitude towards *VLLR* was entered into a multiple linear regression analysis with the ten independent variables and the five navigation variables (refer to Chapter 6, Section 6.5.1 and Chapter 7, Section 7.4). The model, which explained 38% of the variance, comprised the independent variables of activist and pragmatist learning styles, computer anxiety, and number of successful searches.

The responses to the *VLLR - User Attitude Questionnaire* were generally very positive (refer to Chapter 7, Table 7.1). This was an important outcome because the learning package was specifically designed for second year occupational therapy students (who

formed the participant population for this research) as a learning resource to supplement conventional teaching/learning methodologies in an introductory occupational health unit. This research was conducted during the first half of the semester, when this unit is taught, and participants would have had some basic knowledge of the subject matter covered in *VRLR*. They would be aware of the educational benefits to be gained from increasing their knowledge in this area and thereby their motivation should have increased. The coverage of vocational rehabilitation in the curriculum had suffered in the past through the dearth of resource materials, a confusing range of terminology used, and the resistance of students to consider working in this area when they complete their qualifications (refer to Chapter 3, Section 3.4.1). Considerable effort was made in the design and development of *VRLR* to make it attractive and meaningful to occupational therapy students, who were involved throughout in its design, development, and evaluation. Therefore, it was not unexpected that participants, who were occupational therapy students, would respond positively.

### **8.5 Limitations of this Study**

The significant cost of development and designing of curriculum materials to be accessed independently by learners using computers and telecommunications technology should in future dictate that sufficient resources are allocated to measure their educational effectiveness (Hooper & Hannafin, 1991; Jonassen, Campbell, & Davidson, 1994; Laurillard, 1993; West, 1997). Changes in higher education involving the use of information technology challenge the existing generally accepted methodologies of teaching and learning. In these traditional face-to-face encounters between a lecturer and groups of varying numbers of students “unplanned interactions such as questions in lectures typically take care of the management function without specially resourced and timetabled mechanisms” (Draper, 1997). With the increasing use of distance learning, involving self-paced learning packages delivered by

computer/telecommunications technology, there is a need for a more systematic approach to educational program evaluation. This is particularly so because academic administrators demand evidence of the cost-effectiveness of new programs. This research was exploratory in nature and sought to determine the influence of some learner characteristics on navigation performance as part of an evaluation of curriculum reform utilising computer technology.

### **8.5.1 Variables not considered and measured**

The measurement of motivational factors, which are critical at the initial stages of a learning experience, were not considered for this current study. The emotive impact on some students can be significant as they face challenges such as when they first access multimedia with its unique user interface, interactivity, level of control, and media mix. Some students could be significantly threatened. Other cognitive dimensions could have been measured using instruments available and may have produced stronger predictor models. Measurement of other dimensions of learning style and cognitive style, such as locus of control (Palenzuela, 1988) as discussed in Chapter 2, Section 2.4, may shed more light on significant variables influencing navigation strategies. This research set-out to select measuring instruments which had a proven record of reliability in other studies, over a considerable period of time, and with a range of university student participants. However, multimedia navigation is a relatively recent endeavour brought about by significant advances in computer technology and currently available research instruments may not measure adequately the characteristics which contribute most (or least) to navigation skills. This point is taken up in Section 8.6.1. Specifically, the degree of knowledge gained by learners of the contents of a multimedia package, such as *VRLR*, is a question which should be considered by researchers. Subsequently, an instrument was designed to assess knowledge of the subject matter for inclusion in this research, but was not included as it was felt that it could distract from the main focus of this study, learning

characteristics and their impact on multimedia navigation. Also, it would have involved the instrument being administered both before and after accessing *VRLR* for learning acquired to be adequately assessed. However, research investigating effectiveness of the introduction of a learning package such as *VRLR* would be incomplete without the measurement of student learning achieved.

This investigation could have explored more thoroughly, specific details pertaining to case studies in an attempt to elicit information on important variables which influence users' navigation in a multimedia environment. The use of scatterplots to explore non-linear relationships could determine special cases worthy of in-depth study, rather than choose the two extremes for navigation and attitude used in the qualitative component of this study (refer to Chapter 4, Section 4.5.5). The qualitative component may have been more fruitful if questionnaires were designed and interviews conducted with the case studies to probe into participants' explanations about why they took specific actions when navigating. The 'think-aloud' strategy had inconsistent results with most students either forgetting or feeling embarrassed participating in this technique. It appears that new users are more than sufficiently challenged when learning with multimedia, particularly at the initial stages. Familiarising themselves with the content, structure and learner control all make demands without having to contend with explaining out loud to an investigator. It would appear that a more appropriate time to use the think-aloud process would be with learners who have progressed beyond the novice stage. Another criticism of the think-aloud data collection method was the absence of clear, proven guidelines on how it can be conducted to give consistent results in an area "dependent on invisible mental processes supported by a set of inferences and assumptions" (Afflerbach & Johnston, 1990).

### **8.5.2 Participant population**

Criticism could be levelled at the relatively small research population in this study and the 'captive audience' which involved all second year occupational therapy students at Curtin University of Technology. As all enrolled students ( $n = 74$ ) agreed to participate (refer to Chapter 4, Section 4.2), there was little alternative which could have offered a larger population. An option could have been to seek recruitment of occupational therapy students other than from Curtin University of Technology, but this is the only tertiary institution in the state offering this course and other universities inter-state and overseas have a different curriculum. In addition, there would be substantial costs entailed in managing a project over a large geographical area. A longitudinal study, over a number of years second year, involving occupational therapy students from Curtin University could be observed accessing VRLR would generate a much larger population. However, the disadvantages of employing this strategy would be significant. For instance, the delay in reporting results, being involved in the increasing trend of curriculum change, and the availability of researchers to continue with the data collection in a consistent manner over a period of years are some indication of the drawbacks to this approach.

The homogeneous nature of the participant population in this study dictates that many of the findings cannot be generalised to second year undergraduate university students in Australia and other countries. For instance, occupational therapy students have to attain significantly higher school leaving examination marks to gain entry into the occupational therapy undergraduate course than do the vast majority of students entering other courses at Curtin University of Technology (Curtin University of Technology Handbook, 1998). Therefore, their performance navigating in a multimedia environment may not be representative of the undergraduate university population as a whole.

### **8.5.3 Researcher's involvement in design of *VRLR***

Another factor which could have influenced the findings of this study was the choice of multimedia learning package. The researcher was also the chief designer/developer of *VRLR* which was produced to meet the needs of occupational therapy undergraduate students studying an introductory occupational health unit. Perhaps a choice of some other multimedia package (if there was another appropriate package available) which was not specifically designed for this population, may have demonstrated different results, and the outcome of the Word Wide Web research indicates this (see Section 8.5). Although the researcher attempted to be focused and objective at all times during this research, and the methodology was designed to address this, there were times during the navigation observations, where participants' comments or actions led to the researcher noting these instances as part of an evaluation of the software. However, the few instances where this occurred did not distract from the research observations which were also noted by a 'neutral' research assistant observer (see Chapter 4, Section 4.3.5).

### **8.5.4 Research focused on initial stages of using *VRLR***

Reeves, Ellis, Ring, Ring, & Oliver (1993, p.5) state that a major condition which must be met by research in this area is that learners "should spend many hours rather than minutes" interacting with multimedia. This view has merit, as it can allow reflective observations to be conducted free from the initial phases where the learner has mastered the basic controls of the hardware and has some knowledge of the interface design and its function. This topic is of particular concern in mental model formation (see Chapter 2, Section 2.3.5) where the learner progresses from 'novice' to 'expert' (Allen, 1991; Payne, 1991; Waern, 1993). In this research, concern was focused on users' initial navigation responses to the introduction stages of learning with a multimedia package. This researcher believes that it is at this critical point many students can be discouraged from progressing with this media, particularly if the

content is not considered essential. This point is developed further in the following section. In addition, *VRLR* was designed as a supplement to lectures and tutorials and students are not anticipated to use it for lengthy spells at any one time.

#### **8.5.5 Follow-Up Study Investigating World Wide Web Navigation**

A separate research project was conducted with the same occupational therapy student population ( $n = 67$ ), where participants accessed information from the World Wide Web (WWW) related to occupational health. This WWW research, which was funded by a Telstra Social and Policy Research in Telecommunications Grant (Cameron & Treagust, 1997), was conducted concurrently with this research project. The WWW research project investigated linkages between learner characteristics, navigation performance, and attitude towards the WWW browsing software Netscape Navigator™ version 2.02 (Netscape Communications Corporation, 1996). The research involved the same 12 learner variables and similar types of searching, browsing, problem-solving and teach-back navigation exercises as were employed with this research involving *VRLR*. The WWW browsing software package Netscape Navigator was accessed by participants and navigation exercises attempted. Results of these are reported briefly in this section and more complete details are presented in Appendix O to enable the reader to make comparisons with the research employing *VRLR* reported in this thesis.

With the Netscape research, multiple linear regression analysis identified only three statistically significant models (refer Appendix O, Table 5). Two of these models generated were for the navigation performance dependent variables, time for searches (13% of variance explained) and number of times assistance requested (17% of variance explained). The independent variables of computer anxiety and activist learning style were grouped together in a model partially explaining time for searches whereas computer knowledge, reflective learning style and computer anxiety partially



explained number of times assistance requested. The dependent variable attitude towards the WWW, explained 38% of the predicted variance when coupled with the learner characteristics and navigation performance variables in a regression analysis. The independent variables in this statistical model were age, prior computer experience, theorist learning style, computer thoughts, and time to search WWW. Interestingly, this model predicted the same strength of variance (38%) to that in the attitude regression model for this research with *VRLR* (see Chap 7, Table 7.8), but none of the independent variables were common to both models.

The navigation exercises in the WWW research followed immediately after the navigation exercises with *VRLR*. The smaller number of significant models derived by multiple regression analysis, with little correlation between the variables in the two studies, could at least be partially explained by the WWW materials being less meaningful to the participants in these research studies and that familiarity with the research set-up and the user interface could result in learning characteristics having less impact on navigation performance. This latter relationship has been suggested by other researchers (Bellardo, 1985, Ellis, Ford, & Wood, 1993), where results suggested that the influence of learning characteristics is most significant at the initial stages of using multimedia and bibliographic searches.

## **8.6 Implications of the Study**

As reported in Chapter 2, Section 2.6, there is currently a lack of any reported investigatory research in the literature into occupational therapy student's performance learning with the assistance of computers. This current research has attempted to address this and has identified learning characteristic variables that can have moderate results explaining the influences on learners' multimedia navigation, but still leaves substantial amounts of predictor variance not accounted for. At the same time, the

research has identified strengths and weaknesses of the learner population which should be of interest to multimedia developers and educators in general.

### **8.6.1 Identification of characteristics which impact on learning**

Evidence from this and previous research (e.g. Ellis, Ford, & Wood, 1993; Melara, 1966) suggests that there is no single strong learner characteristic variable that stands out from the others in multimedia navigation. Many influences are at work, including quality and meaningfulness of learning materials to users and the resultant student motivation. One observations from this study is that there is a need to make not only developers and educators aware of targeted students' learning characteristics, but that the students themselves should be advised. This research proposes that knowledge of their strengths and weaknesses can be of benefit to students in self-paced learning environments such as computer-assisted learning or World Wide Web browsing. Measuring each student for these characteristics, providing awareness of strengths and weaknesses, then providing guidance on utilising these strengths and overcoming areas of weakness can go some way to assist each student in utilising this technology.

There is also a need to develop new measuring instruments, which may incorporate some of the more relevant items from the instruments used in this study, but also measure other dimensions of personal styles which are beneficial in accessing and utilising multimedia and Web technology. The significant number of students who experience some form of aversion to computer technology is of concern and is an area which should be addressed. Currently, most Australian universities make the assumption that new entrants have developed adequate levels of computer awareness and computer literacy before entering tertiary education. This is clearly not the case as indicated in some recent findings of computer abilities of Australian university students (Jones, 1997; Reid, 1997; Yeatman & Stace, 1997). Providing computer laboratories, World Wide Web sites, e-mail facilities, CD-ROM mounted computer-

assisted learning packages may not be to the benefit of all students and failure to provide training with coping strategies could be viewed as an equity issue.

With increasing dependency on electronic media in today's learning environment, the significant percentage of students who demonstrated signs of aversion to using this technology in this study is of concern. Considering the improved graphical interface of current generation computers and the presumed increased student computer awareness and computer literacy, the level of negative thoughts and anxiety was unexpected. On reflection, aversion to this technology may be akin to students' anxiety when studying mathematics and sitting for examinations. Overcoming aversion to information technology should be a focus of educational research. Exploration of strategies to overcome or minimise aversion to electronic media may be assisted by encouraging co-operative learning environments, ensuring progressive introduction through rewarding experiences, and providing adequate help features to cater for divergent learners. Tertiary courses should be investigated to ensure that students' early experience with this technology does not kindle aversion to its future employment. In the past, occupational therapy students first formal exposure to computers in their undergraduate study has been in a statistical unit. With many students traditionally struggling with this subject, without the potential additional threats from using computer technology, perhaps a more sensitive introduction to the use of information technology should be investigated.

An area in the psychology literature that is worthy of exploration by multimedia researchers is the cognitively-oriented theory of stress and coping developed by Lazarus and his colleagues (Drumheller, Ericke, & Scherer, 1991; Folkman, 1984; Folkman, & Lazarus, 1985; Hudiburg & Necessary, 1996). Folkman (1984, p. 840) defines a stressful situation "as a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and as endangering his or her well-being". The theory of stress and coping is based on two

processes, cognitive appraisal and coping, which are mediators of stress and stress-related adaptational outcomes. The meaning of an event is determined by cognitive appraisal processes. There are two major forms of appraisal: primary appraisal, through which the person evaluates the significance of a specific transaction with respect to well-being, and secondary appraisal, through which the person evaluates coping resources and options. Primary and secondary appraisal converge to shape the meaning of every encounter. Coping refers to cognitive and behavioural efforts to master, reduce, or tolerate the internal and/or external demands that are created by the stressful transaction (Folkman, 1984).

Emotions can be a powerful influence on the way people manage a stressful situation. Coleman (1995) explains why continual emotional distress can create deficits in a person's intellectual abilities, crippling the capacity to learn. These deficits, if more subtle, are not always tapped by traditional intelligence testing (IQ), though they show up through more targeted neuropsychological measures, as well as in a person's continual agitation and impulsivity. IQ, according to Coleman, contributes about 20 percent to the factors that determine life success, which leaves 80 percent to other factors which includes emotional intelligence abilities. These factors include being able to motivate oneself and persist in the face of frustrations; to control impulse and delay gratification; to regulate one's moods and keep distress from swamping the ability to think; to empathise and to hope (Coleman, 1995, p. 34). Identifying these emotional aspects should be investigated and their influence determined on navigation performance in a multimedia environment with a intent in developing instruments measuring characteristics which can include appropriate emotional components.

The *Ways of Coping Scale* (Folkman & Lazarus (1985) which measures problem-focused and emotion-focused coping strategies, is an instrument which is worthy of investigation of its value in determining learner characteristics which may impact on successful navigation in a multimedia environment. In referring to the little research

conducted to analyse coping strategies in human-computer interactions, Hudiburg and Necessary (1996), studied university students by administering the *Ways of Coping Scale*. The results demonstrated that emotional-focused coping is employed more often in dealing with computer-stress than problem-focused coping. Emotional ways of coping, according to Folkman (1984), are mainly negative and can include avoidance. Development of problem-focused approaches to dealing with computer-stress should be considered by computer users and researchers to identify the initial appraisal processing which is undertaken by users of this media and the coping strategies that they employ. Identifying successful users' appraisal and coping strategies would be useful in developing comprehensive instruments dedicated to measuring performance in this environment.

A strategy to minimise emotional coping approaches and focus on the problem-solving approach has recently been emphasised by Jonassen (1996), where students learn to work *with* computers rather than learn *from* or *about* them. Computers can be a much more powerful learning and less threatening tool when they assist students to actively construct their own knowledge. Learning *with* computers is in line with the philosophy of constructivism which focuses on the self-directed approach to learning required with new interactive technologies

Students working with computers can support the development of specific learning skills, for instance the *reflective* learning style component as identified in the *Learning Style Questionnaire* (Honey & Mumford, 1992). Reflective thinking requires deliberation about a situation encountered, thinking about it, reflecting on stored knowledge, making inferences about it, and determining implications (Jonassen, 1996). Reflective thinking is a skill which student occupational therapists are encouraged to develop with its relationship to the problem-solving process of clinical reasoning (Royeen, 1990). Computers have advantages to assist with teaching

reflective learning style, according to Rowe (1995), because they protect privacy, promote individualisation and provide feedback.

Using the computer, students can practice skills tailored to their own needs, can proceed at their own pace, can receive immediate and/or corrective feedback, and can repeat the process as often as necessary - all without the danger of ridicule.

(Rowe, 1995, p. 347)

Word processing is a simple example where computers can be used to develop reflective learning strategies. For example, students can focus on the more important tasks of developing and refining their thoughts during the drafting stages. Working with computers also can be used to enhance collaboration between students. The social interaction generated when working on computer projects can help overcome cognitive problems as individual students teach their less computer literate colleagues and help to reduce technophobia (Cameron, 1994; 1995c; Jonassen, 1996; Reeves, 1997).

Computers can be employed in the occupational therapy curriculum in a non-threatening way when students design and develop multimedia computer programs for others to use and hence promote the development of a range of skills. Mogy (1995) believes that this use of the technology encourages awareness of the therapeutic applications of information technology, and that newly qualified occupational therapy practitioners will be more capable of selecting appropriate therapeutic software for their clients. Student involvement in project planning and production has been employed at Curtin University of Technology's School of Occupational Therapy for several years. Third year undergraduate students have been involved in the production of learning packages and World Wide Web sites which have been aimed at a range of end users; including specific student groups, clients and therapists. This introduction to computer/telecommunications technology has been brought forward to the first year of undergraduate studies from 1997, with the aim of encouraging students to embrace

it more readily throughout their undergraduate studies and be more prepared to use computer technology as practising therapists. Advantages to student learning of this usage includes reduction of computer anxiety, motivation due to ownership, opportunities to utilise a range of skills not normally called for in student projects (e.g. script writing, selecting and producing appropriate media including video recording), active engagement in a creative process, teacher/learner roles change - more of a team process, opportunities to practice research processes during formative and summative evaluations, structuring content in a way that is meaningful to end users' needs, applying learning theory in a unique way, promoting computer literacy (Cameron, 1997, pp. 285-288).

### **8.6.2 Internationalising the curriculum**

A recently released Government sponsored discussion paper on tertiary education in Australia (West, 1997) devotes a chapter to the future impact of information and communications on university education. The authors point to the development of 'location-independent communication' technology in contrast to the traditional view that higher education services are best "provided on a campus, to a student body resident nearby, via a narrow set of delivery methodologies will come under increasing scrutiny" (West, 1997, p. 9). Internet communications through World Wide Web based technologies, according to West, can provide opportunities for improving the effectiveness and reducing the costs of marketing, materials distribution, student testing and assessment and various administrative transactions. In a paper prepared to support the West review, Global Alliance (1997) cites evidence indicating that the on-line education industry is gathering momentum in the USA where approximately US\$162 million was invested by venture capital firms in new on-line education businesses in 1996.

To compete in this increasingly international market, Australian universities have to develop curricula which are effective and meaningful to learners' needs. Curriculum development research will be more essential to ensure needs are cost effective. Multimedia packages, such as *VRLR*, can be offered externally through the World Wide Web, provided they meet these criteria. Therefore, studies such as this exploratory research can provide a starting point in developing research methodology in the area of curriculum design using interactive, telecommunications technologies.

### **8.6.3 Statistical models methodology**

The statistical methodology of utilising multiple linear regression analysis was employed in this study to allow clusters of statistically significant independent variables to be identified. This approach can establish the relationship of these variables with each other and their impact on each of the navigation and attitude dependent variables. Multiple linear regression does not, however, provide the opportunity to investigate the possibility that combinations of dependent variables relate to combinations of independent variables. Canonical correlation analysis can be employed to explain a set of related dependent variables taken together and is useful when dealing with multi-dimensional phenomena, such as multimedia navigation (see Chapter 4, Section 4.5.3). This analysis can help to give richer and more crucial explanation of the elements undergoing scrutiny (Cohen & Cohen, 1983; Levine, 1997; Thompson, 1991). Levine identified some of the main benefits of canonical correlation analysis as providing information regarding the:

- nature of the limits of patterns of independency that joins two sets.
- number of statistically significant links between sets
- extent to which the variance in one set is conditional upon or redundant given the other sets

(p.12).



As explained in Chapter 4, Section 4.5.3, however, it was not possible to employ canonical correlation analysis in this research due to the small population and the large number of variables (Stevens, 1992). Future research in multimedia navigation should seek to meet these criteria and explain the combined effects of both independent and dependent variables.

#### **8.6.4 Qualitative investigations in interactive media**

The quantitative components of this research far outweigh the qualitative in depths and time allocation, but the latter demonstrated some promising 'leads' for future research. For instance, Case 2 demonstrated considerable low esteem in perception of computer knowledge, moderate to high technophobia, and limited experience with computers, but nonetheless performed near the group mean for navigation and was on the mean for attitude towards *VRLR* (refer to Chapter 6, Section 6.6). Reasonable expectations would be that this participant scored poorly for navigation and similarly for attitude. This type of finding was not entirely unexpected by the researcher who has witnessed similar performances in his day-to-day exposure to working with occupational therapy students using computers. On many occasions, less computer literate and aware students have outperformed their more computer experienced colleagues without there being an apparent ready explanation.

Identifying special cases who perform better (or worse) against expectations using available learner characteristics instruments, monitoring their navigation, and probing use of questioning should lead to advancing our knowledge of uncovering the learner characteristics which impacts on these unexpected outcomes. This calls for more intensive qualitative research into multimedia navigation.

#### **8.7 Summary of the Chapter**

This chapter set out to overview the research and initially discussed the rationale, methodology and the goals. The result chapters were summarised together with a

discussion of the interpretations of the study. A significant majority of the occupational therapy students involved in this research, who were predominantly female and under twenty years of age, tended towards field-independency cognitive style, suggesting strength in problem-solving and a tendency to examine component parts rather than consider them globally. Two significant types of learning style were evident, Activist and Reflector, which both have advantages in multimedia navigation. There was a significant degree of technophobia measured in this participant group, which is of concern in the short term for successful integration of this technology into the curriculum, but also for the future adoption of computer/telecommunications technology into occupational therapy practice. There is a need to continue to address this issue by introducing positive and meaningful computer experiences into the curriculum.

Four significant, though weak, statistical models of learning characteristics independent variables and dependent navigation variables were analysed by multiple linear regression. This suggested that other variables, which were not measured, contributed to navigation. When all of the learning characteristics and navigation were entered as independent variables into a multiple regression analysis, a stronger statistical linear model was derived for attitude towards *VRLR*.

Some of the limitations of this exploratory study were the small participant population, exclusion of variables involving motivational elements, and the absence of a critical qualitative methodology which may have uncovered elements which impact on successful and unsuccessful multimedia navigation. On the positive side, this study has endeavoured to develop a methodology in the growing area of research into curriculum materials for delivery by electronic means. It has identified some of the cognitive learning characteristics of occupational therapy students and recommended the investigation of emotive elements, particularly related to appraisal and coping.

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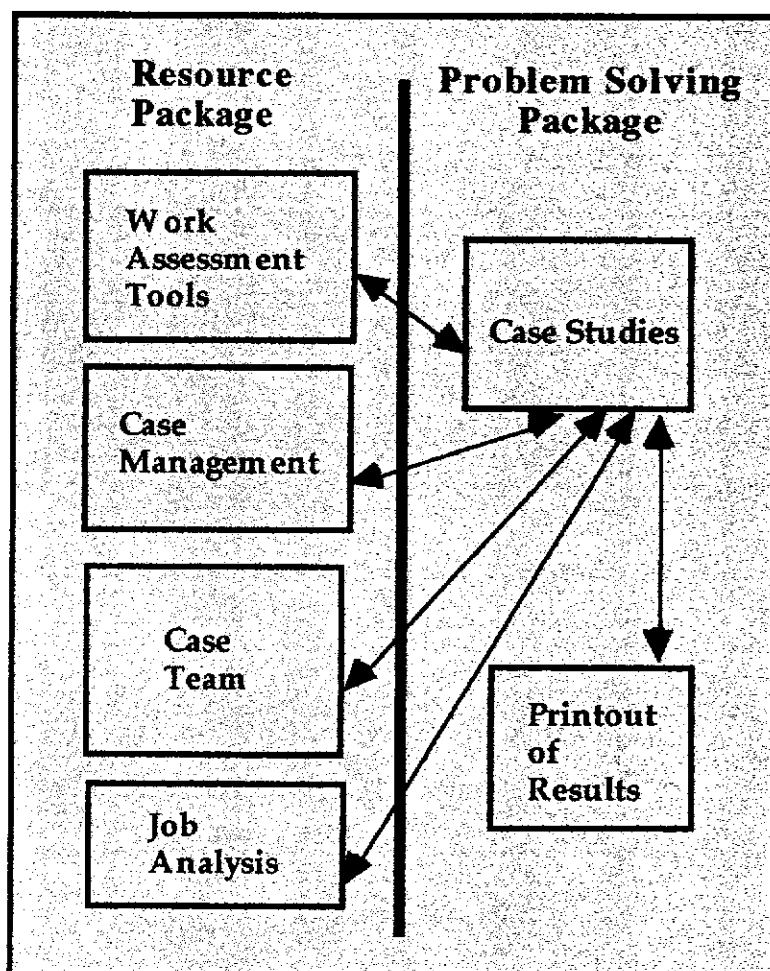
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## APPENDICES

## Appendix. A

*Vocational Rehabilitation Learning Resource Structure*

*Vocational Rehabilitation Learning Resource (VRLR)* is designed to provide opportunities for occupational therapy students and clinicians to practice making case management decisions from a bank of case studies. Accessing referral information from a range of injury types (or randomly from a list of client names), users can problem-solve by linking with the resource databases. This is executed from within *Case Studies*, where a 'problem-solving' button accesses a floating palette on-screen with buttons provided to link to *Resource Packages*. Users can then decide on appropriate selection of work assessment tools, job analysis, case team, and alternative job selection if client is unable to return to original occupation.

*Work Assessment Tools*, *Case Team*, *Case Management*, and *Job Analysis* may also be accessed directly for use as general references in their respective areas.

**Note: The contents of the CD Rom, Vocational Rehabilitation Learning Resource (ISBN 186342587X) presented with the thesis is not able to be converted to pdf format and so has not been reproduced.**

**(Co-ordinator, ADT Project (Retrospective), Curtin University of Technology, 20.11.02)**

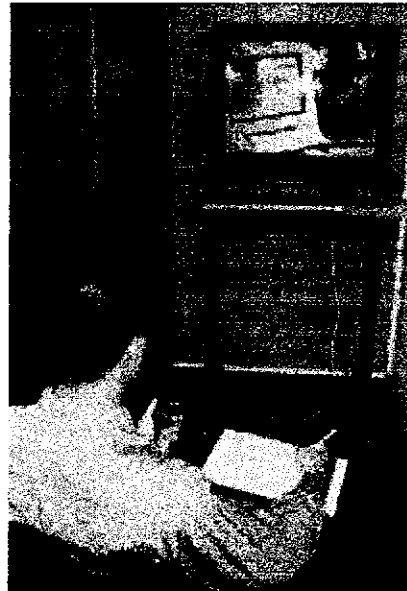


## Appendix B

### Investigation Laboratory



**Figure 1. Investigator noting participant's actions with video camera recording and relaying**



**Figure 2. Assistant observing participant in remote location**



**Fig. 3. Investigator introducing VRLR to participant with mirror used to monitor facial expression**

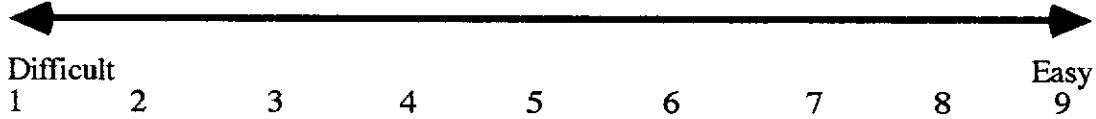
Appendix C

USABILITY SPECIFICATION TABLE - RESULTS

Subject No.	Initial Performance		Learnability Task (1)		Learnability (Task 2)		Retainability	
	Time (secs)	No. Screens	Time (secs)	No. Screens	Time (secs)	No. Screens	Time (secs)	No. Screens
1	61	9	176	18	23	3	169	15
2	119	10	244	24	27	3	159	11
3	141	16	293	25	24	3	186	13
4	108	9	218	28	23	3	85	11
6	69	11	165	25	28	3	120	12
7	63	9	124	16	23	3	104	9
19	62	9	285	29	32	3	112	9
<b>Mean</b>	<b>89</b>	<b>10.4</b>	<b>238</b>	<b>23.6</b>	<b>25.7</b>	<b>3</b>	<b>141</b>	<b>13.6</b>

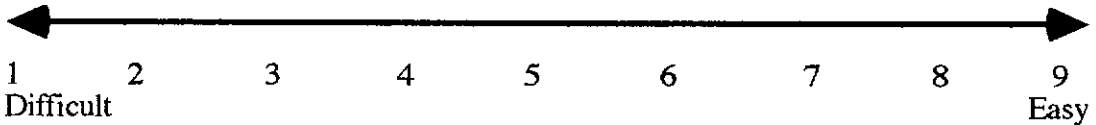
**Appendix D****User Attitude Questionnaire**

**Instructions.** For each of the following rate on the 1 - 9 scale by circling your choice. Please add any comments below each question which may clarify or explain your rating.

**1. Ease of use**

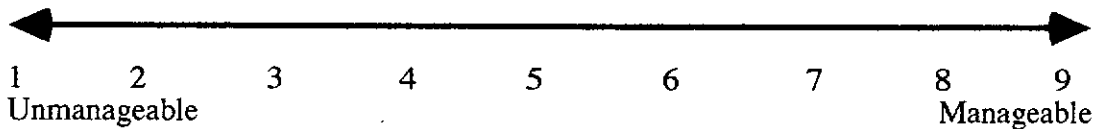
Comments:

**2. Navigation.** To what degree did you feel that you knew where you were within the program and how to get to another part of it



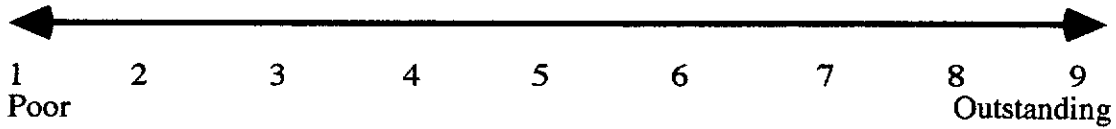
Comments:

**3. Cognitive Load.** How "manageable" did you find the program coping with the integrative demands of the content, structure and response options.



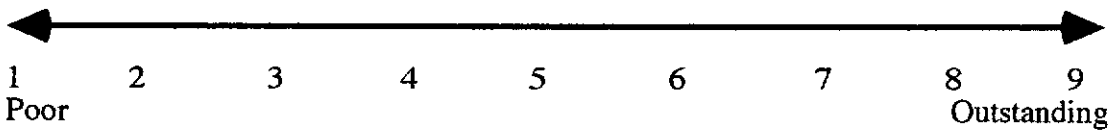
Comments:

**4. Screen Design.** Includes arrangement of text, icons, colour aspects of the interactive program



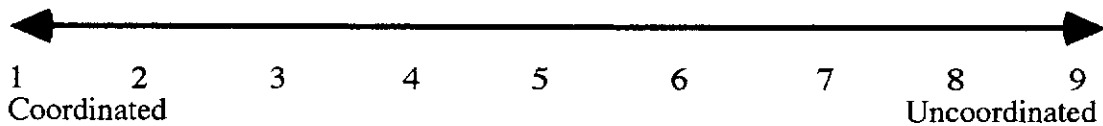
Comments:

**5. Video sequences.** Do you consider them potentially useful resources when accessing VRLR



Comments:

**6. Media Integration.** Does the VRLR combine different media(text, video and graphics) work together in a cohesive manner.



Comments:

## Appendix E

### Learning Characteristics Profile

Name: \_\_\_\_\_


#### Introduction

Many personal characteristics influence learning and the potential formation of mental models in interactive learning situations. Some of the most recognised influences include cognitive style (Coventry, 1989; Sein & Bostrom, 1989), learning style (Logan, 1990; Sein & Bostrom, 1989; Van der Veer, 1989), and computer experience and computer anxiety (Marcoulides, 1988; Nelson, Wiese & Cooper, 1991; Honeyman & White, 1987).

#### • COGNITIVE STYLE

Cognitive style is a concept which is concerned with individual differences in cognitive functions that are the product of rather permanent dispositions like intelligence, problem solving and relating to others (Van der Veer, 1989). Witkin (1976) stated that cognitive styles concern the form rather than the content of activity when he developed the theory of "psychological differentiation". That is, cognitive styles reflect differences in the extent to which individuals make perceptual decisions independently of the context or background provided. *The Embedded Figure Test* developed by Witkin, Oltman, Raskin and Karp (1971) is the best known assessment of individual's cognitive style and measures the individual's degree of field dependency - field independency (Hockey, 1990). People who are significantly influenced by the surrounding field are called field-dependant whereas those who are relatively uninfluenced are referred to as field-independent.

#### Scoring

Quartiles	Men	Women	Field dependency
1	0 - 9	0 - 8	
2	10 - 12	9 - 11	
3	13 - 15	12 - 14	
4	16 - 18	15 - 18	

Field independency

According to the above norms, your score of \_\_\_\_\_ places you in the \_\_\_\_\_ quartile.

### • LEARNING STYLE

Another dimension of individual cognition is learning style which is sometimes referred to as a subset of cognitive style and is defined as the way people absorb or retain information (Hayes & Allison, 1993). A measure of learning style, which is based largely on Piaget's work, is Honey and Mumford's (1992) *Learning Styles Questionnaire*. By combining the characteristics of learning and the problem-solving processes, Honey and Mumford suggest that individuals learn in four modes: through active experimentation, reflective observation, adaptive observation, and pragmatic involvement. The choice of learning mode is governed by each individual's goals and his or her objectives. Because individuals have different goals, their learning modes become highly individualised (Sein & Bostrom, 1989).

### Scoring

The following represents your score from the *Learning Styles Questionnaire*.

Activist	Reflector	Theorist	Pragmatist	
20	20	20	20	Very Strong Preference
19				
18		19	19	
17	19			
16		18	18	
15				
14		17		
13	18	16	17	Strong Preference
12	17	15	16	
11	16	14	15	
10	14	13	14	Moderate Preference
9				
8	13	12	13	
7	12	11	12	
6	11	10	11	Low Preference
5	10	9	10	
4	9	8	9	
3	8	7	8	Very Low Preference
	7	6	7	
	6	5	6	
2	5	4	5	
	4	3	4	
1	3	2	3	
	2	1	2	
0	1	0	1	
	0		0	

• **TECHNOPHOBIA**

High levels of computer awareness and aptitude provide many students with opportunities to gain ascendancy over their less computer literate peers. Large numbers of otherwise competent students experience varying degrees of anxiety when exposed to computers. This experience can be particularly debilitating as computers become more and more a crucial component of the educational process. Computer anxiety can be defined as an affective response of apprehension or fear of computer technology accompanied by feelings of nervousness, intimidation, and hostility (McInerney, McInerney & Sinclair, 1994). Negative cognitions and attitudes towards computers may also accompany such feelings of anxiety and include worries about embarrassment and looking foolish. Rosen and Weil (1992) developed three instruments to measure individual's degree of "technophobia," i.e., their comfort with computer technology. These instruments, *Computer Anxiety Rating Scale*, *Computer Thoughts Survey* and *General Attitudes Towards Computers*, have been applied to thousands of participants drawn from tertiary institutes in different countries (Rosen & Weil, 1995).

**Scoring**

**Computer Anxiety Rating Scale**

No technophobia	20-41
Low technophobia	42-49
Moderate/high technophobia	50-100

**Computer Thoughts Survey**

No technophobia	69-100
Low technophobia	61-68
Moderate/high technophobia	20-60

**General Attitudes Towards Computers**

No technophobia	64-100
Low technophobia	56-63
Moderate/high technophobia	20-55

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## **Appendix F**

### **Front Cover of Group Embedded Figures Test**

**Note: For copyright reasons Appendix F, containing the front cover of the Group Embedded Figures Test, by Philip K. Oltman, Evelyn Raskin and Herman A. Witkin, has not been reproduced.**

**(Co-ordinator, ADT Project (Retrospective), Curtin University of Technology, 20.11.02)**

## Appendix G

### Learning Style Questionnaire    Revised 1986

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## Appendix H

### Computer Anxiety Rating Scale

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## **Appendix I**

### **Computer Thoughts Survey**

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## Appendix J

### General Attitudes Toward Computers Scale

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## Appendix K

### Demographic Data And Technology Experience Questionnaire

**Participant Code Number:** \_\_\_\_\_

Please circle number below representing your response

#### **Demographic Data**

1. Gender: female = **1**, male = **2**
2. Age: Under 20 = **1**, 20-25 = **2**, 26- 30 = **3**, Over 30 = **4**

#### **Prior computer/technology experience**

3. Prior to entering university, in which of the following did you achieve your greatest amount of computer experience  
Year 12 = **1**, Year 11 = **2**, Years 1-10 = **3**, TAFE = **4**, Home = **5**
4. Do you use a computer at home to assist with your university studies?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
5. How often have you accessed the World Wide Web on the Internet?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
6. How often have you used the computer laboratory facilities at Shenton Park Campus?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
7. How often have you used computerised library literature search facilities?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
8. How often have you used word processing?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
9. How often have you played computer games?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
10. How often have you played arcade games?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
11. How often have you written a computer program?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
12. How often have you used a programmable video-cassette recorder?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
13. How often have you used a programmable microwave oven?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
14. How often have you used automatic banking machines?  
never = **1**, 1-2 times = **2**, 3-5 times = **3**, 6 or more times = **4**
15. Which of the following best describes your level of computer knowledge when compared to your undergraduate occupational therapy colleagues?  
much lower than average = **1**, lower than average = **2**, average = **3**, above average = **4**, much higher than average = **5**

## **Appendix L**

### **Data Collection Protocol**

This part of the study to involve three consecutive components. These are to be conducted in an office and an adjoining screened area within the Heavy Activities Laboratory at the School of Occupational Therapy, Shenton Park. Days scheduled for these sessions are Mondays (9am-5pm), Tuesdays (9am-5pm) and Wednesdays (1pm-5pm) of weeks 3-6 of 1st Semester 1996. This schedule has been set to fit within the non-class contact time of participants. Total time per participant is 45 minutes which will allow 18 subjects to be processed each week. Research duties during these sessions will be shared between the investigator and a research assistant.

#### **Arrival component**

Location: Screened area

Responsibility: Research assistant

Time: five minutes

Each participant to be welcomed by name and thanked for their assistance by Research Assistant, who introduces himself.

"Hello "X", my name is Kelwyn and I'd like to thank you for coming along today to assist with our study. There are three components to this the final data collection part of the study into the influence of users' characteristics when learning in a multimedia environment. Firstly, I'm going to issue you with a questionnaire which should take you about five minutes to complete. Then you will join Don in the adjacent office to spend 45 minutes accessing multimedia materials on a computer which are relevant to Occupational Health 241. Lastly, you will return to this area to complete your contribution to data collection for this study. This will involve filling in two other questionnaires which should take approximately 10 to 15 minutes.

Remember, the purpose of this study is not to evaluate participant's performance, but, to investigate how people with different learning characteristics navigate multimedia"

*Demographic Data and Technology Experience Questionnaire* given to the participants for completion.

Explanation of Experiment:

"The next part of the study requires you to access a multimedia learning resource which is set-up on the computer in the office. So if you would please join Don there, details will be explained to you".

#### **Accessing VRLR and WWW Component**

Location: office and screened area.

Responsibility:

Investigator (in office) - Welcomes participant, gives instructions, prompts participant, administering appropriate tools, loads/removes video tape, switches video on/off, , takes field notes.

Research assistant( in screened area) - Times tasks with tape counter on monitor, operates time measurement with stop-watch, takes field notes, files video tapes and field notes with participant's questionnaires

Time: 30 minutes

Participant welcomed by Investigator. Focus of study emphasised .

"Hello "X". This part of the study requires observation of a user accessing interactive multimedia. This session will be captured by a video camera and transmitted to a monitor located just outside the office where Kelwyn will observe proceedings. It will

also be recorded in case we miss something in our observations. As for all components of this study, your identity will remain confidential to the Research Team i.e. Kelwyn and I".

Don't load tape with participant's code number on label into the video player.

"This component requires you to firstly access *Vocational Rehabilitation Learning Resource*, which is a multimedia package designed specifically for students of Occupational Health 241. After a brief introduction and demonstration by me, you will be asked to tackle 4 exercises using this package.

Each of the above exercises will have a time limit of 4 minutes. If you don't finish any part within this limit you will be asked to stop and move to the next part. Are there any questions before I explain basic operations"?

Open *VRLR* and enter *Introduction* screen.

"There are a number of user help features within the package, including an individual overview for each of the databases. I am going to open the introductory overview from the Main Menu which will briefly explain the overall features of *Vocational Rehabilitation Learning Resource*".

Run Introduction overview.

"Navigation within the package is by clicking on text and graphics buttons using the mouse. Do you feel quite comfortable pointing and clicking with the mouse?"

If answer is negative repeat demonstration of above opening session entering on Introduction screen.

"It would be helpful in this part of the study if you could think aloud as you tackle exercises i.e. talk out loud while working within the package".

Quit *VRLR* on main menu screen.

### **Exercise 1. WAT Search**

"I'd like you now to open the Resource Packages section and access *Work Assessment Tools* database. Select the Valpar 19 Assessment Tool and answer the following questions:

What is the full title of the Valpar 19 assessment tool?

How long does it take to administer?

Name one of the three objectives in using this tool"

The above 3 questions to be displayed on a card and positioned on the desk in view of the participant for reference.

"Please think aloud as you are working and state your answers to me verbally and by pointing to the screen if necessary.

Have you any questions before we begin?"

If no, then start video tape recording and stop watch.

Stop stop-watch after 4 minutes.

### **Exercise 2. Exploring VRLR**



"I'd like you now to spend 4 minutes exploring both the Resource Packages and Problem Solving sections of *Vocational Rehabilitation Learning Resource* thinking aloud while you are working. Feel free to open and close screens at will and move between links. Any questions?"

If no then start stop-watch .

Stop stop-watch after 4 minutes or on completion of task.

### **Exercise 3. Problem-solving**

"Now imagine you are a Case Manager and have just received referral information on a client named Susan White. Access the problem-solving section of *Vocational Rehabilitation Learning Resource* and answer the following questions linking to Resource Packages as required:

What was Susan's injury?

What is her occupation?

Why would a Social Worker be a useful member of your case team?

Which three physical demands of this job are most likely to aggravate this type of injury?

The above 3 questions to be displayed on a card and positioned on the desk in view of the participant for reference.

"Please think aloud while you are working. Any questions?"

If no then start stop-watch .

Stop stop-watch after 4 minutes or on completion of task.

### **Exercise 4. Teach-back VRLR**

"Now I am going to ask you to imagine that I am new to using *Vocational Rehabilitation Learning Resource* and invite you to instruct me on accessing and using the problem-solving component of this package. Please describe verbally accessing procedures, format and uses of the various components as you proceed with the demonstration".

The above question to be displayed on a card and positioned on the desk in view of the participant for reference.

"Any questions?"

If no then start stop-watch .

Stop stop-watch after 5 minutes or on completion of task.

## Appendix M

### Observations Recorded

Component		Tasks to be Measured	Successfully Answered	Date:			Participant's Code Number:		
				Time to Complete	No. Screens Accessed	Overview Accessed	Where am I Accessed	Assistance Requested	Start Time:
Accessing information from Work Assessment Database	Find full title of Valpar 19 assessment tool								
	Find how long it takes to administer the Valpar 19								
	Name one of the objectives when using the Valpar 19								
<u>Verbal Observations</u>				<u>Non-Verbal Observations</u>					

Participant's Code Number:						
Component	No. Screens Accessed	Overview Accessed	Assistance Requested	Component	No. Database Accessed	No. Screens Accessed
Exploring VRLR				Teach back		
<u>Verbal Observations</u>			<u>Verbal Observations</u>			
<u>Non-Verbal Observations</u>			<u>Non-Verbal Observations</u>			

		Participant's Code Number:					
Component	Tasks to be Measured	Successfully Answered	Time to Complete	No. Screens Accessed	Overview Accessed	No. Database Accessed	Assistance Requested
Problem-solving	What was Susan's injury						
	What is her occupation						
	Physical demands of the job likely to aggravate injury						
	Why would Social worker be useful team member						
<u>Verbal Observations</u>		<u>Non-Verbal Observations</u>					

## Appendix N

### INFORMATION FOR PARTICIPANTS IN RESEARCH INVESTIGATION

**TOPIC: The influence of users' characteristics when learning with interactive multimedia.**

You have been selected as a research participant investigating interactive multimedia. The purpose of this research is to provide information for a PhD project investigating learner characteristics and mental models when using an interactive multimedia learning package *Vocational Rehabilitation Learning Resource (VRLR)*.

The investigation will initially require you to complete a written component to identify your: computer experience, computer anxiety, cognitive style and learning style. You will then be requested to access *VRLR* and explore its structure before attempting to tackle search problems. The sessions utilising *VRLR* will be video taped to allow analysis of navigation patterns to be conducted, but participants identity will not be disclosed as the camera angle will be across the shoulder focusing on the computer screen and participant's control of the mouse.

Students choosing to participate in the study may benefit from:

- i) Access to useful information on their individual learning characteristics. Although the information will remain confidential, a participant will be able to request his/her own results from all tests
- ii) Time spent using the *VRLR*. This opportunity will allow participants to increase their knowledge base in occupational health and in particular vocational rehabilitation and the development of case management skills.

Students using *VRLR* in future also will benefit from this investigation as the quality of this learning package should be considerably enhanced by addressing the needs of targeted users in later versions.

It is envisaged that the first stage of the investigation (written component) will take approximately 60 minutes to complete. Accessing *VRLR* will take approximately 45 minutes. Should you desire not to participate in this study, it will not in any way be prejudicial to your further study in the unit Occupational Health 241.

Any questions about this research can be directed to Don Cameron at the School of Occupational Therapy, Curtin University of Technology (351 3621).

#### CONSENT FORM FOR PARTICIPANTS IN RESEARCH INVESTIGATION

**TOPIC: The influence of users' characteristics when learning with interactive multimedia.**

I (the participant) have read the details for the above research topic on the leaflet *Information For Participants In Research Investigation* and any questions I have asked have been answered to my satisfaction. I agree to participate in this activity, realising I may withdraw at any time and I agree that the research data gathered for this study may be published provided that I am not identifiable.

\_\_\_\_\_  
Participant or authorised representative Date

\_\_\_\_\_  
Investigator Date

## Appendix O

### WORLD WIDE WEB (WWW) RESEARCH PROJECT

#### WWW Research Project Methodology

This WWW research project employed the same occupational therapy population as was involved with the thesis research *Learning Characteristics and their Impact on Multimedia Navigation*. It utilised the results from the learner characteristics measured in that research and monitored their influence on participants' navigation performance on the WWW using the browser navigation software *Netscape*. The four groups of exercises employed navigating the WWW were accessing data, browsing, problem-solving, and teach-back respectively, as detailed in Figure 1. Immediately after the time allocation for these navigation tasks was exhausted, participants were invited to complete the attitude form, *Netscape-User Attitude Questionnaire* (refer to Figure 2).

---

#### Exercise 1: Accessing data

---

Open *Netscape* and access the School of Occupational Therapy Website and attempt the following:

- Find the e-mail address of Tanya Barrett, co-ordinator of this unit Occupational Health 241
  - What is the World Wide Web address for the Occupational Therapy Research Centre of WA?
  - Name one of the News Groups in the OT Internet Resources Menu
- 

#### Exercise 2: Exploring

---

I'd like you now to explore *Netscape* for a few minutes thinking aloud while you are browsing. Feel free to open and close screens at will, but confine your exploration within the addresses available through School and Curtin University's Websites. These are addresses frequently accessed from campus and have been conveniently set to minimise delays which may otherwise occur in down-loading information during an open search.

---

#### Exercise 3: Problem-solving

---

Access the Western Australian Department of Occupational Safety, Health, and Welfare's Website, *SafetyLine* and attempt the following:

- Find the Main Menu of *SafetyLine*
  - Which three Western Australian safety and health laws are detailed in *SafetyLine*?
  - Search to find out if "migraine" can be claimed as a work related disease or injury under West Australian Legislation
- 





#### Exercise 4: Teach-back

---

Now I am going to ask you to imagine that I am new to using World Wide Web and invite you to instruct me on how to access the School's Website and *SafetyLine*. Please describe verbally accessing procedures, format and uses of the various components as you proceed with the demonstration.

---

**Figure 1. WWW Navigation Exercises Attempted by Each Participant**

<b>NETSCAPE- User Attitude Questionnaire</b>									
<b>Instructions.</b> For each of the following rate on the 1 - 9 scale by circling your choice. Please add any comments below each question which may clarify or explain your rating.									
<b>1. Ease of use</b>									
									
Difficult									Easy
1	2	3	4	5	6	7	8	9	
<div style="border: 1px solid black; height: 60px; margin-top: 5px;">Comments</div>									
<b>2. Navigation.</b> To what degree did you feel that you knew where you were within the program and how to get to another part of it									
									
Difficult									Easy
1	2	3	4	5	6	7	8	9	
<div style="border: 1px solid black; height: 60px; margin-top: 5px;">Comments</div>									
<b>3. Cognitive Load.</b> How "manageable" did you find the program coping with the integrative demands of the content, structure and response options.									
									
Unmanageable									Manageable
1	2	3	4	5	6	7	8	9	
<div style="border: 1px solid black; height: 60px; margin-top: 5px;">Comments</div>									
<b>4. Screen Design.</b> Includes arrangement of text, icons, colour aspects of the interactive program									
									
Poor									Outstanding
1	2	3	4	5	6	7	8	9	
<div style="border: 1px solid black; height: 60px; margin-top: 5px;">Comments</div>									

**Figure 2. Netscape - User Attitude Questionnaire**

### WWW Research Project Results

Sixty seven occupational therapy students participated in all four groups of exercises and their navigational responses were recorded on the pre-prepared form, *Observations Recorded for Netscape Research*, which was similar to the form developed for the thesis research (refer Appendix Q). Measurements were recorded for the number of screens opened and the number of times that assistance was required for all four groups of exercises. In the accessing data and problem-solving sections (see Exercises 1 and 3 in Figure 1) the number of help screens accessed, successful searches, and time for searches also were recorded (see Table 1).

**Table 1. Descriptive Statistics of Summation of Netscape Navigation Variables for Occupational Therapy Students (n = 67)**

Navigation Performance	Total for All Four Groups of Exercises			
	Mean	Std. Dev.	Minimum	Maximum
SUCWEB (successful searches)	4.45	1.03	1	6
NOBUT (number of buttons)	21.79	3.7	14	31
NONAV (number of nav. buttons)	19.82	5.62	8	35
TOTBUT (number of buttons total)	41.61	8.83	22	59
WEBTIME (time taken in secs)*	467.16	40.86	276	480
WEBHELP (help accessed)	.149	.50	0	6
WEBASS (assistance requested)	2.28	1.48	0	6
WEBATT (attitude to Netscape)	25.15	5.07	14	36

Eighty seven percent of participants failed to complete all of the exercises successfully. Participants, generally, failed to find the solution to the last question in Exercise 3 within the time allocation (see Figure 1 above). This exercise involved using the *Search* tool in *SafetyLine*. Most participants (74.2%) were successful with at least four questions. The number of navigation buttons utilised by participants,



which are available at the top of each screen in *Netscape*, varied significantly. One participant used these buttons on only a total of eight occasions, whereas another utilised them on a total of 35 occasions. There was statistically significant correlation between the number of *Netscape* navigation buttons used and the number of link buttons employed to move to other screens within both the School of Occupational Therapy's Website and *SafetyLine*. Because of the strong correlation between link and navigation buttons ( $p < .001$ ) it was decided to total these two scores (TOTBUT) which resulted in the minimum total number of buttons accessed being 22 for one participant to a maximum of 59 buttons for another. Not many participants used the help features of *Netscape* (10%) with only one using it on three or more occasions. Most participants asked at least once for assistance (20%), although only one required assistance on six or more occasions.

As a preliminary investigation to exploring relationships with learner characteristics, measurement of linear association between the navigation variables was conducted using the *Correlations* procedure of the statistical package SPSS (Norusis, 1992c). All totals of variables identified and measured in Table 1 were included in the pairings and illustrated in a matrix of all these correlations (see Table 2). The labels used in this table are as specified in Table 1 above.

**Table 2. Correlation Matrix: Web Navigation**

VARIABLE	SUCWEB	NOBUT	WEBTIME	WEBHELP	WEBASS
SUCWEB	1.00	-.18	-.479***	-.073	-.112
NOBUT			.10	-.02	.19
WEBTIME				.095	.1746
WEBHELP					-.265*
WEBASS					1.00

\*  $p < .05$ , \*\*\*  $p < .001$

The most significant relationship was between successful Web searches and time taken ( $p < .001$ ). This was also the most statistically significant correlation in the thesis research (refer to Chapter 6, Table 6.6). In this research into Web navigation, there was also a statistically significant relationship between the number of times help was used and number of times assistance was requested ( $p = .03$ ). A correlation matrix of the 12 independent variables and the five dependent variables is presented in Table 3. The labels used for the independent variables are identified in Chapter 6, Figure 6.1

**Table 3. Correlation Matrix: for Web Navigation and Learner Characteristics**

	SUCWEB	TOTBUT	WEBTIME	WEBHELP	WEBASS
ACTIVIST	-.02	.05	.04	..08	.01
AGE	.03	-.23	-.14	.08	-.08
ANX	.01	-.05	-.04	-.10	.32*
COGSTYLE	.15	.07	.03	-.05	-.13
COMEXP	.00	-.14	-.01	-.08	-.04
COMKNOW	.12	-.22	-.09	.17	-.38**
GEN	.10	-.12	-.37**	-.04	-.20
PRAG	-.03	-.07	-.17	.11	-.11
PRIOREXP	-.04	-.04	.03	.19	-.29*
REFL	-.04	.02	-.17	-.04	-.18
THEO	.04	.14	-.15	.14	-.03
THOUGHT	-.06	-.09	-.03	.12	-.38**

\*  $P < .01$ , \*\*  $p < .01$

There was a statistically significant relationship ( $p < .05$ ) between the number of times that assistance was requested and computer thoughts, computer anxiety, computer

knowledge, and computer training. In the thesis research, the number of times assistance requested was also significantly related to a number of learner characteristic variables, but the only one in common with the Web experiment was with computer thoughts. Time taken for searches was significantly related to gender with female participants taking longer than males. However these two variables were not significant in the thesis study.

An investigation of relationships between the five navigation performance variables measured in the two studies showed a significant relationship between successful searches where  $p < .001$  (see Table 4) showing that successful searchers of *VRLR* were also successful with the Web searches. However, none of the other four dependent variables were significantly correlated with their counterpart in the other research project, although successful searching in the WWW was statistically related to the thesis variables measuring number of times assistance requested ( $p = .001$ ), number of screens accessed ( $p = .015$ ), and time taken ( $p = .02$ )

**Table 4. Correlation Matrix: WWW Navigation/VRLR Navigation**

VARIABLE	SUCSEAR	NOS	TIME	OVERVW	ASSIST
SUCWEB	.423***				
TOTBUT		.13			
WEBSITE			-.054		
WEBHELP				.077	
WEBASS					.124

\*\*\*  $p < .001$ ,

Multiple linear regression analysis was then employed to explore the interactive effects of the independent variables on the dependent variables in this WWW research. All of the five dependent navigation variables (see Table 1) were in turn entered into

backward elimination multiple linear regression analysis with ten of the independent learner characteristic variables collected as interval scales (see Table 2). Two of the original twelve variables, gender and source of learning about computers, were excluded from the regression analysis on the grounds that their scores were categorical. The same criteria of entering variables into the regression was applied as in Chapter 6, Section 6.5.3. (refer to Table 5).

**Table 5. Best Predictor of Occupational Therapy Participants' Navigation Performance and Attitudes Using Multiple Linear Regression**

Dependent Variable	Independent Variable	Beta-Standardised Regression Coefficient	Adjusted R-Square	F-Ratio	Significance (F)
SUCWEB	f undefined				
NOBUT	f undefined				
WEBSITE	ACTIVIST	.19	.13	4.59	.014*
	ANX	.31			
WEBHELP	F undefined				
WEBASS	COMKNOW	-.28	.17	5.29	.003**
	REFL	-.08			
	ANX	.22			
WEBATT	AGE	-.25	.37	8.26	.000***
	PRIORGEXP	-.11			
	THEO	.16			
	THOUGHT	.57			
	WEBSITE	-.33			

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

The analysis identified significant models for only two of the dependent navigation variables, time for searches and number of times assistance requested. Of the independent variables, computer anxiety and activist learning style were grouped together in a model partially explaining time for searchers. Computer knowledge, reflective learning style and computer anxiety partially explained number of times assistance requested. The model equations were:

$$\bullet \text{ WEBSITE} = .73 + .07\text{ACTIVIST} + .03\text{ANX}$$

$$\bullet \text{ WEBASS} = 3.67 - .52\text{COMKNOW} - .08\text{REFL} - .03\text{ANX}$$

Computer anxiety and activist learning style in combination explained 13% of the variance for the time taken for searches. This model was of equal strength to the time for searches model in the *VRLR* study, but the models differed in the composition of the independent variables. The independent variables computer knowledge, reflector learning style, and computer anxiety in combination explained 17% of the variance for the number of times assistance was requested. This is close in strength of the regression model for this variable in the *VRLR* study which was 14%. However, once again the models differed in the composition of the independent variables. This demonstrated that there is little statistically significant linear relationship in the time taken and the number of times assistance was requested between the *VRLR* search exercises and the *Netscape* search exercises.

The *Attitude to Netscape Questionnaire* asked four questions relating to participants' perception of the user friendliness of *Netscape*. Participants were asked to rate each response on a nine-point Likert scale relating to ease of use, navigation, cognitive load, and screen design. The results of this questionnaire are reported in Table 7 with the results of the *VRLR-User Attitude Questionnaire* also shown for comparison.

Generally, attitudes were positive towards the usability of *Netscape* and similar to this same populations' attitude towards *VRLR*. The question in the *Netscape-User Attitude Questionnaire* which elicited the highest positive response score was Question 4 (*Screen Design*), where 62.2% of participants scored a seven or more out of a possible maximum of nine. The least positive response was to Question 2 (*Navigation*) where 45.5% of participants scored seven or more from a possible maximum of nine.

Table 8 is a correlation matrix of scores for all twelve independent learner characteristics and the dependent variable attitude to *Netscape*. The attitude score (WEBATT) is the sum of the scores to all questions in the *Netscape - User Attitude*

*Questionnaire.* The labels used for the 12 independent learner characteristics variables are described in Chapter 5, Figure 5A.

**Table 7. Descriptive Statistics Showing Comparison of Results for Attitude to Netscape Questionnaire and Attitude to VRLR Questionnaire (n = 67)**

No.	Question	Mean	Std. Dev.	Maximum	Minimum
1*	Ease of use	6.23	1.58	9	3
1	“ “ “	6.28	1.61	9	2
2*	Navigation	6.00	1.80	9	2
2	“	6.24	1.60	9	3
3*	Cognitive load	6.23	1.39	9	2
3	“ “	6.58	1.34	9	3
4*	Screen design	6.70	1.30	9	4
4	“ “	7.45	.96	9	4

\* Netscape

**Table 8. Correlation Matrix of Learner Characteristics and Attitude to Netscape (n = 67)**

Dependent	LEARNER CHARACTERISTICS					
Variable	ACTIVIST	AGE	ANX	COGSTYL	COMEXP	COMKNOW
WEBATT	-.22	-.08	-.30**	.11	.01	.36**

Dependent	LEARNER CHARACTERISTICS (cont.)					
Variable	GEN	PRAG	PRIOREXP	REFL	THEO	THOUGHT
WEBATT	-.00	-.02	.19	.12	.15	.46***

\* p <.05, \*\*p <.01. \*\*\* p<.001

Computer thoughts, computer anxiety, and computer knowledge were significantly correlated with attitude as they were with *VRLR*. Activist learning style and prior experience also correlated with attitude and *VRLR*, but though approaching significance they fell outside  $p < .05$ . Table 9 is a correlation matrix between attitudes and navigation variables (see Table 1 for descriptions of codings).

**Table 9. Correlation Matrix of Participants' Navigation Performance and Attitudes Towards *Netscape* (n = 67)**

Dependent Variable	NAVIGATION PROCEDURES				
	WEBASS	NOBUT	WEBHELP	SUCWEB	WEBSITE
ATTIT	-.34**	-.09	-.06	.19	-.48***

\*\*  $p < .01$ , \*\*\*  $p < .000$

There was significant correlation between attitude towards *Netscape* and the number of times assistance was requested and times taken for searching as there were for attitudes towards *VRLR*. The number of successful searches was also significantly correlated with attitude towards *VRLR*, but on this occasion was just outside the significance limit.

All 10 learner characteristics which were collected as categorical variables plus the five navigation variables were entered into a multiple regression analysis as independent variable with attitude towards *Netscape* being the dependent variable. A statistically significant predicting equation resulted (see below); predicting 38% of variance in this statistical model incorporating age, prior computer experience, theorist learning style, computer thoughts, and time to search the WWW. The predictor equation was:

$$\text{WEBATT} = 20.75 - 1.82\text{AGE} - .13\text{PRIOREXP} + .21\text{THEO} + .20\text{THOUGHT} - 1.5\text{WEBSITE}$$

Appendix P

COMPARISON BETWEEN ACTUAL AND MODEL SCORES FOR NAVIGATION AND ATTITUDE VARIABLES

Participant	ASSISTANCE		NO of SCREENS		TIME		SUCCESSFUL SEARCHES		ATTITUDE TOWARDS VRLR			
	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model 1*	Model 2**	
1	2.00	2.07	80.00	55.19	353.00	405.65	5.00	4.86	24.00	28.51	26.27	
2	2.00	1.70	46.00	70.02	470.00	404.07	5.00	5.12	27.00	27.93	27.12	
3	3.00	2.51	103.00	79.23	480.00	408.81	2.00	4.75	16.00	22.02	17.96	
4	3.00	2.04	79.00	80.23	474.00	426.77	5.00	4.96	24.00	27.04	27.78	
5	2.00	1.76	70.00	70.24	480.00	494.02	4.00	3.78	19.00	24.64	23.13	
6	2.00	1.96	96.00	88.42	480.00	439.92	5.00	5.48	19.00	22.89	22.31	
7	3.00	2.43	81.00	82.49	480.00	449.48	4.00	3.70	21.00	21.93	22.35	
8	2.00	2.04	86.00	82.16	442.00	443.31	6.00	4.70	28.00	24.88	26.62	
9	3.00	2.20	63.00	78.77	480.00	453.60	3.00	4.65	19.00	25.88	24.26	
10	2.00	2.19	85.00	90.78	398.00	467.36	6.00	5.20	32.00	25.16	26.87	
11	4.00	2.24	86.00	79.71	411.00	414.29	6.00	5.52	29.00	25.71	28.34	
12	1.00	1.43	91.00	90.97	466.00	419.26	6.00	5.85	29.00	27.96	27.67	
13	2.00	2.32	84.00	82.30	443.00	450.07	5.00	4.68	25.00	26.19	26.68	
14	2.00	1.90	80.00	86.68	372.00	383.93	7.00	6.47	27.00	23.37	25.97	
15	3.00	2.38	50.00	74.34	363.00	450.07	6.00	4.67	31.00	26.35	28.74	
16	1.00	2.03	70.00	78.25	281.00	379.12	7.00	5.97	31.00	26.98	30.22	
17	1.00	1.42	75.00	68.47	381.00	464.79	5.00	4.58	28.00	30.91	29.83	
18†												
19†												
20	1.00	1.72	60.00	75.80	211.00	361.32	7.00	5.90	33.00	28.27	30.09	
21†												
22	2.00	1.21	93.00	83.32	279.00	420.99	7.00	5.82	33.00	28.73	28.24	



Participant	ASSISTANCE		NO of SCREENS		TIME		SUCCESSFUL SEARCHES		ATTITUDE TOWARDS VRLR			
	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model 1*	Model 2**	
23†												
24	4.00	2.67	62.00	68.86	480.00	493.87	4.00	3.47	30.00	25.59	26.98	
25	1.00	1.25	89.00	83.67	334.00	404.08	6.00	5.90	28.00	30.06	29.18	
26	3.00	1.50	87.00	87.20	381.00	399.27	6.00	5.46	27.00	25.82	25.78	
27	1.00	1.36	114.00	79.71	328.00	399.27	7.00	6.23	32.00	30.75	30.88	
28	2.00	1.89	51.00	77.40	358.00	414.37	6.00	5.93	24.00	27.18	27.85	
29	1.00	1.69	68.00	71.50	377.00	391.30	7.00	5.12	35.00	27.22	29.98	
30	3.00	1.40	73.00	85.46	346.00	414.45	7.00	5.75	26.00	26.27	28.01	
31	2.00	1.68	121.00	79.48	425.00	434.36	6.00	5.49	27.00	29.09	30.59	
32	2.00	2.35	55.00	67.97	386.00	355.01	5.00	5.56	23.00	24.67	23.29	
33†												
34	1.00	1.98	73.00	71.61	379.00	417.15	6.00	4.92	25.00	27.96	30.07	
35	1.00	1.66	77.00	80.84	315.00	376.50	7.00	5.89	30.00	27.68	29.25	
36	2.00	1.35	62.00	75.93	480.00	429.25	3.00	5.10	34.00	28.32	24.44	
37	3.00	1.76	59.00	72.12	373.00	414.45	6.00	5.13	31.00	28.95	27.84	
38	2.00	2.12	51.00	66.31	480.00	447.58	4.00	5.13	24.00	27.52	24.53	
39	2.00	1.87	78.00	79.71	456.00	398.52	6.00	5.68	22.00	28.34	29.08	
40	3.00	1.79	41.00	75.59	480.00	438.87	5.00	4.89	26.00	25.69	23.76	
41	3.00	1.52	63.00	73.62	480.00	432.03	3.00	5.01	24.00	27.88	24.32	
42	3.00	1.69	77.00	78.14	480.00	469.23	3.00	4.84	27.00	27.86	24.09	
43	2.00	2.15	55.00	81.11	480.00	464.20	3.00	4.47	21.00	25.98	23.98	
44	3.00	1.78	69.00	78.72	480.00	388.82	2.00	6.04	24.00	27.78	22.41	
45	2.00	2.00	89.00	86.07	335.00	432.33	6.00	5.27	25.00	26.15	28.15	
46	3.00	2.11	100.00	84.94	387.00	400.55	6.00	4.82	22.00	24.89	27.19	
47	2.00	1.40	94.00	77.03	383.00	399.27	6.00	5.93	28.00	30.57	30.83	
48†												
49	1.00	2.06	94.00	85.60	330.00	418.51	7.00	5.20	31.00	25.01	28.76	
50	3.00	2.59	65.00	74.62	396.00	421.82	5.00	4.02	27.00	25.51	26.59	

Participant	ASSISTANCE		NO of SCREENS		TIME		SUCCESSFUL SEARCHES		ATTITUDE TOWARDS VRLR		
	Actual	Model	Actual	Model	Actual	Model	Actual	Model	Actual	Model 1*	Model 2**
51	2.00	1.70	54.00	65.94	480.00	459.53	4.00	4.65	29.00	30.72	28.25
52	2.00	1.79	65.00	76.93	480.00	404.08	5.00	5.01	24.00	27.63	26.71
53	3.00	1.69	85.00	80.73	480.00	416.10	5.00	5.31	19.00	24.42	23.76
54	2.00	1.69	120.00	77.92	474.00	406.11	7.00	5.38	34.00	28.72	30.15
55	3.00	1.60	88.00	84.75	449.00	401.97	6.00	6.47	32.00	29.67	29.35
56	2.00	2.27	72.00	79.76	480.00	402.58	4.00	4.80	28.00	24.81	25.16
57	1.00	1.74	84.00	82.91	432.00	384.09	6.00	5.92	27.00	26.46	26.35
58	2.00	1.99	57.00	76.93	471.00	396.33	5.00	5.99	26.00	27.37	27.08
59	3.00	2.21	79.00	77.40	480.00	421.29	3.00	4.42	28.00	26.38	23.93
60	2.00	1.54	82.00	76.46	480.00	414.45	5.00	5.38	32.00	28.22	26.63
61	1.00	1.97	89.00	79.85	480.00	414.37	5.00	5.17	27.00	25.10	25.07
62†											
63	1.00	1.14	101.00	76.43	480.00	436.62	5.00	4.55	26.00	29.16	26.98
64	3.00	1.82	50.00	79.66	480.00	393.71	4.00	5.45	16.00	25.88	23.21
65	2.00	2.46	81.00	63.69	428.00	410.76	6.00	5.56	32.00	28.58	30.24
66	2.00	2.12	93.00	77.78	423.00	439.78	5.00	4.71	29.00	29.67	29.50
67	3.00	1.90	83.00	73.94	367.00	436.09	7.00	5.04	28.00	27.88	28.49
68	2.00	2.09	77.00	75.71	350.00	379.81	6.00	5.26	28.00	28.63	30.92
69	1.00	1.64	67.00	66.69	428.00	424.44	6.00	4.68	30.00	28.20	27.88
70	3.00	2.29	94.00	79.00	480.00	443.23	5.00	4.76	21.00	25.15	25.24
71	2.00	1.98	101.00	69.45	473.00	463.96	6.00	4.31	26.00	22.36	23.19
72	3.00	2.16	77.00	76.86	326.00	422.25	7.00	4.95	23.00	22.42	25.00
73	2.00	2.18	86.00	70.83	480.00	445.02	5.00	4.81	23.00	24.91	24.25
74	1.00	1.99	64.00	77.57	480.00	436.84	2.00	4.21	26.00	24.58	19.89

\* Model 1 comprises of learner characteristic variables

\*\* Model 2 comprises of learner characteristic variables plus navigation variables

† Participants without scores recorded either were part of the pilot study or failed to complete all sections of the investigation

## Appendix Q

### Data Coding

#### Demographic Data

1. GEN: Gender: female = 1, male = 2
2. AGE: Under 20 = 1, 20-25 = 2, 26- 30 = 3, Over 30 = 4

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#### Prior computer/technology experience

3. COMEXP: Prior to entering university, in which of the following did you achieve your greatest amount of computer experience  
Year 12 = 1, Year 11 = 2, Years 1-10 = 3, TAFE = 4, Home = 5
4. HOMCOM: Do you use a computer at home to assist with your university studies?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
5. INTACC: How often have you accessed the World Wide Web?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
6. COMLAB: How often have you used the computer laboratory facilities at Shenton Park Campus?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
7. COMLIB: How often have you used computerised library literature search facilities?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
8. WORDPRO: How often have you used word processing?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
9. COMGAME: How often have you played computer games?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
10. ARCGAME: How often have you played arcade games?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
11. COMPROG: How often have you written a computer program?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4

12. VIDCAS: How often have you used a programmable video-cassette recorder?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
13. MICOVEN: How often have you used a programmable microwave oven?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
14. AUTOBAN: How often have you used automatic banking machines?  
never = 1, 1-2 times = 2, 3-5 times = 3, 6 or more times = 4
15. COMKNOW: Which of the following best describes your level of computer knowledge when compared to your undergraduate occupational therapy colleagues?  
much lower than average = 1, lower than average = 2, average = 3, above average = 4, much higher than average = 5

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### Cognitive Style

16. COGSTYL: Cognitive Style actual score
17. COGRATE: Cognitive Style category
- |                      | Men   | Women | Quartile |
|----------------------|-------|-------|----------|
| Field dependency 0-9 | 0-8   |       | 1        |
|                      | 10-12 | 9-11  | 2        |
|                      | 13-15 | 12-14 | 3        |
| Field independency   | 16-18 | 15-18 | 4        |

---

### Learning Style Questionnaire

18. ACT: Activist actual score
19. ACTRATE: Activist category  
Very strong preference = 1, strong preference = 2, moderate preference = 3, low preference = 4, very low preference = 5.
20. REFL: Reflector actual score
21. REFRATE: reflector category  
Very strong preference = 1, strong preference = 2, moderate preference = 3, low preference = 4, very low preference = 5.
22. THEO: Theorist actual score

23. THERATE: Theorist category  
 Very strong preference = 1, strong preference = 2, moderate preference = 3, low preference = 4, very low preference = 5.

24. PRAG: Pragmatist score:

25. PRARATE: Pragmatist category  
 Very strong preference = 1, strong preference = 2, moderate preference = 3, low preference = 4, very low preference = 5.

### Technophobia

26. ANX: Computer anxiety rating scale (CARS)

27. ANXRATE: CARS category

No technophobia	20-41	1
Low technophobia	42-49	2
Moderate/high technophobia	50-100	3

28. THOUGHT: Computer thoughts survey (CTS)

29. THORATE: CTC category

No technophobia	69-100	1
Low technophobia	61-68	2
Moderate/high technophobia	20-60	3

30 ATTIT: General attitude towards computers (GATCS)

31. ATTRATE: GATCS category

No technophobia	64-100	1
Low technophobia	56-63	2
Moderate/high technophobia	20-55	3

### VRLR Navigation

Accesssing information from Work Assessment Database

Full title of Valpar 19

32. TITLEA: Successfully answered Yes = 1, No = 2

33. TITLEC1: Time to complete (actual)

34. TITLEC: Time to complete (range)

0-2mins. = 1, over 2-3mins. = 2, over 3 = 3

35. TITLEN1: No.of screens accessed (actual)

36. TITLEN: No.of screens accessed (range)  
4 = 1, 5-7 = 2, 8 or more = 3
37. TITLEO: Overview accessed Yes = 1, No = 2
38. TITLEW: "Where am I accessed" Yes = 1, No = 2
39. TITLER: Assistance requested Yes = 1, No = 2
- How long does it take to administer Valpar 19?
40. TIMEA: Successfully answered Yes = 1, No = 2
41. TIMEC1: Time to complete (actual)
42. TIMEC: Time to complete (range)  
up to 30 secs. = 1, 30 - 60 secs. = 2, over 60 secs = 3
43. TIMEN1: No.of screens accessed (actual)
44. TIMEN: No.of screens accessed (range)  
2 = 1, 3-5 = 2, 6 or more = 3
45. TIMEO: Overview accessed Yes = 1, No = 2
46. TIMEW: "Where am I accessed" Yes = 1, No = 2
47. TIMER: Assistance requested Yes = 1, No = 2
- Name one of the objectives of the Valpar 19
48. OBJA: Successfully answered Yes = 1, No = 2
49. OBJC1: Time to complete (actual)
50. OBJC: Time to complete (range)  
up to 30 secs. = 1, 31-60 secs.. = 2, over 60secs = 3
51. OBJN1: No.of screens accessed (actual)
52. OBJN: No.of screens accessed (range)  
4 = 1, 5-7 = 2, 8 or more = 3
53. OBJO: Overview accessed Yes = 1, No = 2
54. OBJW: "Where am I accessed" Yes = 1, No = 2
55. OBJR: Assistance requested Yes = 1, No = 2

## Exploring VRLR

56. EXPLORN1: No.of screens accessed (actual)

57. EXPLORN: No.of screens accessed (range)

up to 4 = 1, 5-7 = 2, 8 - 12= 3, 13 or more = 4

58. EXPLORO: Overview accessed Yes = 1, No = 2

59. EXPLORA: Assistance requested Yes = 1, No = 2

## Teach back

60. TEACHD: No. of databases accessed

1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5

61. TEACHS1: No.of screens accessed (actual)

62. TEACHS: No.of screens accessed (range)

4 or less= 1, 5-10 = 2, 11-15 = 3, 16-20 = 4, 21 plus= 5

63. TEACHO: Overview accessed Yes = 1, No = 2

64. TEACHR: Assistance requested Yes = 1, No = 2

## Problem-Solving

### What was Susan's injury

65. INJURA Successfully answered Yes = 1, No = 2

66. INJURT1: Time to complete (actual)

67. INJURT Time to complete (range)

up to 30 secs. = 1, 31-60 secs.. = 2, over 60secs = 3

68. INJURS1: No.of screens accessed (actual)

69. INJURS: No.of screens accessed (range)

2 = 1, 3-5 = 2, 6 or more = 3

70. INJURO: Overview accessed Yes = 1, No = 2

71. INJURD1: No. of databases opened (actual)

72. INJURD: No. of databases opened (range)

1 = 1, 2 = 2, 3 or more = 3

73. INJURDR: Assistance requested Yes = 1, No = 2

**What is her occupation**

65. OCCA Successfully answered Yes = 1, No = 2

66. OCCT1: Time to complete (actual)

67. OCCT Time to complete (range)

up to 30 secs. = 1, 31-60 secs. = 2, over 60 secs. = 3

68. OCCS1: No. of screens accessed (actual)

69. OCCS: No. of screens accessed (range)

1 = 1, 2-3 = 2, 4 or more = 3

70. OCCO: Overview accessed Yes = 1, No = 2

71. OCCD1: No. of databases accessed (actual)

72. OCCD: No. of databases accessed (range)

1 = 1, 2 = 2, 3 or more = 3

73. OCCR: Assistance requested Yes = 1, No = 2

**Physical demands of the job which could aggravate injury**

74. AGGRA Successfully answered Yes = 1, No = 2

75. AGGRT1: Time to complete (actual)

76. AGGRT Time to complete (range)

up to 30 secs. = 1, 31-60 secs. = 2, over 60secs = 3

77. AGGRS1: No. of screens accessed (actual)

78. AGGRS: No. of screens accessed (range)

2 = 1, 3-5 = 2, 6 or more = 3

79. AGGRO: Overview accessed Yes = 1, No = 2

80. AGGRD1: No. of databases opened (actual)



81. AGGRD: No. of databases opened (range)

1 = 1, 2 = 2, 3 or more = 3

82. AGGRR: Assistance requested Yes = 1, No = 2

Why should a social worker be a useful team member

83. SOCA Successfully answered Yes = 1, No = 2

84. SOCT1: Time to complete (actual)

85. SOCT Time to complete (range)

up to 30 secs. = 1, 31-60 secs. = 2, over 60secs = 3

86. SOCS1: No. of screens accessed (actual)

87. SOCS: No. of screens accessed (range)

2 = 1, 3-5 = 2, 6 or more = 3

88. SOCO: Overview accessed Yes = 1, No = 2

89. SOCD1: No. of databases opened (actual)

90. SOCD: No. of databases opened (range)

1 = 1, 2 = 2, 3 or more = 3

91. SOCR: Assistance requested Yes = 1, No = 2

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#### VRLR Knowledge of Structure and Content

92. VIDEO1: Which one of the following databases in VRLR does not include a short video sequence

Case Management = 1, Case Studies = 2, Job Analysis = 3, Work Assessment = 4

93. OVER: Which button accesses a brief commentary and visual display on the structure and function of each of the databases in this package.

"Overview" = 1, "Where am I" = 2, "test" = 3. "VRLR" = 4

94. MENTIT: Which two menu titles allows you to access client referral information.

Client Name/Job Analysis = 1, Case Management/Injury = 2, Injury/Client Name = 3, Work History/Case Team = 4

95. WATMENU: Which of the following is not a menu choice, when accessing information from Work Assessment Tools  
"Description" = 1, "Objectives" = 2, " Introduction" = 3, "Education" = 4
96. HOWMANY1: How many client entries are there in the *Case Studies* database (actual)
97. HOWMANY1: How many client entries are there in the *Case Studies* database (range)  
up to 4 = 1, 5-14 = 2, 15-22 = 3, 23 or more = 4

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#### VRLR Attitudes Questionnaire

98. EASUSE1: Ease of Use ( actual)
99. EASUSE Ease of Use (range)  
1-3 = 1, 4-6 = 2, 7-9 = 3
- 100.NAVI1: Ease of Use ( actual)
- 101.NAVI: Ease of Use (range)  
1-3 = 1, 4-6 = 2, 7-9 = 3
- 102.COGLOAD1: Ease of Use ( actual)
- 103.COGLOAD: Ease of Use (range)  
1-3 = 1, 4-6 = 2, 7-9 = 3
- 104.SCRDES1: Ease of Use ( actual)
105. SCRDES: Ease of Use (range)  
1-3 = 1, 4-6 = 2, 7-9 = 3
- 106.VIDSEQ1: Ease of Use ( actual)
- 107.VIDSEQ: Ease of Use (range)  
1-3 = 1, 4-6 = 2, 7-9 = 3
- 108.MEDINT1: Ease of Use ( actual)
- 109.MEDINT: Ease of Use (range)  
1-3 = 1, 4-6 = 2, 7-9 = 3
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