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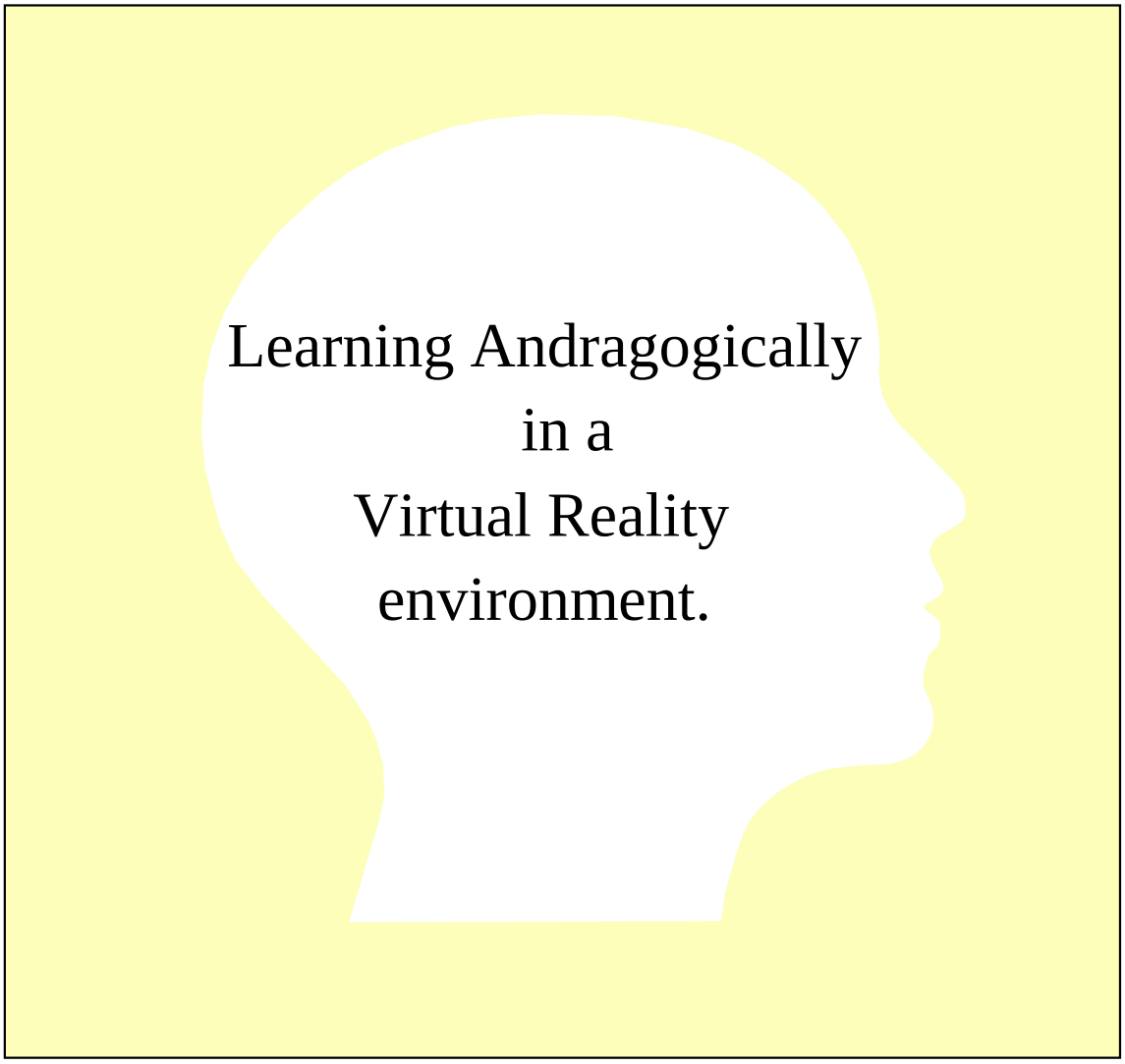

A Thesis Presented to the University of Canberra

in partial fulfillment of the requirements
for the Degree of Doctor of Philosophy.

by
Bruce L. Murn
August 2008

Abstract

This study compared the impact of three media: book, internet and Virtual Reality (VR) to support adults learning through self direction to determine whether, against an adult learning framework, a VR system would support adults' learning needs better than other less sophisticated media.

Results from experimentation indicated that adult learners had generally high levels of dissatisfaction with books, high satisfaction with electronic web-browser type delivery media, and personal satisfaction (but not functional efficiency) in learning information through touring a virtual reality 'world'. Web learners learned a greater volume of information than book learners who learned more than VR learners. Results from quantitative data indicate that the internet is the most effective of the three media tested to learn with. These results have significance for educators, as well as for individuals planning and designing their own learning.

A model of adult, self-directed learning with VR technology was developed from findings from research and the literature.

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Form B

Certificate of Authorship of thesis

Dedication

This thesis is dedicated to the memory of

Janet Margaret Molyneux
(1961 – 2003)

Acknowledgements

Many people have made significant contributions to the development of this thesis through giving their time, expertise, critical opinions and encouragement. I wish to thank Adjunct Professors Peter Clayton and Barbara Chambers and Professor Carole Kayrooz both for their supervision of this thesis over years and perseverance in that endeavour; Associate Professor Francesco Sofo for his technical support and collegial guidance as an independent sounding board in adult learning matters and Associate Professor Jennifer McMahon and Dr Ruth Shrensky for advice on the framing of this study. Similarly, Professor John Dearn for critical educational insights regarding the literature content and argument in the design stages; Dr Noel Vanzetti for his supervisory direction in the initial stages of the study; Dr Terry Webb for preliminary direction in VR matters. Dr Henry Gardner for discussion, advice and hands-on assistance in VR matters generally and Mr Chris Gunn of his staff who assisted my selection of VR software. Professor Alan Welsh for research design advice; Dr David Pederson for feedback on the statistical data collection design used; Mr Robin Collins for statistical data analysis advice. Mesdames Nancy Seivers and Lurline Fraser for advice in a range of matters that aided the smooth implementation of the study's laboratory research activity.

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To the owners of the SDLRS-A, LSI, VARK instruments, for supplying and agreeing to their instruments being used in this study and providing support with those where it was required, I extend my utmost thanks.

The anonymous participants of the pilot study and the experiment are also owed a thank you as this study would not have been possible without their co-operation, candid insights and responding to my call for volunteers.

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GLOSSARY

- ***adult*** - a person that is both psychologically and physically mature. (Knowles 1990); a person aged 22 years or greater (Kennedy 1992).

- ***adult education*** – 'a process through which learners become aware of significant experience. Recognition of significance leads to evaluation. Meanings accompany experience when we know what is happening and what importance the event includes for our personalities' (Lindeman in Knowles 1990 p30).

- ***adult learners*** – 'those whose intellectual aspirations are least likely to be aroused by the rigid, uncompromising requirements of authoritative, conventionalized institutions of learning' (Lindeman (1926 pp 27-28 cited in Knowles 1990 p30).

- ***andragogy*** – the umbrella term used to refer to theories of adult learning. Andragogy is associated with the work of Knowles (1975, 1990) and viewed as a 'philosophy' of adult learning. Theoretical assumptions (motivation, self-directedness, experience, life-centredness, age) explain how adults learn.

- ***CAVE*** - multidimensional virtual reality theatres used for displaying complex, interactive images to prototype new products and examine the behavior of complex molecules or viruses (Network World, Dec 23-30 1996).

- ***Cyberspace*** – a shared reality based on computer connections; forms of cyberspace are communicating on a network, telephone or bulletin board system conversations (Newquist 1992).

- ***education*** – 'an activity undertaken or initiated by one or more agents that is designed to effect changes in the knowledge, skill, and attitudes of individuals, groups, or communities. The term *education* emphasizes the educator, the agent of change who presents stimuli and reinforcement for learning and designs activities to induce change' (Wright cited by Knowles 1990 p10).

- ***head-mounted display*** - a virtual reality technology helmet (hardware item) which projects computer-generated, synchronised images onto the user's two eyeballs to generate three-dimensional representations of objects or data.

- ***immersion*** - an 'effect' generated by virtual reality technology, which makes a person feel present within a world other than the real world.

- ***immersive head-mounted display virtual reality technology learning system*** - an arrangement of virtual reality hardware equipment, software systems and application programs specially configured around an immersive head-mounted display headset (interface), and information programmed for display in an electronic 'virtual world' (generated by the VR equipment), which allows a VR

user on entry to the virtual world to learn the information contained in that world visually, orally and kinesthetically.

- ***learning*** - an internal process that results in a change in the learner (Knowles 1990).

- ***learning in an 'adult way'*** - the steps and processes adults traverse to learn as described in Knowles' (1995) theory of adult learning (Andragogy).

- ***learning environment*** - an arrangement of physical and psychological conditions that a learner inhabits whilst learning. It is inclusive of perceptually 'real' or 'virtual' events.

- ***learning styles*** - 'characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment' (Sims & Sims 1995 xii).

- ***learning style types*** - identified by Kolb (1983, 1985), as: Diverger, Assimilator, Converger and Accommodator.

- ***learning system*** - an arrangement of physical components (electronic or non-electronic) that a learner uses to facilitate his learning.

- ***non-immersive VR*** - screen-based.

- ***pedagogy*** – a child teaching strategy.

- ***self-directed adult learners*** - psychologically mature humans (Knowles 1990) - in this study, aged 22 to 39 years - who choose[1] and self-manage a topic of interest, and the conditions of delivery of the topic's information (time, place, rate, pace, format, information engagement sequence), to satisfy their individual physical and psychological learning requirements.

- ***self-directed learning*** - a learning technique in which a learner is responsible for all aspects of, and draws on resources available to satisfy, his learning need, including the choice of sequence that information is engaged with in that learning activity.

- ***traditional learning systems*** – configurations of book-based, and two-dimensional (2D) computer-based learning (CBL) equipment which adults would encounter and use in many real-world settings to learn about subjects that satisfy their individual physical and psychological learning requirements.

[1] In this study, to ensure standardised measurement of learning in the experiment, though neither ideal nor preferred by the researcher, the participants learned a topic chosen by the researcher (Alexandria). As engagement with the topic chosen was critical to the learning results, participants were admitted to the study only where they indicated an interest in learning about ancient Alexandria.

- ***virtual reality*** **–** 'a thing or state that has no physical existence, but does exist functionally', which Jaron Lanier claims is created artificially through computerized apparatus (Kumada 1992).

- ***virtual reality environment*** - a synthetic 'world' generated by an arrangement of computer hardware and software equipment; the 'world' may appear as real as our day-to-day world, or a make-believe one in which a human may immerse their senses as though it were real, and interact with objects or other humans to carry out tasks, observe others or a range of other purposes, and which is limited in its variety only by the capacities of the technology at hand and its designers' imagination.

- ***virtual reality learning system*** - the configuration of virtual reality hardware and software (the system) and learning which supports human learning.

- ***virtual reality system*** - a configuration of virtual reality hardware and software.

- ***virtual reality technology*** - computer components capable of generating a three-dimensional virtual world.

- ***virtual world*** - an electronically fabricated 'world' created through the electronic computer medium 'virtual reality' technology which can simulate a real or fantasy world.

ACRONYMS

AI	artificial intelligence
ANCOVA	analysis of covariance
AR	augmented reality
ATM	asynchronous transfer mode
CAVE	Cave Automatic Virtual Environment
CBT	computer-based training
DVE	distributed Virtual Environment
DVE	desktop virtual environment
ESL	English (as) second language
HIT	Human Interface Technology (Laboratory)
HMD	head-mounted display
ISD	instructional systems design
IVI	interactive video instruction
IVR	immersive virtual reality
LSI	learning style inventory
PC	personal computer
SDL	self-directed learning
VARK	visual, auditory, reading, kinaesthetic
VCASS	Visually-Coupled Airborne System Simulator
VDU	visual display unit
VE	virtual environment
VPL	VPL Research Inc
VR	virtual reality
VRML	virtual reality modelling language