USE OF A CORE CONCEPT SEARCH TOOL FOR THE INFORMATION LITERACY EDUCATION OF UNDERGRADUATE STUDENTS

By

Victoria Redfern

A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Information Studies (Research)

University of Canberra

2012

Acknowledgements

Days, weeks, months, years, tears, fears, anguish, pain, joy and laughter are elements that accompany any major research and thesis. However, the loneliness and time passes very quickly especially with the support of supportive and superlative heroes. Friends, colleagues and especially family are the glue, the spine, the unwritten pages and the text between the lines. Thanks Will.

Olga Raskin is a beautiful woman in so many ways. She has been my best friend, cohort, stalwart and confidante for many years and it was her belief that I could achieve so much. Olga encouraged me to take flight from the high rocky outcrop, to soar and seek the sun. The sun now warms my wings as I am lifted and carried globally on life soaring thermals. Spasibo moya lublue Olechka.

I offer my great thanks to my supervisors, Professor Stuart Ferguson and Dr Peter Donnan who have contributed an enormous amount of their time and experience to assist me in my studies.

I am grateful and give thanks to Dr Auriol Weigold who was the subject convener for International Studies Foundations. Thanks Auriol.

I would especially like to thank Ron Miller for his past editorial effort, assistance and advice he provided when it came down to the wire. Thanks Ron.

Other persons who I am thankful for their support and assistance are Carol Kayrooze, Linda Li, Coralie McCormack, Linda Hort, Faiz Hassan, Bruce Maun, David Pedersen, Sumaira Qureshi, Malcolm Marshall and, the inimitable Cath Raby.

Abbreviations

ABS	Australian Bureau of Statistics
ACRL	Association of College and Research Libraries
ALIA	Australian Library and Information Association
ANU	Australian National University
CIT	Canberra Institute of Technology
GNP	Gross National Product
HCI	Human Computer Interface
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
IP	Intellectual Property
IR	Information Retrieval
LC	Library of Congress
NESB	Non-English Speaking Background
OOP	Object Oriented Programming
PHP	PHP: Hypertext Processor (formerly Personal Home Page)
SARS	Severe Acute Respiratory Syndrome
SMS	Short Messaging Service
URL	Uniform Resource Locator
WoS	Web of Science
WWW	World Wide Web
XML	Extended Markup Language

List of Tables

Table 1: Summation of important terminology used....43
Table 2: Google search using the term asynchronous switching....88
Table 3: Online information seeking training and tools....96
Table 4: Five Bruce faces and five elements of Rootza alignment....132
Table 5: Bruce and Rootza information seeker alignment....136
Table 6: Example of core concept search terms on the Rootza page....158
Table 7: Countries of birth of all participants....169
Table 8: Country of primary education....170
Table 9: Country of secondary education....172
Table 10: Number of years living in Australia....173
Table 11: Participant degree enrolment....174
Table 12: Participant course subjects completed....175
Table 13: Participant spoken first language....176
Table 14: Participant spoken second language....177
Table 15: Comfort with computer technology....180
Table 16: Home computer hours of weekly use....181
Table 17: Home computer used for study or recreation....182
Table 18: University computers hours of weekly use....183
Table 19: Age group frequency....184
Table 20: Library electronic database use....185
Table 21: Library electronic journals use....186
Table 22: Library E-reserve collection use....187
Table 23: Netscape use....188
Table 24: Microsoft Explorer use....189
Table 25: Google use....190
Table 26: Comparison of information seeking tool use....191
Table 27: Other search engine or search tool use....192
Table 28: Named other search engines or information search tools....193
Table 29: Participant demographics and percentages....195
Table 30: Dominant information seeking tools and percentage....196
Table 31: Both groups pre-test six steps of information seeking comparison....202
Table 32: Differential presenting pairs of adjectives....221
Table 33: Participant opinion of Rootza -the online search tool....224

List of Figures

Figure 1: Information Matrix....44
Figure 2: Bruce and Rootza five faces interaction blend 138
Figure 3: WWW searching without using Rootza....141
Figure 4: WWW searching using Rootza....142
Figure 5: Flow process leading to the building of the tool.....149
Figure 6: The Rootza path. 152
Figure 7: Diagrammatic structure of the database.....161
Figure 8: Participant age groups.....168
Figure 9: All participant pre-test named six steps of information seeking....200
Figure 10: Both groups pre-test named six steps of information seeking 201
Figure 11: Both groups post-test six steps of information seeking 202
Figure 12: Experimental group pre-test post-test six steps of information seeking 203
Figure 13: Question 1. Identified Search Terms 206
Figure 14: Question 1. Both groups pre-test identified search terms 207
Figure 15: Question 1. Both groups post-test identified search terms 208
Figure 16: Question 1. Both groups pre-test post-test identified search terms 209
Figure 17: Question 2. All participant identified search terms 210
Figure 18: Question 2. Both groups pre-test identified search terms 211
Figure 19: Question 2. Both groups post-test identified search terms 212
Figure 20: Question 2. Both groups pre-test post-test identified search terms 213
Figure 21: Question 3. All participants pre-test identified search terms....214
Figure 22: Question 3. Both groups pre-test identified search terms 216
Figure 23: Question 3. Both groups post-test identified search terms 217
Figure 24: Question 3. Both groups post-test identified search terms 218
Figure 25: Both groups criteria for academic citation comparison 219
Figure 26: Phase 2 Question 1. 'Was the online search tool helpful?'....233
Figure 27: Phase 2 Question 2. What was learnt from the online search tool....234
Figure 28: Phase 2 Question 3. Would users pay for using the online search tool 235

Table of Contents

Acknowledgements vii

Abbreviations..... ix

List of Tables.....xi

List of Figures..... xiii

Abstract.....xxi

1 Introduction 23

1.1 Background to the Study - The Problem and its Significance.....23
1.2 Research Problem.....28
1.3 Aims and Objectives.....29

2 Literature Review 47

2.1 Outline and Literature Review Issues Being Addressed 50
2.2 Information Literacy and IL Frameworks 51
2.3 Undergraduate student problems in finding research material.....57
2.4 Information Seeking Behaviour 74
2.5 Studies and Evaluations of Various Solutions.....85
2.6 Summary and Contribution to the Body of Research.....98

3 The Research Design 105

3.1 A Two-Phase Study.....105
3.2 Phase 2 of the Study 111
3.3 The Experiment Process.....118
3.4 Phase 1 of the Study 119
3.5 Phase 2 Population, Sample and Demographics 127

4 Design of the core concept thesaural database and search tool (Rootza) 129

4.1 What is Rootza?.....130
4.2 Theoretical Design of Rootza.....131
4.3 Rootza™ System Overview 139

4.4 Rootza Preliminary Development 143

4.5 Rootza System Specification 150

5 Findings 164

5.1 Results 166
5.2 Demographics 166
5.3 Control and Experimental Groups - Age Statistics 184
5.4 Experiment Pre-test Results 197
5.5 Knowledge of Six Steps of Information Seeking 200
5.6 Search Terms and Questions 205
5.7 Control and Experimental Groups Pre-test Post-test Comparison 218
5.8 Experimental Group T-test – Search Term Identification Pre-test Post-test Results 219
5.9 Web page Criteria Evaluation for Academic Citation 219
5.10 Participant Opinion of the Online Search Tool 220
5.11 Findings from Phase 2 231
5.12 Assumptions 232
5.13 Conduct of the Evaluation 232
5.14 Question Responses 233
5.15 Participant Perception of Rootza 236
5.16 Evaluation Summary 245

6 Discussion and Conclusions 248

6.1 Introduction and Research Problem 248
6.2 Summary of Results 250
6.3 Undergraduate student problems in finding research material 253
6.4 Undergraduate student problems in recognizing authoritative research material 256
6.5 Studies and evaluations of various solutions 258
6.6 Implications for Teaching Information Literacy 259
6.7 Implications of the Research 261
6.8 Limitations of the Study 263
6.9 Recommendations and Future Research 264
6.10 Significance and Contribution of the Research 264
6.11 Concluding Remarks 266

REFERENCES.....270
APPENDICES..... 239

Abstract

Through largely experimental research, this thesis addresses the problems faced by many undergraduate students in finding appropriate research materials for their academic work. Problems include identifying the best search terms to use with the various information retrieval tools and recognizing authoritative materials in the result sets. The problems are made more critical by the tendency for younger students to go straight to the Web because they have experience in using search tools such as Google and find the university-provided tools relatively difficult to use. The study also identifies at-risk groups such as those who lack digital literacies.

The study set out to establish whether an educational tool that combined information literacy instruction with a web search facility would help undergraduate students find appropriate research materials and develop the information literacy understandings and skills required for university study. A unique purpose-built tool, with embedded thesaural database, was developed and then a two-phase test was conducted. There were three sub-questions in this research; can an online search tool improve student information seeking knowledge/skills, assist students with identification of search terms and assist with evaluation of appropriate research materials?

The Phase 1 experiment was a pre-test/post-test experiment using a questionnaire. There were three pre-post research questions which participants were asked to answer providing search terms and any of the steps of information seeking and the criteria for recognizing the authority of found materials. After collecting pre-test data that helped identify existing knowledge of the six steps of information seeking and authority of research material, the pre-test post-test data was to enable comparison of the results.

The post-test result of the Phase 1 experiment showed that 21.6% could identify some basic steps of information seeking whereas the pre-test result was 8.1%, representing an increase of 13.5%. This is the level of increase in knowledge aimed for in the research design however because of the sample size the findings are not conclusive. Regarding the criteria for identifying the authority of found material, following the pre-test post-test comparison 44.4% addressed one criterion, four participants 22.2% addressed two criteria, 16.6% addressed three criteria and 22.2% addressed four criteria. This shows an increase in the knowledge of recognition of authoritative materials.

The Phase 2 group used the tool while the researcher, using talk-aloud protocols, collected information about participants' tool use and their observations. Phase 2 contributed to the study by students providing verbal input that they recognized the importance of using correct search terms.

The experiment was unique, in embedding information literacy instruction in a web search tool, at point-of-need. It provided positive responses to suggest that further research and development in this field would have important educational impacts. The small sample size indicates that the results lack statistical significance. The thesis suggests ways to overcome the study's limitations and to broaden the evaluation such as the use of a library information literacy package as a control in future evaluation and testing.

1 Introduction

1.1 Background to the Study - The Problem and its Significance

The problem that this research is attempting to inform and address is that first, undergraduate students and students who are attending university for the first time experience difficulty in determining research terms for academic research, finding appropriate academic resources as well as finding too many unusable materials on the Web and furthermore students experience difficulty in recognizing authoritative research materials in their sourced results.

In the American elementary school curriculum, in order to provide a solution to assist student information seeking it is compulsory through enhancing technology in education (United States Congress 2007) to teach children basic steps of information seeking.

In Australian primary schools there has been a review conducted to examine the views of teacher, library and students on information retrieval for the purpose of addressing assignment questions and also to investigate the issue of information retrieval skills of students over time and subjects and how this affects weak students (Herring 2010). This is to ensure that on reaching high school, college and university they are fluent with their information seeking. This thesis is based on the idea that the provision of an information literacy tool built into an online search tool followed by experimental research would demonstrate an enhancement of information seeking knowledge and skills amongst undergraduate students. It is intended that the research would also provide information on whether the tool would assist students.

1.1.2 Undergraduate student problems in recognizing authoritative research material

When international, undergraduate or other new students enter university, they do not always have knowledge and ability to recognize materials suitable for citation in an academic document (Holscher & Strube 2000).

Bias exists on many web pages and it is clearly important that information seekers learn not only to evaluate the authoritativeness of websites but also to develop information seeking experience and skills to find materials that are authoritative research materials. Undergraduate students need to be able to find authoritative materials that are being sourced from educational institution websites, informed by research, written by reputable academics, have a bibliography, are regularly updated and, provide the author's contact details.

As well as being able to recognize authoritative materials, learning the requirements and skills for evaluating found information is an additional problem for undergraduate students. Although students progressing through the school system may be taught to evaluate search results, a number of undergraduates and new students are unfamiliar with acceptable standards and requirements of information found in university-level research material. Holscher and Strube (2000) who researched differences between individual information seekers evaluation of web pages say that many did not know, for example, the difference between information seeking and browsing. Information seeking is the act of deliberate use of search terms to find information whereas browsing is the act of clicking on links (without typing in search terms) and following them from website pages to other website pages. Reih and Belkin (2000) researched the dimensions of information quality and information seekers' cognitive abilities and found that many information seekers quickly open a new web page and make an immediate judgment of the value of the web site without proceeding to other pages to investigate the possibility and potential value of other possible materials.

1.1.3 Undergraduate identification and development of appropriate search techniques

The identification of search terms and being able to use those search terms is not dependent on knowledge of digital tools and digital literacy skills as some students may be unable to identify or develop appropriate search techniques using computers (Navarro-Prieto, Scaife & Rogers 1999, Weideman & Strumpfer 2004).

Badke (2002) says that although educational institutions and students in many capitalist countries in the western world are often taught information literacy skills and the need for the ability to evaluate authoritative research material, this is not necessarily being taught in developing countries. To compound the problem, the use and ownership of computers both personally and organizationally in developing countries is not as prevalent as those in developed countries (Badke 2002). Thus, the problems addressed in this study are particularly acute for those students who also lack the required digital literacies. It is proposed that the development of an online digital information literacy tool may provide a solution for those who conduct research on the world wide web (Redfern 2004).

Moreover, although universities in Australia provide information literacy sessions, there are some students who do not attend the classes and therefore miss the opportunity of taking advantage of recent technological advances in information retrieval tools. Some of these advances are the use of tools such as Google Scholar, Webcasts and the use of IPods™. A question that could be asked is whether the information literacy skills taught at school are being geared to the university environment.

Although researchers such as Monerero, Fuentes and Sanches (2000) and Tabatabi and Luconi (2004) have investigated student information seeking behaviour seeking on the www, and Holman (2010) examined students' mental models of information searching, there appears to be no mention of student knowledge of information seeking nor did Holman (2010) mention the use of specific computer technologies to aid information seeking in academic literature. Although Tabatabi and Luconi referred to student use

of the www, there is no indication of future use of www educational technologies and the adjustments that students may have to make.

The research suggests that students conceptualize research, especially tasks associated with seeking information, as a competency learned by rote, rather than as an opportunity to learn, develop, or expand upon an information-gathering strategy which leverages the wide range of resources available to them in the digital age.

Until this research was undertaken, there appears to have been no purposeful development of an online search tool that engaged students with a hands-on-learning environment to improve their skills in information seeking. By conducting an experiment within the lifelong learning paradigm of students using the tool developed and built for this experiment, it is hoped that the resulting data will add to the knowledge of student information literacy. Additionally, it may show whether the preferred way to teach information literacy knowledge and information seeking skills is by teaching skills in school by rote, encouraging students to change their information seeking behaviour or providing them with an online tool that informs students of the steps of information seeking and the means of evaluating found information.

Throughout the last ten years, technological development in the fields of entertainment and media have undergone significant change however, it does not appear that the education sector has matched these changes, although there have been improvements in engineering and development of new digital tools, some of which are used in education. These newly developed or enhanced tools include learning management systems such as Blackboard which has a suite of educational products such as Blackboard Learn. The relevance of Blackboard Learn to information seeking is that, besides Blackboard Learn providing a suite of educational tools, it also provides a search facility which focuses on accessing information and online social communication whilst using tutorials and guides and information seeking (Blackboard 2010). There is a degree of adoption of these technologies in some educational institutions but with the growth of electronic databases and the lack of familiarity with some of these tools and the design, for some students, these tools can be confusing. Consequently, some students, because they are more familiar with the www, sometimes resort to using only the www to assist

with finding relevant information to suit their needs or research question (Ellis & Salisbury 2004, McNaught, Phillips, Rossiter & Winn 2000 and, Redfern 2004).

Researchers have investigated key aspects and conducted evaluations of single and multiple searches. Specific elements within single searches have identified search term selection and differences between search strategies and techniques. A study of the information seeking skill behaviour of freshmen at Michigan State University was conducted by Matthews and Wiggins (2001). The study revealed that most freshmen were familiar with the www before attending university and once undertaking scholarly research in higher education, those freshmen still mainly utilized the www and specifically Google. Additionally, the students also held the belief that if information could not be found in Google then the information did not exist. Therefore, this indicates to me that those freshmen have either not been taught information seeking skills or simply choose to not practice those skills when using the internet or may use Google or some other web site through habit

Because there is a lack of student knowledge of the basics of information seeking accompanied by a lack of student understanding of recognizing authoritative research materials, there appears to be a need for a solution. In the first instance, students require assistance to overcome difficulties that result in the use of the www to source academic materials and secondly, to help them judge whether the sourced materials are appropriate for use in an academic context.

1.2 Research Problem

There is an unwritten assumption that undergraduate students entering universities will know how to use the internet, libraries and digital services, and that students' information seeking is 'an efficient and easy process' (Debowski 2001). However research conducted by Badke (2002) indicates that students face many obstacles. Undergraduate students must be able to not only recognize the level of authority of materials but also to know where they may be found. Accordingly, some students commence higher education with inadequate information seeking skills. Vise (2009) also says that students struggle with finding and using appropriate academic literature.

On the www, this is made more difficult by the large number of hobby, commercial, political or organizational web pages that are unrelated to the task and may also exhibit bias. It is also worthwhile adding that since this doctoral research began research has suggested there are continuing problems for undergraduate students e.g. Head and Eisenberg (2009).

In preparation for academic studies, skills needed by undergraduate students are now being taught within high school and college curricula to help prepare students for advancement to university or further education. Although these skills place a strong emphasis on using computers for research to help prepare students for advancement to university or further education, there are still some new students who are ill-prepared to conduct online searches and may be unskilled with recognizing the appropriateness of academic materials. These students may be mature aged or may not have progressed immediately from college or high school to university or they may be international students from countries with education systems in which digital technologies are not prominent.

Briguglio (2000), Lacina (2002) and McClure (2001) are of the opinion that for both domestic and international students, language is the primary challenge. Ding, Chowdhury and Foo (2000) add to the argument by saying that because of differences in methods of interrogation, the lack of recognition of appropriate search terms and the lack of consistency in terminologies, there are novice searchers who experience

difficulties using databases, library catalogues, online journals and the www. This creates an inefficient and time-wasting experience. Although using electronic media and using the www for research is often assumed to be efficient and easy, for undergraduate students this is not necessarily correct. Because of the differences in software design and their appearance, various information retrieval tools such as library catalogues, subscription databases, search engines and directories found in many electronic search systems can become substantially complex.

In order to simplify the identification of search terms, the information seeker must be able to identify core concepts and develop a strategy to effectively retrieve information. For the experienced researcher this may not be difficult but for the novice researcher, such as undergraduate or international students, it can be quite onerous and complicated by materials that are inadequate or provide results that can divert researchers from their required path.

1.3 Aims and Objectives

1.3.1 Research Aim

In Australia, although some schools teach children information literacy skills, there are some students who are further progressed in their school years who have missed out. Some students have been through high school and college and entered universities without a basic knowledge of information seeking. Therefore, by designing and building an information literacy computer tool that embeds commonly accepted steps in information seeking in a web tool for students will assist students develop information literacy understandings and skills.

Because information seekers are unclear when establishing search terms and also prefer to search on the www using a proprietary search tool such as Google (Matthews & Wiggins 2001; Jansen, Spink & Saracevic 2000; Marchionini 1995; and Redfern 2004), it was observed at the University of Canberra that students were experiencing difficulties in finding relevant information to answer research questions. After using subscription databases, they resorted to using a general purpose online search tool or a directory such as Yahoo.

Observation of student information seeking difficulties at the University of Canberra led to the development of an online tool to make academic research easier for students. It was seen to be advantageous if the tool were to be balanced between subscription databases and generic online search tools, easy to use and intuitive. Limiting information seeking to a single technology could result in finding a less than adequate number of appropriate materials for academic use in assignments.

Therefore this less than optimal result may be averted by using a selection of tools such as subscription databases, digital library catalogues, search engines and so on. With more tools being utilized, this will result in a larger number of sources which leads to a larger number of appropriate materials that may be used for academic research.

Because some undergraduate students experience difficulties using online academic tools such as subscription databases and their problems are based in determining or establishing search terms, finding appropriate academic materials and/or also have difficulty recognizing the appropriateness of academic materials, and because the majority of students prefer to search for information on the www, then it was considered appropriate to develop a web based tool that would first inform students on the steps of information seeking and the criteria for recognition of appropriateness of academic materials and, second, help them develop search terms. Because some international students experience both language and search term selection issues of concern, it is logical that the tool should also be as easy to use as possible.

Of academic research, Large, Lucy, Tedd and Hartley (1999) say that in order to produce comprehensive results barriers must be removed to finding information. Marchionini (1995) says that students take the easiest path to find academic materials and often use the www to source those academic materials. However, the quality of the materials sourced from the www is not always appropriate for academic citation. The development and building of the tool for this research and experiment was designed to remove barriers and to work within a lifelong learning and constructivist paradigm. The lifelong learning paradigm of learn-by-doing was at the forefront of the tool's design because if students experience difficulties in using electronic databases and

instead turn to an online tool that is proprietary (commercial business that benefits financially by providing advertising) because of its ease of use, then it is deemed sensible to design the proposed research tool for ease of use whilst being informative and enhancing information literacy.

Once it had been determined other similar tools did not exist, a study was conducted in the University Library to investigate further and to ascertain if the previous observations were correct and whether these observations and the researcher's personal experience were common amongst other students. Following the library study three underlying objectives were identified prior to the development of a www tool to address the issues.

The first underlying objective was to provide an online tool to aid and teach student information seeking skills; the second was to provide a subject based tool for searching on the www; and the third was to develop a teaching tool to help students identify search terms for their subject area and also to help them evaluate the appropriateness of found materials for academic research.

It was then intended to test whether the online tool when developed would show student learning to be more focused when appropriate information is retrieved and to provide a learning environment for information seekers.

The objective of the research was to develop and test an online core concept subject specific thesaural database in an online search tool which would not only inform students about the basic principles of information seeking but also enhance their knowledge of subject core concepts. Additionally, because of the lack of consistency in terminology in using databases, library catalogues, online journals and the internet, it was also an objective to assist students to overcome the difficulty they experience in the recognition of appropriate search terms and various methods of interrogation. Although the focus is a web based tool, the aim is that the understanding it helps develop will be transferrable across a range of information retrieval tools. Transferability is an important attribute.

1.3.2 Research Question

The research problem is being address by examining past research, which will be examined in the literature review, and embedding an online core concept subject specific thesaural database in an online search tool and conducting an experiment with students who enrolled in an appropriate subject, International Studies Foundations. For the experiment, the student participants will be using the newly developed online search tool, which includes the steps of information seeking and a list of criteria to help recognize the appropriateness of online resources for academic use. This combination of past research and current experiment is expected to answer the research question 'Can student information literacy knowledge and skills be improved by the use of a specific online educational tool for finding relevant research information on the world wide web.' This main research question was intended to help determine if the use on an online search tool which shows the six steps of information to the participants while they perform an online search will help with their search methodology and processes.

There are three sub-questions:

1. Can an online search tool improve student information seeking knowledge/skills?

2. Can an online search tool assist students with identification of search terms?

3. Can an online search tool assist students with evaluation of appropriate research materials?

The first sub-question 'Can an online search tool improve student information seeking knowledge/skills' is intended/expected, to show whether a purpose built tool for student use while conducting an online search for authoritative information will help improve student knowledge and/or skills when information seeking.

The second sub-question 'Can an online search tool assist student with identification of search terms' is intended to show whether a purpose built tool for student use while

conducting an online search will help the student determine appropriate search terms before undertaking a search..

The third sub-question ‘Can an online search tool assist students with evaluation of appropriate research materials’ is intended to determine if a purpose built tool for student use will help the student evaluate whether found information is suitable for academic use.

1.3.3 Significance

Education has changed substantially over the past twenty or thirty years. This change has been driven by the rapid development of digital technology, systems technology and especially the growth of computers in education. The provision of educational services and the change in the socio-cultural, socioeconomic and socio-political environment worldwide has had a major effect on the provision of education services.

In Australia the changing landscape of citizen workplace environments and working hour arrangements have also altered significantly. This alteration has taken place incrementally in the primary, manufacturing and corporate areas and has resulted in fewer full time positions. Additionally, there are fewer blue collar workers and less stability in employment due to the decrease in full-time jobs and an accompanying increase in casual and part-time positions. This situation has led to a ‘work smarter not harder’ ethos that is driving more citizens of employment age to upgrade their education in order to situate themselves in a better position to gain employment (Marginson 1997).

This alteration in the social and cultural mores of Australian society has resulted in decreased time for relaxation and educational pursuits. With increasing numbers of people who are undertaking further education and attending classes, lectures and tutorials, it is important that their time has to be judiciously managed. Additionally, continually rising costs of educational services are accompanied by limits on the amount of time available to students due to the aforementioned altered employment arrangements.

To remain competitive, educational institutions, especially universities, are providing more courses via flexible delivery. Flexible delivery involves the provision of classes and tutorials outside the 9am to 5pm, Monday to Friday, spectrum. Classes and tutorials are accompanied by various forms of digital technology that are employed to support the paradigm of twenty-four hour availability of classes and by provision of academic materials such as online communications and library services. To ensure positive learning outcomes are achieved, students must be able to use online information seeking tools effectively and to become digitally literate and skilled whilst using the increasing number of electronic databases being installed by academic libraries.

As the number of digital tools and computer systems to support flexible delivery programs is increasing, universities, particularly through academic libraries, are providing training in the use of their online facilities. However, the design of these computer technology tools make them difficult to use and users could find them confusing (Danino 2001).

Although the purpose of universities are to educate people further our workforce resource and to build Australia into an educated and informed society and in turn to aid our economy it is also all educational institutions to produce graduates that are information literate and who are able to undertake a path of lifelong learning. When children progress from primary school to high school, college and university, it is expected that the knowledge and skills are transferred with the student as they progress and this is what educators are aiming for, positive graduate outcomes. In turn is a driver for lifelong learning as student skills learnt will be transferred throughout the progress of their lives and enhance the paradigm of education market economies and the knowledge society.

There is scant research evidence first, on the development of such a technological tool for educational use as an academic search tool and secondly, on an online educational tool that informs/educates students on basic steps of information seeking and the elements that indicate what online materials are appropriate for academic research. It is

believed that the approach of this research is taking a novel approach and this will be explored in Chapter 2.

The design, development and production of a combined tool that provides students with subject core concepts and teaches information seeking skills while instructing on the components that determine an academically acceptable document and simultaneously searching the www for academic materials, could contribute valuable research benefits not only to students but also to education more broadly. Furthermore, because the tool has been specifically developed for education, and is able to be used to educate undergraduate students, those students will become more confident and proficient using subscription databases and will realize they are authoritatively valuable.

1.3.4 Terminology

There are five terms defined in this section: Information Literacy, Information Seeking, Digital Literacy, Information Seeking Process and Authoritative (that which constitutes authoritative material). These five terms will be used frequently in this research and thesis.

There has been considerable debate over a number of years about what is and is not Information Literacy and what constitutes an information literate person. When the term Information Literacy is being used in this thesis it is being defined as the act of/ and ability to recognize information need, use, evaluate and assess resources using non-digital tools, and to measure outcome effectiveness. It is important to note that this research and thesis distinguishes a difference between information literacy and digital literacy. Information literacy involves using only textual based tools for research. In contrast digital literacy involved using computer technology digital tools such as electronic databases and online resources. The term information seeking is also used in this thesis and is defined as; 'The act of individual/s requesting, searching and then accessing information for pre-determined content'. Therefore, information seeking is an act performed by an individual however in performing this act information seekers are also following a process.

Below is a collection of definition of information literacy, information seeking and digital literacy accessed from various resources.

Of Information Literacy, the Bruce (1997) definition is lengthy and involved and is reflected in an information literacy model the 'Seven Faces of Information Literacy' and they are;

> *...using information technology for information retrieval and communication,*
> *...finding information located in information sources,*
> *...the ability to confront novel situations, and to deal with those situations on the basis of being equipped with a process for finding and using the necessary information,*
> *...using various media to bring information within the [the information user's] sphere of influence, so that they can retrieve and manipulate it when necessary,*
> *...evaluation and analysis to build up a personal knowledge base in a new area of interest,*
> *...working with knowledge and personal perspectives adopted in such a way that novel insights are gained and,*
> *...placing information in a larger context, and seeing it in the light of broader experience, for example, historically, temporarily, socio-culturally.*

The above definitive faces are more about abilities cognition and processes rather than a definition of information literacy.

The University of Idaho Information Literacy Portal states that Information Literacy is:

> *... the ability to identify what information is needed, understand how the information is organized, identify the best sources of information for a given need, locate those sources, evaluate the sources critically, and share that information (University of Idaho 2010).*

Plattsburgh State University of New York states that Information Literacy is;

> *…the ability to recognize the extent and nature of an information need, then to locate, evaluate, and effectively use the needed information (Plattsburgh State Information and Computer Literacy Task Force, 2001).*

This statement has been adopted from the United States Literacy Frameworks. It is also worthwhile noting that it is also similar to the Bruce (1997) statement/definition.

The University of Queensland (UoQ) (2010) has also based its definition of information literacy on the United States Information Literacy Frameworks. UoQ states their definition of Information Literacy as:

> *Information literacy is a set of abilities requiring individuals to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information.*

The Australia and New Zealand Institute for Information Literacy (ANZIIL) does not define the term Information Literacy however they say:

> *Information literacy is an intellectual framework for recognising the need for, understanding, finding, evaluating, and using information.*

ANZIIL defines an information literate person as one whom:

> *…recognises when information is needed and has the ability to locate, evaluate and use effectively the needed information.*

Webber and Johnston (2000) say that an Information Literate person is one who is:

> *…able to recognize when information is needed and have the ability to locate, evaluate and use the information needed.*

The University of Calgary Library states the abilities of an information literate person are:

> *… to recognize the need for information; to know how to access information; to understand how to evaluate information; to know how to synthesize information; to be able to communicate information. An information literate person recognizes the different levels, types and formats of information and their appropriate uses. The ability to place information in a context and an awareness of information access issues.*

Although academic experts, researchers and organizations such the United States Department of Education, University of Idaho, Plattsburgh University of New York, Webber and Johnstone, University of Calgary Alberta Canada and ANZIIL have placed their definitions of the term Information Literacy and what is an information literate person, this thesis, in undertaking to be brief yet precise provides a different statement defining Information Literacy as:

> *The act of/and ability to recognize information need, use, evaluate and assess resources using non-digital tools, and to measure outcome effectiveness.*

In this research and thesis this stated definition of information literacy (which also refers to an information literate person) will be used throughout to reflect the use, act and practice of recognising and finding information using text and print based materials. A number of academics, researchers and educational institutions and libraries, in order to find exactitude when defining meaning of terminology those definitions can sound convoluted and fail to be plain and easily read and understood. The reason for developing another definition is because in order to qualify with exactness the definition of terms, she has attempted to define terminologies with an exactness of meaning which is plain and easily understood.

Of Information Seeking¸ Kingrey (2002) says that:

> *The term information seeking often serves as an umbrella overarching a set of related concepts and issues. In the library world, discussions of database construction and management, community information needs, reference services, and many other topics resonate with the term. Yet, a single, serviceable definition remains elusive.*

Kingrey (2002) continues to say that the term Information Seeking is:

> *…used to denote experiences or situations in which content is accessed, used, and synthesized into personal knowledge.*

Although Kingrey proposed this definition in 2003, Carole Kuhlthau whilst referring to Information Seeking Behaviour as at May 2011 still prefers to use Kelly's 1996 definition which is:

> *Information seeking involves construction in which the person actively pursues understanding and seeks meaning from the information encountered over a period of time.*

Tom Wilson instead of using the term Information Seeking, prefers to refer to models and use the term Information Seeking Behaviour. Spink and Wilson (1999**)** say Information Seeking Behaviour is:

> *Statements, often in the form of diagrams, that attempt to describe an information-seeking activity, the causes and consequences of that activity, or the relationships among stages in information-seeking behaviour.*

Throughout this research there is a difference between information seeking and information seeking behaviour. Information seeking is the process in which an information seeker is looking for and accessing resources in order to find information.

Information seeking behaviour is how information seekers behaves and react and feel about the tools they use in the process of information seeking.

Higher education places a strong emphasis not only on encouraging and promoting the text-based literacy and comprehension of incoming undergraduate students, but also on the expectation of a level of competence with digital literacy.

Cornell University in the United States defines Digital Literacy as:

> *…the ability to find, evaluate, utilize, and create information using digital technology.*

Wikipedia (2011) defines Digital Literacy as:

> *Digital literacy is the ability to locate, organize, understand, evaluate, and create information using digital technology. It involves a working knowledge of current high-technology, and an understanding of how it can be used.*

The FreeDictionary (2008) defines Digital Literacy thus:

> *Digital literacy is the ability to locate, organize, understand, evaluate, and create information using digital technology. It involves a working knowledge of current high-technology, and an understanding of how it can be used.*

However a more workable definition of Digital Literacy comes from a speech made by Lesley Osborne from the Australian Media and Communications who uses Livingston (2004) definition. The definition is:

> *The ability to access, understand and participate or create content using digital media.*

The above definitions of Digital Literacy are stated using language and phraseology that can also be used for information literacy, but with the addition of the word 'digital'.

The University of Information Technology cite Jones-Kavalier and Flannigan (2006) for their definition of Digital Literacy as:

> *…a person's ability to perform tasks effectively in a digital environment it includes the ability to read and interpret media (text, sound, images), to reproduce data and images through digital manipulation, and to evaluate and apply new knowledge gained from digital environments…the most critical of these is the ability to make educated judgments about what we find online.*

Kavalier and Flannigan (2006) have made the above statement related to the digital environment however, they also equate the task of digital literacy as being involving digital manipulation. It is an expressed opinion in this research that manipulation of digital images is not so much a component of digital literacy as digital manipulation is a process.

However, in obtaining a consensus on the term Digital Literacy, there are a number of variations which has been examined for this research. As mentioned above, according to Kavalier and Flannigan digital literacy also involves the manipulation of digital images, Cornell University sees digital literacy in a similar way to ANZIIL, the United States Information Literacy Frameworks and Bruce (1997) and others.

Because the above definitions and viewpoints have been taken into account a composite of the above viewpoints to define the term Digital Literacy to mean:

> *The act of/and ability to find, utilize, create, use and evaluate digital information and resources using digital tools, and to measure their effectiveness.*

This above definition will be used thorough out this research and thesis when referring to Digital Literacy.

Information Literacy and becoming information literate has been paramount in education before digital technologies had been invented. Information Literacy and Digital Literacy are two separate entities. Information Literacy is the learning and practice of using skills and increasing knowledge of text based technologies and Digital Literacy is the practice of using skills and increasing knowledge of digital technologies.

The Kingrey (2002) definition of Information Seeking is being used as a base for the development of an alternative definition of Information Seeking Process. Thus, the definition of Information Seeking Process for this research is:

> *The process of using digital or non-digital devices to source, find, access and evaluate information.*

The term Authoritative is used widely in this thesis. Authoritative materials found in academic research are a core factor and influence on the quality of research and academic rigor from all facets of education.

Table 1: Summation of important terminology used

Term	Meaning
Information Literacy	The act of/ and ability to recognize information need, use, evaluate and assess resources using non-digital tools, and to measure outcome effectiveness.
Information Seeking	The act of individual/s requesting, searching and then accessing information for pre-determined content
Digital Literacy	The act of/and ability to find, utilize, create, use and evaluate digital information and resources using digital tools, and to measure their effectiveness.
Information Seeking Process	The process of using digital or non-digital devices to source, find, access and evaluate information.
Authoritative	Information which holds academic credibility.

1.3.5 Information Matrix

In order to provide clarity and understanding of the relationships between the terms Information Literacy, Digital Literacy, Information Seeking Process and, Information a matrix is provided to display the relationships.

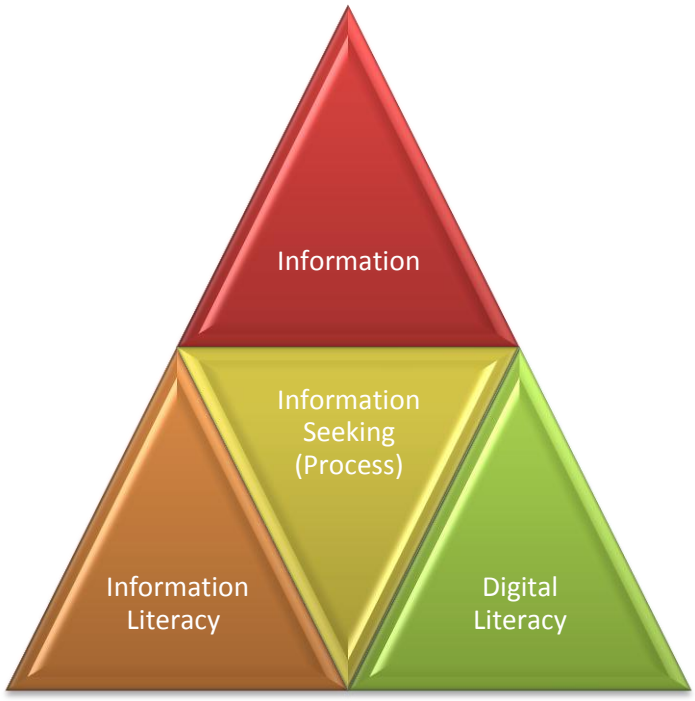


Figure 1: Information Matrix

Figure 1 shows the relationship between Information Literacy and Digital Literacy and their independency from each other. Although they both are connected to Information Seeking, which is connected to Information, both Information Literacy and Digital Literacy are separate entities that use Information Seeking as a conduit to Information.

Although Information Literacy is similar to Digital Literacy, digital literacy does not have a strong influence on this research and thesis since the main focus is Information Literacy. The experimental component of this research has been conducted using digital technology but the tool used has been designed to foster Information Literacy, as understood above.

1.3.6 Thesis Structure

Chapter 1 (this chapter) provides an introduction to the research which has provided a background to the study and its significance which relates to undergraduate students difficulties with recognizing authoritative research material and, appropriate search techniques when using computers for academic research. This is followed by the statement on the research problem, aims and objectives, the research question and, the significance of the research. Following this is detailed terminology used in this research as well as the thesis structure.

Chapter 2 is the literature review. The literature review commences with information literacy frameworks followed by the specific problems undergraduate students face in information seeking an evaluation (including students whose first language is not English), information seeking process and information seeking behavior, current educational tools that address the information literacy problems of undergraduate students (such as PILOT and Web-Ezy in the Australian context) and a discussion of where this study fits into and contributes to our knowledge of this field of education. In particular, it identifies the gap that this research is attempting to address, which is the need for alternative web solutions to assist students and specifically for online search tools to assist students with learning to develop subject search terms and to evaluate online materials appropriate for academic use.

Chapter 3 provides the theoretical framework, research methods and the research design. Broadly, the data that was being attempted to gather were participant demographics, current literacy and language skills, existing knowledge of the steps of information seeking and, existing knowledge of the criteria for authoritativeness of research material. Additionally, because there was insufficient data collected from the initial experiment, at a later date a second set of data was collected with additional participants.

Chapter 4 details the theoretical design, system development, functionality and purposeful design of the core concept thesaural database and online search tool. It outlines the theory that precedes the building of the tool (Rootza) as well as the web

page development. Also included are search engines and strategies and the building of the online search tool software from conception until the final product was produced. In brief, this chapter's focus is what the tool does and how and why it works – in other words, how it is hoped such a tool will benefit undergraduate students and others who need to develop information literacy understandings and skills.

Chapter 5 provides the presentation of the statistical data to address the research findings for both Phase 1 and Phase 2 of the study. It provides the quantitative and qualitative results for Phase 1 as well as including demographics, thoughts and opinions of the participants and the statistical results of the experiment as well as Phase 2. Data was collected by using pre and post test questionnaires during the experiment. Besides demographical information, participants were asked to write down as many research steps they could and also select one out of four research questions on the questionnaire and indicate what search terms they would use or construct for an online search. Participants were also asked to write down how they would recognize whether online material would be authoritative research resources. Lastly, upon completion of finding online material they considered to be authoritative for research, participants were asked to print a copy of the web page and this was then collected and evaluated and measured for its authority as research material.

Chapter 6 is the discussion and conclusion and provides a summary of major results of the experiment as well as a discussion of the experimental results in terms of information and digital literacy, the information seeking process, information seeking behaviour and digital technologies and the www, information seeker evaluation of web pages and implications for teaching information literacy. It also includes implications of the research, limitations of the study, recommendations for future research, contribution of the research and concluding remarks.

2 Literature Review

2.1 Outline

The focus of this literature review is Information Literacy and the problems educationalists encounter with undergraduate student information literacy standards. As students have progressed from primary to high school/colleges and university some have not fully embraced and adopted effective information seeking skills. These skills include being able to effectively develop search terms and evaluate online materials for the appropriateness for citing in academic papers.

Reasons for the lack of student information seeking skills can vary from lack of interest to being absent from the education environment for a long time if they have been in the workforce for a number of years. Research and development reported in the literature attempts to address the problem by offering solutions such as recommending online tutorials and teaching aids and addresses their level of success and whether enough has been done to tackle the problem. In some of the tools a lifelong learning approach may be evident in the paradigm of learning. Student information seeking behavior and the research questions are also being considered, reviewed, evaluated and discussed. The literature review will identify gaps in the research and point to a solution that will contribute to educational research. Additionally, some of the problems this research and literature review address are not only concerned with Information Literacy and information seeking but also with student use of digital technologies. Although not central to this research, digital literacies will need to be factored in.

It is the intention in the literature review to:

- Examine past research and recommendations and developments in the field of information literacy;
- determine the previous research and development related to information seeking, use of search terms and student evaluation of found information;

- determine the current status of development of online digital solutions for teaching information literacy; and
- determine whether digital tools can assist students to ascertain the authority of online materials.

The literature in the field of information literacy and student relationships with information seeking is extensive as is the use of digital technology and how students use these tools to serve their information literacy needs. Information Literacy literature categories being examined are: Information Literacy Frameworks and Standards; Models of Information Literacy; Learner Theories; Constructivism; International Students and Information Literacy and; Language, Speech and Terminology.

The significance of this research is founded on the development of a digital solution to address the issues of student inadequate knowledge of information seeking and the ability to recognize online materials as being authoritative. The research problem has a focus on student ability to use search tools quickly and easily however, some there is a preference for quick and easy methods which may result in taking short cuts which can result in and compromise the quality of the materials and information found. Because there are a large number of international students from non-English speaking geographical areas such as Africa, the Middle East and Asia, who typically lack confidence and expertise using English, this literature review will also address language issues which may cause academic difficulties for these students. Thus, this literature review under the auspices of Information Seeking Behaviour also examines: Information Seeking Skills; Information Seekers and Authority of Online Materials and; Information Seeker Evaluation of Web Pages.

Because the first research aim and objective of this research was to provide an online tool to teach students information seeking skills and to test the tool for its effectiveness in overcoming the difficulty in recognizing appropriate search terms, the literature review will inform on previous empirical research on online tools for teaching information literacy. The aim of developing a teaching tool for core concepts for this research is supported by the inclusion of online digital tool development.

The literature being examined includes: Human Computer Interaction; WWW Information Seeker Behaviour; WWW Information Seeker Cognitive Processes; WWW Information Seeking; WWW Query Success; Information Seekers and Authority of Online Materials; Information Seeker Evaluation of Web Pages; Information Seeker Evaluation of Authoritative Materials; and Digital Literacy Tools.

The examination of established approaches to IL education such as PILOT will assist, if not illuminate, the benefits of the provision of alternative search tools for enhancing information literacy whilst providing an alternative method of searching on the www. If alternative tools such as PILOT are implemented into the curricula this may become a lifelong learning paradigm in action as it involves the way students are engaged in learning whilst using a different educational tool. Provision of current information on online tools available as well as an analysis of IL educational tools, will have implications for this thesis argument for the development for further online tools to enhance information literacy.

The literature in the field of information literacy and student relationships with information seeking is extensive as is the use of digital technology and how students use these tools to serve their information literacy needs. This literature will inform the reader of previous research conducted on these issues as well as the place that digital technology plays in educational information seeking. The problem is one of teaching students' information literacy specifically digital literacy skills to those who, in their educational journey, have not learnt these skills because of generational or cultural issues.

The review will not only outline the state of knowledge about undergraduate information problems, how they have been addressed and how well they have been addressed, but also forms the basis for the educational tool proposed in this thesis and the pedagogical thinking behind its design (discussed in Chapter 4).

Literature Review Issues Being Addressed

The following are the main topics reviewed.

(2.2) Information literacy and IL frameworks

The starting point for the review is the state of knowledge about information literacy and the IL frameworks that have informed research and development. This will not only illuminate the thinking underlying current educational tools and the understandings and skills expected of undergraduate students, but also help to explain the basis of the educational tool developed for the purposes of this study.

(2.3) Undergraduate student problems in finding and evaluating research

Some factors to be examined regarding the problems undergraduate and international students experience in finding and evaluating research will include; development of search terms, information seeking skills, search techniques and processes, keyword selection, natural language, use of electronic databases, and information seeking tools, including search engines and web pages. Difficulties international students experience is also included.

(2.4) Information seeking behaviour

This section takes a broader approach to information seeking and the evaluation of research material, once it has been located. It examines relevant literature on information seeking behavior and the conceptual processes involved in information seeking behavior. It also considers related research such as the evaluation of web pages for authoritativeness.

(2.5) Studies and evaluations of various solutions

This section will focus on solutions and will include topics such as search engines, natural language searching, electronic databases and Library of Congress Subject Headings, information literacy instruction and concept based instruction.

(2.6) Summary and contribution of this research

This section considers the state of knowledge and specifically shortcomings in the research studies, including design and search process and education tools. It outlines the gap in the research that this project will address.

2.2 Information Literacy and IL Frameworks

An information literate person is not only one who is able to utilize information seeking tools, but also able to understand what it means to be information literate. According to the ANZIIL statement (2007) an information literate person is one who:

> *…recognizes when information is needed and has the ability to locate, evaluate and use effectively the needed information.*

Griffiths and Brophy (2005) produced research showing that information seekers using electronic databases, the internet and the www all prefer to use the fastest methods possible.

Information literacy instruction has increasingly grown in education over the past thirty years. The growth has been accompanied by theoretical and practical responses in the form of increased development and implementation of initiatives that further the student knowledge and expertise. Webber and Johnston (2000), in examining the concept of information literacy and the associated perspectives and implications, provide a definition of an information literacy skilled person as being:

> *…able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the information needed.*

In information literacy, the emphasis is on the individual person being able to carry out the tasks of recognizing when information is needed and being able to access and use it

for their intended purpose. It is considered more time economical if information seekers become proficient as quickly as possible by being instructed in information literacy.

A similar definition of information literacy is Doyle's (1992), which states that an information literate person also:

> *…recognizes that accurate and complete information is the basis of intelligent decision making, identifies potential sources of information, develops successful search strategies, assesses sources of information including computer-based and other technologies, evaluates information, organizes information for practical application, integrates new information into an existing body of knowledge and, uses information in critical thinking and problem solving.*

Lennox and Walker (1993) characterize an information literate person as someone able to analyze and critically reflect on the formulation of search questions and evaluate results. Additionally important is that they have the skills of being able to use a variety of information seeking tools.

An information literate person as described by Doyle (1992), Lennox and Walker (1993), Goetsch and Kaufman (1998) and Webber and Johnston (2000) has gone from being able to recognize information need, and is able to locate, evaluate and use information effectively in a literacy system.

Although the term 'information literacy' appears a most often used term, Goetsch and Kaufman (1998) prefer the term 'information competency' however the term 'information competency' is more closely related to physical skills of information seeking using tools such as computers and books rather than the cognitive skill of evaluating resources and therefore has not been widely adopted in this study. The Goetsch and Kaufman (1998) 'information competency' is an overarching term that is related to the Doyle (1992) and Lenox and Walker (1993) skills mentioned above.

In addition to the information literacy skills already outlined, the Association of College and Research Libraries (ACRL) Information Literacy Competency Standards for Higher Education (2000) in the United States also place emphasis on a person's understanding of the legal and social issues surrounding the use of information and its ethical use.

Gratch (1992), states that previous knowledge on behalf of the information seeker, and an attitude of persistence and an 'eye' for detail is also important. Gratch (1992) adds that when information literacy is being promoted in educational institutions, an appreciation of the various forms and formats such as newspapers, digital and online information must be taken into account.

Two prominent designers of information literacy models are Kuhlthau (1995) who developed a six stage model and Bruce (1997) who developed a seven face model. Bruce (1997) sees the information seeking process not only from a theoretical view but also as a practice in which information seekers actively engage with information such as sourcing and evaluating information for their needs. However, Kuhlthau (1995) prefers to examine the information literacy process from a theoretical perspective.

Kuhlthau's (1995) six-stage model takes as its starting point the introduction of a problem. In the first stage a problem is indicated when students are unsure how to proceed and the second is the identification of the area to be searched. The third is the exploration stage where students are exploring sources and tools to use and the fourth is formulation, in which students cogitatively ascertain it is suitable to answer the information seeking question. The fifth stage is the collection and assimilation of data for evaluation and usage and the sixth stage is presentation of data in narrative form.

Bruce's model (1997) consists of seven faces or categories of information literacy that are formulated so:

1. The first face is Information Technology such as the physical components of information technology,

2. the second face is Information Sources that has the importance of access to gain information and enhance user knowledge of sources available,
3. the third face is Information Process and this allows retrieval and use of human cognitive processes and user ability to solve problems,
4. the fourth face is Information Control that is the controlling of information and user objectivity in developing strategies,
5. the fifth face is Knowledge Construction for the controlling of information as well as the building of user personal knowledge,
6. the sixth is Personal Knowledge that increases after being based on the users previous experience and
7. the seventh is Sharing Benefit with Others which occurs after knowledge is expanded, the conception of wisdom allows the use of information to benefit others.

The Bruce (1997) model can be related to the way in which students use information technology, identify where information sources may be found and, once found, process that information. Another consideration involved is being able to control the information and being aware that knowledge is being built as well as reflecting on the knowledge whilst using it wisely to benefit others. This particular model does not appear to be readily and quickly practiced by new undergraduate students. It is not something that happens by osmosis, in other words, this particular model does not appear to be something that happens automatically as soon as a student is enrolled. It is a constructive process that undergraduate students in particular must think about as they sometimes have to discover or be told or shown how to become reflective and think laterally if not logically about the whole process before it is undertaken and, it is an aspect of information seeking behaviour that could be useful when designing an educational tool.

Preceding Bruce's (1997) seven faces of information literacy, and the building of personal knowledge in information literacy, Eisenberg and Berkowitz (1988) developed a theoretical model of information literacy that was then turned into a tool and

implemented into an educational curriculum. The tool was named the Big 6™ program.

The Big 6 by Eisenberg and Berkowitz (1988) was developed and designed to be used by aligning theoretical information literacy and information seeking skills with curricula to provide value in helping students to accomplish the research process. Eisenberg and Berkowitz (1988) from their own personal, professional practice and study found that successful information seeking processes have six steps. The first step is Task Definition which means the problem is to define and ascertain the information need. The second is Information Seeking Strategies that are used to determine all possible sources. Third is Location and Access which is to locate sources. Fourth is Use of Information meaning to engage and/or extract information. Fifth is Synthesize which is to organize and present the information. Sixth is Evaluation which is to judge the product and process (Big6 [2007]).

Eisenberg and Berkowitz (1988) state that people intuitively use the six steps when seeking to solve a problem, make a decision and apply information although the steps do not have to be used in any particular order. To ensure success in information use, all stages have to be addressed. The Big6 has become a widely known web site for using technology to teach information literacy skills to primary/elementary school children as well as adults and is a problem-solving model that uses technology to systematically integrate information searching in tandem with technology tools to find, use, apply, and evaluate information.

From a broader perspective, Hannafin and Hill (1997) identified five different types of knowledge necessary for information gathering. They are: meta-cognitive or awareness of cognitive processes required for successful searches; perceived orientation or awareness of location within the system; judgment of capability to execute actions; system knowledge; and knowledge of the content being searched.

Eisenberg and Berkowitz's (1988) model, which focused on the information seeker's conscious act or practice of finding information, goes beyond the Hannafin and Hill (1997) model by taking the behavioral and cognitive model forward to a model of awareness and cognition of the information seeker. The theories of Eisenberg and Berkowitz (1988) and Hannafin and Hill (1997) were developed a number of years ago but they still hold well today and highlight student cognitive processes especially in the www environment. Although human cognitive processes are being used in student information processing, students make mistakes however they learn from those mistakes.

It is also worth noting the study by Monerero, Fuentes and Sanches (2000), who highlight the conscious cognitive processes involved in the process of following web page links and evaluation of materials, which in turn has an effect on whether a search is successful. This supports Moss and Hale's (1999) research, which linked student cognitive style and successful search outcomes. This has implications for information s literacy on the internet within an educational context.

It is worth adding that Bawden (2001) and Badke (2002) see digital literacy and academic literacy as being different. Digital literacy according to Bawden (2001) is focused on basic skills such as establishing internet search terms, using programs such as Netscape or Microsoft Explorer or Google and locating materials that may be used to cite in an academic paper. Earlier on, Kuhlthau (1995) says digital literacy skills are based on an information seeker's knowledge, perceptions and attitudes. Badke's (2002) academic literacy allows the information seeker to also learn about the paradigm of lifelong learning as well as digital technology and the internet in education. Thus, as more digital tools are being used, and students are gaining more skills and forming a closer relationship with digital resources, they also use the internet for information gathering.

Information literacy and information seeking is far more than books and electronic databases as it also involves evaluation of sources and materials, assimilation, reading, writing and critical reflection and what Bruce (1997) sees as wisdom.

The Eisenberg and Berkowitz (1988) Big6 curriculum system is supported by the thoughts of Grafstein (2002) and Badke (2002) who both support the fact that the teaching of information literacy should be from a discipline approach and the responsibility should be shared through an institution rather than a localized area of that institution such as the library. Thus, by forming models of information literacy, they are best utilized if they are put into practical use and if those uses are to be put into place it is essential to examine undergraduate and international student problems in the area of information seeking and evaluation of academic materials.

2.3 Undergraduate student problems in finding research material

This section is focused on undergraduate student problems such as information seeking and evaluation of found materials as well as international students and language. Within this, development of search terms, information seeking skills, search techniques and processes, use of electronic databases, information seeking tools including search engines and web pages are also a part of information seeking difficulties. Additionally, efficiency of information seeking methodologies, comprehensiveness and authoritativeness of materials are included.

Clearly, the efficiency of information seeking is important in a fast paced modern world and it is believed that it is important when students as a component of undertaking information seeking, first examine their search behavior in order to make it more efficient because although the use of digital information seeking is evident, finding accurate and appropriate information for academic citation on the world wide web remains problematic.

2.3.1 Student information seeking knowledge and skills

This research commenced with the question ‘To what extent are students’ information literacy knowledge and skills improved by the use of a specific online educational tool for finding relevant research information on the world wide web’.

To determine student skills when establishing or developing search terms and finding information, it was necessary to establish students' current knowledge and skills and address the theoretical aspects chosen to answer the research question. Because student information seeking skill and abilities may vary from inadequate to adequate and there a variety of information seeking tools such as library catalogues, microfiche, journal publications and the use of computer technologies such as the www in which techniques of developing search terms and use search engines to find information that is authoritative must be undertaken.

Within the literature examined, undergraduate and postgraduate students as well as academics have referred to four major concerns that arise at the beginning of a search for academic literature. Lindsay and McLaren (2000) express the view that those concerns revolve around information seeking tools, including electronic databases and paper based journals and books, internet search engines and web pages. There is, of course, no guarantee that needed information will be found. The four concerns are: the efficiency of information seeking methodologies; the number and comprehensiveness of academically citable materials available; the volume of information seeking previously undertaken and the time involved in the information seeking task using electronic media (Nachmias and Gilad [2002], Weidman and Strumpfer [2004]). However, before this could be examined, it was necessary to determine what factors are associated with an experienced or skilled information seeker.

Holsher and Strube (2000) express the opinion that, although different models for information seeking in electronic information systems were proposed by such people as Marchionini, Dwiggins, Katz and Lin (1993) and Schneiderman, Byrd and Croft (1997), these authors/researchers failed to distinguish between bibliographic databases and the World Wide Web.

The failure of Holsher and Strube (2000), Marchionini, Dwiggins, Katz and Lin (1993) and Schneiderman, Byrd and Croft (1997) to mention bibliographic databases could be because bibliographic databases are generally repositories held on the computers of a university, library or organization and could be considered a part of the hidden web and their existence is only known by staff and students in those individual universities. In contrast, the www is global information available on any computer anywhere in the world, as long as that computer or computer system is connected to the internet.

Chapman (2002), a librarian at the University of Melbourne in order to determine the level of student information seeking skills, expressed her concerns with colleagues that;

> *…many students appeared to not have adequate skills to deal with technology and software problems, search effectively, filter the information retrieved for relevant materials, critically evaluate the results for accuracy, currency and suitability for research.*

Chapman (2002) conducted a survey research at Latrobe University in Melbourne after being prompted by students who maintained that finding information on the internet was like 'Russian roulette', or a question of chance or a lucky dip.

Chapman (2002) notes that there is neither systematic editing of web published material nor any expert reviews of material on the www. Chapman's (2002) survey of students' and academic staff use of the internet for research showed that the most popular method involved basic search techniques by generally using single key words on one search engine. The next most popular method was 'surfing' or browsing websites and following links in those websites or directories.

The Chapman (2002) survey revealed that few respondents made use of 'Advanced' options provided in the 'Advanced' area of a search engine. However, this survey was conducted during 1999/2000, and considering the incremental growth of digital technology design and the rapid proliferation of home computers, the use of the 'Advanced' feature may have increased but there is no data. Since then, current

information seekers may be more familiar with the advanced type of options that Google and other search engines provide. In contrast, in 1999/2000, fewer information seekers would have been familiar with the advanced options. If information seekers considered themselves successful and adept at finding information, they should know about the 'Advanced' feature of Google. Information seekers believing that they are adept at information seeking yet not knowing about the Google Advanced feature suggests that there is a discrepancy between information seeker knowledge and self belief.

Because the Chapman survey findings did not indicate what functions the Google Advanced features provides, and/or that the respondents used, this again places a limit on the findings and could have added additional light on the results. Following on from the use of advanced features, and in order to determine student skills, the Chapman study asked participants the length of time they used the internet (however, this question adds a degree of ambiguity as time using the internet can mean the number of years or could also mean the number of hours daily or weekly and therefore, this ambiguity needs to be addressed). Additionally, students provided their own self assessment on whether they were successful in sourcing information and evaluating it successfully. Self assessment may not be a preferable way to measure information seeking and obtaining information because information seekers may feel they are adept and successful. Often, however, users don't know how unsuccessful they are until they learn what success is (Redfern 2004). Student lack of self knowledge of determinants of success leads to problems with internet skills knowledge.

Chapman's (2002) research identified internet skills-based problems which were determined by asking survey participants about internet search methods used, how often and how long the internet was used and where it was accessed. They were also asked was whether they were successful in finding information that was relevant and appropriate.

Chapman (2002) says that internet skills based problems relate to retrieving too much information and too much irrelevant information. Technology based problems relate to websites, the nature of the websites themselves, missing web pages and out

of date uniform resource locators (urls). Other technology problems include slow modem speeds, lack of fast broadband in some geographic areas, older versions of web browsers and problems and accidents with cables. This places limitations and constraints in the broader computer environment and have an impact on online searchers as any hindrance is a deterrent to information seeking success.

The Chapman survey was followed by interviews with the participating students and this was compared with student self-assessment provided beforehand. This resulted in a discrepancy as most students carried out single keyword searches, only three used Boolean operators and when the students were asked to describe how effective their searching was twenty four were not sure how they searched and three said they 'just type in the words and hope'. This is an indication that the self-assessment was not accurate as most of the participants were not efficient searchers and more importantly, this suggests that some students do not realize they are lacking skills. McNaught, Phillips, Rossiter and Winn (2000) state that studies do not often report student prior knowledge of information literacy skills in any detail. However, if Chapman could have first determined the level and degree of knowledge and skill of the student participants by using, say, the six ANZIIL standards to test the participants for their level of being able to: determine the extent and nature of the information needed, find that information effectively and efficiently, critically evaluate that information, manage that information, construct and create new understanding and, uses the information whilst understanding and acknowledging the cultural, ethical, economic, legal and social issues surrounding the use of the information. This approach could have provided provide further statistics and a less distorted picture of the final results of the experiment.

The Chapman (2002) and the Ellis & Salisbury (2004) surveys allowed students to qualify their own level of experience (Chapman 2002) and also to quantify the amount of time students use the www (Ellis and Salisbury 2004) to qualify their level of experience with information seeking on the www. Reih and Belkin (2000) affirm that it may be preferable to consider the alternative way of measuring the type of search strategy such as using computer analysis prediction which can quantify the number of search terms and the single words in a single search as well as the frequency they are used when using the www.

Macpherson (2002) conducted a study on the effectiveness of concept-based instruction for undergraduate students. There were 254 first year students at the University of Canberra. The study was experimental and there was a pre-test/post-test control group. The participants were all enrolled in the subject Communication Interface 1. They were taught the process of developing their search question by firstly, breaking the topic into main and lesser concepts, and secondly, establishing synonyms for those concepts and lastly, taught Boolean operator usage. The experiment group was taught information retrieval from electronic databases using grounded learning theory teaching strategies. The Macpherson (2002) study to evaluate information seekers knowledge of electronic databases asked participants to locate citations for articles that were 'highly relevant' for three search topics. Participant results for the Macpherson (2002) research showed that the number of concepts (total mean) for the experimental group was 8.25 and the control was 7.49. The number of inappropriate concepts for the experimental group was 1.32 and the control was 0.97. The number of reformulations for the experimental group was 13.24 and the control was 12.36.

Macpherson's research on teaching core concepts to students is supported by Bates (1986), Borgman (1986), Lancaster, Elzy, Zeter, Metzler and Yuen-Man (1994), Saracevic (1991) and Spink's (1996), which suggest that information seekers' inability to identify core concepts appropriately is one of the main reasons for inadequate search results. Macpherson's results suggested that a concept based approach is more effective than the traditional skills based demonstration approach and it is suggested that embedding information literacy instruction by using core concepts may assist students.

Internet information seeking statistics of the web search tool Excite were gathered by Wolfram, Spink, Jansen and Saracevic (2001) by using computer logging. The statistics gathered examined how public web searching behaviour had changed over the 1997-2001 period. The first of three stages was conducted in 1997, stage 2 was in 1999 and stage 3 in 2001. The results for 1997 and 2001 show a decrease in the percentage of modified queries from 52% in 1997 to 44.6% in 2001. (A modified query involves changes in original search terms to produce additional or different results).

These statistics suggest that information seekers were using shorter queries with less modification whilst using more Boolean operators. Wolfram, Spink, Jansen and Saracevic (2001) also reports that an unusually large number of terms were used with low frequency, such as personal names, non-English words and web-specific terms such as urls. Excite was not the only web search tool used as there has also been a growth in the use of other search tools such as Alta Vista, Wolfram Alpha, Google Scholar and Google Chrome. (Wolfram, Spink, Jansen and Saracevic [2001]).

The use of the www for academic information seeking does not necessarily provide accurate or academically appropriate information for academic evaluation. Although research from Ellis and Salisbury (2004), Redfern (2004) and Saunders (2004) concludes that information seekers prefer the internet, Ellis and Salisbury (2004) state that the amount of time spent using the internet is not an indicator that the results found represent authoritative information that may be evaluated for academic use. Finding appropriate information that adheres to academic standards and authority is paramount. Therefore, this is a consideration when conducting further research and a deterrent from equating the number of hour's students spend using the internet with being experienced and adept at finding information and evaluating whether the information is appropriate for academic use.

To investigate students' information/knowledge seeking skill and tool use, Redfern (2004) conducted a survey of students in the University of Canberra Library. The survey sample comprised twenty participants who were asked to nominate the tool/s they had used for locating search terms.

Regarding information/knowledge and seeking skill, the number of participants who felt they were efficient information seekers compared with inefficient information seekers was almost even as 46% felt that they were not efficient at finding information and 54% felt they were adequate or good at finding information.

The results of the Redfern (2004) survey revealed that the most popular tools used for searching were: www and internet 65%, library books 50%, online serials (such as specific journals and newspapers focused on specific subjects and topics) 45% and, electronic databases (which hold materials on many subjects and topics) 35%. The results of the Redfern survey (2004) which consisted of a small sample group are in concordance with the results of the Ellis and Salisbury (2004) only in the preference for the internet. The Ellis and Salisbury (2004 study showing that 65% preferred the internet, 24% preferred library catalogues, 7% preferred the local library and, 4% preferred electronic journal databases. It is significant that the studies conducted by Ellis and Salisbury (2004) at the University of Melbourne also revealed that students prefer using the internet and www for research rather than other media. This research supports the Redfern (2004) study at the University of Canberra and the two studies of Chapman (2002) show that students are increasingly using online search tools for locating academic materials.

These studies present substantial evidence to the effect that students prefer to use the www and internet rather than library databases for research. Additional evidence by Large, Lucy, Tedd and Hartley, (1999), Lindsay and McLaren (2000) and Moore (1997) confirms that the WWW is widely used for student information seeking.

Finally, other studies by Nachmias and Gilad (2002), Saunders (2004), Weideman and Strumpfer (2004) who also confirm the dominance of education information seeking using information technology that is widely used by academics and staff for information seeking. McNaught, Phillips, Rossiter and Winn (2000) state that although there are a number of electronic databases available, there has not been an uptake of computer-aided learning. Therefore, the development and testing of online search tools is timely to assist students with their information seeking strategies.

When placing the ANZIIL statement of what constitutes an information literate person in the context of the Chapman (2002), Ellis and Salisbury (2004) and the Redfern (2004) survey statistics (published in the Australian Academic & Research Libraries journal) these may have produced a different outcome if participants had been asked to provide self-evaluation of their level of information literacy. Thus, if

those participants were measured against well tried information literacy such as ANZIIL, this may have indicated that although information seekers may evaluate themselves being skilled at information seeking, in reality, this may not be the case.

Academic materials that are sourced from an authoritative authority such as a university or government web site may be assumed to be worthy of citation however the validity of the information is not guaranteed. Hassan (2001) states that when searching the internet the undergraduate or information seeker, will encounter a lot that is 'trivial and bizarre'. However, Hassan (2001) adds that the amount of valuable and up-to-date information on many government and non-government organizations and research institution web sites is increasing and thereby provide additional information that is useful for the researcher. Fensel, Hendler, Lieberman and (2003) observe that the exponential growth of the www makes finding information difficult because of the increasingly large amount of material. Unfortunately, researchers encounter difficulties such as the superficiality and inconsistency of web site information. Additionally, Ellsworth (2001) reinforces the opinion of Hassan (2001) and Fensel, Hendler, Lieberman and Wahlster (2003) by stating that the reservoir of knowledge on this planet is the largest ever known and students have to develop search and retrieval strategies that are more sophisticated. Therefore, a part of developing information seeking strategies is the use of using a variety of search keywords and terms.

2.3.2 Keywords and Search Terms

Researchers in the humanities experience difficulties when searching databases. In order to create more comprehensive search techniques Knapp, Cohen and Judes (1998) developed a non-www based humanities-oriented thesaurus with controlled vocabulary search terms to conduct free-text searching in the humanities and/or social sciences, however, using a thesaurus that is focused on an academic area or subject is a departure from free text searching as a thesaurus is a controlled vocabulary and free text is not controlled. The difficulty in the humanities information searching is caused by the broad spectrum of social science subjects as many synonyms may be used to describe one concept. Additionally, terms vary in the degree of precision. Knapp, Cohen and Judes (1998) refer to free-text in natural

language terms and add that the cause of failure to recall search terms in a free-text search is the inability of the searcher to think of related terms that the author may have used. An important conclusion is that the choice of keywords, core concepts or phrases are important for successful internet or www searching and success may rest on information seeker cognitive processes.

To determine whether information seeker cognitive processes and choice of keyword selection had an effect on the outcome of a search, Weideman and Strumpfer (2004) conducted experimental research with a significant sample of 1,109 students across forty-five institutes of higher education. The relationships between keywords, age, race and gender were compared against the success rate. The results revealed that gender was the only factor that did not have a bearing on the success rate. The report states that figures indicate that the most successful information seeking is conducted by students who are young (under twenty-five years old) because they are more adept with technology at an earlier age. That they are the most successful at information seeking could be because they have had more experience in their personal and educational lives than older students.

The Weideman and Strumpfer (2004) research report concludes that the greater the number of keywords used searching the internet, the more fruitful the results. That may be so, but in their research report, the word 'fruitful' is not qualified in its meaning. Although Weiderman and Strumpfer said that the use of a larger number of keywords does gain a larger number of results, this does not equate with quality results that are sourced from authoritative web sites such as university and research institutions nor does it determine if the articles were written by those who are well versed in their specific academic area of expertise.

The extensive amount of literature available on the subject of search terms, keywords and information seeking skills and behaviour indicates that students and other information seekers using electronic databases and www tools choose to use the fastest way possible to find information (Ellis and Salisbury [2004], McNaught, Phillips, Rossiter and Winn [(2000]). Additionally, this is supported by the Redfern (2004) survey and is also consistent with later research results and evidence by Helms-Park, Radia, Stapleton (2007) preliminary research on student use of online

search tools and search engines such as Google Scholar. Helms-Park, Radia, Stapleton (2007) state:

> *While the use of a search engine to find secondary sources is now a commonplace practice among undergraduate writers, recent studies show that students' online searchers often lead to materials that are wholly or partially unsuitable for academic purposes.*

Correlating numbers is quantitative but in academia, qualitative is preferable when referring to searching success and information seeking success. Information seeking success may be guided by various models that purport to show what constitutes a successful and information literate student and this may be guided by the number of search terms used or the number of alternative search strategies such as the use of Boolean operators.

2.3.3 Boolean Searching

From the substantial amount of research conducted on the information seeking skills of students, and a small amount on academics, and as previously stated in this thesis, the research is conclusive that information seekers using electronic databases, the internet and the www whilst attempting to use the fastest methods possible although there are advantages and disadvantages. It seems that the advantage of quick and easy access is disadvantaged by the lack of finding quality and authoritative materials. The seemingly advantage of slower and perhaps more difficult access can result in more authoritative materials. Therefore the information seeker may have to determine which they prefer, quick and easy access whilst gaining a lesser degree of authoritative materials or slower access with more authoritative materials and in this, Boolean operators have a place to play.

There is an assumption that the more experienced information seekers such as academics and advanced post graduate students have knowledge and use Boolean operators in their search (Redfern 2004). Information seeker' Boolean query usage for databases, as reported by Jansen and Pooch (2001) was 37%. Siegfried, Bates

and Wilde's (1993) research on searching databases showed that the sole use of Boolean operator queries constituted 5-10% of queries and the use of one query term (non-Boolean) constituted 63%. However, the statistics for searchers using Boolean logic may fall in the future as the popularity of www searching increases and Boolean operators are replaced by alternative search tools, such as the Google Advanced feature and Google Chrome and Google Scholar.

There is an indication that the use of multiple keywords and an increased use of alternative strategies should be undertaken to increase information seeking success. Chapman (2002) shows that most participants use single keyword searching and Weideman and Strumpfer (2004) add that the more keywords used the better the results. This opinion is enhanced by the Siegfried, Bates and Wilde (1993) finding that the use of Boolean operators by searchers was between five and ten percent of queries.

The Siegfried, Bates and Wilde (1993) research revealed that Boolean operators were used by 10% of the participants. The fact that some information seekers became familiar and comfortable with computers and other digital technologies at an earlier age combined with an increase in the ease-of-use of computer and digital technologies means that the lessening of the use of Boolean operators – ten percent, as reported in the Siegfried, Bates and Wilde study (1993) - is hardly surprising. Thus, as digital technologies are evolving and software developers are building models which are easier to use, whether or not students are information literate they still may be able to find authoritative information and information seeker behavior has an impact on their level of success.

2.3.4 International students and language

When information seekers such as international students enroll in westernized universities, they are not necessarily comfortable accessing online information and are often not versed in what constitutes authoritative information for citation and this is an issue for those wanting to become information literate within the digital sphere. Students and others from a Non-English speaking background must be considered because when those students use libraries in English speaking nations, Badke (2002)

believes that what is particularly necessary, and come to the fore, are basic literacy communication skills such as listening, hearing, speaking and writing in the English language.

Marginson (1997) says universities are increasingly enrolling many international students who make a large contribution to Australia's Gross National Product (GNP). Naturally, it is in the best interests of Australian universities for international students to be academically successful. Badke (2002) agrees with Marginson (1997) but adds that universities need to make a concerted effort to assist students who lack language or academic skills.

As trans-national education is a growing market commodity, there is a need to offer education as a high quality product (Briguglio 2000). Accordingly, it is necessary for the provision of high quality education to be accompanied by ancillary programs to support both domestic students and international students. Although ancillary educational programs such as training in information seeking and the use of appropriate research tools may offer a solution and promote independence and autonomy when undertaking research, student socio-economics come into play. So when we consider Marginson (1997) and his statement that international students make a large contribution to Australia's GDP and Badke (2002) who adds that a concerted effort must be made to assist students who lack language skills is accompanied with Briguglio (2002) who sees that education, in order to support the market economy students must be assisted. Therefore, digital technology and ancillary programs in the form of literacy and language skill tools may benefit all students and in particular, those who are international.

Some researchers such as Badke (2002), Leder and Forgaz (2004), Ramburuth and McCormick (2001) and, Scheyvens, Wild and Overton (2003) assert that some of the challenges faced by international students are writing at academic level, working independently and conducting research. Additionally, the difficulty of learning English adds to the problems that international students face and these problems must be overcome to help address academic demands to ensure success for the student Badke (2002).

Biggs (1999) believes that international students experience greater difficulties than local students in coping with academic demands. Burns (1991) points out that international students feel stressed and less competent with academic skills and adds that, in identifying international student problems, it is important to look for the gaps and problems experienced and attempt to address them. Badke (2002) stated that some of the other key challenges for international students are library systems and technology. However, Briguglio (2000), Lacina (2002), Scheyvens, Wild and Overton (2003) and Leder and Forgasz (2004) are of the opinion that language is the primary challenge. Whether the problem is technology or language that entails colloquial, idioms or dialect it is desirable to examine and address these issues.

International students often do not understand the Australian dialogue because of the speed, intonation, accent, idioms and colloquialisms. Although these students have studied English prior to undertaking their academic studies in Australia, Jandt (2004) suggests that elements that cause problems are the lack of equivalences in vocabulary, idioms, grammar, syntax, experiences and concepts. Additionally, sometimes direct word to word translations cannot be made.

In 1999, at Massey University of New Zealand, Scheyvens, Wild and Overton (2003) conducted research on international students undertaking postgraduate studies at the University. The research was based on interviews with 12 key support providers, such as tutors and staff and those in the academic skills program. The results revealed that in addition to general problems with the English language, international students have a particular problem with colloquialisms and this reduces their comprehension. The research concluded with Scheyvens, Wild and Overton (2003) acknowledging that although the visibility of international students in westernized universities is high, provision of adequate exploration of ways to assist these students is worthy of further research.

Considering Scheyvens, Wild and Overton (2003) suggest that provision of ‘adequate’ exploration and further research through new forms of communication and tools is of concern. Scheyvens, Wild and Overton (2003) use the word ‘adequate’ because this seems to infer that the exploration and new forms of

communication and tools should only be carried as far as to provide an adequate solution or, just enough to get the job done.

Field (1997) advocates that the way of helping international students is through new forms of communication and tools and as Field (1997) points out, international students who sometimes lack a firm grasp on English, are also likely to have difficulties in determining subject core concepts. Jansen, Spink, Saracevic and Tefko's (2000) upon stating that it would be helpful if an online tool has an academic context, this implies that subject core concepts is pertaining to academic context and therefore included.

If as Field (1997) suggests, that international students lack a firm grip on English, it seems doubtful that only going as far as 'adequate' as stated by Scheyvens, Wild and Overton (2003) is not progressive. Therefore, only working to a level of adequacy would lessen the chance of success and hasten the exploration and development of language and tools to assist international students and their digital literacy.

Based on the studies of Scheyvens, Wild and Overton (2003), Field (1997), Badke (2002), Leder a& Forgaz (2004), and Ramburuth & McCormick (2001), it is not only evident that uncertain English comprehension and language skills are a problem but international students may tend to use tools such as Google or another search engine that is familiar and easy to use.

Contemporary language is language in common use and international students may experience difficulties with colloquialisms, idioms, slang, phrases and deliberately devised expressions, jingoistic terminology and acronyms that are regularly brought into common usage. Because of the informality of contemporary language used in common conversation and media such as television and newspapers etcetera, contemporary language used in common human dialogue and the media does not necessarily match the language of academia. Consequently, the use of search tools that allow for international language differences for information seeking may make the research task easier. The modernization of English language and adoption of societal and regional dialects is a continuum as all languages naturally evolve because of usage or by adoption or design. (Redfern 2007).

Summation

The growth of information literacy and more recently digital literacy between 1978 and 2009 has seen significant research and interest in the areas of recognition of information need, evaluation of sources, cognitive processing, analysis and synthesis of the information. There has also been the growth of information literacy models such as those of Kuhlthau and Bruce and accompanying this has been the development of research and initiatives to assist international students.

The development of information literacy systems of Kuhlthau (1995) and Bruce (1997) with the Badke (2002) and Bawden (2001) paradigms of lifelong learning and digital literacy skills has seen the growth of such initiatives such as the aforementioned Eisenberg and Berkowitz (1988) Big6 program that embeds information literacy instruction in the curriculum. The Big6 is being promoted and practiced in libraries and educational institutions.

The information literacy framework of Australia and New Zealand government schools curricula states that the purposes and principles are to facilitate learning, diagnose learning gaps, measure learning, provide opportunities for students and teachers to discuss learning, provide information for evaluation of teaching and to provide certification information (ANZIIL [2007]).

Following, there is now provision of different online tools to teach and demonstrate information literacy. Information literacy frameworks are in place and are taught and demonstrated with in-class group activities in schools and colleges, university libraries under the guidelines and standards of the ANZIIL (2007) frameworks whilst aligning the standards with the curriculum.

Although training and education in information seeking skills and strategies are taught to students and others, it is common for information seekers to still experience difficulty in finding their required information on the internet. Sherman and Price (2001) express the opinion, that the difficulty lies in a combination of information seekers not being able to effectively develop search strategies and also the disparate nature of web sites and the seemingly uncontrolled nature of the www.

In the forgoing literature review it has been shown that difficulties exist in information seeker skills however, Sherman and Price (2001) further assert that material on the www/internet must be optimized in order to provide more educational opportunities for novice and advanced researchers. As well, It has been shown in the above literature that students experience difficulties in finding appropriate and authoritative on the Web as well sometimes being unaware that their information seeking skills may be improved upon. Additionally, there is an issue with the development and use of keywords and search terms as demonstrated by Chapman's finding (2002) that most students used single word searching.

In answering the research question, 'To what extent are students' information literacy knowledge and skills improved by the use of a specific online educational tool for finding relevant research information on the world wide web', researchers such as Jansen, Spink and Saracevic (2000) and Marchionini (1995) have said that information seekers want to find information as quickly and efficiently as possible. However, as well as the opinions of Spink and Wilson (1999), Kuhlthau (1995), Chapman (2004) and Bruce (1997) on the topic of information seeking and literacy, Jansen, Spink and Saracevic (2000) and Marchionini (1995) add that regardless of whether an information seeker is successful or unsuccessful in finding authoritative information difficulties may lay in information seeker behavior. In order to understand student information seeking further, the next section will examine information seeking behavior and evaluation of authoritative materials.

2.4 Information Seeking Behaviour

The previous section focused on undergraduate student information seeking problems with finding information using search information seeking skills, search techniques and processes. This section will examine information seeking behavior, international students and language as well as evaluation of authoritative materials.

Human cognitive processes and information seeking behavior are involved when using search tools and resources in the digital environment are being examined. Because this research and thesis involves information literacy and skills, the information seeking process and the building of an online tool to be used in testing the research questions, it is relevant and necessary to examine how student cognitive processes and behavior commence and proceed to find information and what is involved.

Cognitive Processes

Cognitive search strategies employed by information seekers searching the www was examined by Navarro-Prieto, Scaife and Rogers (1999). The research involved making comparison of novice and more experienced www searchers. The conclusion to the research was that the more experienced searcher used their 'web knowledge' and planned their search strategy ahead of time whereas the novice searchers plan less and are more reactive to representations on the computer screen and tend to follow links. Phrased another way, the novice searchers tended to browse more than search. Whether novice searchers browse or search leads to the question about the role of information seeker cognitive processes and search behaviour.

Moss and Hale (1999) conducted research on human cognitive style and personality. The research conducted on higher education students was to investigate internet search strategies and emerging issues and the research hypotheses concerned links between cognitive style and search behavior. Fifteen participants were interviewed in an examination of search patterns from pre-specified search problems of 1,509 searches.

As the research progressed, the researchers realized that human cognitive style and personality was a dominant factor in search strategies employed by information seekers. The Moss and Hale (1999) research concluded that the themes of different search strategies adopted for differing cognitive style and personality have implications on information seeking training in education. The themes of information seekers cognitive style and personality are particularly relevant and are issues which appear to have been addressed by previous research as previous studies sought simply to improve information retrieval skills rather than examine the relationship between information seeking and cognitive processes and behavior.

Information Seeking Behavior

Information seeking behavior is different from cognitive processes. Whereas cognitive processes involve unconscious and non-deliberate evaluation and decision making, behavior involves conscious and deliberate evaluation and decision making. When using information retrieval systems such as the www, information seekers often use different types of techniques and search behavior to seek and collect information such as browsing the www using directories, following links, or typing in terms that may produce some relevant information. Jansen, Spink and Saracevic (2000) say that www information seekers behavior indicates that they use the least effort possible and take short cuts. On the other hand, Marchionini (1995) expresses it differently, by observing that humans will take the least resistant path. Whether or not information seekers take a path of least resistance or effort, even considering the academic content of electronic databases as being more valuable than the www, those students will still resort to using the www after experiencing difficulties or dissatisfaction with the electronic databases (Marchionini [1995]). Jansen, Spink and Saracevic (2000) and Marchionini (1995) state that information seekers take the path of least effort or the least resistant path; this still means that www users want to gain their information quickly and easily.

Holsher and Strube (2000) investigated student information student seeking behaviour while browsing the web. Information seeking or web searching is a

deliberate behaviour as the information seeker is looking for specific materials by constructing search terms in a search engine. In contrast, browsing is less structured and is based on following web page links or urls. Holsher and Strube (2000) regard the behaviour of an experienced user as exhibiting knowledge, skills and behaviour to use the www to successfully solve information seeking problems. Therefore, it is the more experienced information seeker who searches rather than browses.

In order to understand the behaviour and experience of information seekers using the www, Reih and Belkin (2000) at Rutgers University, conducted research using a background questionnaire. Following the questionnaire, an experiment was conducted. The sample comprised fifteen academics that came from a range of fields within the university, including communication, library and information science, linguistics, sociology, chemistry and computer science. Participants were allowed fifteen minutes to conduct four www searches on four topics. There were 1,321 web pages accessed from sixty searches by the fifteen participants. Nine participants (60%) said they used the www every day, or at least once a day. All participants said they used search engines and directory services ranging from 'somewhat' to 'a great deal'. The conclusion to the research revealed that the relative behaviour and experience of the information seeker on the www, made a difference to the outcome.

Kuhlthau (1995) and Ellis (1998) in two separate pieces of research found that library user information seeking behavior processes occurred in six stages and these are related to the cognitive and affective state of the user's search activities such as successive searching. Spink, Griesdorf and Bateman (1999) say that successive searching is to conduct a series of related or 'successive searches or users searches in digital environments over time related to the same or evolving information problem' and this may be by using tools such as the internet/www or electronic databases.

After information seekers encounter difficulty using electronic databases and follow the path that Jansen, Spink and Saracevic (2000) and, Marchionini (1995) have observed, that is, taking the easiest path and taking short cuts, they turn to using Google or another proprietary search engine.

In contrast to Jansen, Spink and Saracevic (2000) and, Marchionini (1995), Head and Eisenberg (2009) who conducted research on the reasons undergraduate student behaviour led to using academic databases, detailed the following key findings. The highest percentile provided the reason that electronic databases were credible (78%); have in-depth detailed information (76%) and have simple search interfaces (74%). The lowest percentile said the electronic databases allowed the quick finding of articles 'just in time' (43%) which indicates that to find authoritative information, those students may have used electronic databases as a last minute resort. It is questionable that the figure of 74% finding electronic databases held a degree of simplicity in the design of the search interface. Search interfaces may appear user friendly but in reality, if this is so, why do so many students resort to using Google or other such tools. It must be noted that the Head and Eisenberg (2009) research was not asking what tools the participant used, rather, it was asking why scholarly research databases are used, which is quite a different question to a question that is related to choice of tool so, if Head and Eisenberg (2009) are asking why electronic databases are used, there is also the need to ask what of the information seeking behavior and skills of students using those databases and other digital technologies.

Hsieh-Yee (1993), Siegfried, Bates and Wilde (1993) developed an understanding of student information seeking behaviour when using the www. A picture of how students search the www has also been provided by additional research of Wolfrem, Spink, Jansen and Saracevic (2001) and, Tabatabai and Luconi (2004) who researched whether student information seeking needs were being met. The picture provided was one in which it was acknowledged that information seeker needs were being met however they felt that there was a need for the provision of differently styled tools that more closely reflected academic subjects and the use of core search terms (Wolfrem, Spink, Jansen & Saracevic 2001; Tabatabai and Luconi 2004).

Additionally, Redfern's (2002) findings suggest that the building of different subject based tools for the www had not been developed for teaching information seeking skills or teaching subject concepts to assist easier information retrieval and it is worthwhile to develop such an information seeking tool and to evaluate its value and worth when examining student information behaviour in the digital environment.

A study of information seeking skill behaviour of freshmen at Michigan State University was conducted by Matthews and Wiggins (2001) and the study revealed that most freshmen were familiar with the www before attending university and once undertaking scholarly research in higher education, those freshmen still mainly utilized the www and Google. Additionally, the students also held the belief that if information cannot be found in Google then the information did not exist although they then tried different search techniques. Although freshmen mainly used the www and Google for their information seeking needs, the wide use of these tools could be driven by habit because of the ease of use and current and/or former access of them in a home environment and this creates a degree of familiarity and again, this supports Marchionini (1995) and Danino's (2001) statement for user preference to be for tools and information that are accessed quickly, easily whilst taking a route of least effort.

In order to achieve finding information with least effort and to make information seeking easier on the www, the major tools launched during the period of this thesis, 2004 to 2009, were: Google Scholar in 2004, Google Chrome in 2008 and Wolfrem Alpha in 2009.

There is a large amount of evidence regarding the information seeking behavior and skills of students using digital technologies. This supports the view that students, while wanting to find information, are prepared to use various technologies and tools to find that information whether they be an online search tool, electronic database or an online tool and resource such as Wolfrem Alpha, Google Scholar and Google Chrome and others.

The importance of Navarro-Prieto, Scaife and Roger's (1999) comparison of novice and experienced www searchers led to the conclusion that the more experienced the searcher the more planned and effective the search results. Navarro-Prieto, Scaife and Roger's (1999) concluded that effective search results were the result of information seeking behaviour cognitive processes and the choice of keywords. Additionally, human cognitive style and personality was a dominant factor in search strategies employed by information seekers. This is also in agreement with the Moss and Hale (1999) research that concluded with the statement that emergent themes of different

search strategies adopted for differing information seeking behaviour and cognitive style and personality have implications for educational issues such as information seeking strategies related to training in internet and www information seeking. So, the picture of an experienced searcher according to Navarro-Prieto, Scaife and Roger's (1999), Weideman and Strumpfer (2004) and Hale (1999) is one who is more planned, thinks more about keywords, and has a personality that leans towards being self-driven.

Research on information seeker behavior conducted by Jansen and Pooch (2001) shows that for an average information seeker a database session consists of seven queries. Hsieh-Yee (1993) reports figures of 8.8 for the novice seeker and 7.2 for the more experienced seeker. In contrast, other researchers such as Seiden, Szymborski and Norelli (1997) and Vakkari (2000), contend that the number of queries is two to three. The significance of the number of queries may provide an indication of the amount of determination, interest or willingness to undertake lengthy examination of electronic databases as well as the level of preparedness in using and/or establishing new or different search or strings of search terms and this more experienced student behaviour indicates a successful information seeking outcome. However, if an information seeker's behaviour indicates that they conduct information seeking using only one database query it could be an indicator that they are either not particularly interested or conversely, they are adept at developing search terms and quickly find needed information.

That the Jansen and Pooch (2001) research shows an average of seven queries and the Hsieh-Yee (1993) research shows that there is a difference of 1.6 search queries between novice and experienced seekers it seems that both the novice and experienced seekers are almost matched in both the Hsieh-Yee (1993) and the Jansen and Pooch (2001 research.

Comparing the Hsieh-Yee (1993) Jansen and Pooch (2001) research with Seiden, Szymborski and Norelli (1997) and Vakkari's (2000) contention that the number of queries is three, considerations are first whether both sets of results were gained from both novice and experienced information seekers and secondly, the currency of the Szymborski and Norelli (1997) research. This leads to another consideration that

it may not be whether the student is a novice or experienced information seeker but whether they exhibit behaviour that leads to information seeking success.

Recognition and evaluation of authoritative materials

The research question being addressed; 'How can an online search tool assist students with evaluation of research materials?' is being addressed by examining how students evaluate online materials for authoritativeness. Acknowledgement of the effectiveness of information seeker cognitive processes and evaluation of material has been provided elsewhere in this thesis by Hawkridge (1983), Lindsay and McLaren (2000) and Carroll (1999) and are in agreement on the importance of cognitive processes in information seekers. Notwithstanding is the viewpoint of Monerero, Fuentes and Sanches (2000) who expound not only on the importance of information seekers being able to evaluate web pages but also for those information seekers to then link the found information to their research.

The conclusions to the above research, especially when considered in tandem with the opinions of Ellsworth (2001), Hassan (2001) and Fensel, Hendler, Lieberman and Wahlster (2003), is that it is all very well to have a large reservoir of knowledge available on the internet/www but the information must firstly be found and secondly must be of a standard appropriate for use in academia, that is, it must be authoritative. However, there is no guarantee that information found is authoritative but, it is important to try and impart evaluative skills to students.

Reih and Belkin's (2000) study on academic and doctoral students' evaluation of web pages shows that information seekers initially use predictive judgments to decide the worth of the web page and this is supported by Holscher and Strube (2000) whose research shows similar results. However, a significant research consideration is whether students know the steps or processes or are consciously aware of their information seeking behavior whilst searching for information on the www and this has a significance of meaning for international students and those who are not well versed in the use of online tools.

Research on academic and doctoral students' evaluation of web pages was conducted by Rieh and Belkin (2000). The research revealed that when information seekers initially open their web browser, their first search is strongly based on human reasoning also known as 'predicative judgment'. Predicative judgment is based on knowledge, experience, and other people's recommendations. Information seekers automatically perform a quick evaluation of a web page at the first opening. When a required web page is accessed, the information seeker makes an evaluative judgment and decision of the worth of that presented web page. For example, if the web page shows a visible link that is of interest to the information seeker, they quickly become interested in what the web site offers. This is an evaluative decision based on the quality of the information, how useful it is, whether there are other useful links and, the information seekers evaluation of the 'authority' of the page.

The judgment of the quality of the page is made by the users 'evaluative judgment'. Information seeker evaluative judgment is based on experience and determined by the 'look' or characteristics of the page. Sometimes, this creates a situation whereby the predicative judgments of the first page does not match the evaluative judgments of the second page and the information seeker decides to proceed or return to another page or source in order to find a page that they judge as being authoritative. Alternatively, if the predicative and evaluative judgments match then the information seeker may use the information.

Although the Reih and Belkin (2000) study focuses on the dimensions of information quality and cognitive process of information seekers, the study provides an insight on how information seekers think and react to web pages and their content. It is worthwhile considering if a single web page requires too much reading, the information seeker will pass onto a different web page that is easier to read.

Of 'authority', Schedler (1999) refers to provision by the author of their academic credentials and biographical information and the author's affiliations as well as the level of authority, trust and degree of the information being on an 'official' web site.

The degree of being 'official' is recommended via the nature of sponsoring by its organization on the web site plus it being referred to in other references and cited works. Additionally, there is the addition of other unique components such as the web site showing evidence of the work being an original contribution, bearing primary information and the degree of discourse that questions the '*notions of authority, legitimacy, or originality on the web*'. Schedler (1999).

'Integrity' refers to the accuracy of the information on the site and also links to other web sites and the currency and how often the web site is updated. Also important is the presence and availability of archives as well as the number of times and dates the web site was updated. Additionally, also provided is assurance of the comprehensiveness of the site in the form of contents, full text, links or provision of a site map. Also important is the appearance that the information is accurate and comprehensive.

Objectivity encourages the information seeker to ask what is the purpose of the website information, that is, is it for 'light' information in an entertaining manner or is it aimed at a deeper level such as to suit academic information seeker needs. There is also the matter of the 'tone' of the website and whether it is written using informal jargon or formal language. The presence of any form of bias exhibited by the content, author or organization is to be considered as well as asking does the web site promote values that are positive and objective. These are the elements that provide authentication of authoritative information. Schedler (2002).

Holscher and Strube (2000) researched the differences between information seekers browsing versus searching and in determining how those information seekers evaluated web pages for their authority, Holscher and Strube (2000) asked students why they selected a particular page to view, and what aspects of the page motivated them to make decisions on what to do next. The answered questions revealed that 442 predicative judgments were made and 156 (51.1%) of the participants were concerned that information quality of the web page was considered to be a 'cognitive authority'. Words that indicated 'cognitive authority' were along the lines of 'trustworthy', 'reliable', 'credible', 'reputable' and 'respectable'.

Holscher and Strube (2000) also report that the total number of evaluative judgments was 534. When the question relating to the information being 'good', 'accurate', 'current' or 'correct' and 'useful' to assist in solving their information problem at the same time as being trusted information, Holscher and Strube (2000) found that 354 (66.3%) of the participants were concerned with the quality of information and authority. This is all very well, but it must be asked what level of skill and knowledge did the students have in order to recognize or qualify what constitutes quality and authority of the information. Holscher and Strube's (2000) findings are limited by the fact that they did not test the participants' information seeking. Although this part of the Holscher and Strube (2000) research on the recognition of authoritative materials and the students using words like trustworthy, reliable, credible etc. to determine authoritativeness of found materials etc., it is possible that the students may not be well versed in what determines authoritative material.

Summation

This section has provided information and argument on the issues of student information seeking behaviour and cognitive processes, and recognition and evaluation of authoritative materials. Thus it has drawn on the related student problems and has reflected on the importance that students must either be able to understand not only the English language but also the vernacular and colloquial expressions of their residential English language dialect as well as being able to effectively use online tools whilst being familiar with American and to a lesser extent, British English dialect and language.

Also of consequence, is the issue of the provision of online tools that are easy to use as well as being able to access online information that are credible and hold authority.

The inclusion of international students and language and recognition and evaluation of authoritative materials in this section and thesis has helped answer the research question 'How can an online search tool assist students with evaluation of appropriate research materials?' As well, it has shed light on information seeker behaviour and cognitive processes.

This section has provided information on how information seekers determine whether information found online is authoritative material appropriate for academic use and this has added to the body of knowledge by providing information of previous research whist adding to the subject of information literacy.

It is observed that scholarly research on undergraduate and international student use of the internet/www, student information seeking behaviour and their evaluation of online academic materials may be enhanced by the development of computer programs that teach information seeking within the www context. Online subject based search tools for the www have not previously been developed for teaching information seeking skills or teaching subject concepts to assist easier information retrieval in the digital environment Thus, student's information seeking behaviour and cognitive processes also play a part in the use of such tools and educational solutions.

2.5 Studies and Evaluations of Various Solutions

This literature review commenced with theoretical models of information literacy which was followed by undergraduate student information seeking problems, information seeker behaviour and cognitive processes and, international students and language and then evaluation of online academic materials. Continuing, this section will focus on solutions and will reflect on student relationships with search engines, electronic databases, Library of Congress Subject Headings, information literacy instruction and, concept based instruction.

Earlier in this literature review it has been shown that when students are searching for information they prefer to be judicious in their use of time and effort. In order to achieve this, student's use a variety of techniques and methodologies such as using different search engines and directories whilst using natural language, that is, using language as it is spoken in the vernacular. Consequently, information seekers have to alter their strategies and language according to the tools used. For example, different search languages such as British, Australian and American English as well as various dialects, vernacular or colloquialisms are used according to the search engine and directory country of origin compared to electronic databases and libraries which use the Library of Congress Subject Headings. This is best exemplified by information seekers using controlled vocabularies in electronic databases and in contrast natural language and/or vernacular when using search engines and directories.

To provide information to libraries on the various information seeking computer programs available, their design and usability, Dorner and Curtis (2004) surveyed 79 user interfaces which were evaluated in an eight broad categories. The categories were; searching, user interaction, customization, authentication, design, database communication protocols, after sale support and, software platform support.

The Dorner and Curtis (2004) research indicated that many of the program interfaces consisted of well known accepted standards in line with the eight broad categories established for the survey.

The survey determined that the overall standard was high with approximately 75 per cent supporting the eight evaluation criteria. The use of key searching and cross-database searching will continue to be popular as well as the programs being used. Additionally, Dorner and Curtis (2004) add that they are also popular amongst providers of library services.

The Dorner and Curtis (2004) survey findings revealed that because there were attempts to reduce information seeker time and effort, it was common to incorporate organizational branding, user login authentication screens and dialogue boxes to the interfaces. Consequently, this adds an additional complexity in the form of additional steps that information seekers encounter, which in turn appears counter-productive to achieving the simplification of user interfaces and computer operation.

The Redfern (2004) survey revealed that many novice information seekers believe that web tools such as Yahoo, Excite, AltaVista, Google, Netscape, Mozilla and Opera etc. are used for searching for information on the www and these tools used individually can find all information on the www that is related to the typed in query. This belief is erroneous because there are differences between search engines, search directories and crawlers and how they operate. Whatever the information seeker's personal search characteristics or preferred tool, the inexperienced student may not be able to source or use some electronic databases.

It has been stated by Field (1997) and Scheyvens, Wild and Overton (2003), that scholarly research on student use of the internet and student information seeking behaviour may be enhanced by the development of computer programs that teach information seeking within the www context. Additionally, as Jansen, Spink and Saracevic (2000) said, it is important to provided tools that assist students to take the easiest and quickest path to find their required information and, as Danino (2001) puts it, it is important that computer programs are built to not only to suit individual preferences. Additionally, Dix, Finlay, Abowd and Beal (2004) state that computer program usability is important and it must feel natural and easy to use. The aforementioned Chapman (2002) and Redfern (2004) surveys have shown that

students, in selecting and using various online tools and search engines to suit their individual preferences, are attempting to find authoritative materials faster however, this is only beneficial if those students are able to recognize and evaluate those materials for their level of authority.

2.5.1 Student Relationships with Search Engines

Because of the number of different search engines available it is surprising that information seekers after a lengthy process, find what they are looking for. This is mainly because those information seekers try different search engines until they find one that provides a solution.

This literature review has previously shown that if information seekers can't find what they are seeking they use a different search engine or directory (Chapman 2002) and Redfern (2004) such as Google or Excite.

The reason for information seekers encountering unsuccessful search results is because of incorrect interrogation and the search engine misunderstanding what the user is looking for. An example is that sometimes information seekers use the wrong search tool, such as directly accessing search engines for news on a general purpose search engine instead of directly accessing an online newspaper. Sherman and Price (2001a.) use the analogy of using a screwdriver to drive a nail into a board rather than using a hammer. Therefore, use the right tool for the right purpose and the task will be achieved more easily (Redfern 2004).

As revealed in the research conducted by Ellis and Salisbury (2004), McNaught, Phillips, Rossiter and Winn (2000), Large, Lucy, Tedd and Hartley, (1999), Lindsay and McLaren (2000) and Moore (1997), many students use search engines such as Google, Google Scholar and AltaVista for information seeking needs. However, these search engines are not designed for student or academic information seeking because they only search for information based on the information seekers typed in terms. Unfortunately, typed in terms may cover a large number of subjects that are not suitable for finding information that is academically authoritative.

Because generic search engines are not specifically designed for academic research, the internet and www searching can produce a wide range of results. Deibert (1998) conducted an unrestricted web page Google search using the term 'asynchronous switching'. This query produced the following results.

Table 2: Google search using the term asynchronous switching

Year and Search Query Tool	**Number of Results**	**Query Searcher**
1998 Google	164,000	Diebert
2004 (October) Google	401,000	Redfern
2004 Google Advanced (Exact Term 'asynchronous switching')	76	Redfern
2004 Google Advanced (.edu domain only)	114	Redfern
2005 (May) Google	580,000	Redfern
2007 (May) Google Advanced	17,400	Redfern

Table 2 shows the results of the same query (asynchronous switching) reproduced from October 2004 to May 2007. The same query in October 2004 produced more than 401,000 again from unrestricted web pages. Also in October 2004, the same query was undertaken using Google 'advanced', using 'exact term' function, asynchronous switching'.

This action limited the results to 76, a figure that is more (asynchronous switching) manageable. With the search limited to .edu, the result was 114. A very large numbers of information seekers whether they are considered inexperienced or experienced may not know how to limit a Google search to .edu domain and if not this must affect the quality of authority of their obtained material (Redfern 2004).

An unrestricted search using the same search term on all public available web pages was conducted in May 2005, the result produced a result of 580,000. Using unrestricted web pages the search was again repeated at the same time and the result was 17,400. However, if the term is considered a core concept and restricted to this core concept or term only and also limited to a domain such as .edu, the result was 67 which in turn will make information seeking faster with a gain of more authoritative results. (Redfern 2007).

During the period 2005 - 2007 Google implemented Google Scholar and this action and the upgrading of the Google search syntax has not appeared to help solve the problem of excessive 'hits' that are extremely difficult for information seekers to sort through and a part of this problem is the increase of new websites and information.

2.5.2 Electronic Databases, Subject Headings and Consistency of Search Terms

McDonald (2000) whilst developing a viticulture knowledge based system found some core concepts used in viticulture were either not represented in the literature nor were they represented in the Library of Congress Subject Headings. Various electronic databases such as Web of Science (WOS) for Science subjects, Informit Health for health subjects and, Georef for the geosciences. However in catering for these specific interest groups they hold search terms and core concepts as per those particular areas of interest. As McDonald (2002) says 'A problem arises however, when different information professions address the same knowledge domain and there is no explicit correspondence between the conceptual structures embedded independently in each'.

McDonald continues to display differences in a schematic which portrays the differences between three educational domains of Librarianship, Teaching and, Information Sciences. The Viticulture domain housed 2201 concepts of which the concept ‘acid-soil conditioners is unique to the Library profession, ‘Australia’ occurs in both Librarianship and Teaching and ‘diseases’ is used by Librarianship, Teaching and, Information Sciences (McDonald [2002]).

The Charles Sturt University Applied Science area has Viticulture as a specialization. In order to obtain the concepts and search terms for the database the curriculum specifications, lecture and tutorial notes, text books and two reference books were utilized as well as Viticulture research journals. Following, these were compared with resources such as the Library of Congress Subject Headings (LCSH) 21st ed. (no date), Commonwealth Agriculture Bureau International (CAB) Thesaurus, and Dewey Decimal Classification (DDC21) to determine if an extract from these sources could be used McDonald (2000). McDonald (2000) also found various disciplinary differences in research methodological terms and as Feitzer (2002) states, inconsistencies such as a lack of up-to-date terminology or the increased use of common use of acronyms (e.g. SMS) and search terms have occurred because developers while continually seeking to improve their databases, online catalogues and web sites, are not able to keep pace with the rapid change of new or outmoded terms and these can be labour intensive to keep up-to-date as they are traditionally managed by an individual. Thus, the thesaurus based system management and updating of terms of the core concept database is automatically done by the unique configuration of the software.

The Library of Congress use subject headings, some electronic databases have inbuilt search term/keyword classifications, some also have a thesaurus and there are some electronic databases that do not display a list of terms. Weidman and Strumpfer (2004) say that researchers whilst developing their search term, have to adapt their strategies according to the different electronic medium used. Some databases are searched by keywords such as ‘policy’, search terms such as ‘policy analysis’, or free-text which is how the database searches for documents where terms such as ‘policy‘ or ‘policy analysis‘ occur. Therefore, there is an onus placed on the information seeker to identify

correct search terms or combine them if the terms have not already been placed in the database by the indexer.

Although some databases are similar, some terms may be evident in one database or catalogue but omitted in others. Additionally, search terms are regularly changed, adapted or deleted. Some variations between the Library of Congress Subject Headings and the Academic Search Elite database thesaurus terms is evidenced by the following: the terms ‘flight delay’, ‘day dreaming’, ‘debt management’, ‘fire back-drafts‘, ‘flexible workplace practices’, ‘SARS’ and ‘SMS’, all of which are not listed in the Library of Congress Subject Headings (LCSH). However, in Academic Search Elite the following suggestions are made; ‘flight delay’ - ’see easements’, ’day dreaming’ - ‘use fantasy’, ‘SMS’ - ‘use test messages’. ‘Debt management’ and ‘SARS’ are listed however, but ‘fire back-drafts’ and ‘flexible workplace practices’ are not listed although all these terms are in common use in everyday speech and media. Additionally, because of the different designs of databases, the functionality is not always the same and this can be a handicap to information seekers and here is a similar issue with information seeking when searching the www and using random words or phrases. (Redfern 2007).

Fensel, Hendler, Lieberman and Wahlster (2003) state that information seeking on the www is different to databases because much information can be found by using any random word or phrase however, this is also true of electronic databases but because of the limited size of electronic database thesaurus and materials compared to the www, there is a need to use a variety of random words in the databases. Another issue is that compared to the www electronic databases hold a small amount of material. On the www, it is unfortunate that the results list may be so large that finding information that is academically authoritative and relevant to information seeker needs is difficult. The difficulty is compounded because the large number of commercial and personal ’hobby’ pages on the www make it difficult to locate academically sound and refereed materials as well as produce results that are accurate and valid.

There are two things that are needed, the first is to develop a search engine or program, tool, web crawler etc that will address and overcome the problem of accessing a large number of commercial and hobby pages and the second is to improve information literacy instruction to help information seekers overcome the problem of avoiding unwanted web sites.

The significance of this research and in order to answer the research question; 'To what extent are students' information literacy knowledge and skills improved by the use of a specific online educational tool for finding relevant research information on the world wide web', was by acknowledging other researchers attempts to address student information literacy problems and examining information seeker behaviour.

2.5.3 Information Literacy Instruction

Information literacy instruction has increasingly grown in education over the past thirty years. The growth has been accompanied by theoretical and practical responses in the form of increased development and implementation of initiatives that further the student knowledge and expertise.

Besides the information literacy skills of Webber and Johnston (2000), Doyle (1992), Lenox and Walker (1993) and Goetsch and Kaufman (1998), the Association of College and Research Libraries (ACRL) Information Literacy Competency Standards for Higher Education (2000) in the United States also place emphasis on a person's value system and their understanding of the legal and social issues surrounding the use of information and its ethical use.

Although training and education in information seeking skills and strategies are taught to students and others, it is common for information seekers to still experience difficulty in finding their required information on the internet. Sherman and Price (2001) express the opinion, that the difficulty lies in a combination of information seekers not being able to effectively develop search strategies and also the seemingly uncontrolled nature of the www. In the forgoing literature review it has been shown

that difficulties exist in information seeker skills however, Sherman and Price (2001) further assert that material on the www/internet must be optimized in order to provide more educational opportunities for novice and advanced researchers.

2.5.4 Information Literacy and Tools

The concerns for undergraduate and postgraduate students, as expressed by Lindsay and McLaren (2000), Nachmias and Gilad (2002) and Weidman and Strumpfer (2004), could firstly be addressed by encouraging students to become efficient information seekers and secondly to use efficient www search tools to find, access and evaluate academic information. This, in turn, would assist in the provision of academic and digital literacy in libraries and universities as supported by Moore (2003). The provision of an online search tool that is intuitive would be a positive compromise by library educators and student researchers, as both parties would have their information seeking needs addressed. Library educators are focused on library services and products, but students shop around for their information needs and one of those shops is the www.

On skills based problems and the use of the internet to locate academic materials, Chapman (2002) and other researchers who focus on library studies, believe the path to success lies in providing more training. However, Berners-Lee (1999) who is focused on computer technology, sees the problem being solved not by more training, but rather by the provision of internet search tools that assist researchers and other information seekers. It may be preferable to see the provision of information literacy instruction embedded into academic curricula as a composite of both library studies and information literacy education and computer technology. It is better to provide a holistic solution which fits in with the lifelong learning paradigm in order to not only provide easier searching and a more productive outcome with the generation of authoritative material but also to ensure it is a learning experience for the student and to address both undergraduate and international student concerns. Another concern is that it is important to ensure the development of information literacy instruction tools to assist students with information seeking and it is an advantage if those tools are embedded into the academic curricula.

The difficulties of using electronic databases and the ease of using the www is why Scheyvens, Wild and Overton (2003) and Lacina (2002) advocate development of academic online search tools and products such as; Google which is a generic online search tool, Google Scholar which allows users to access articles, books, theses, abstracts etc by searching by author or title etc. (Holzberg 2006), Wolfrem Alpha (2008) which is an online computational knowledge engine and online scientific database, Excite which is an online search tool, PILOT which is an information literacy tool located at the Queensland University of Technology, RDB Virtual Training Suite which is an online set of tutorials designed to improve information seekers with internet searching skills.

Although tools such and online services such as Excite, PILOT and RDB Virtual Training Suite provide information and skills development activities to assist information seekers, they do not provide an opportunity to teach or inform information literacy while information seekers are searching for information on the internet and www however they are heading in the right direction of online search tools and products that Scheyvens, Wild and Overton (2003), Lacina (2002) and more recently Holzberg (2006) who also support the development of tools such as Google Scholar and Wolfrem Alpha.

To assist students and other information seekers and to allow information seeking to become easier, Buzikashvili's (2005) supports Jansen, Spink, Saracevic and Tefko's (2000) argument of putting an online tool into an academic context and adapting a well used and known technology such as the www to support information literacy. A way of students learning information skills whilst searching online is the development of a tool that provides core concepts and information literacy instruction that is viewable while students are undertaking a search on the www.

Yang (2004) says the www is diverse, unpredictable and information seekers often see the www as a large bookshelf holding the world's collective knowledge. Educational institutions are constantly attempting to support students by providing the most up-to-date equipment and teaching tools but if students experience difficulties using electronic databases those students will resort to using the www.

Drewry (2007) conducted research on Google Scholar and Windows Live Academic Search (WLAS) and sees that both Google Scholar and Windows Live Academic Search are examples of blended databases. He sees blended databases as a new type of tool that provides fast access to academic content as well as citation analysis capabilities. Blended databases are a search tool that houses a search engine such as Google however a blended database also has access to academic content as well as citations and other such services that are exampled in Google Scholar. Drewry (2007) sees these blended databases as a new style of tool that provide free, speedy access to academic content as well as having citation analysis capabilities, linkage to individual library holdings and other services. Though researchers have published dozens of theoretical and empirical studies involving these tools, none have yet described how they were actually being used in a variety of academic settings.

Drewry (2007) sent questionnaires to 540 librarians at 108 ARL libraries to learn how they deployed Google Scholar and WLAS in reference and instruction sessions. Participants were asked to provide information on the ways that non-traditional databases are affecting research in academic libraries. Drewry (2007) found that librarians expressed mixed reactions about Google Scholar's popularity and usefulness and Drewry (2007 felt that this is forcing librarians to acknowledge the '*possible arrival of a new paradigm in academic research'.* There have been a number of information literacy tools that have been developed for different purposes. Some have been developed to teach information literacy skills, to use as assistance in writing assignments, student information literacy knowledge building tool, or to use in the process of information seeking. To provide examples of these tools and to examine provide an overview, the tools covered in this section are Web-Ezy which is a program for library information tutorials, PILOT which is learning tool to assist with the development of knowledge, RDN Virtual Training Suite which is a set of tutorials to improve internet searching skills and is provided by Monash University**.**

Table 3: Online information seeking training and tools

Tool	Purpose	Advantages	Disadvantages
Web-Ezy (Teach Yourself Online	Library Information Based Tutorials	Additional Online Tutorial for: Internet for Images, Internet for Video, Internet for Archives	No Search Facility
PILOT	Tutorials Information Seeking Skills	Quiz Has Subject Core Concepts	No Search Facility
RDN Virtual Training Suite	Tutorials for Learning Internet Skills		No Search Facility No Subject Core Concepts

Table 3 provides conceptual alignment of three IL education tools. The table provides an overview of each tool's purpose, advantages and disadvantages.

PILOT

PILOT is a text based learning program developed at the Queensland University of Technology. It is being used in twelve Australian universities and four overseas. PILOT is a learning tool to assist students to develop and use skills to find and evaluate information. The url is https://pilot.library.qut.edu.au/

The online tutorial consists of six modules which are: Determine your information needs, Identify and obtain information, Evaluate your information, Manage your information, Synthesize and communicate your information and, Use your information appropriately. The modules are supported by a quiz that is used to support the training and when the quiz has been completed the student gains a PILOT License.
PILOT informs on the development of subject concepts as well as building search term vocabulary whilst considering alternative terms that are broad, narrow or related. PILOT also has examples of search strategies as well as a glossary of library terms and links to other resources.

RDN Virtual Training Suite

The RDN Virtual Training Suite is a collection of online tutorials to help improve information seeking skills online. It is self driven and there is a component of quizzes and interactive exercises. The Virtual Training suite provides a program called Internet Detective that teaches the user 'to discern the good, the bad and the ugly for your online research' other online tutorials that are available are: Internet for audio resources, Internet for image searching, Internet for video & moving images and, Internet for Archives ILRT JISC (2008).

Web-Ezy

Web-Ezy is software is a shell that is used to develop a customized, interactive, web-based library and information skills program. (National Library of Australia [2003]). Web-Ezy is a software shell that was used to customize an online tutorial for information skills. It was provided as a new service at the National Library of Australia (NLA) and was renamed *Teach Yourself Online.* At the time of writing this review, the online tutorials are no longer available.

Summation

The thrust of this section was to highlight the deficiencies in information seeking and the need for a variety of search strategies. At the time this research commenced, problems that existed were inconsistencies of search term/keyword thesauri and the varied use and understanding of the English language dialect. The development of the online core concept thesaural database and search tool that was built for this research was attempting to address and solve the problems and evaluate the success of the solution. Although there have been a number of information literacy tools developed for teaching information literacy face to face as well as in text, slideshow, html or other, there is no evidence of tools developed in an online search tool format to teach and/or inform students on information literacy. The IL educational tools studied lack search facilities and the main search tools available are not designed as educational tools.

In the research on information literacy and the provision of alternative methods of teaching information literacy such as online instruction, the provision of an online search tool holding core concepts whilst providing simple information seeking instruction in establishing key words and search terms had not previously been developed. This suggests the value of developing such a tool and measuring the response of students whilst using the online search tool, in an attempt to answer the two research questions; 'How can an online search tool improve students' information seeking knowledge/skills' and, 'How can an online search tool assist students with identification of search terms?'

2.6 Summary and Contribution to the Body of Research

The aim of this literature review was to examine information literacy and frameworks, undergraduate student problems with finding and evaluating information as being authoritative, information seeking behavior and the educational solutions that have been developed.

This literature review has: examined past research and developments in the field of information literacy; established the previous success of research and development related to information seeking, use of search terms and student evaluation of found information; outlined the development of online digital solutions for teaching information literacy; explored whether digital tools can assist students to ascertain the authority of online materials; determine the current status of IL education tools and their value to students.

The main research question is;

> *To what extent are students' information literacy knowledge and skills improved by the use of a specific online educational tool for finding relevant research information on the world wide web.'*

Although the literature review contributed towards answering the main research question, this is not able to be completed until after the experiment and will be included in the conclusion of this thesis.

The three sub-questions: Can *an online tool assist students with identification of search terms? Can an online search tool assist students with evaluation of appropriate research materials? Can an online tool assist students with identification of search terms?* have been addressed in this literature review.

The growth of information literacy research over the past thirty years has seen many theoretical and practical improvements during that period. This has been accompanied by theoretical and practical responses in the form of increased development and implementation of initiatives both in information and digital literacy as well as the development of digital tools to further the knowledge and information seeking skill of students. Webber and Johnston (2000) and Doyle (1992) both state that an information literate person is one who is able to not only to recognize when information is needed, is able to find that information but is also able to use that information effectively. Additionally, it has been established that an information literate person is one who is able to critically reflect upon the information seeking process – something that the educational tool developed and tested in this study seeks to foster.

The literature covers a continuum of user interaction and cognitive processes whilst using the www for information seeking. It has been demonstrated in this research that information seekers follow the path of least resistance whilst thinking about how best to solve their information seeking problems by using tools such as Google and the www in preference to library catalogues and electronic databases. It has also been demonstrated that because information seekers experience difficulties using traditional library resources they feel driven to use the www for their information seeking. One of the drivers is that work and study commitments are encouraging information seekers to access information and address their research needs as quickly as possible.

Scholars such as Khulthau (1995) and Bruce (1997) have developed information literacy models such as Khulthau's (1995) six stage model and Bruce's Seven faces of Information Literacy to assist students in their information gathering, assimilation and evaluation.

In the section Information Literacy Frameworks and Models it has been demonstrated that there has been a substantial growth of information and digital literacy over the last twenty years. This growth has seen the development of many information literacy systems and models and attempts to teach digital literacies, such as Eisenberg and Berkowitz (1988) and their implementation of the Big 6 into an academic curriculum. These systems and models have often been governed by information literacy frameworks such as the Australia and New Zealand Information Literacy (ANZIL 2007) framework.

The design and development of the tool used in this study and the inclusion of the instructional mode in the design are based on the ANZIL (2007) framework, which has informed this and previous research. After considering all the different models and the alignment of Hannafin and Hill (1997) and Eisenberg and Berkowitz's Models (1988) of cognitive process and information literacy and various online information seeking training and tools, it has become evident that the six steps of information seeking in the Eisenberg and Berkowitz's Model closely align with the other well-established models and could form the basis of the instructional aspect of the online core concept tool proposed for this study. The literature review produced several IL frameworks and models that could have been used to inform development of the educational tool developed for the purposes of this study. In the end, Bruce's theoretical model, with its seven faces of information literacy, was seen as aligning most closely with the design and function of the proposed tool (discussed further in Chapter 4).

Information seekers experience difficulty in finding required information on the www. But as Sherman and Price (2001) state, the difficulty is that information seekers are not always able to effectively develop search strategies. The difficulty is added to by the varying content of many websites, some of which have what is considered authoritative material but some of which are lacking both in information and credibility, thus, it is

student information seekers who must learn to recognize what constitutes an authoritative resource. Although there are differences in the quality of websites and the www is relatively uncontrolled, this can be a challenge for the less experienced information seeker especially if they find difficulty with developing keywords and search terms as demonstrated by Chapman (2002) and if most students use single word searching. Although information seekers want to find information as quickly and efficiently as possible and with minimum effort, this means that to help students to conduct a search it is important to also examine their information seeking behavior (Marchionini 1995; Jansen, Spink and Saracevic 2000).

There are many factors in this literature review that provide evidence for and reasons why information seekers experience difficulties in finding appropriate information in readiness for use in assignments and other academic papers.

Some of these other reasons are: lack of knowledge, difficulties and unpopular use of Boolean operators, how to effectively identify and use search terms, identification and recognition of authoritative materials on the www. This empirical research in the literature review covered various topics in order to address the research question for this thesis.

Information seeking behavior and cognitive processes, international students and language and recognition and evaluation of authoritative materials has been reflected upon and has highlighted the importance of all students being able to understand what the information seeking processes are but also being able to use their cognitive powers by thinking, planning and putting into place strategies that will produce a successful information seeking outcome. As Navarro-Prieto, Scaife and Roger's (1999) concluded, information seeker success depended on behavior cognitive processes.

There were a number of deficiencies in information seeking that affected students. It was a challenge for students to realize that thesauri in varying electronic databases were not consistent and that using the same search term in one electronic database would not necessarily lead to a productive outcome in another, and that the Library of Congress uses Subject Headings and very few used subject core concepts. It is the aim of this research to produce and provide a tool that would address these problems and in turn

assist students learn information literacy skills and the rigors of information seeking and inform and teach students how best to conduct an online search. By developing a specialist educational tool that shows students the steps of information seeking will provide a way to improve student information literacy knowledge and skills whilst helping them find relevant information on the world wide web and in turn, also address the main research question of this thesis.

In some ways, this research has a focus on the problem of teaching information literacy to students who have not learnt these skills because of generational or cultural issues and this research has identified various inhibiting factors that impose on information users' ability to easily, effectively find and use information to their best advantage.

Some other information users who experience difficulties are international students and those who experience difficulties when using the various dialects of the English language such as Non-English Speaking Background students (NESB). The difficulties they experience are caused by the varying use of colloqualism and dialect in information seeking tools as well as inconsistiencies in digital tools search term databases. Besides, other English language speaking students, international and NESB students also turn to using a proprietry search engines or tools such as Google for their information seeking needs. However, because of the unregimented and uncontrolled nature of the internet and www, consistency in the use of search terms and the fact that often materials that could be valuable for academic purposes are often not registered with a large number of search tools such as Yahoo, Google etc., those materials are unable to be found on the www and are seemingly a part of the 'invisible web'.

As well, there is the difference in developing search terms in a Library database compared to terms used on the www. Library of Congress Subject Headings are standardized wheras searching on the www can be done using any word, phrase or a combination of a number of words or phrases.

There is also the issue of language that encompasses not only the English language but also vernacular and colloquial expressions of their residential English language dialect while being able to us online tools.

Ramburuth and McCormick (2001), Scheyvens, Wild and Overton (2003), Leder and Forgaz (2004), and especially Badke (2002) assert that not only is writing at an academic level a challenge for international students but so is working independently and conducting research, and these problems must be addressed to overcome student academic demands to ensure success.

This review has addressed the shortcoming demonstrated that until this research an online information literacy tool with full search functionality has never existed. Thus, there has been no previous research conducted on such a tool. There are online information literacy search tools to help students learn and practice their information literacy skills such as the steps of information seeking as well as how to evaluate online research materials for authoritativeness and they have been examined in this research. If such tutorials are not embedded in the curriculum, their educational value is limited.

There are no educational information literacy tools online that are purposefully built with www search functionality. Additionally, an educational online search tool which is subject based and houses subject specific search terms and concepts in its database has also never previously been built. There are online information literacy resources to help students with information literacy information seeking steps and the criteria used to evaluate online research materials for authoritativeness but there are no online search tools whereby an information seeker may view instruction on information literacy whilst conducting an online search. Therefore, the building of the database and online search tool and experiment conducted for this research project is expected to inform education in the area of information literacy and promote good practice. Although there are existing web solutions to assist students with particular information seeking tasks, there is a lack of research and development of online search tools to assist students with learning to develop subject based search terms and also to evaluate online materials appropriate for academic use and this is the gap that this research is attempting to bridge.

3 The Research Design

3.1 A Two-Phase Study

3.1.1 An Overview

This research and study was prompted by the recognition that undergraduate students were experiencing information seeking difficulties. Those difficulties were related to the development of search terms and using them to find information in subscription databases and on the www. Even once materials were found the issue of identifying those materials that are authoritative and appropriate for use in an assignment was also a problem.

As shown in the literature review there have been many models of information literacy developed and there have also been information literacy instruction packages provided in the form of web tools that provide either textual based instruction and/or web pages that have the instruction as a game or quiz.

There has never been an online tool such as the one developed for this study, which holds subject core concept terms, provides access to the www to conduct a search for authoritative materials, using those core concepts, and contains an element of information literacy instruction. Additionally, such a concept and tool has never been evaluated for its effectiveness. The aim of the study was therefore to develop a search tool, based on a constructivist approach to education and learning, that embeds both IL instruction and subject core concepts, and to test it out on University of Canberra undergraduate students.

The experimental approach to this research was designed to evaluate whether such a tool would be beneficial for information seekers and therefore answer the main research question: 'To what extent are students' information literacy knowledge and skills improved by the use of a specific online educational tool for finding relevant research information on the world wide web.' This main research question was designed to evaluate and address student current knowledge of the steps of information seeking and

whether an online search tool that displays the six steps of information to students while conducting a search on the www would be of value.

The experimental research is built on the current knowledge of student information seeking skills and levels of information literacy and seeks to establish whether the IL skills and understandings can be fostered by such a tool.

The first step involved to organize the conducting of the experiment was to arrange permission from the University Computing Centre to book a number of computer rooms to hold the experiment and have access to the tool provided. The second step was to consult with the Subject Convener of International Foundation Studies (which was seen as especially relevant to the study; see below) to gain permission and assistance to enlist students enrolled in the subject to participate in the experiment. The third step was to conduct a pilot test to ensure the online software was compatible with the University computers, the design of the questionnaire was appropriate and, the process worked. The fourth step was to enlist participants and the fifth step was to conduct the experiment.

It is clearly acknowledged as documented below that the number of participants was disappointingly low. This placed limitations on any conclusions that could be drawn from the findings.

In order to overcome the problem, a different research design could be implemented in the form of an academic assignment as a component of the subject area and student assessment. This therefore means that all students in the subject International Studies Foundation would be participating in the experiment however it would be a component of their normal assessment work. Additionally, as well as embedding academic assignments in the research design, increasing the number of subjects available in the tool's database and including students from other academic courses and universities and colleges, this would provide a greater number of participants across a wider scope of education and help obviate the need for Phase 2. Following, this also would provide an opportunity for a statistical significant outcome.

In hindsight, it would have been beneficial to delay the results of the experiment for a year during which time the research design could have been revised and a greater cohort of participants enlisted from other educational institutions for the experiment. In turn this may have produced results that would provide more validity than those previously produced.

Following the lack of participants for this current research, an extra phase of data gathering was designed in the form of Phase 2 and this was aimed at establishing what participants thought of the core concept thesaural database and search tool (see section 3.2).

3.1.2 Experimental Methodology

An investigation of research methodologies in Gay and Airasian (c2003), Charles and Mertler (2002) and Fitz-Gibbon and Morris (1987) revealed that the most appropriate research design for the testing of the core concept search tool was experimental.

This is experimental because in experimental designs, participants are randomly assigned to experimental and control groups. This research and experiment drew a low number of participants because the researcher had to fit in with student needs and availability for the experiment, however, the experimental design was still considered appropriate for the research. Experimental designs dictate that after an experiment has been completed all participant results are measured to determine the effects, if any, have occurred as a result of the experiment. Data are usually obtained in the form of scoring on a post-test and includes testing for significance of difference and this was done by using the data from the experiment.

Participants were students enrolled in the subject *International Studies Foundations* in the School of Languages, International Studies and Tourism at the University of Canberra. There was a control and an experimental group and the experiment consisted of pre-testing and post-testing via questionnaires.

The research methodology is known as approximate equivalent control group, pretest-post-test design (Fitz-Gibbon and Morris 1987).

3.1.3 Demographics

Because this research was intended to help undergraduate and to a lesser degree, international students, it was necessary to select a subject in which the student consort were from these demographics.

Early estimates of the number of students enrolling in *International Studies Foundations* were 300 but the researcher felt an expected enrolment of about 200 was a more realistic number from which to source possible participants for the experiment. As it turned out, the number of enrolled students for the subject in 2006 was approximately 140. The experiment was planned to be conducted only during Semester 2. The experiment was conducted using a control and an experimental group. The total number of participants was 37 of which 24 were in the experimental group and 13 in the control group. The reason for the low number of participants was simply because the invitation to participate in the experiment was declined. Although it was hoped that there would be more participants, those participants were expected to be a representative sample of students (primarily mature aged students) enrolled in the subject *International Studies Foundations* at the University.

3.1.4 Population and Sample

The sampling was a convenience sample within the University of Canberra and participants were international or Australian students enrolled in *International Studies Foundations* during Semester 2, 2006 in the Division of Communication and Education. *International Studies Foundations* is a year-long two-semester subject that is broken into two halves. Semester one provides an overview of the subject area and the majority of topics have an Australian focus and Semester two is focused on international issues.

The rationale for undertaking the research at the University of Canberra included the fact that the researcher worked and studied at the University, as did her primary and secondary supervisors. The researcher also had formed relationships with staff at all levels and was familiar with the University's computer laboratories. This meant the researcher was conversant with the environment, constructs and culture of the University of Canberra and this made it easier to conduct the experiment at the UC campus rather than using students enrolled in another subject at another university.

The rationale for selecting *International Studies Foundations* was based on a combination of reasons including the researcher's personal interest and the international nature of the subject. Also, the subject contained a wide base of concepts available on the internet, it was a compulsory subject and it potentially held a large number of students. It also provided an opportunity to conduct the experiment as both an investigation and as a learning experience for those students fitting the lifelong learning paradigm. The subject comprised a mixture of topics such as culture and communication, international politics, globalization, intercultural communication, cultural literacy, global systems of government and sustainable development. There also was a strong representation of international and mature aged students – both regarded as 'at risk' groups in terms of IL understanding and skills – and this was expected to provide evidence that the core concept online search tool would particularly assist these groups whilst also teaching/informing information seeking skills.

Participants were sought in order to evaluate their interest in the research and to encourage their involvement in the experiment. Because the *International Studies Foundations* convener was a subject specialist in the field, she was asked to assist in the development of the proposed three research questions that were to be put to the experimental group participants. Because the experiment took place near the beginning of semester two and students were not yet familiar with the international topics of the subject, the convener advised that it would be more prudent to develop the research questions based on the first semester's work. Therefore, the subject convener was the principal agent who assisted with the development of the Australian-based research questions and the possible search terms related to the

questions that were available in the online core concept thesaural database.

The experiment could have shown that the core concept thesaurus was helpful to mature aged students, however because the majority of the sample were aged under 24, this only provided evidence for the younger rather than older students. The researcher would have preferred the sample to closely match the percentage of mature aged students enrolled in the subject. The experiment was devised to see if the core concept thesaurus would assist students in their information seeking and more specifically, to find whether a specific demographic group in the sample were assisted rather than the whole sample itself. If a specific demographic group within the sample was assisted rather than the sample as a whole, this would have added to the value of the research. However, if evidence showed that any participants benefited from using the online core concept tool, this was still considered enough to provide sufficient data to inform the research question.

As encouragement to participate in the experiment, all participants were able to print out information sourced on the www to be used in their academic studies and were also provided free and unlimited access to Rootza until the 31st January 2007. This access was extended and there was not a scheduled date when it would be discontinued.

All research was conducted under the guidelines of the University of Canberra's Committee for Ethics in Human Research Human Ethics Manual (2005) as well as adhering to the Australian Privacy Act of 1988.

3.2 Phase 2 of the Study

Initially, the experiment was expected to be conducted with a large number of participants because in previous years there were a large number of undergraduate and international students enrolled in the subject International Studies Foundations. However, in the year of the experiment, the number of international students was surprisingly small. Consequently this meant that it was necessary to conduct the experiment again in a second phase.

There were various ways that the Phase 2 participant experience could have been evaluated but the method of using the think-aloud protocols as advanced by Lewis and Rieman (1994) was used. Because the measurement of knowledge and learning of the steps of information seeking or the criteria for the authority of online materials were not being measured, as it had been in Phase 1, it was not appropriate for participants to undertake the same quantitative testing. The process of a full qualitative questionnaire as per Phase 1 was considered for the evaluation however, it was felt desirable to keep the process as simple and effective as possible as the information to be elicited from participants was related to their thoughts and feelings while they were using the tool. Hix and Hartson (1993) also advocate the use of the think-aloud protocol for this type of evaluative research, saying there can be disadvantages such as the slowing down of participant thought processes during an experiment which can lead to slower working, but more care would be taken with less errors occurring. Consequently, it was decided to use the think-aloud method as advocated by Newell and Simon (1972), Lewis and Rieman (1994) and Hix and Hartson (1993).

The think-aloud method involves participants saying what they are thinking as they perform a task or series of tasks. They are asked to say what they are looking at, why they are looking at it, what they see, what they are doing or thinking of doing and what they are feeling while they perform the task/s. This allows the observer (researcher) to take notes not only on what the participant says and does but also to take notes on participant behavior and how they are reacting to the task they are

performing with the object they are using, in this case, the online core concept thesaural database.

The think-aloud method had a number of advantages over other research methods. By using the think-aloud protocol it was possible to ascertain participants' feelings and thoughts immediately which was advantageous as it is a method that provides information from participants whilst lessening corruption of data because of its immediacy. Participants' thoughts and feelings were expressed verbally and recorded on a hand held tape recorder. By using this research method it was specifically hoped to capture on the recording student verbal expressions and information that was related to the research questions.

Phase 2 was principally designed to ascertain a deeper understanding of how participants would use the tool, the steps they would take whilst using the tool and also to determine if using the tool would assist ease of use for participants. Therefore, Phase 1 was conducted as an experiment and Phase 2 was conducted as an evaluation. Phase 1 quantified participants' use and results of using the online tool, whereas Phase 2 qualified participants' opinions of the tool and assessed the changes made to the database and web page design.

The relevance of Phase 2 was couched in providing additional information on the value of the tool. Phase 2 was added to the study not only to gain extra participants but also to help provide relevance to the initial research question which was asking whether student information literacy skills could be improved by a purpose built educational search tool. It was hoped that the three sub-questions 'Can an online search tool improve student information seeking knowledge/skills', 'Can an online search tool assist students with identification of search terms' and 'Can an online search tool assist students with evaluation of appropriate research materials' was going to provide some form of answer in Phase 2. This is because the participants in Phase 2 were students studying at both CIT and university and they may see the tool as something they could use to assist them in information seeking for their assignments. However, because of talk aloud protocols and accepted practice of only asking the scheduled questions and adding encouraging remarks, forecasting the student responses when using the tool was an unknown. Therefore, the responses generated in Phase 2 did not particularly relate

to the research sub-questions. Because the participants provided statements that indicated a lack of interest in learning about the six steps of information seeking, this does provide an answer to the main research question which was 'Can student information literacy knowledge and skills be improved by the use of a specific online educational tool for finding relevant research information on the world wide web'. For Phase 2 the answer is no because the students indicated a lack of interest because if they were interested, the answer would have been yes. Therefore, although the answer is in the negative, the research question is answered. The relevance of Phase 2 to the main research question is not strong because there was no indication from the participants that the tool would be helpful. This is evident because there was only a mention from one participant who said that the tool would help them find information that was not accessible using Google. Another said they were not interested in using the information on the six steps and the six criteria for recognition of online citation.

The design of Phase 2 could have benefited by the provision of an additional sub-question in the research design and a change of focus. Instead of focusing on student opinion of the tool it would have been more useful to determine how undergraduate students evaluate search results. Indeed, an additional sub-question and change in focus would provide more relevance to the research questions.

There could have been extra research questions added into the research and these could have been along the lines of 'Are students interested in learning the steps of information seeking?' or, 'Are students successful and adept at easily finding information appropriate for use in academic assignments?' By adding these questions to the research it would in the first instance verify student interest in learning the steps of information seeking and therefore determine whether or not the research is worthwhile conducting again. The rationale behind this is that if students are not interested a positive outcome may not be possible because an uninterested student gains less than one who is interested. Regarding the question on students being adept at finding authoritative information, this question could have added to the value of the research by examining the different ways that students view the factors needed to verify the authority of found information.

The data collected from student found documents for the experiment did detail the authoritativeness of found information. The examination of documents revealed how many held the date of authorship and/or date updated, name of author, name of organization and whether contact details of the author were provided etc. but because of the small number it was decided to not mention it in the thesis. However, if there was a greater number of participants and more data produced then the data would have better informed the research question. With the additional questions and additional data, this might have addressed or partially addressed not only the research questions but also to add value to the research.

Following the completion of the Phase 1 experiment, the online core concept thesaural database and web page underwent some changes. The changes were in the page design, the data and the program coding and database structure. The changes were intended to make the web page more appealing, user friendly and useful. More subjects were added along with additional speed to the programs' search capacity.

Phase 2 was implemented to evaluate updated design changes made to the tool since the initial program and experiment was conducted in the preceding twelve months. The changes to the web page and database were new fonts, web page design and inclusion of additional subjects.

The subjects used for Phase 2 were:

- *Education Foundations*
- *Information Systems in Organizations*
- *Information Technology in Education*
- *International Studies Foundations A*
- *International Studies Foundations B*
- *Organizational Leadership*
- *Organizational Management*
- *Society and World Politics*
- *Sociology In Education*
- *Teaching in Education*

Because participants came from a variety of backgrounds and education, the inclusion of the above subjects provided the Phase 2 participants with a much wider choice of subjects which in turn, was expected to increase the level of interest for participants whilst they used the tool.

The researcher's office was used for Phase 2. The Phase 2 experiments took place over a three week period according to the availability of the participants.

3.2.1 Variables

The Phase 1 and Phase 2 variables are notably different in the testing environments. Phase 1 was in a computer laboratory at the University of Canberra. Phase 2 was in this researcher's office at the University of Canberra. Independent variables such as age and language skill were similar in both groups, however the gender variables were opposite. Because Phase 1 was initially intended as the only experiment for this research, with Phase 2 added later with additional participants as an evaluation of the tool and its upgrades, it was decided to exclude extensive demographic data such as geographic background, language, knowledge of the internet and computer literacy levels of the second set of participants.

The dependent variables in Phase 1 of student recognition of core concepts for the subject and ability to find information related to those core concepts, was not a factor in the Phase 2 evaluation. Also not a factor was participants' ability to measure the suitability of online documents for academic citation. Phase 1 was focused on evidence of students learning the steps of information seeking and the criteria for the academic suitability of online materials. Phase 2 held no component of recognition of research terms, core concept questions or recognition of citation evaluation and its relationship to the research question. The relationship between the Phase 1 dependent variables and the independent variables was important because they were a factor in measuring participant outcomes whereas the dependent and independent variables were less important in Phase 2 because Phase 2 was designed to gain participant opinion of the search tool upgrade.

The measurement of dependent variables was undertaken by using a combination of questions asked in the pre-test questionnaire and this was later compared to the same questions in the post-test questionnaire. The pre-test questionnaire had provided research questions in which participants were asked to identify search terms. The post-test questionnaire asked participants to write down search terms they remembered using during the experiment. The evaluation between the pre-test and post-test questionnaires also allowed for examination of participant ability to recognize and evaluate online documents for academic suitability. As detailed below, the questionnaires used may be seen in the Appendixes.

The dependent variables were student recognition of core concepts of the subject, ability to find relevant articles, evaluation of their suitability for academic citation and the value of the article in the context of the research question. The link between dependent variables may reveal successful results shown by the quality and the number of academic or authoritative materials sourced on the www. The quality of the materials found on the www was gauged by the six criteria for citation of online materials.

The measurement of the independent variables was undertaken by obtaining and using demographic data provided by the participants in the questionnaire instruments. The independent variables were age, gender, self confidence, language skill, computer skills, previous knowledge of the subject core concepts, existing knowledge of the subject, educational background, knowledge of the internet, www and search engines such as Google and Excite as well as internet interfaces such as Netscape, Microsoft Explorer and Mozilla.

The impact of confounding variables for the experiment was negligible. Because the experiment took place mid semester when there were no pressures of exams, no large assignments due or pending, confounding variables were not a factor that should have an impact on the research. Therefore, measurement of confounding variables was not undertaken.

By containing internal variables such as the experimental environment of a computer laboratory and computer equipment that was familiar to the participants, and limiting the experiment to students enrolled in *International Studies Foundations,* it was expected that the research would provide internal validity in testing that the concept thesaural database tool would assist students.

The limitations of the experiment were the number of students enrolled in the subject *International Studies Foundations,* the amount of time to conduct the experiment due to the restricted amount of time extracted from the subject tutorials during semester and the availability of the computer laboratories for the experiment. The results could have indicated a level of superficiality as the true test would be to measure the remembered search terms at a later date rather than at the end of the experiment. The experiment was also restricted to the University of Canberra because the core concept thesaural database was designed for *International Studies Foundations* which is not available at any other university in the ACT. Therefore, the number of possible participants was also limited to the number of students enrolled in the subject.

When participants were being enlisted for the experiment, it was known that in previous years the subject had a large number of mature aged students. However, during the year of the experiment the subject was predominately enrolled with students under twenty-four years of age and therefore, the experiment was not expected to enlist a dominant number of mature aged students.

The manner of information seeking of participants and the way they interacted with the design of the online core concept thesaural database and amount of information available on the www was also expected to reveal whether there was an indication of difficulty in using the thesaural database. When the experiment research was concluded, the results were expected to enhance the lifelong paradigm of the research.

The next chapter will report findings from Phase 1 of the research.
The findings report on participant demographics, statistical data from the pre and post-test questionnaires as well as participant opinions of the online research tool.

3.2.2 Assumptions

There were four methodological assumptions in this research. Of these four assumptions, three related to students and one to computer technology.

The four assumptions were:

1. students have basic computer literacy;
2. students prefer to use computers and the www/internet for research purposes rather than paper artifacts;
3. students already have a basic knowledge of their subject area;
4. students are interested in finding easier and quicker ways of conducting research.

3.3 The Experiment Process

Initially this research project was to be conducted as a single phase study with a large number of participants. However, because a lower number of participants than expected was obtained, it was decided to add a second phase of the study to augment the data.

The core concept online search tool research utilized both quantitative and qualitative measurements to evaluate the effectiveness of the tool for information seekers. There were two phases in the measurement process. Phase 1 was both quantitative and qualitative and Phase 2 was only qualitative. The Phase 1 quantitative data was used to measure participant knowledge of information seeking skills and the Phase 2 qualitative data was used to examine participant opinion of the tool after it was upgraded.

Under Phase 1, two pilot tests were conducted prior to the experiment. The first pilot test was to verify the experiment instruments (pre-test and post-test questionnaires) and the second pilot test to verify the experiment instruments in conjunction with the experiment environment. Besides being an attempt to gain further participants, Phase 2 was also to evaluate the web and software upgrades that had been completed on the core concept online search tool.

3.4 Phase 1 of the Study

3.4.1 Conduct of the Experiment

The accepted symbolic design for experimental, time series design non-equivalent group is being used for this research and is displayed below.

The experiment design in symbolic form is:

R = Random allocation of participants
O = Pre-test and Post-test observations (Questionnaires)
X = the intervention
n = 37

Summarized symbolic representation of the process:

Control Group	R O O
Experimental Group	R O X O

At the commencement of the experiment, participants were divided between two groups of students. The first was the control group and the second was the experimental group. Both control and experimental group participants were randomly selected according to the order they walked into the computer laboratory. That is, each participant was automatically a member of the control or experimental group depending on where and what computer they chose to be seated.

The experiment commenced with the pre-test questionnaire which sought information on the experiment population, sample and demographics. When the experiment was being conducted, all participants were told that they only had to answer one of three research questions on the questionnaire but could answer more if they preferred and time allowed.

3.4.2 Procedures

The experiment procedure was: to enlist student participants from the subject *International Studies Foundations;* conduct the pre-test questionnaire; conduct the experiment; conduct the post-test questionnaire; and collect and analyze the data. The students enlisted for the two pilot tests were different from those who participated in the experiment.

The aim of the pre-test questionnaire was to verify the experience of the participants and participant current knowledge of information seeking.

The experiment aim was to verify whether the thesaural database would: aid teaching student information seeking skills; enhance student subject concept knowledge (post-test); provide easier internet searching (not browsing); enable the student to be more productive; act as a learning experience for the student; and additionally, test the effectiveness of the evaluation tools, i.e. the questionnaires and computer program for future research.

The data in the experiment were mainly quantitative and were obtained from the questionnaires. This was then analyzed using SPSS. Because the number of participants was not large, the researcher decided to use Microsoft Excel to assist with the processing of data following results produced by SPSS queries. The qualitative data from the pre-test and post-test questionnaires consisted of open-ended expressions of participant views and opinions of the core concept online thesaural (Rootza) program and participant opinion of the www and information seeking.

3.4.3 Phase 1 First Pilot Test

The Phase 1 first pilot test took place during Semester 1, 2006 and involved a postgraduate international student, a postgraduate domestic student and a CIT student. None of these students had ever been involved in the subject *International Studies Foundations*.

This was to allow for complete impartiality and lack of familiarity with the subject and therefore provide an 'uninformed user' to ensure that the testing instruments remained outside the domain of the proposed participants. The test also gathered statistics to verify obvious errors in the database, flaws in the statistical design of the methodology and technical problems in the thesaural database and operating system.

3.4.4 Phase 1 Second Pilot Test

The Phase 1 second pilot test was devised to pre-test the research questionnaires in conjunction with the experiment environment. The second pilot test was run one week preceding the experiment. The aim was to verify that the pre-test and post-test questionnaires were able to be understood by participants and to ensure the experiment was able to be conducted in the allotted time frame. This also provided the opportunity to make any corrections or adjustments to the database and website if necessary. Because the full experiment was conducted using newly conceptualized and developed software that was housed on a server external to the University, and the university computer laboratories were used for a number of days for the experiment, it was necessary to conduct the second pilot study as soon as possible preceding the experiment.

Participants for the 2nd pilot study were sought from the course International Studies at the University and the subject chosen was *Sociology*. Following permission from the subject lecturer, a leaflet outlining this research was distributed to all students enrolled in *Sociology* and the lecturer gave an overview talk to the students inviting them to participate in the second pilot test. There was only one student who wished

to take part in the pilot test.

The second pilot test was conducted in the scheduled computer laboratory a few days before and was designed to duplicate the upcoming experiment. The research tools consisted of the questionnaires, the research questions and the online software program. These were used in the computer laboratory scheduled for the experiment. The second pilot test was successful with no anomalies in the software, questionnaires or the environment. Accordingly, all was ready for the Phase 1 experiment.

3.4.5 Experiment Procedure Overview

The experiment was conducted during Semester 2, 2006.
The computer laboratories for Phase 1 held twenty-four personal computers. Twenty four computers were to be used for the experiment. Of the twenty-four computers, twelve were set up with Rootza and twelve were set up with Google. Because the computer laboratory was continually available on a 'walk in' basis for all students enrolled in the University, to ensure the laboratory's availability for the experiment it was booked for thirty minutes prior and thirty minutes after each experiment session. The extra time was to allow for the setting up and shutting down of the computer laboratory. If technological problems such as university server problems, failure of laboratory equipment or the Rootza web page and/or server were to occur, then the strategy was to attempt to conduct the experiment either the following day or a week later when the problems had been rectified.

Additionally, if there were students who would have liked to become participants and the scheduled experiment dates and times were not suitable, another time was to be negotiated.

3.4.6 Phase 1 Experiment

Recruitment of participants for the experiment was by an announcement by the tutor and researcher in the tutorials for the subject *International Studies Foundations*. As encouragement to participate in the experiment, all participants were advised they would be provided with six months free access to Rootza and also be provided with free access to print materials accessed on the www during the experiment.

Participants were advised that the experiment would take approximately thirty minutes. (Given that at this stage participants would have no idea what Rootza was, let alone potential benefits, it is noted retrospectively that students were not given enough incentive to take part, hence the low participation rate.)

Preceding the experiment, all participants were given a Participant Information Sheet (Appendix 1) outlining the research and participant involvement. The Participant Information Sheet advised participants that at the conclusion of the research project, they would be invited to attend the researcher's final seminar and the results would be available in a thesis in the University of Canberra Library. (After the experiment was completed, all participants were invited to experiment online with Rootza's database and web page.)

Participants were asked to complete an Informed Consent Form (Appendix 2). Once consent was granted participants were asked to fold and place the form in an envelope that was supplied by the researcher. The researcher ensured she was not able to view the completed forms. No participant declined to complete an Informed Consent Form. Participants were permitted to participate in the experiment only once.

No participants were asked for their name, address or any details that could reveal their identity. Each participant was provided with a unique number that was used on the questionnaires in order that anonymity could be ensured.

All records are held on a password protected computer at the University of Canberra and documentation is held in a locked filing cabinet in a locked office in the Division of Communication and Education and will be held there for a period of five years, in accordance with University policy.

Because the research was experimental and there was a control and an experimental group, the control group did not have access to Rootza. In order to provide equity between the two groups, all participants in the control and experimental groups were provided with access to Rootza once the experiment was over.

There were four questionnaires (Appendices 3, 4, 5 and 6). They were the Control Pre-test, Experimental Pre-test, Control Post-test and the Experimental Post-test.

The control and experimental post-test questionnaires contained three research questions and two adjectival lists for the participant evaluation of the thesaurus and the web page. The adjectival lists were designed to elicit participant opinion and were scaled on a Likert scale of one to seven of the adjectival pairs, for example, ranging from 'irrelevant' to 'relevant'. This particular design was adapted from Kappelman's (1995) user involvement scales for 'the measurement of user involvement or interest in a new computer system'.

Participants were allocated a sequential number which was on the front of all questionnaires and this enabled matching of pre and post-test questionnaires.

The control group questionnaires commenced with 'C' and the consecutive numbering commenced with '1'. The experimental group commenced with 'E' and were also numbered consecutively commencing with '1'. The questionnaire and computer logging is represented by C1XX, where 'C'=Control, '1' = the first semester the experiment was to be run, number, XX or XXX = identification number. The experimental group questionnaires followed the same pattern (E1XX) and 'E'= Experimental. The pre-test questionnaire was identical for both groups however, the post-test questionnaire for the control group did not ask questions related to the Rootza program or website.

Participants were asked to complete pre-test and post-test questionnaires. The pre-test questionnaire was used to gauge participant's current internet usage for research, how often participants normally used computers, their level of computer experience and expertise, their understanding of the steps of information seeking and their knowledge of search terms. There were preliminary demographic questions such as age, education and current course being studied and this was followed by questions related to participant's first language, level of English language fluency and country of origin.

The post-test questionnaire consisted of questions relating to the steps of information seeking and search terms participants remembered using during the experiment.

This was followed by elicitation of their opinion whilst using the online core concept thesaurus and website. Participants were asked to write down their thoughts and opinions on the online search tool on the post-test questionnaire. This resulted in all of the experimental participants responding with their thoughts and opinions on the web page and twenty-two responding with their thoughts and opinions on the thesaural tool. The post-test questionnaire was expected to provide balance with the pre-test questionnaire as the questions were designed on a 'before and after' comparative study, similar to the Kappelman (1995) process.

The research was hoping to provide information on the benefits of the informative/teaching components in the tool, the extent to which the core concept data would enhance the knowledge of subject core concepts and whether participants were helped to distinguish an 'academically authoritative' source. Thus, the 'before and after' comparative method was expected to add to the knowledge of information seeking within an information literacy framework. The research was also designed to gauge if participants found the core concept thesaural database a beneficial tool for information seeking. It was also hoped the method would provide a forum for the expression of any additional viewpoints or thoughts of participants on the core concept online tool.

During the experiment, participants had to research and source academic materials on the www using the core concept thesaurus software (Rootza) or, in the case of the control group, Google. All information found was to be acceptable for citation in an academic paper and be sourced from an educational institution, organization or government website. There was no time limit for each question, not all questions had to be answered but a minimum of one did have to be attempted. The core concepts were not highlighted on the thesaurus testing instrument.

Experimental group participants were advised that criteria for the steps of information seeking and criteria for the evaluation of online documents were to be shown to them as an instructional component of Rootza and that they were to use these criteria in their selection of the suitability of material for citation in an academic paper.

Participants' found articles were reproduced on a printer in the computer laboratory for later evaluation by the researcher.

Towards the end of the experiment, the questionnaires provided an opportunity for participants to contribute their opinions and thoughts on the Rootza thesaurus and the website. Therefore, all questionnaires were both quantitatively and qualitatively based.

The experimental group was given an individual login and password to access Rootza. This was automatically generated by Rootza security protocols.

3.5 Phase 2 Population, Sample and Demographics

Participating students in the Phase 1 experiment were predominately aged between fifteen and nineteen (forty-five percent of the sample). The sample in the Phase 1 experiment was not statistically representative of the demographic age of students at the University of Canberra. When conducting Phase 2 as an evaluation rather than an experiment, it was decided to use students in the same age demographic as Phase 1 in an attempt to maintain some consistency for both Phase 1 and Phase 2 of the research. The evaluation was conducted using the revised version of Rootza and also a similar age group of students, that is, sixteen to nineteen.

It was hoped that the Phase 1 experiment would enlist a number of mature aged and non-English speaking background students from the university but this did not eventuate, which was clearly a limitation.

Because the Phase 1 experiment was dominated by younger students from an English speaking background, having Phase 2 participants coming from the same background was welcomed as it provided a degree of similarity that enabled Phase 1 and Phase 2 to be compared.

There were eleven participants in Phase 2. Three were female and eight were male. All of their backgrounds were either first year undergraduate university students or students at the Canberra Institute of Technology (CIT). Their studies were Automotive Mechanics, Automotive Spray Painting, BA Arts/Law, BA Law, Engineering, Library Studies, Media Production, Organizational Management and Public Relations. The rationale of selecting students of the same age as Phase 1 was to maintain a similarity of social and age demographics.

The researcher wanted to expand the research to include students who were studying and practicing a trade and were apprentices. This was done to obtain their opinion of the tool as they could find it of benefit in their studies.

4 Design of the core concept thesaural database and search tool (Rootza)

This chapter details the theoretical design, system development, functionality and purposeful design of the core concept thesaural database and online search tool which, since the study, has been patented under the name Rootza. It outlines the theory that precedes the building of the tool as well as the web page development. The tool itself is not the focus of this research, which is basically a piece of educational research designed to establish whether IL education could be embedded in a www search tool. The chapter is not concerned primarily with system analysis and design, therefore, but rather with what the tool does and how and why it works – in other words, how it is hoped such a tool might benefit undergraduate students and others who need to develop information literacy understandings and skills.

It is also worth stressing that the study and the tool developed for the study are not designed to provide empirical verification for any particular IL framework or theoretical IL model drawn from the huge literature on information literacy. Nonetheless, decisions have had to be made about the IL instruction to be embedded in the software. One of the aims of the project has been to outline the steps of information seeking for undergraduate students and the model that was used is the Big 6 (Eisenberg and Berkowitz 1988), which has wide currency in the US educational system and largely aligns with many of the other models and frameworks reviewed for the study. The thinking behind Rootza is also influenced significantly by Bruce's Seven Faces of Information Literacy (1997), which has informed much of our current thinking on information literacy. Bruce's model, however, is a theoretical one and this study is not the place to test it empirically.

4.1 What is Rootza?

Rootza's core functionality is to be a dual purpose web based tool to help information seekers finding authoritative information quickly, easily and accurately without wasting time and effort. One purpose of Rootza is to provide academic subject core and alternative search terms to help information seekers think differently and conceptually about developing and using different search terms. Another purpose of Rootza is to provide instruction and information on the steps of information seeking and also the criteria that need to be addressed when looking for academic authority materials on the www.

How does Rootza help students and information seekers?

Because Rootza was specifically designed to help students and information seekers in the education sector, it was purposely designed and built within these confines. In this, Rootza is designed to eliminate non-educational websites as much as possible. Thus by default, Rootza searches on .edu, .ac, .org, .gov, .net, however users may select .com if they wish. Thus, because Rootza also provides subject core concepts and search terms, this limits the number of hits and web noise which in turn means that students and information seekers have far less web page results to wade through.

Because Rootza also is embedded with and displays the steps of information seeking and criteria for recognizing authoritative information on the Web on various pages, the student and information seeker as a matter of osmosis, whether consciously or subconsciously absorb the information on the screen and this in turn is a learning experience of which the student and information seeker has no alternative but to view. This is seen as a positive step to help those students who fail to attend information literacy classes and/or activities. Therefore, by using Rootza, students and information seekers are not only provided with faster, accurate and more concise search results, but they are also participating in an information literacy instruction exercise and in effect as they perform a search on the www, they are learning or, learning by doing – part of the constructivist design that informs the whole study.

Thus, the provision of core concept searching focused on a particular domain and the inclusion of the embedded information literacy elements, students will see how Rootza will benefit them and assist their learning and research needs.

4.2 Theoretical Design of Rootza

Rootza's contribution to the study and understanding of information literacy is an intervention that was heavily influenced by Bruce's (1997) model of Seven Faces of Information Literacy. In particular, it adopts five of Bruce's seven faces or categories of information literacy and places them into a practical working model and tool.

Bruce's seven categories are:

1. Information technology for information retrieval and communication;
2. Information sources for finding information;
3. Information process results that address an information problem;
4. Information control that is controlling information;
5. Knowledge construction is building new knowledge in individuals;
6. Knowledge extension is reflective transformation of knowledge and the individual; and
7. Wisdom is using information wisely to benefit others.

The linking five of Bruce's faces to five of Rootza's elements creates a united theoretical and practical tool that takes information seekers on an upward path to information literacy. This process and model seeks to convert theoretical constructs into a functioning tool that enhances Bruce's faces whilst providing not only a theoretical model but a practical computer based tool to be used to further the path of information literacy.

Table 4: Five Bruce faces and five elements of Rootza alignment

Bruce	Rootza
Information technology	Online search tool
Information sources	No specific knowledge needed design
Information process	Information seeking instruction
Information control	Search term thesaurus
Knowledge construction	Critical reflection and analysis

Table 4 shows the five Bruce faces and the conceptual alignment of Rootza, which seeks to address five of the faces in the Bruce model.

Bruce's category one (Information Technology) is based on information literacy and the provision of 'information access and personal networking' and awareness in order to 'make information accessible'. It therefore fits the Rootza model which is an online research tool for accessing information on the internet and www. Bruce sees this category as having two subcategories that provide a situation whereby users may use information technology either as an achievable or unachievable goal. Rootza was specifically designed with human computer interaction (HCI) components in order to make the tool accessible and easy to use. This enhances the opportunity of success for the user and thus reflects the first face or category of Bruce's seven faces.

The second category (Information Sources) places sources such as Rootza in the digital environment. The three subcategories of knowing the information sources and their structure, being able to use them independently and using the sources flexibly are possibly three inherent problems users have to overcome. However, with the theoretical and practical nature of Rootza and in the manner it accesses the

internet users do not have to know the sources of the data nor the structure. This is because the URLs that are connected to the sources are automatically accessed via the Rootza database and search engine. Information seekers do not require previous knowledge to enable them to access the source as Rootza search results are produced and accessed to the sourced material via a link from the search results. User ability is not needed to use accessible tools independently or flexibly as the information seeker simply opens the Rootza page, selects the required subject area, then a search term and presses the button 'Go Rootza'. Rootza produces the resulting URL 'hits'. Therefore, Rootza tried to address the three subcategories and addresses the problem of information seekers experiencing difficulties in using information seeking tools, which has been a problem within information literacy. The provision of a new tool and manner of instructing information seekers in the steps of information seeking and the online criteria used to determine academically acceptable material, should enhance the second face or category of Bruce's seven faces of information literacy, thereby making another contribution to information literacy. The learning process for the information seeker is an absorption or osmosis process. As information seekers are exposed to the combination of the steps of information seeking and the evaluative criteria, they should become familiar with these steps and criteria. Thus, Rootza becomes a teaching tool.

The third category (Information Process) is the recognition by information seekers that they need information. Within Rootza's design, providing the steps of information seeking – defining the task (establishing the search term); information seeking strategies (determine where and what tools to start searching); location and access (is the location able to be accessed physically or digitally) – helps the information seeker learn appropriate and logical strategies. Additionally when use of information (determining if the information being sought will address the user needs); synthesis (how it is going to be used in an assignment etcetera); and evaluation (has the process produced the required results?) is added, this not only instructs information seekers but also enhances recognition of the need for information.

By providing the third category of the steps to information seekers as a main component of the Rootza website, information seekers are placed in a position where they have to consider if they recognize their needs for information gathering and whether this increases their knowledge of the use of this information once it is sourced. Accordingly, by putting into place a process for this to occur using Bruce's five faces/categories, it is hoped that this will add value to the field of information literacy.

The fourth category (Information Control) places a degree of objectivity at the information seeker's disposal. Rootza reveals additional information and another dimension in the form of suggesting second and third search terms in thesaural form. This enables information seekers to become familiar with other possible search terms and provides them with an opportunity to search the www with those alternative terms. Thus allows the users to form a degree of objectivity with their searching.

The fifth category (Knowledge Construction) is information seeker development as they build on current knowledge and they become critically reflective. Therefore, Knowledge Construction is a generalization that students are actively involved in learning and creating their own meanings. Additionally, the fifth category, by building a knowledge base, provides the feature of information seekers being able to analyze and evaluate the worth of the search results. In providing two instructional elements (the steps of information seeking and criteria for evaluation), Rootza adds another dimension to faces of information literacy and provides a concrete tool to enable five of the seven faces or categories to be set into place. It also makes available to information seekers and students of information literacy another component that not only enhances their digital literacy skills but also their knowledge of current developments in the field of information literacy.

The theoretical dimensions of five of Bruce's seven faces (categories) of information literacy blended with Rootza's contribution to the study and understanding of information literacy is an intervention that is designed to enhance information

literacy. The adoption and joining of the five categories of Bruce and Rootza can be expressed in tabular form.

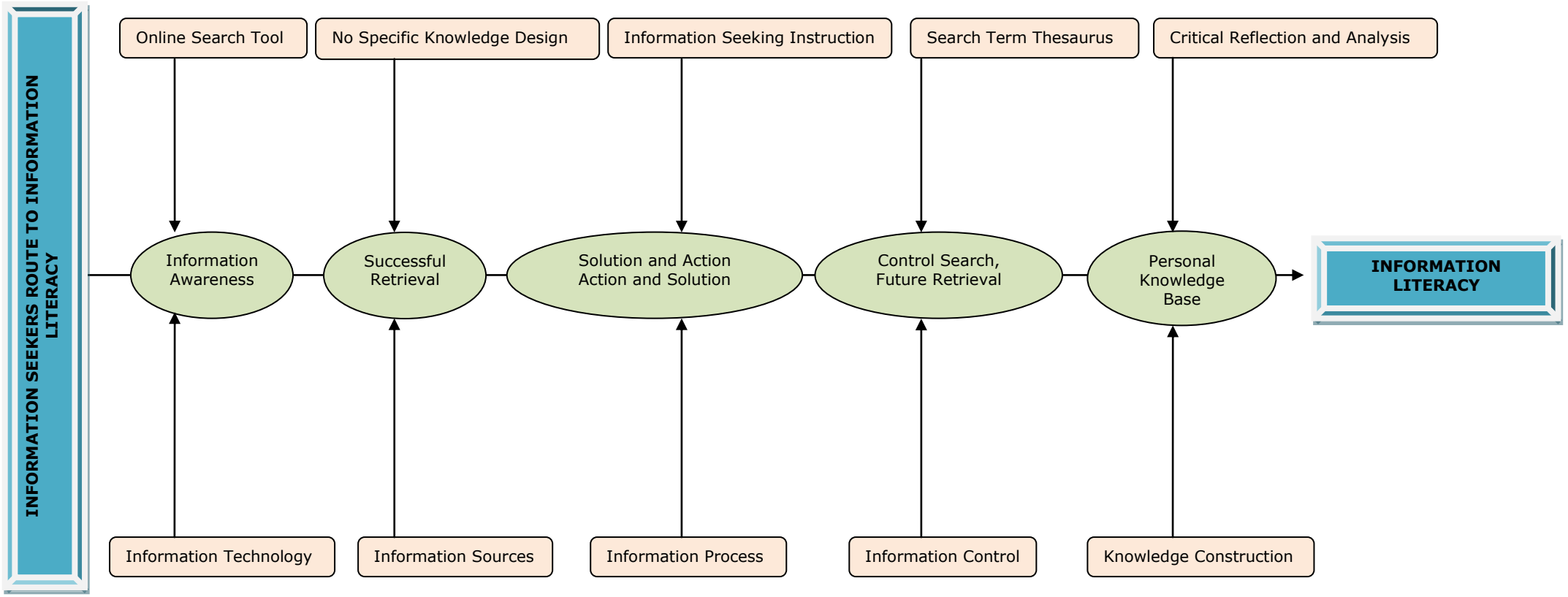
Table 5: Bruce and Rootza information seeker alignment

Bruce	Rootza
Information Technology (Information Awareness)	Online Search Tool (Information Awareness)
Information Sources (Successful Retrieval)	Flexible Design - no need for user specific knowledge (Successful Retrieval)
Information Process (Action, Solution)	Information Seeking Instruction (Solution, Action)
Information Control (Future Retrieval)	Search Term Thesaural Database (Control Search, Future Retrieval)
Knowledge Construction (Personal Knowledge Base)	Critical Reflection and Analysis (Personal Knowledge Base)

Table 5 provides a conceptual alignment showing the relationship between the Bruce theoretical model and the Rootza practical model. Bruce's theoretical face of Information technology is aligned with the Rootza Online Search Tool and this alignment shows that both are based on Information Awareness although one is theoretical and the other is practical, both are in concordance. Bruce contends that when information seekers use Information Sources they often do so without prior training. Rootza has an intuitive and flexible design of which no specific knowledge is required and this also leads to Successful Retrieval. The Bruce (1997) face of Information Process is an information seeker performing an Action and finding a Solution. Correspondingly, the Rootza tool has Information Seeking Instruction in the form of the steps of information seeking and the criteria used to determine authoritativeness of sourced information, and this provides a Solution on which an Action may be performed. The Bruce face of Information Control allows for an information seeker to retrieve previous information found at a later date (Future

Retrieval) and the Rootza Search Term Thesaural Database allows an information seeker to control their search (Control Search) to enable them to retrieve the information at a later date (Future Retrieval). Bruce's Knowledge Construction which allows an information seeker to improve their Personal Knowledge Base is aligned with the Rootza's Critical Reflection and Analysis. As information seekers use Rootza, onscreen information is displayed and this allows them to improve their Personal Knowledge Base because they are learning information literacy skills while performing an online search. The joining of the five categories of Bruce and Rootza is shown how it progresses along the Information Seeking Route to Information Literacy is in Figure 2.

ROOTZA WORKING MODEL



BRUCE THEORETICAL MODEL

Figure 2: Bruce and Rootza five faces interaction blend

4.3 Rootza™ System Overview

The concept and design of the system thesaural database and website interface for Rootza has been the sole product of research and development by the researcher as has all data input. The researcher privately contracted a computer programmer to enable the online thesaural database to be taken from the concept mode to a working model. This enabled the building of dataset relationships, the writing of computer code scripts for the database and the construction of the web page and search engine. This was completed using open source computer programs. The researcher liaised with the programmer with the aim of developing the database and the website to access the internet. The program, website and search engine was subsumed on server space leased by the researcher.

The name 'Rootza' was developed from two conceptual sources. The first source refers to the software extending its roots deeply into the www to reach the source of the information by omitting commercial websites on the www and thereby only targeting academic, organizational or scientific specific websites. The second source of the name 'Rootza' comes from the common parlance phrase 'rooting around'. For example, 'rooting around' is a phrase used to express the practice of rummaging and searching for an item in a difficult or inaccessible area in a particular repository such as a wardrobe. Therefore, Rootza has been named to reflect these two concepts.

Rootza specifications were initially conceptual and user orientated because at the gestation period it was unclear clear whether Rootza could be built according to the specifications and although there was a preparedness to alter the design, this was not necessary. The design specifications were broken into three components. The first was the database; the second was an online presence with search capability and the third was the overlaying of information literacy information.

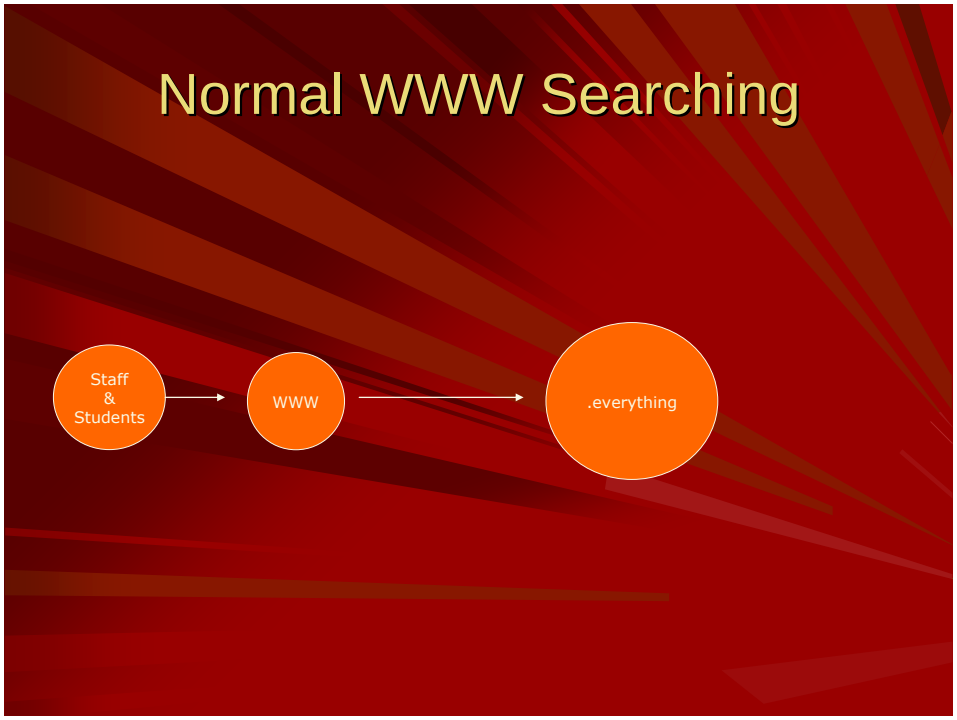


Figure 2: WWW searching without using Rootza

Figure 3 Normal www searching depicts the way information seekers access pages on the www. It shows the direct path from the information seeker (Staff and Students) as they use a browser or search engine to access the www. Without intervention of using an advanced search and placing limits on the domain/s to be searched, the browser or search engines searches on every domain (.everything).

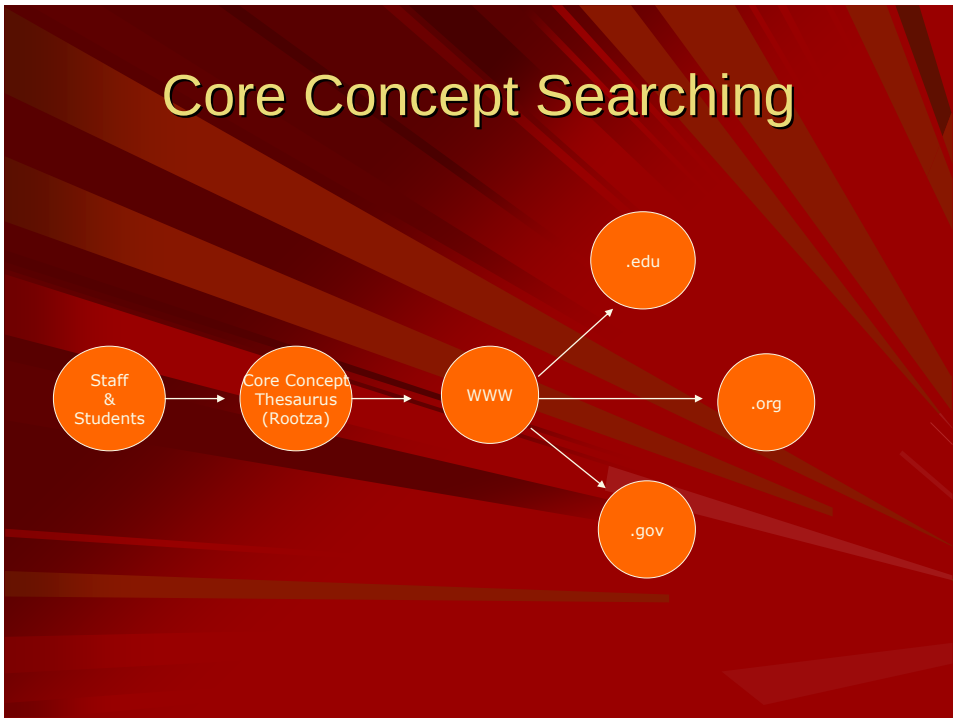


Figure 3: WWW searching using Rootza

Figure 4 Core Concept Searching shows the Rootza information seeking path and the relationship between information seekers and the www. The difference between Figure 3 the www information seeker path without using Rootza and Figure 4 the Rootza path, is that the online core concept thesaural database tool (Rootza) is an intervention between information seekers and various domains on the www. The intervention graphically displayed above shows how Rootza accesses the www whilst only accessing non-commercial websites, thus accessing only what may constitute authoritative websites in the domains of .edu, .org and .gov. (One limitation to come to light since the experiment was run has been the omission of the .ac domain, used in countries such as New Zealand and Britain.)

The URL for Rootza at the time of the experiment was www.redferninnovation.com/rootza and is now www.rootza.com**.** The participants had access to Rootza through the University of Canberra web server and the Rootza system and database were housed on an external server. The database at the time of the experiment was accessed via a web page interface and a proprietary search engine such as Netscape, Mozilla, Opera or Internet Explorer to search the www.

4.4 Rootza Preliminary Development

The nature of the research saw the researcher not only investigating and learning how to develop and build the tool, however there was also a substantial amount of time in evaluating a large number of international and Australian patents. The in-depth evaluation of patents was to ensure two things: the first was that the proposed tool did not currently exist; and the second was to ensure the development of the tool did not infringe on any patent or other intellectual property. This process took approximately six to eight months and following this, more than a year was spent in the development of the tool itself.

The development of the tool commenced with the following fourteen investigations:

1. Library of Congress Subject Headings and similar subject heading lists/thesauri;
2. Library of Congress processes and protocols for search term classification lists;
3. The form of search terms for academic subjects;
4. Electronic database developers classification of information;
5. How search engines work;
6. How the www/internet/intranet works;
7. How computer software is developed;
8. How electronic database developers construct databases;
9. How could all core concepts be linked together rather than as simple search terms;
10. What are the different computer codes and how they work;
11. Intellectual property law both domestically and internationally;
12. Requirements for patent registration;
13. Process of registering a patent both domestically and internationally;
14. Methods and procedures for dealing with IP lawyers;

The above list of investigations was divided into three groups: classification of search terms; search engines and software; and intellectual property.

The rationale was the need to establish how search terms are decided upon and their classification structure for paper and electronic databases. This was followed by an investigation of internet software designed for internet searching. Then it became necessary to protect the researcher's intellectual property and an investigation was conducted on intellectual property and patent rights.

4.4.1 Examination of Search Term Classifications

The investigation into the Library of Congress Subject Heading (LCSH) protocols and procedures commenced with accessing their online policy documents in order to understand the procedural guidelines for LCSH acceptance. The researcher also undertook a study of the Oxford Dictionary editorial procedures as well as the television program 'History of English'. This provided the researcher with a deeper understanding of the rules, policies and procedures necessary for the inclusion of words and phrases in search term databases and dictionaries. When these investigations were completed, the researcher accessed various digital academic database developer company web pages to examine their policies and procedures related to the inclusion of search terms in their databases.

Generally, it was found that the Library of Congress commence the process of classification of search terms when various academics, librarians, school teachers and the general public propose and provide a rationale for a search term to be included in LCSH. The Oxford Dictionary editors commence the process of word inclusion in the same manner. That is, academics, librarians, school teachers, their own staff and the general public suggest words. However, the Oxford Dictionary editors also take into consideration whether the word has been in 'common use', whether it is well known or if it is simply a variation of a common word that is also currently in existence. Electronic database developers tend to use a slightly different process - generally many use the LC subject terms, others use their own company developed thesauri and there are some who appear to have no vocabulary control at all.

The research collection at the University of Canberra holds paper copies of specific discipline search terms. When the researcher used these for her own research, these paper copies were found to be not term comprehensive and were dated. However, the researcher discovered a modern thesaurus of online search terms and this provided insight and validation for the need for an online tool which held core concept search terms. When the researcher understood how the LCSH, the Oxford Dictionary, the thesaurus of online search terms, and how electronic database developers organized their terms, the researcher commenced an examination of how search engines work.

4.4.2 Examination of Search Engines

Because this researcher had invented a new concept for searching on the internet, it was necessary to determine how search engines work and whether the invention could be programmed to work on or with a search engine. In order to achieve this it was not only necessary to understand the technical construction of search engines and how they work in tandem with the internet but also, the process of software and database development. This was followed by the researcher gaining an understanding of how academic subject core concepts could be built into a database to enable all terms to be linked together for an internet search. Under current internet search techniques, search terms in a database are in indexes and these are the terms used to search on the internet.

The researcher not only had to establish how databases are constructed and how the internet works but also she had to develop a new way for databases and search tools to perform this newly invented method of searching. These inherent difficulties were overcome in various ways. The researcher used a number of text books especially those by Tim Berners-Lee (who has been credited with inventing the internet) as well as reading many online web pages and blogs, and daily reading of the internet technology news pages such as CNet, Apple and other technology pages and technology news websites. Additionally, many computer magazines were read. The researcher knew she would need a computer programmer who would

consistently confer with the researcher regarding the programming design to ensure that it fitted with the researcher's concept and needs.

The major difficulty the researcher encountered and was unable to find a solution for in the early stages was to determine how to achieve the linking of all the core concepts to each other rather than in simple subject lists similar to LCSH and other search term databases. This difficulty was overcome by the researcher conceiving a different way of linking search terms using Microsoft Excel.

4.4.3 Examination of Intellectual Property Law

When the researcher conceived the idea for the core concept thesaural database and search tool, she had little idea that it was a newly invented process that warranted intellectual property protection in the form of a patent. After committing to spend much time examining domestic and international patents, the researcher conducted preliminary research on Australian, American, European, Canadian and World Intellectual Property Organization (WIPO) databases. The researcher realized that the tool did not exist and therefore was entitled to be patented. Following this revelation, the researcher also examined the requirements, process, methods and procedures needed when dealing with domestic and international lawyers. Lastly, the researcher wrote the patent application that was initially submitted to Intellectual Property Australia (IP) and is also currently undergoing the patent process in America, Canada, New Zealand and the United Kingdom.

While the above investigations were continuing, it was necessary to build the tool from the basics and put into place intellectual property protection.

The linear research process was used for the experiment and thesis and the preliminaries of the investigations into search term classifications, database and internet workings and intellectual property followed. Below, Figure 1 'Linear Research Process' is followed by Figure 2 'Flow process leading to the building of the tool' which is the linear research process that has been adapted to suit the initial

investigations on the term classifications, database, internet workings and intellectual property requirements.

4.4.4 Rootza Development Flow Process

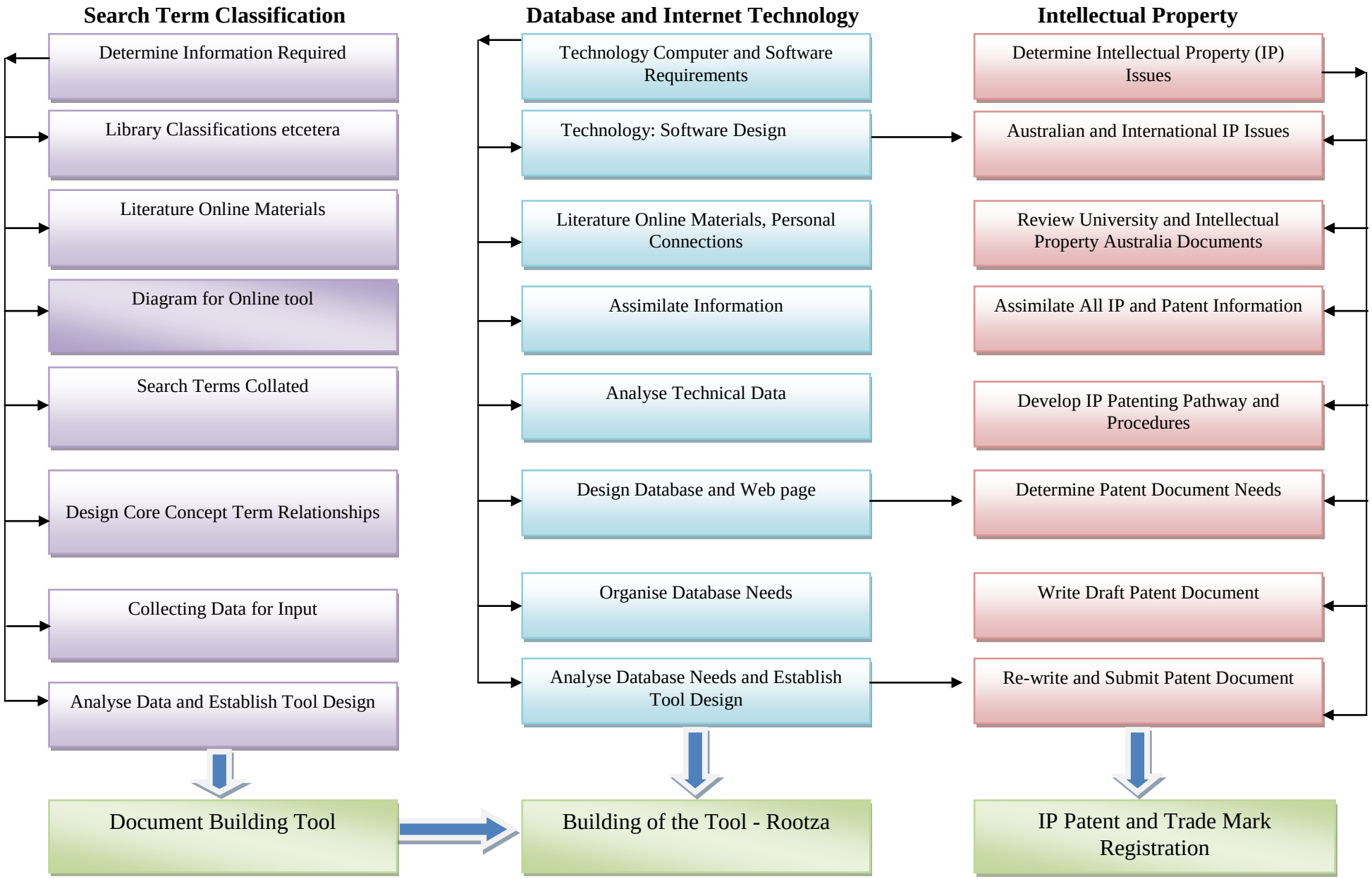


Figure 4: Flow process leading to the building of the tool.

Figure 5 displays the linear flow process leading to the building of the tool.
The lineal process was undertaken in parallel for the three examinations of: Search Term Classification, Database and Internet Technology, and Intellectual Property.

The diagram represents the very complex and lengthy investigations, as well as the research and development that had to be completed before the experiment could be undertaken. The thorough analysis of search term classifications and how they would impact on the design of the newly devised search tool commenced and followed a continual flow until the tool was completed and ready for the experiment and all the intellectual property issues were addressed.

There are only three steps that graduate from the Database and Internet Technology to Intellectual Property and they are: Technology and Software Design, Design Database and Web Page, Analyze Database Needs and Establish Tool Design.

When all the steps of the Search Term Classification were completed, the writing of the documentation to build the tool was followed by the computer and database programming. Following programming and building of the tool, all the intellectual property protection was put into place in the form of patent and trade mark registration.

4.5 Rootza System Specification

Because the aim was to provide ease of use and to be inviting, informative, instructional and fast whilst providing clear and concise results of a search, the functionality of Rootza was a big issue. The specifications were written and developed to ensure the aim of functionality was met. Rootza functionality needed to allow the testing of the research questions that this study addresses.

The specifications for building the Rootza system as a core concept thesaural database and online information literacy teaching aid for information seekers was specified to contain:

- a subject specific directory linked to a search engine;
- core concept search terms for the information seeker;
- access to the www to find academic resources related to that search term;
- the steps of information seeking using 'bubbles' 'boxes' and 'banners';
- basic elements that define academically acceptable literature; and
- a user constructed folder for web bibliographic records and search terms.

It was necessary to develop Rootza in three sections compromising the database, the online presence with search capability and the embedded information literacy instruction.

The database specifications supplied to the programmer were to be designed to allow for:

- Academic subjects/units to be located on the main page and were to be selectable by the user
- Main search terms for subject to be linked to 3/5 corresponding units.
- Users being able to scroll though the list of subjects and search terms
- Users being able to select alternative search terms.

The online presence and search capability specifications were:

- a search using an online facility built into the Rootza web interface
- a search being limited or expanded to the domains of .edu, .org, .net and, .gov.
- users being able to save the results in a folder
- users being able to print the results
- users being able to conduct consecutive searching.

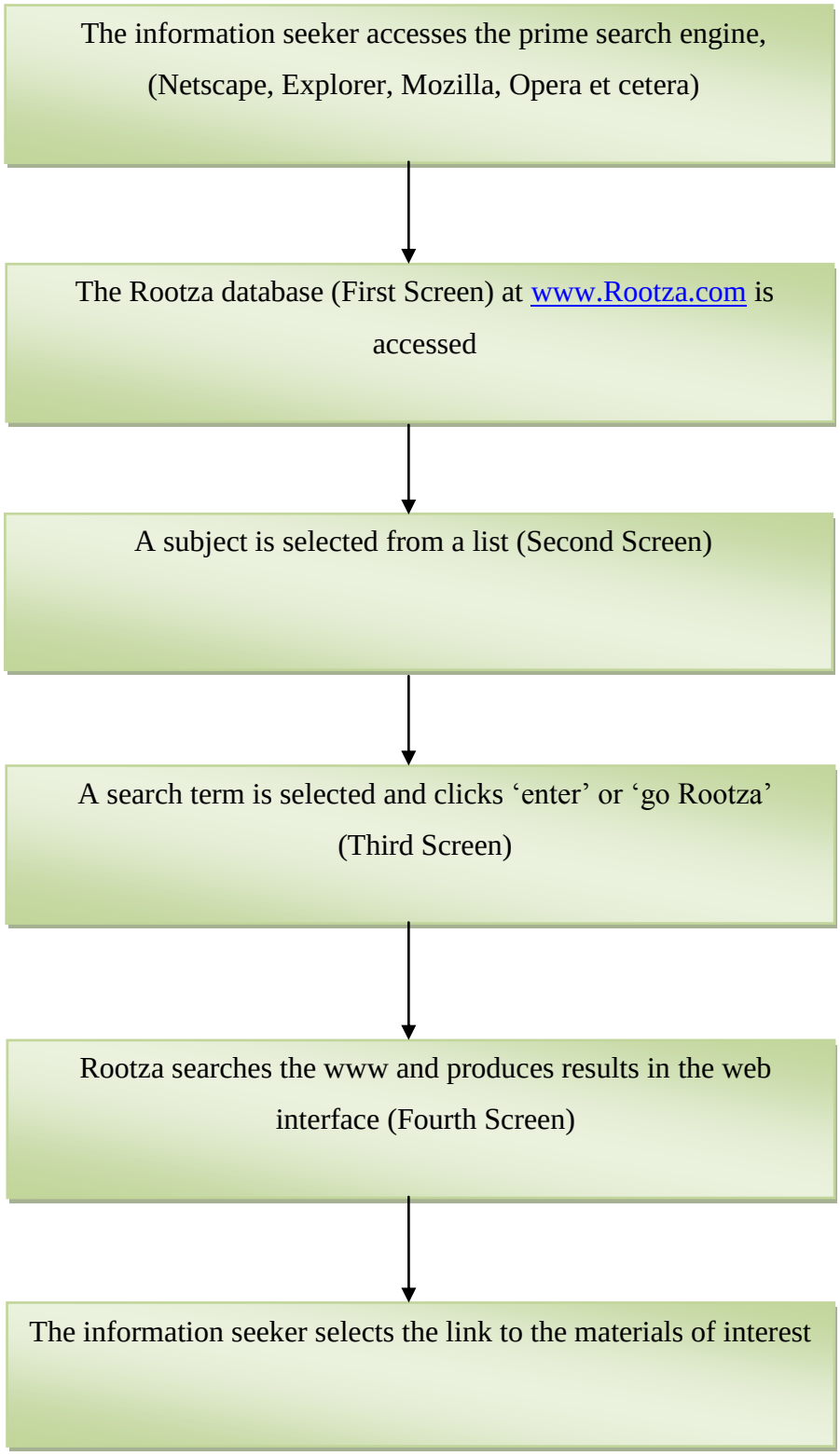


Figure 5: The Rootza path.

Figure 6 shows the path that an information seeker takes when undertaking an online search using Rootza. The user first opens there general browser such as Microsoft

Explorer, opens the database, selects their subject area and then selects the search term to be used. The information seeker hits the 'go Rootza' button and the software searches on the Web for information using that search term. When information seekers have found an article they would like to read, they select it for viewing.

The information literacy instruction is able to:

- Be overlaid on any of the web pages
- Show the steps of information seeking
- Show the authoritativeness of sourced materials.

The Six Steps of Information Seeking

1. Task Definition
2. Information Seeking Strategies
3. Location and Access
4. Use of Information
5. Synthesis
6. Evaluation

The bubbles will be:

Task Definition

What are you looking for, what are your search terms?

Information Seeking Strategies

Where might you find the information?

Location and Access

Are you able to access the information?

Use of Information

How are you going to use the information?

Synthesis

Sort your information and put it together

Evaluation

Did the information help your assignment or research?

The Six Criteria for Academic Materials Online

1. Evidence of being refereed
2. Web page regularly updated
3. University/Organization/Government department
4. Authors credentials
5. Reference bibliographic list
6. Contact details of the author or organization responsible for the content

The bubbles will be:

Evidence of being refereed

Is the article in an academic journal?

Web page regularly updated

When was the web page last updated?

University/Organization/Government department

Is the website a well known institution or organization?

Author's credentials

Does the author have academic qualifications like Masters or PhD?

Reference bibliographic list

Are there references or bibliographic citations at the end of the article?

Contact details of the author or organization responsible for the content

Is there an address, email or phone numbers to contact the author?

Additional requirements:

- Users able to print sourced information or save to an external device such as a USB key
- all web pages to allow for easy reading by the vision impaired
- all web page designs are to plain and uncluttered
- all web pages to be designed with a maximum of three colours.

4.5.1 Thesaurus Design

The core concept thesaural database structure was designed to operate using controlled vocabulary. Because controlled vocabularies have limited and defined search terms, search terms in controlled vocabularies may be open to different meaning and interpretations. Chu (2003) stated that a controlled vocabulary thesaurus must be constructed and maintained within specific subject areas.

The thesaural database is designed to search one term and because of hidden mappings, this term relates to others. During the experiment participants were asked to select the search term they wrote on the pre-test questionnaire. However, the core concept thesaural database also displayed alternative search terms the user could select. At the time the experiment was conducted, the database program did not search multiple terms during the one search, whereas in the future Rootza would be programmed for this

function in order to support more intelligent searching. An example of intelligent searching is a search that may be undertaken for instance, for the core concept term 'policy process'. The database searches for 'policy process' as well as 'local policy process', 'municipal policy process', 'national policy process', 'federal policy process' etcetera as well as associated suffixes, prefixes and terms that are associated with the original core concept term. It is for this type of search that the online core concept thesaural database was developed as a tool to assist information seekers.

4.5.2 Development of the Rootza Database

The first stage in the development of the thesaural database was to compile a thesaurus for the subject *International Studies Foundations* by identifying all core and lesser concept terms, synonyms, contemporary terms or phrases related to the subject that could be used to seek information on the World Wide Web. The reason for the choice of this subject is detailed in the following chapter.

The compilation of the data was first entered into Microsoft Excel and when complete it was transferred into MySQL database. The compilation of search terms was made from the subject outline, courseware, notes and the reading list from e-reserve documents lodged in digital format on the University of Canberra Library website as well as hard copies obtained from the subject convener for *International Studies Foundations.* All core concept terms, synonyms, contemporary terms or phrases related to the subject were entered directly into the web based thesaural database. The ontological structure of the database has four classes of entry. In descending order they are: Primary Term (Term - T); Secondary Term (Near Term – NT); Primary Related Term (Broader [related] Term – BT); and Secondary Related Term (Related [related-lower level] Term – RT). This is similar to the Library of Congress Subject Heading classification structure as well as the commonly accepted procedure of thesaurus structure.

When core concepts were determined, although they were not necessarily single words and may have consisted of phrases, they were entered in the Primary Term (T), the Secondary Term (NT), Primary Related Term (BT) and Secondary Related Term (RT) lists. To provide as comprehensive a thesaurus as possible, all core concepts entered on the database were used to source additional terms from the Directory of Contemporary

and Natural Language Search Terms for the Internet (2000), the Macquarie Concise Thesaurus (2004) and the Oxford Thesaurus (2002). The rationale for omitting the Library of Congress Subject Headings is because they do not specifically contain contemporary natural language terms that are often used on the internet, whereas the Directory of Contemporary and Natural Search Terms for the Internet provides contemporary natural language.

The use of the Macquarie Thesaurus and the Oxford Thesaurus was to gain terms, synonyms and subsidiary terms that are used in Australia, the USA and the UK. Because the Oxford Thesaurus contains both British-English and American-English, this was used for English and American terms. The rationale was that language and idioms in Australia today are often a mixture of English dialects of Australia, America and England and this is important when information seeking on the www as web pages have a mixture of differing terminologies. Another reason is because proper nouns and synonyms change over time. For example, the country Ceylon is now named Sri Lanka, the European Union is a recent development and the terms such as El Nino and Tsunami were not in common usage. Therefore, the core concept semantic thesaural database was best programmed not only with core concepts and synonyms and their semantic affiliations, but also with idioms and language that are in common use and are part of contemporary and natural language.

Table 6: Example of core concept search terms on the Rootza page

Primary Term	Secondary Term	First Semantic Term	Second Semantic Term
Airwave	Radio Wave	Radio Receiver	Wireless Radio Transistor Trannie Ghetto Blaster Beat Box
Australian Quarantine Act	Quarantine Law Australia	Quarantine Imports Illegal Smuggling	Illegal Australian Imports Illegal Australian Exports
Olympic Games	Summer Olympic Games	Winter Olympic Games	Summer Olympic Sports Winter Olympic Sports
I Have a Dream	Martin Luther King	Black Equality	Black Panther Movement American Freedom
UN	United Nations	World Organizations	UNESCO World Health Organization World Bank
Thatcher Administration	British Government	UK Government	British Liberalism Tory Party
Reffo	Refugee	Australian Immigration	Australian Asylum

(Redfern 2006)

Table 6 displays an example of the web page, core concepts and search terms that an information seeker may view and use to find information on the www.

The relationship of the database was linear in respect of the distance from the Primary Term to the Second Semantic Term. The secondary term holds the closest conceptual relationship to the primary term, the first semantic term is the closest to the secondary term and the second semantic term is closest to the first semantic term. Therefore, the most distant are the primary term and the second semantic term.

The primary term, secondary term, first semantic term and second semantic terms were all obtained from different sources. The primary terms were obtained from subject courseware and reading lists, the secondary terms were obtained from *The contemporary thesaurus of search terms and synonyms; a guide for natural language computer searching*. Knapp [2000], the first and second semantic terms were obtained from both the Concise Oxford Thesaurus (2002) and the Macquarie Concise Thesaurus (2004) and the collection of all search terms was placed in a database.

This research project and experiment consisted of the building of the Rootza database using elements of computer technology of which the researcher had little knowledge, experience or qualifications. Therefore, to program the database and web pages in computer languages, assistance was sought from a computer programmer. Although the online core concept thesaural database was conceived, developed and designed and the technical specifications were written by the researcher, the computer programmer undertook the technological development and design of the architectural backbone.

The Rootza infrastructure was built entirely using PHP 5 and MySQL 5, which are both commercial level open source products. The decision to use open source products was to minimize the development and maintenance costs.

The Rootza system is based on a 3-tier architecture, and the primary components are:

1st Tier:	MySQL database for holding search terms and synonym sets
2nd Tier:	PHP scripts to access and manipulate the data within the database
3rd Tier:	Web pages designed in HTML, PHP and JavaScript to provide a front-end user interface.

Each of these components is explained in further detail below, including the details of their interactions with each other.

4.5.3 1st Tier – MySQL Database

The 1st Tier of the system architecture is the level where raw data is stored. The search terms and synonym sets used by Rootza are broken down into their simplest sub-components and stored within the database in such a way as to minimize repetition of data and the possibility for errors during data entry. When an information seeker searches for a particular term using Rootza, they are presented with a set of related search terms and they are given the option to search using any of those terms, depending on whether they require a broad or narrow search.

In order to efficiently store the data needed to power such a system, the synonym sets were first broken down into individual search terms and each term was given a unique, automatically generated identification number. The identification number was then used to link the search terms into sets of words with the same or similar meanings. The word sets in turn were linked to create the synonym sets that would be seen and used by information seekers using the site.

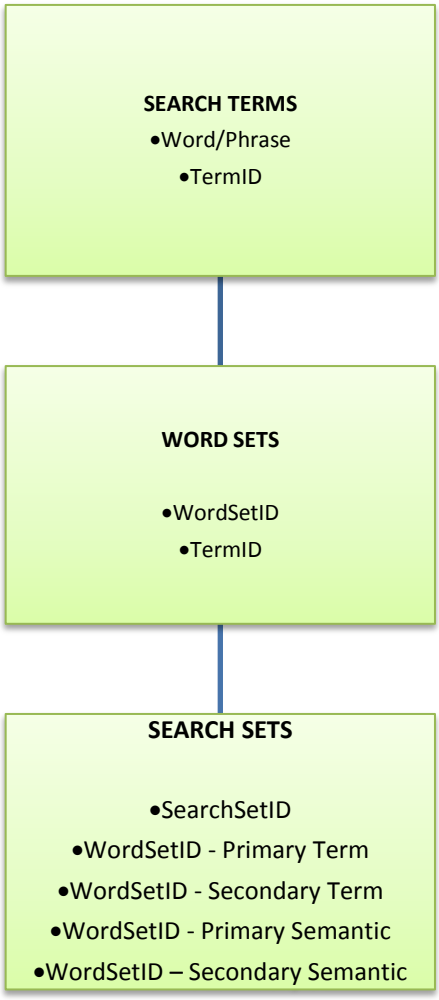


Figure 6: Diagrammatic structure of the database.

(Edwin 2006)

Figure 7 is displaying the diagrammatic structure of the database and also displays the construction path of the database. The search terms were established as terms or phrases and each of these were provided with an identification code. The search terms were linked into word sets and then search sets. The search sets hold the search set identification codes as well as the word set identification codes. The word set identification codes were linked to the primary and secondary terms and also to the primary and secondary semantic terms.

By designing the structure of the database as simply as possible by having the Search Terms hold words/phrases and term identification, the WordSets holding the WordSet

and terms identification and the Search sets holding the SearchSet, WordSet-Primary Term, Secondary Term, Primary Semantic and Secondary Semantic identification, it allowed convenient entry and forming the relationships between those search terms whilst also writing easy scripts that allowed the term relationships in the database to be searched.

4.5.4 2nd Tier – PHP Scripts

Scripts are strings of computer programming code that provide operating instructions to the program.

The scripts to access and manipulate the database was created using PHP 5, an enterprise level open source programming language that is growing in popularity within both the business and internet communities. Unlike its predecessors, PHP 5 extensively supports the Object Oriented Programming (OOP) paradigm, whereby programs are written to represent real word objects, as opposed to merely being collections of functions and variables. The Rootza system utilizes OOP to represent search terms, word sets and search sets. This approach offers the following advantages:

1. Since the code for each object is written and stored separately, it is easy to add or modify new information and functions without affecting the existing operation of the system.

2. The objects can in turn be linked to one another, making it possible to reuse blocks of code within the system – future corrections or modifications would only need to be made in one part of the code, and all related parts would be automatically corrected/modified as well.

3. The portion of the code that interacts with the database has been created as an entirely independent module (database interface), which in turn is 'plugged in' to the rest of the code. This means that in the future, if the MySQL database needs to be upgraded, any technical changes will only need

to be made within the Database Interface, and the rest of the system will remain entirely unaffected.

As may be seen from the aforementioned benefits, the Rootza system has been designed and created to be as fully extensible as possible, while still offering the optimum speed and reliability.

4.5.5 3rd Tier – The User Interface

The front end of the Rootza system, that is, the user interface, consists of a collection of web pages that accept the users' input through HTML forms and pass this input data to the PHP scripts, which in turn interact with the database and return the search results. These search results are then processed by the PHP scripts and displayed in HTML format by the user interface.

The pages were created in HTML 4.0 and the formatting is applied via external formatting files, known as cascading style sheets. This method allows the separation of content from design within the web pages. This means that designs can be modified or even completely switched by simply applying different style sheets. This technique is used to present the same basic system through different user interfaces that are specifically tailored to match the needs and preferences of various user groups.

Rootza has an instructional/teaching component of 'speech bubbles' that appear over the text for the Six Steps of Information Seeking used. The bubbles provide additional information. For example, the first step is 'Task Definition' and when the mouse pointer is placed over this text the phrases 'What are you looking for?, 'What are your search terms?' etcetera appears. An example for the Six Criteria for Academic Materials Online used in this study is 'Evidence of being refereed', and the bubble asks 'Is the article in an academic journal?' This occurs on all of the web pages where the 'Six Steps of Information Seeking' and the 'Six Criteria for Academic Materials Online' appear.

5 Findings

Information literacy and information seeking is an important component of student learning and higher education. The major beneficiaries of conducting experimental research on a newly developed research tool should be the academic community and the education sector. The experiment was conducted in order to determine if students in the education community would benefit from using Rootza and as such, it was appropriate that students as participants were invited to take part in the experiment.

The experimental testing of the core concept thesaural database was conducted and administered by the researcher. Both the experimental and control groups were in the same computer environment using the same equipment and survey instruments.

The experimental group had to search for articles on the www by using the key concept terms or subsidiary terms of *International Studies Foundations* in the Rootza database. The control group used Google. The research questions were sourced from a teaching component of the subject outline following consultation with the subject convener.

In order to avoid bias, students who had been involved in a similar study before were excluded from the experiment. During the enlisting of participants at the end of the tutorials, one potential participant advised they had been involved in a computer experiment before but was unsure if it was similar to the online core concept thesaural experiment, as that participant had not seen nor heard of Rootza. However, to avoid bias, both the researcher and proposed participant agreed that it was best for the participant to be excluded from the experiment.

The experiment commenced immediately the participants entered the computer laboratory. They were invited to sit at whatever computer they preferred and told not to touch any of part of the computer or keyboard. In readiness, all computers had previously been logged in using the researcher's university login. Half of the computers were open at the Rootza website and half were open at Google and all screens were turned off in readiness for the experiment.

Participants were divided into two groups. The first were the control group and the second were the experimental group. Both control and experimental group participants were randomly selected according to the order they walked into the computer laboratory. That is, each participant was automatically a member of the control or experimental group depending on where and at what computer they chose to be seated. There were thirteen in the control group and twenty-four in the experimental group.

After the experiment, participants printed out the www sourced materials they felt were addressing the research question. These were evaluated for the appropriateness for citation in assignments. The six criteria on which the article sources were evaluated were: evidence of being refereed; web page regularly updated; university/organization/government department being a 'recognized' publicly known entity; author's credentials; reference or bibliographic list; and contact details of the author or organization responsible for the content. These six criteria are taught in the University of Canberra Academic Skills program and are also communicated to the students as a part of the academic curriculum at the University. They are also widely accepted in academic literature.

5.1 Results

To answer the question whether an online core concept subject specific contemporary thesaural database would assist student researchers with finding relevant materials on the internet, it was necessary to commence the data analysis by documenting participant demographics. Some of the demographics were educational and social background, level of computer usage, English language knowledge and the number of subjects already completed at university. This was followed by participant knowledge of the Six Steps of Information Seeking (the 'Big 6') and an evaluation of success in identification of research question search terms and then the criteria for evaluation of online academic materials.

The first section in the Experiment Results is quantitative and provides participant demographic information and statistical results from the experiment. It commences with the pre-test questionnaire for all participants, then the experimental group followed by the control group. The last section is qualitative and provides experimental group participant opinions of the online thesaural database and web page.

5.2 Demographics

In Australia's education system it is very unusual for a university student to be aged less than seventeen years of age yet the age group for this experiment was fifteen to forty-nine years of age. The wide spread of age was because *International Studies Foundations* (and similar subjects at the University of Canberra) has on many occasions been a subject in which many mature aged students enrolled.

Lifelong learning and the lifelong learning paradigm has become a standard and accepted practice in education in Australia. It is not unusual for universities to have a large proportion of mature aged students in their classes and academic curricula and course design encourages self-driven learners to build knowledge upon knowledge and experience continual growth. The experiment age demographics show that two participants (5.4%) were aged forty-five to forty-nine and an additional two (5.4%) aged

forty to forty-four. That the next closest age group was one participant (2.7%) each for the age groups of thirty to thirty-four and twenty-five to twenty-nine, this indicates that it is not unusual for the older, or mature aged students to be commencing study at university, hence on the path of lifelong learning. This research and the sample demographics are not typical of the University of Canberra demographics for undergraduate students and they were also not typical of the Australian Bureau of Statistics (ABS) for students in Australian Universities. ABS (2007) states that of students enrolled in a Bachelor degree, 45% were aged between twenty and twenty-four years and 27% were aged between fifteen and nineteen years. The age group fifteen to twenty-four statistics for undergraduate students at the University of Canberra was 70%, the ABS was 72% and the sample for this experiment was 81%.

All participant demographic results were obtained from the pre-test questionnaire completed by participants at the commencement of the experiment. The pre-test questions were divided into three sections Preliminary Information, Participant Expertise and Language and Computer Technology.

There were thirty-seven participants in the experiment and they were diverse in age, gender, ethnicity, education, language, use of computer technology and subjects completed in their courses.

Participant Age Groups

In the figure below each age group is followed by the number of participants situated in that age group and the total percentage of the participants in that group.

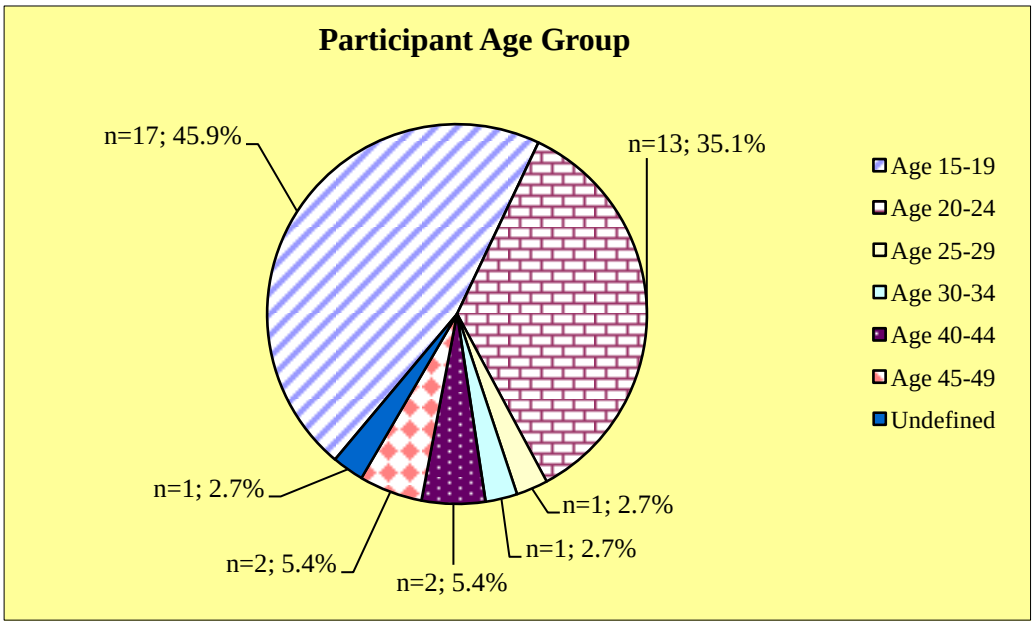


Figure 7: Participant age groups.

Figure 8 participant age consists of six age groups plus one in which a participant failed to indicate their age range. The statistics are: 15 to 19, seventeen participants (45.9%), 20 to 24, thirteen participants (35.1%), 25 to 29, one (2.7%), 30 to 34, one (2.7%), 40 to 44, two (5.4%), 45 to 49, two (5.4%). One participant (2.7%) failed to indicate their age range.

That seventeen participants (45.9%) were in the 15-19 age group and a further thirteen (35.1%) were in the 20-24 group indicates that the majority of the participants, thirty (81%) were between 15 and 24 years of age. The least represented age groups were 25-29 (2.7%) and 30-34 (2.7%).

Participant Gender

Of the thirty-seven participants in the experiment, there were twenty-five females (67.5%) and twelve males (32.4%). It is interesting to note the unbalanced representation between females and males because there was a more even representation of genders enrolled in the subject International Studies Foundations. Of the twenty-four participants in the experimental group, seventeen were female and seven were male. In the control group there were eight females and five males. International Studies Foundations in the past appeared to be predominately female although there were no statistics available to support this, therefore, it is not unusual to have the gender balance for this experiment predominately female.

Participant Country of Birth

Of all participants, there were seven individual countries of birth represented. Table 3 shows participant country of birth. Each country is followed by the percentage of the total participants for that country of birth.

Table 7: Countries of birth of all participants

Country	**Frequency**	**%**
Australia	31	83.8
Hong Kong	1	2.7
Lebanon	1	2.7
Macedonia	1	2.7
Poland	1	2.7
Sudan	1	2.7
United States of America	1	2.7
Total	37	100

Table 7 participant country of primary education shows that nine countries were represented. The table significantly shows that the majority of the participants were born in Australia. Unfortunately, this is a factor that prevented the experiment from being predominately international student based. That the majority of participants, (83.8%), were born in Australia indicates that English is the dominant first language of the participants. Five participants (13.5%) were born in a 'non-English as a first language' country and one participant 2.7% was born in the United States of America, a country perceived as an English as a first language country. The one participant born in the United States of America was added to the Australian born participants. Therefore, 32 participants (86.5%) were fluent in the English language and five participants (13.5%) were not fluent.

Participant Country of Primary Education

Table 8: Country of primary education

Country	**Frequency**	**%**
Australia	29	78.4
Australia/England	1	2.7
Australia/Japan	1	2.7
Australia/Singapore	1	2.7
Australia/Spain	1	2.7
Indonesia/Australia	1	2.7
Lebanon	1	2.7
Sudan	1	2.7
Tonga/Australia	1	2.7
Total	37	100

Table 8 participant country of primary education shows that the highest frequency for primary education was Australia. Besides twenty-nine participants (78.4%) had their primary education in Australia, five participants had their primary education distributed between Australia and another country: Australia/England, Australia/Japan, Australia/Singapore, Australia/Spain, Indonesia/Australia and Tonga/Australia. Two participants who were born elsewhere had all their primary education in their birth countries (Lebanon and the Sudan).

Participant Country of Secondary Education

Table 9: Country of secondary education

Country	Frequency	%
Australia	31	83.8
Australia/Denmark	1	2.7
Australia/Spain	1	2.7
Australia/Sweden	1	2.7
Australia/Thailand	1	2.7
Lebanon	1	2.7
Sudan	1	2.7
Total	37	100

Table 9 country of secondary education shows representation from three individual countries shows thirty-one participants (83.8%) received their secondary education in Australia and Lebanon was one (2.7%) and the Sudan was also one (2.7%). It is interesting that there were four participants' whose secondary education was nationally distributed between Australia and other countries which were Denmark, Spain, Sweden and Thailand. The city of Canberra in the ACT is the capital of Australia and because of a large number of embassies and foreign government representation and the strong presence of the Australian military and the associated mobile nature of these entities, it is not surprising that four participants had their secondary education in two countries. Two participants who were born elsewhere had all their secondary education in their birth countries (Lebanon and the Sudan).

Residence - Country of Permanent Residence and Years Living in Australia

All participants indicated that Australia was their country of permanent residence. The number of years participants have been living in Australia was divided into five categories of year comprising: 0-4, 10-19, 20-29, 30-39, and 40-49.

Table 10: Number of years living in Australia

Number of Years Living in Australia	**Frequency**	**%**
0-4	1	2.7
10-19	22	59.5
20-29	9	24.3
30-39	3	8.1
40-49	2	5.4
Total	37	100

Table 10 is the number of years of living in Australia has five age groups: 0-4, 10-19, 20-29, 30-39 and 40-49. The responses to this question show that the majority of participants (59.5%) have lived in Australia for 10-19 years. The next largest group was 20-29 (24.3%). Therefore, the lack of the English language was not going to substantially place any particular significance on the resulting data. Considering the statistics for the age of participants, this has drawn a parallel with the dominant age of participants in the same group.

Course Enrolled at the University of Canberra

The subject *International Studies Foundations* on which this research and experiment is based, can be included in a number of courses in the University of Canberra curriculum. Therefore, the spread of courses is broad.

Table 11: Participant degree enrolment

Single Degrees	**Frequency**	**%**
Arts International Studies	11	29.7
Arts (not specified)	4	10.8
Arts Politics	1	2.7
Arts Public Relations	1	2.7
Arts Tourism	1	2.7
Arts Tourism Management	3	8.2
Arts International Relations	1	2.7
Communication in Public Relations	2	5.4
Arts Education	1	2.7
Arts Law	3	8.1
Arts Marketing	1	2.7
Arts/International Relations	1	2.7
Double Degrees		
Arts International Studies and Communications	1	2.7
Arts International Studies/Journalism	2	5.4
Arts Politics and Communication/Journalism	1	2.7
Arts Management/International Studies	1	2.7
Arts Tourism Management/International Studies	1	2.7
Arts/International Studies	1	2.7
Total	37	100

Table 11. Students at the University of Canberra are enrolled in single or double degrees.

There were thirty participants enrolled in twelve single degrees and seven participants enrolled in double degrees. Participant degree enrolment of shows Arts/International Studies held the largest number of participants with 11 (29.7%).

Number of Subjects Completed

Educational institutions differ in terminology and within this thesis the terms 'unit' and 'subject' may be interchanged as they both mean the same thing. A unit or subject is the element of a course curriculum that consists of one broad topic. As seen in Table 8, the number of subjects completed by participants at the time of the experiment was not large.

Table 12: Participant course subjects completed

Number of Subjects Completed	**Frequency**	**%**
0	2	5.4
1	1	2.7
2	3	8.2
3	2	5.4
4	21	56.7
6	2	5.4
8	1	2.7
12	2	5.4
15	1	2.7
22	2	5.4
Total	37	100

Table 12. The number of subjects completed by the participants varied from 0 to 22. Two participants (5.4%) had not yet completed any subjects and at the opposite end of the scale two participants (5.4%) had completed twenty-two subjects. The majority of the participants 21 (56.7%) had completed four subjects. Eight participants (21.6%) had completed fewer than four subjects and three participants (8.1%) had completed only two subjects in their course.

The large number of participants (21) who had only completed four subjects in their degree is because it is necessary for students to complete core subjects before they continued onto electives. *International Studies Foundations* is a core subject for a number of degrees and core subjects are often completed first. This ensures students gain a thorough knowledge of the basics and an understanding of their field before advancing to more complex studies. There were thirty-two (86.5%) full time students and five (13.5%) part time students. Twelve participants (32.4%) were not born and educated in Australia and 25 (67.6%) were born and educated only in Australia.

Language Expertise

First Language

Table 13: Participant spoken first language

Language	**Frequency**	**%**
English	33	89.2
Arabic	1	2.7
Dinka	1	2.7
Macedonian	1	2.7
Polish	1	2.7
Total	37	100

Table 13. Participants had nominated five spoken first languages and English was the dominate languages. The other first languages were: Arabic, Dinka, Macedonian and Polish. That the dominant participant language was English is not surprising considering that thirty-one participants were born and currently live in Australia, twenty-two had lived in Australia for 10-19 years and thirty-one had their secondary education in Australia.

Second Language

Table 14: Participant spoken second language

Language	**Frequency**	**%**
None	21	56.7
Spanish	6	16.2
English	3	8.2
Chinese	2	5.4
Arabic	1	2.7
Danish	1	2.7
French	1	2.7
Greek/Dari	1	2.7
Swedish	1	2.7
Total	37	100

Table 14. Participants had nominated eight spoken second languages and of those Spanish was the most dominate language. Twenty one participants (56.7%) indicated that they had no second language.

Language Spoken in Current Residential Home

Participant language spoken in the current residential home was defined as the language spoken most often in a current family or household environment. The majority of participants 31 (83.8%) stated that English was the preferred language. This was followed by Dinka, English/Arabic, English/Macedonian, English/Spanish, Spanish/English/Italian as the preferred language, all with one participant for each (2.7%).

Level of Language Skill When First Arrived in Australia

Participants were asked (if applicable) to indicate whether their language skill when they first arrived in Australia was Fluent, Not so Fluent or No English. This question was not applicable to thirty-two participants (86.5%). Two participants (5.4%) were fluent and three (8.2%) spoke no English when first arriving in Australia.

Level of Language Skill at the Time of the Experiment

Participants born in Australia were required to answer questions relating to their first and second languages and what language was spoken in their current home.

Participants not born in Australia were required to answer the additional seven questions. The questions were framed around participant first and second language and their reading, writing and listening ability.

English Language Now: Two participants (5.4%) indicated their English language was now Very Good, two (5.4%) indicated Moderately Good and 33 (89.2%) were Not Applicable.

Reading First Language: Two participants (5.4%) indicated their first language reading as Fluent, two (5.4%) indicated Poor, 32 (86.5%) indicated Not Applicable and one participant (2.7%) failed to answer the question.

Writing First Language: Two participants (5.4%) indicated their first language writing as Very Good, two (5.4%) indicated Poor, thirty-two (86.5%) indicated Not Applicable and one participant (2.7%) failed to answer the question.

Listening First Language: Four participants (10.8%) indicated their first language listening as Very Good, thirty-one (83.8%) indicated Not Applicable and two participants (5.4%) failed to answer the question.

Reading Second Language: Two participants (5.4%) indicated their second language reading was Very Good, two participants (5.4%) indicated Moderately Good, one participant (2.7%) indicated Very Poor, 31 (83.8%) indicated Not Applicable and one participant (2.7%) failed to answer the question.

Writing Second Language: Two participants (5.4%) indicated their second language writing was Very Good, one participant (2.7%) indicated Moderately Good, one participant (2.7%) indicated Average, one participant (2.7%) indicated Poor, 31 (83.8%) indicated Not Applicable and one participant (2.7%) failed to answer the question.

Listening Second Language: Two participants (5.4%) indicated their second language listening was Very Good, two participants (5.4%) indicated Moderately Good, one participant (2.7%) indicated Poor, 31 (83.8%) indicated Not Applicable and one participant (2.7%) failed to answer.

The above questions pertaining to education and language skills have established that the majority of the participants, although a number were not primarily educated in Australia, felt they had good command of the English language and still practiced their non-English language in their current homes whilst maintaining a modicum of expertise in their second language.

Computer Technology

There were six questions related to computer technology and these questions were designed to elicit participant comfort level with computers. The hours of computer use combined with online programs utilized was to provide an indication of the level of expertise of participant information seeking. The questions asked were whether the participant had a computer at home, if it was used for study or recreation and the number of hours per week it was used. Participants were also asked whether they used computers at university and the number of hours a week they were used. The number of hours was on a 1-5 point scale commencing with 1 (1-10 hours), 2 (11-20 hours), 3 (21-30 hours), 4 (31-40 hours) and 5 (41-50 hours).

Comfort with Computer Technology

Table 15: Comfort with computer technology

Scoring	**Frequency**	**%**
Very Comfortable	14	38.9
Moderately Comfortable	20	55.6
Not Comfortable	2	5.5
Total	36	100

Table 15. Participant comfort with computer technology was scored on three levels of comfort: Very Comfortable, Moderately Comfortable and, Not Comfortable. Table 11 shows 14 participants (38.9%) felt very comfortable, twenty participants (55.6%) felt moderately comfortable and two participants (5.5%) were not comfortable. One participant did not answer the question. It was not surprising that the majority of participants were either very comfortable or moderately comfortable with computer technology as the use of computers in schools, universities and the home is very common. This is evident in the following figures that depict home computer ownership.

Computers at Home

Thirty-five participants (94.5%) had computers at home and two participants (5.4%) did not have a computer at home.

Home Computer Hours of Weekly Use

Table 16: Home computer hours of weekly use

Number of Hours	**Frequency**	**%**
1-10	12	32.4
11-20	12	32.4
21-30	8	21.6
31-40	1	2.7
41-50	2	5.4
Non Use	2	5.4
Total	37	100

Table 16. Hours of weekly use of home computer showed that the majority of participants use the computer for 1-20 hours per week. The dominant number of hours of use of a computer at home was 1-20 with a total of twenty-six participants equally spread between 1-10 and 11-20 hours. Two participants (5.4%) did not have a computer at home.

Home Computer Used for Study or Recreation

Table 17: Home computer used for study or recreation

Study/Recreation	**Frequency**	**%**
Study	21	56.8
Recreation	13	35.1
Work	1	2.7
Non Use	2	5.4
Total	37	100

Table 17. Home computer used for study or recreation was distributed between Study, Recreation, Work and Non Use. Of all participants who had computers at home, twenty-one participants (56.8%) used them for study and thirteen participants (35.1%) used them for recreation. One participant (2.7%) noted that they used their home computer for work. Two participants (5.4%) did not have a computer at home. Interestingly, the dominant use of a home computer is for study, followed by recreation.

University Computer Usage

Thirty-one participants (83.8%) indicated they used a computer at university and six (16.2%) indicated they did not use a computer at university. Of the thirty-one participants (83.8%) who did use a computer at university, their usage was: twenty-five participants 1-10 hours (67.6%), four participants 11-20 hours (10.8%) and two participants 21-30 hours (5.4%). Six participants did not use a computer at university.

University Computers Hours of Weekly Use

There are many computers available for student usage at the University of Canberra. They are located in almost every building, especially libraries, academic skills centers, divisional study rooms and computer laboratories as well as information services.

Table 18: University computers hours of weekly use

Number of Hours	**Frequency**	**%**
1-10	25	67.6
11-20	4	10.8
21-30	2	5.4
31-40	0	0.0
41-50	0	0.0
Non Use	6	16.20
Total	37	100

Table 18. Participant use of university computers shows that 25 participants (67.6%) use university computers for 1-10 hours a week. This figure may not appear a large number of hours however the computers in the University library are always in constant use as students use them for short periods to access the library catalogue, electronic databases, personal email and internet use. In the following section on Information Seeking Tools the data pertains to the use of these library and online services.

5.3 Control and Experimental Groups - Age Statistics

Table 19: Age group frequency

Age Groups	Control Frequency	Experimental Frequency	Total Frequency
15-19	6	11	17
20-24	5	8	13
25+	1	5	6
Unanswered	1	0	1
Total	13	24	37

Table 19. The age group frequency is predominately 15-19, 20-24 and 25+. The distribution for the experimental group places eleven participants (45.8%) aged between 15-19 and eight participants (33.3%) were aged 20-24. There were six (25.0%) aged 25+. One participant failed to answer the question.

In running the t test for the control group, SPSS was not able to compute the calculation as 'the correlation and t cannot be computed because the standard error of the difference is 0 because of the small number'. However, it is apparent that the two groups were essentially similar and in this respect valid comparisons might be made between them.

Information Seeking Tools

This section details participant quest for information and tool usage.

Participants were asked to provide information regarding their use of information seeking tools. The question was asked on a Likert scale from 1 to 5 with 1 - All the Time, 2 - Often, 3 - Sometimes, 4 - Not Often and 5 - Never.

The listed tools that participants could select were Library electronic databases, Library electronic journals, Library e-reserve collection, Netscape, Microsoft Explorer, Google or 'Another internet search tool'. In the case of participants selecting 'Another internet search tool', they were asked to write the name of the tool in the space provided on the questionnaire.

Library Electronic Databases

Table 20: Library electronic database use

Scoring	**Frequency**	**%**
All the time	12	32.4
Often	10	27.1
Sometimes	8	21.6
Not Often	6	16.2
Never	1	2.7
Total	37	100

Table 20. There were five categories of scoring for the use of electronic data bases. Participant use, in descending order shows that twelve participants (32.4%) used library electronic databases all the time, ten (27.1%) used them often, eight (21.6%) used them sometimes, six (16.2%) used them not often. One participant (2.7%) never used Library Electronic Databases. The most notable of the above figures may be the representation that 59.5% of participants use the library electronic databases all the time or often and 18.9% used them either not often or never. Interestingly the 21.6% who used them sometimes might represent the 'average' information seeker who uses a variety of tools to find information.

Library Electronic Journals

Table 21: Library electronic journals use

Scoring	**Frequency**	**%**
All the time	9	24.3
Often	11	29.7
Sometimes	9	24.3
Not Often	6	16.2
Never	2	5.4
Total	37	100

Table 21. Scoring for Library electronic journals is strongly favoured towards All the time, Often and Sometimes. The descending order shows 11 participants (29.7%) used library electronic journals often, nine (24.3%) used them all the time and another nine (24.3%) used them sometimes. Six participants (16.2%) used them not often and two participants (5.4%) never used library electronic journals. Those who use the library electronic journals often are more likely to be able to use them successfully because of being the most familiar with their contents and methodology of use.

Library E-reserve

Table 22: Library E-reserve collection use

Scoring	**Frequency**	**%**
All the time	7	19.0
Often	9	24.3
Sometimes	10	27.0
Not Often	6	16.2
Never	4	10.8
No Answer	1	2.7
Total	37	100

Table 22. Use of the Library e-reserve was not answered by one participant. However, in descending order the scoring shows 10 participants (27.0%) used the library e-reserve sometimes, nine (24.3%) used them often, seven (19.0%) used them all the time, six (16.2%) used them not often. It is interesting in making a comparison of participant use of library electronic journals and library e-reserve is that 10.8% never use library e-reserve and 5.4% never use library electronic journals. One participant failed to answer the question and was excluded from the above calculation. The 'sometimes' use of the library e-reserve materials by 27.0% of the participants is moderately strong evidence suggesting that the group was representative of the student population as course conveners and lecturers place their online resources in the library e-reserve collection.

Netscape

Table 23: Netscape use

Scoring	**Frequency**	**%**
All the time	1	2.7
Often	2	5.4
Sometimes	4	10.8
Not Often	3	8.1
Never	23	62.2
No Answer	4	10.8
Total	37	100

Table 23. Netscape use does not indicate popularity amongst the participants. The scoring shows that twenty-three participants (62.2%) never use Netscape and one participant (2.7%) uses it all the time. This is interesting as Netscape had been considered a popular web interface.

Microsoft Explorer

Table 24: Microsoft Explorer use

Scoring	**Frequency**	**%**
All the time	14	37.8
Often	7	19.0
Sometimes	4	10.8
Not Often	1	2.7
Never	8	21.6
No Answer	3	8.1
Total	37	100

Table 24. Microsoft Explorer use is indicates that it is the most popular amongst the participants. The result shows that fourteen participants (37.8%) used Microsoft Explorer all the time. In making a comparison of participant use of Microsoft Explorer and Netscape, there is a decrease of 40.1% of participants who never use Microsoft Explorer. At the other end of the spectrum, 2.7% of participants use Netscape all the time and 37.8% use Microsoft Explorer all the time, being a difference of 35.1%. Consequently, Microsoft Explorer appears more popular.

Google

Table 25: Google use

Scoring	**Frequency**	**%**
All the time	22	59.5
Often	10	27.0
Sometimes	3	8.1
Not Often	0	0.0
Never	2	5.4
Total	37	100

Table 25. The use of Google All the Time and Often was the most popular response. In descending order, participant use of Google indicates that twenty-two participants (59.5%) used Google all the time and 2 (5.4%) never used Google. The scoring for participant use of Google is not surprising as previous empirical and survey research reveal similar figures. However, when participant use of all the time use of Google is compared with the use of library electronic databases there is a difference of 27.1% as 32.4% of participants use electronic databases and 59.5% use Google. Comparing all the time use of Google with the use of library E-reserve, with 19.0% who use E-reserve all the time and 59.5% who use Google all the time shows there is a 40.5% difference. It must be acknowledged that while various search tools available for students may not be exclusively used, the statistics in favour of Google is evidence of its popularity.

Comparison of User Information Seeking Tools

Table 26: Comparison of information seeking tool use

Tool	All the time %	Often %	Sometimes %	Not Often %	Never %
Electronic Databases	32.4	27.1	21.6	16.2	2.7
Electronic Journals	24.3	29.7	24.3	16.2	5.4
E-reserve	19.0	24.3	27.0	16.2	10.8
Netscape	2.7	5.4	10.8	8.1	62.2
Microsoft Explorer	37.8	19.0	10.8	2.7	21.6
Google	59.5	27.0	8.1	0.0	5.4

Table 26 is a comparative table showing the percentage of participants who use various information seeking tools. The widest variation is between Netscape and Google. Netscape is never used by 62.2% of participants and Google is used all the time by 59.5% of participants. This is an indication that the use of non-academic research tools for information seeking is significant.

Other Search Engine or Search Tool

Table 27: Other search engine or search tool use

Scoring	**Frequency**	**%**
All the time	7	18.9
Often	8	21.6
Sometimes	9	24.3
Not Often	3	8.2
Never	4	10.8
No Answer	6	16.2
Total	31	100

Table 27. Other search engine or search tool results are varied. In descending order, use of another search engine or search tool shows that, nine participants (24.3%) sometimes used another search engine, eight (21.6%) often used one, and seven (18.9%) used one all the time. These statistics indicate the variety or number of search engine or search tools participants use for their information seeking needs, thus widening and/or increasing their search.

Other Self Nominated Search Engine

Table 28: Named other search engines or information search tools

Other Tools	**Frequency**	**%**
Yahoo	6	16.20
Dogpile	2	5.4
Mozilla FireFox	2	5.4
Altavista	1	2.7
MSM	1	2.7
Wikipedia	1	2.7
Newspaper Websites	1	2.7
Amazon	1	2.7
Safari	1	2.7
Altavista and Google Scholar	1	2.7
MSN and Yahoo	1	2.7
Altavista and Yahoo	1	2.7
Wikipedia and MSN	1	2.7
Yahoo and Ask Jeeves	1	2.7
No Answer	16	43.2
Total	21	100

Table 28. The most indicated participant response for named other search engines or tools was Yahoo. Sixteen participants (43.2%) indicated that they used another information seeking tool apart from those listed in the pre-test questionnaire however they failed to provide a name of the other tool/s they used. Of those who did indicate the name of the tool, the most named was Yahoo with six participants (16.20%). It is a surprising result that the majority nominated Yahoo as it is not a purpose designed search tool, but rather a directory with links to information, and does not support advanced features similar to Google 'Advanced'. Yahoo is also not necessarily related to academia.

Of the above websites listed by participants as being used for their information seeking, it is interesting to note that a number of them use programs on the World Wide Web that are not information seeking or web search tools and of the fifteen different tools noted**,** some of them were www browsers, newspaper websites and encyclopedias.

Demographic Summary

In the previous section detailing participant demographics the following results detail the dominant or highest scoring percentages.

Table 29: Participant demographics and percentages

Dominant age group	15-19	45.9%
Gender	Female	67.6%
Country of birth	Australia	83.8%
Country of primary education	Australia	78.4%
Secondary education	Australia	83.8%
Years living in Australia	10-19	59.5%
Course enrolled at the University of Canberra	Arts International Studies	29.7%
Number of subjects completed	4	56.7%
Full or part time student	Full time	86.5%
Born and educated only in Australia	25	67.6%
Language - first language	English	89.2%
Language - second language	None	56.7%
Language - spoken in current residential home	English	83.8%
Language - skill when arrived in Australia	Not Applicable	86.5%
Participant comfort - computer technology	Moderately comfortable	55.6%
Hours of weekly use of home computer	1-10 and 11-20	Equal on 32.4% each
Home computer use	Study	56.8%
Hours of weekly use of university computer	1-10	67.6%

Table 29 participant demographics and percentages shows the highest representative results for all participants in the experiment. The results indicate that 83.8% of participants speak English as their first language in their current residential home and 89.2% of them state that English is their first language. Interestingly, 83.8% were Australian born, 86.5% were full time students and the dominant age group was 15-19 which represents 45.9% of the sample.

The summary of Pre-test Questionnaire Demographics above shows that the dominant participant gender is female, is Australian and uses a home computer for study, and has completed four subjects in Arts/International Studies. Regarding computer technology, participants are comfortable and regularly use a variety of information seeking tools for their information seeking, however Google and Yahoo are the dominant choice.

Table 30: Dominant information seeking tools and percentage

Library Databases	All the time	32.4%
Library Electronic Journals	Often	29.7%
Library E-reserve	Sometimes	27.0%
Netscape	Never	62.2%
Microsoft Explorer	All the time	37.8%
Google	All the time	59.5%
Another Search tool or facility	Sometimes	24.3%
Yahoo	No mention of frequency	16.20%

Table 30 depicts the eight most dominant information seeking tools. The results show that Library electronic databases are often utilized by over one third of respondents. However, 59.5% of respondents nominated Google as being used all the time. The use of various different www information seeking tools is indicative that information seekers use a variety of tools and nominated facilities such as Microsoft Explorer. The next stage in the comparative study was to examine the results of the experimental group pre-test question.

5.4 Experiment Pre-test Results

Introduction

The first step in the experiment was the pre-test questionnaire, the second step was participants' use of Rootza or Google (depending on whether they were in the control or experimental group). The third step was the post-test questionnaire which was different in scope to the pre-test questionnaire. This is because it was shorter, and besides providing the second half of the evaluation of participant search terms, it also provided qualitative input into the value of the online core concept thesaural database and web page, collectively named Rootza.

The post-test questionnaire again asked the research questions however, participants were also asked to write down the search terms they remembered using during the experiment. Following the three questions on search terms participants remembered using, participants in the experimental group were also asked to write down as many of the six steps of information seeking they remembered from the experiment. Participants in the experimental or control groups who could not name any steps or search terms particular questions were excluded from the statistical calculations. The name and number of core concepts used by participants were entered into SPSS by the researcher.

As a process to address the research question, before the analysis and evaluation of results was to be examined it was initially determined to establish novice and experienced categories and the differences between them. This was based on a combination of the amount of participant usage of computers both at home and university, how many online web based information seeking tools the participant used and whether this use was frequent or infrequent. Additionally, participant comfort level with computer technology was considered a factor.

A review of other evaluation methods to identify novice information seekers (Marchionini, [1995], Marchionini and Komlodi [1993], Lazonder and Biemans [2000]) had established that the criteria of less than ten hours of previous use of the www accompanied with using fewer than three information tools and search engines accompanied with participant comfort level with computer technology, is an established method. Those participants who have used a computer on the www for less than ten

hours and indicated that they have never used a minimum of three of the nominated information seeking tools or search engines on the questionnaire, and are moderately uncomfortable using computer technology are determined to be novices.

It is important to note that the rapid growth and use of computers in schools, colleges, universities and homes during the last five years has produced the situation whereby very few students do not feel some degree of comfort with computer technology. What constituted a novice five years ago does not necessarily constitute a novice today.

Of the thirty-seven participants in the experiment, fourteen participants were classified as very **c**omfortable and twenty classified as moderately comfortable and two were not comfortable with computer technology. Therefore, almost all participants were considered to be experienced information seekers because of the number of various information seeking tools they used, accompanied by a large amount of hours spent using computers for information seeking. There were no novice information seekers in either the Control or Experimental group. In the experimental group there was only one participant who came close to being evaluated as a novice user. However, he/she stated he/she was very comfortable with computer technology and also used three online search tools all the time, one tool sometimes and used the computer one to ten hours a week. A second participant was also very comfortable as he/she used three tools all the time, one tool sometimes and also used the computer one to ten hours a week. A third participant was also very comfortable as he/she used two tools sometimes, four tools not often and used the computer one to ten hours a week. Participants who were comfortable used at least four tools all the time and often used at least three tools. In the control group the closest participant to a novice user was one who was comfortable, used two tools sometimes, four tools not often and used the computer one to ten hours a week.

Therefore, as the above participants reported themselves to be comfortable with computer technology and their least used tools were between two and four and they used the computer for one to ten hours a week, they did not fit the classification of a novice user. Accordingly, based on the participant answers, this research experiment had no novice users and all participants were considered experienced information seekers.

All statistics in the following figures are calculated by the number of participants in the control and the experimental groups who answered the research questions and all statistics in the following tables are calculated by the number of all participants who took part in the experiment that is, 13 for the control and 24 for the experimental groups. This was done in order to provide statistical information on the control and experimental groups and to also provide information on the numerical variation between those who answered the questions.

5.5 Knowledge of Six Steps of Information Seeking

The first component of the experiment was to determine the participant knowledge of the six steps of information seeking.

There were two questions. The first asked whether the participant was familiar with the Six Steps of Information Seeking (the Big 6) and the second asked participants to name as many of the six steps that they knew. The first question showed that five participants were familiar with the Six Steps of Information Seeking. For the second question asking participants to name any of the six steps, three named one step, one named two steps and one named three steps.

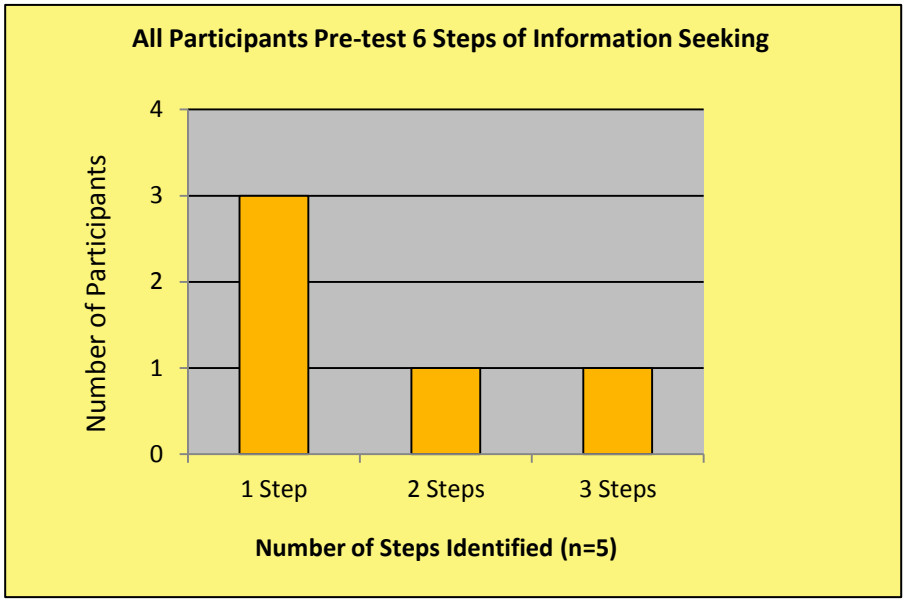


Figure 8: All participant pre-test named six steps of information seeking

Figure 9 shows there were three steps identified for the six steps of information seeking. Of the number of participants who answered this question only, the pre-test Six Steps of Information Seeking shows (8.1%) could name one step, (2.7%) could name two steps and another (2.7%) could name three steps. Thirty two participants (86.5%) of the total sample) failed to answer the question. The research suggests that because participants had noted their questionnaire with a dash (-) this indicated that they did not know any of

the steps. As well, failing to answer the question is another indication that they did not know any of the six steps of information seeking.

During the experiment a number of participants asked the researcher how to note the questionnaire if any of the six steps were unknown. The researcher advised participants to mark the question with the words 'not known', place a stroke or leave blank. Because of the importance of this particular question the researcher, observing participants who had not written anything in that area, checked by asking them if they knew any of the steps. This was because the researcher preferred to point out the question to the participants rather than chancing the participant not writing anything because they failed to see the question. The Six steps of information seeking are: Task definition, information seeking strategies, location and access, use of information, synthesis and evaluation.

Pre-test Knowledge of the Six Steps of Information Seeking

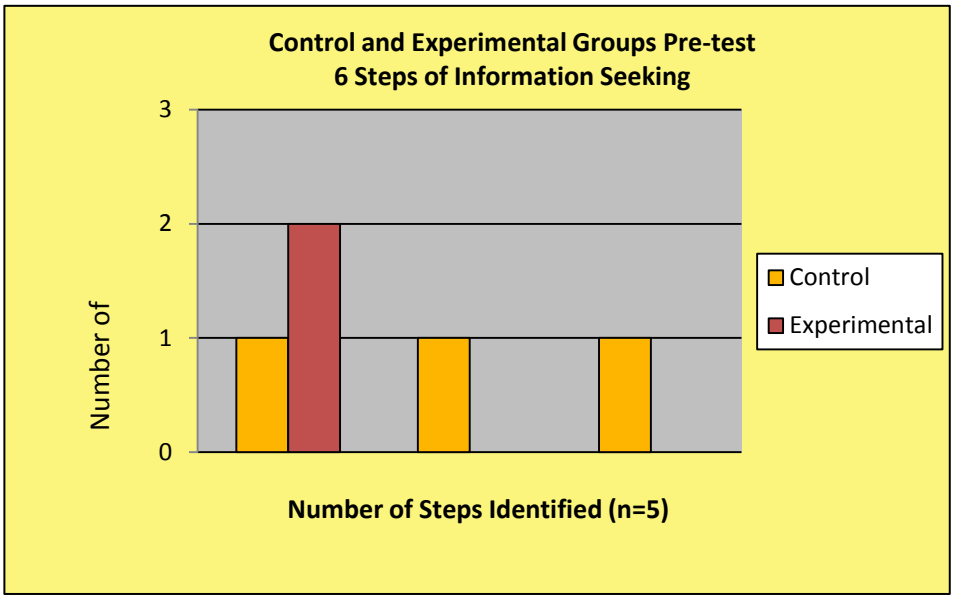


Figure 9: Both groups pre-test named six steps of information seeking

Figure 10 showing that both groups pre-test named six steps of information seeking is a comparison between the control and experimental groups pre-test participant knowledge of the six steps of information seeking. Of the three participants in the control group who answered the question, each participant named one of the six steps and two participants in the experimental group named one step. Figure 8 shows that 13.5% of

all participants could name some of the steps and 86.4% could not name any of the six steps of information seeking.

Table 31: Both groups pre-test six steps of information seeking comparison

Steps	Control Group Frequency	Control Group Participant %	Experimental Group Frequency	Experimental Group Participant %
1 Step	1	33.3	2	100.0
2 Steps	1	33.3	0	0.0
3 Steps	1	33.3	0	0.0

Table 31 is a percentage comparison between the control and experimental group's pre-test participant knowledge of the Six Steps of Information Seeking. The difference is that more of the control group named different steps than the experimental group.

Control and Experimental Groups Post-test Results

Post-test Knowledge-Six Steps of Information Seeking Comparison

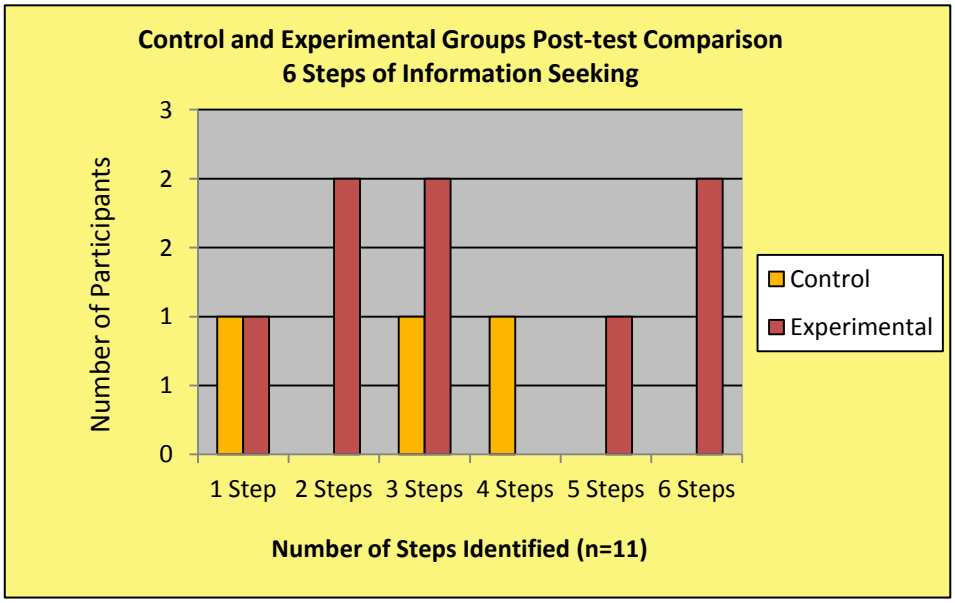


Figure 10: Both groups post-test six steps of information seeking

Figure 11 both groups post-test Six Steps of Information Seeking is a comparison between the control and experimental groups post-test participant knowledge of the Six Steps of Information Seeking. It is interesting that there was an improvement in the knowledge of the steps of information seeking because in the pre-test only two participants in the experimental group could name one step whereas in the post-test there was an increase in the knowledge of two, three, five and six steps. Consistency is evident in both the control and experimental groups naming of steps. Participants in the control group named one, three and four steps. No participants in the control group named the fifth or sixth steps. Participants in the experimental group named the first, second, third, fifth and sixth steps. Three participants (8.1%) in the control group named the first, third and fourth steps and eight participants (21.6%) in the experiment group named the first, second, third, fifth and sixth steps.

Experimental Group Pre-test Post-test comparison of Six Steps of Information Seeking

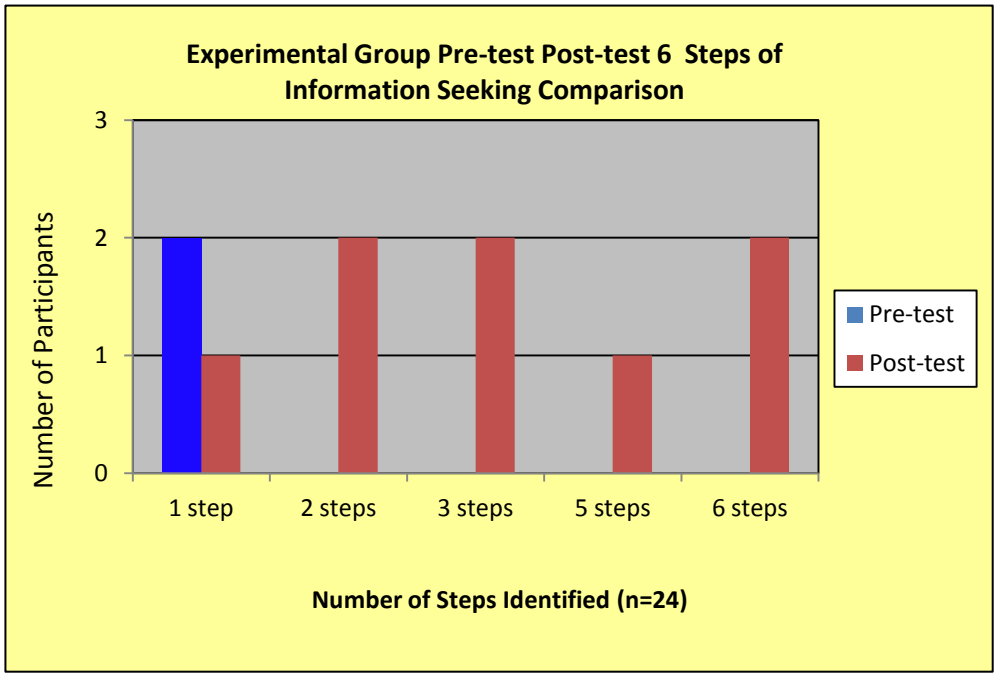


Figure 11: Experimental group pre-test post-test six steps of information seeking

Figure 12 shows the experimental group pre-test post-test six steps of information seeking revealed an increase in for the naming of the steps of information seeking. For the pre-test

only 2 steps were named. However, this increased in the post-test as two, three and five and six steps were named. Percentage wise, the post-test shows an increase from 8.1% to 21.6%, an increase of 13.5%.

Experimental Group T-test – Six Steps of Information Seeking Pre-test Post-test Results

The experimental group pre-test and post-test for the naming of the six steps terms paired sample test for shows that the t = 1.657. The sig 1 tailed result is p< 0.056. The accepted levels of significance for this experiment is 0.05 and in this test, because the probability is p<0.056, this means that the result of the Six Steps of Information Seeking comparison is statistically not significant. Although this result is not statistically significant, presumably because of the small numbers involved, it is nevertheless very close to being significant.

Control Group Pre-test and Post-test Comparison

The control group pre-test and post-test comparison above revealed that both the pre-test and post-test results were identical. One participant (33.3%) named one step, one participant (33.3%) named two steps and one participant (33.7%) named three steps.

Control Group T-test – Six Steps of Information Seeking - Pre-test, Post- test Results

In running the t-test for the control group, SPSS was not able to compute the calculation as 'the correlation and t cannot be computed because the standard error of the difference is 0 because of the small number'.

5.6 Search Terms and Questions

The three research questions put to the participants in the pre-test questionnaire to evaluate participants' ability to establish and/or develop search terms produced the following results.

Below, in descending order, are the pre-test questionnaire results with the number of written search terms, number of participants and the percentage of the total of participants for each question. This is followed by the pre-test identified search terms.

Question 1. All Participants - Identified Search Terms

This section informs on the results for Question 1 for all participants in the control and experimental groups. The question was: 'What is the effect of the White Australia Policy on Australian Society in the 20th Century?'

The types of search terms accepted were either direct from the research question such as 'White Australia Policy' 'Australian Society in the 20th Century' or a combination of the two or composites such as 'White Australia Policy in Australia' or '20th Century Australia and the White Australia Policy'. Other examples of similar terms or phrases accept were 'Indigenous Australia in the 20th Century' and 'Indigenous Australians and White Australia'.

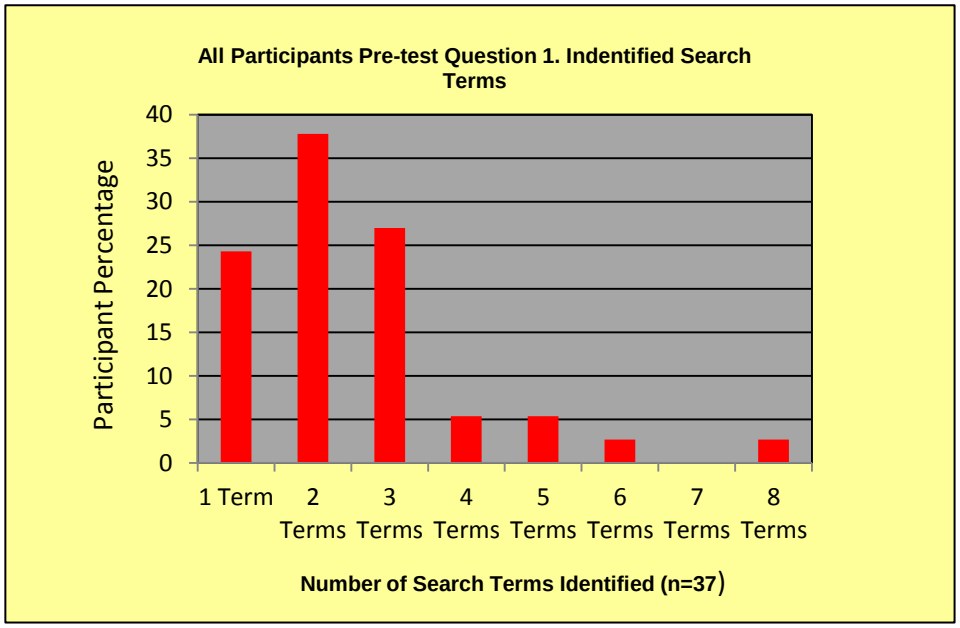


Figure 12: Question 1. Identified Search Terms

Question 1 is the first of three research questions the participants could have selected to answer. Identified Search Terms shows that in the naming of search terms 14 participants (37.8%) identified two terms, nine participants (24.3%) identified three terms and two (25.4%) each identified one term. Two participants failed to write down any terms. However, this does not mean they failed to answer the question because they could not determine the search terms, rather, they selected another question to answer.

Question 1. Control and Experimental Groups Pre-test Comparison

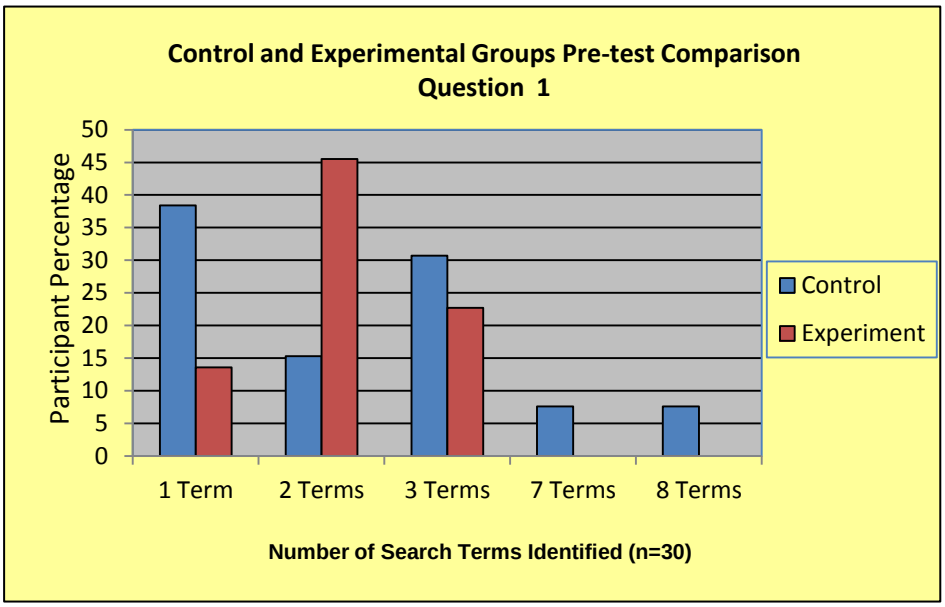


Figure 13: Question 1. Both groups pre-test identified search terms

The experimental group pre-test Question 1 shows the percentage of search terms identified by participants. The identified search terms shows that ten participants (45.5%) identified two terms, five participants (22.7%) identified three terms and three participants (13.6%) identified one term. The absence of any written search terms by participants does not indicate their lack of recognition of search terms, rather, they selected an alternative question to answer.

The control group identified more search terms than the experimental group and also one participant identified eight search terms. Of the 13 participants in the control group five participants (38.4%) identified one term, four (30.7%) identified three terms, two (15.3%) identified two terms, one participant (7.6%) identified six terms and one (7.6%) participant identified eight search terms. A total of nine participants could identify up to three terms.

Question 1. Control and Experimental Groups Post-test Comparison

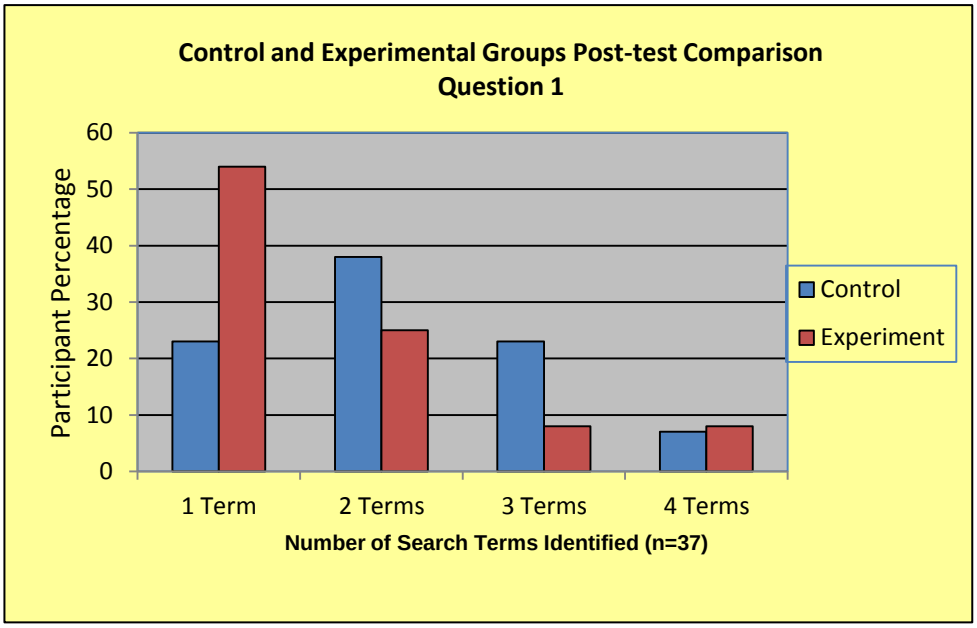


Figure 14: Question 1. Both groups post-test identified search terms

Figure 15. Control and experimental groups post-test Question 1 shows four different search terms identified. Three control group participants (23.7%) identified one term, five participants (38.4%) identified two terms, three participants (23.0%) identified three terms and one participant (7.6%) identified four terms. Of the experimental group, thirteen participants (54.1%) identified one term, six participants (25.0%) two terms, two participants (8.3%) three terms and another two participants (8.3%) identified four terms. Two things are interesting in these statistics. The first is that in the pre-test two participants in the control group each identified 6 and 8 terms and there were two participants in the experimental group who identified a fifth search term, however in the post-test these participants failed to identify as many terms.

Question 1. Control and Experimental Groups Pre-test Post-test Comparison

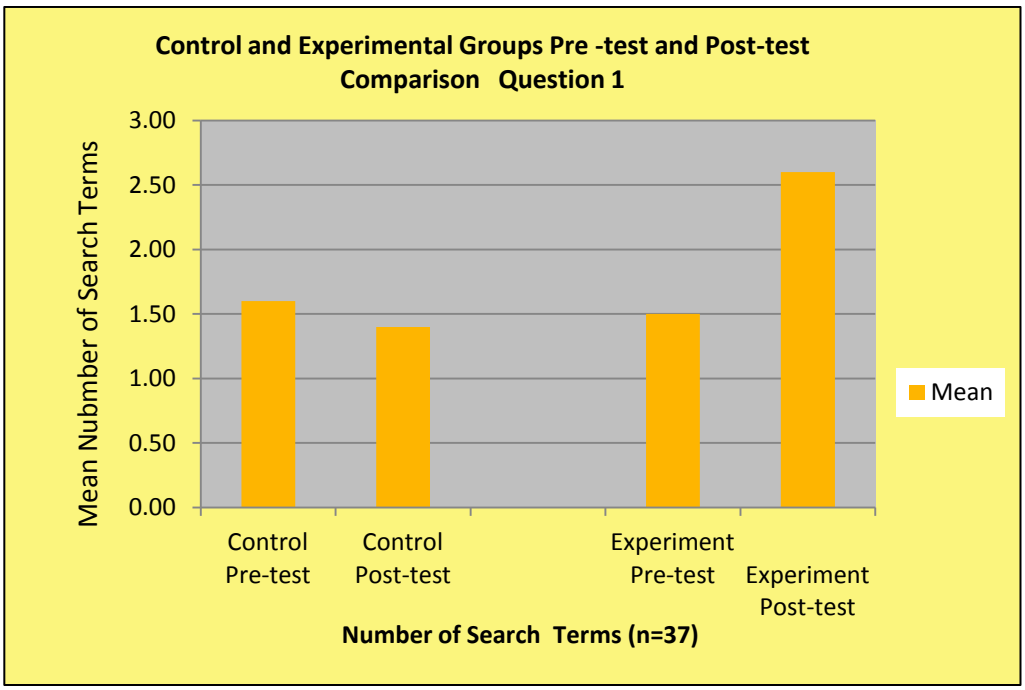


Figure 15: Question 1. Both groups pre-test post-test identified search terms

Figure 16 shows the result difference between the control and experimental groups. The pre-test and post-test comparison reveals evidence of an increase of identification of search terms with the experimental group. The mean number of search terms identified for the control group pre-test was 1.6 and the control post-test was 1.4 which is a drop of 0.2. The mean number for the experimental group pre-test was 1.6 and the experimental group post-test was 2.6 which is an increase of 1.0. Therefore, there was an improvement between the pre-test and post-test identification of search terms for the experimental group.

Question 2. All Participants Identified Search Terms

This section reports on the results for Question 2 for all participants in the control and experimental groups. The question was: 'What does the concept of intercultural awareness mean to Australians?'

The types of search terms accepted came directly from the research question such as 'concept of intercultural awareness', 'intercultural awareness in Australia' or a composite search term/phrase 'concept of Australian intercultural awareness'.

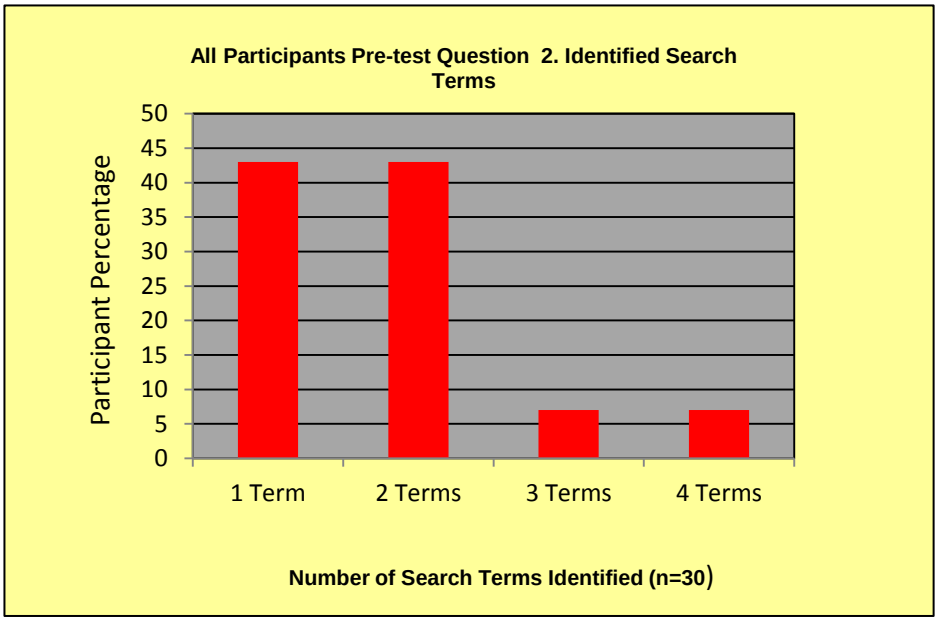


Figure 16: Question 2. All participant identified search terms

Figure 17 Question 2 identified search terms shows four different terms were identified. Thirteen participants (43.3%) identified one term, thirteen participants (43.3%) identified two terms, two participants (6.6%) identified three terms and an additional two participants (6.6%) identified four terms. Seven participants failed to identify any terms.

Question 2. Control and Experimental Groups - Pre-test

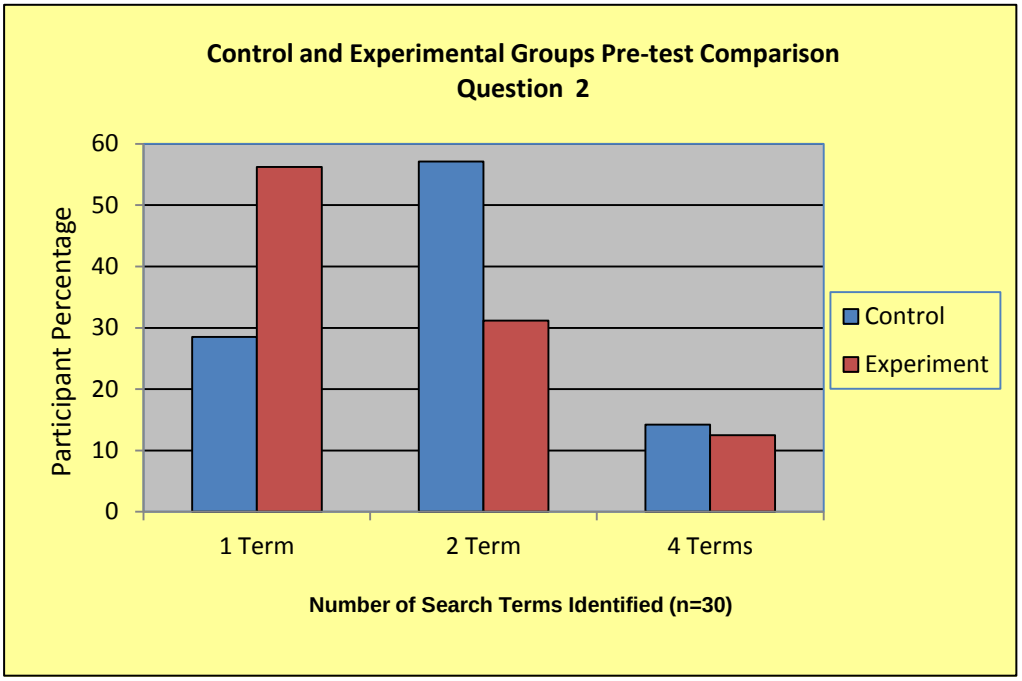


Figure 17: Question 2. Both groups pre-test identified search terms

Figure 18. The control and experimental groups pre-test comparison for Question 2 of identified shows that both the control and experiment groups identified one, two and four search terms. The experimental group result shows that nine participants (56.2%) identified one term, five participants (31.2%) identified two terms and two participants (12.5%) identified four terms. More participants in the control group identified two search terms than those in the experimental group. Four participants (28.5%) identified one term, eight participants (57.1%) identified two terms and two participants (14.2%) identified four terms. The majority of participants (56.2%) could identify two search terms. Seven participants identified no terms.

Question 2. Control and Experimental Groups - Post-test

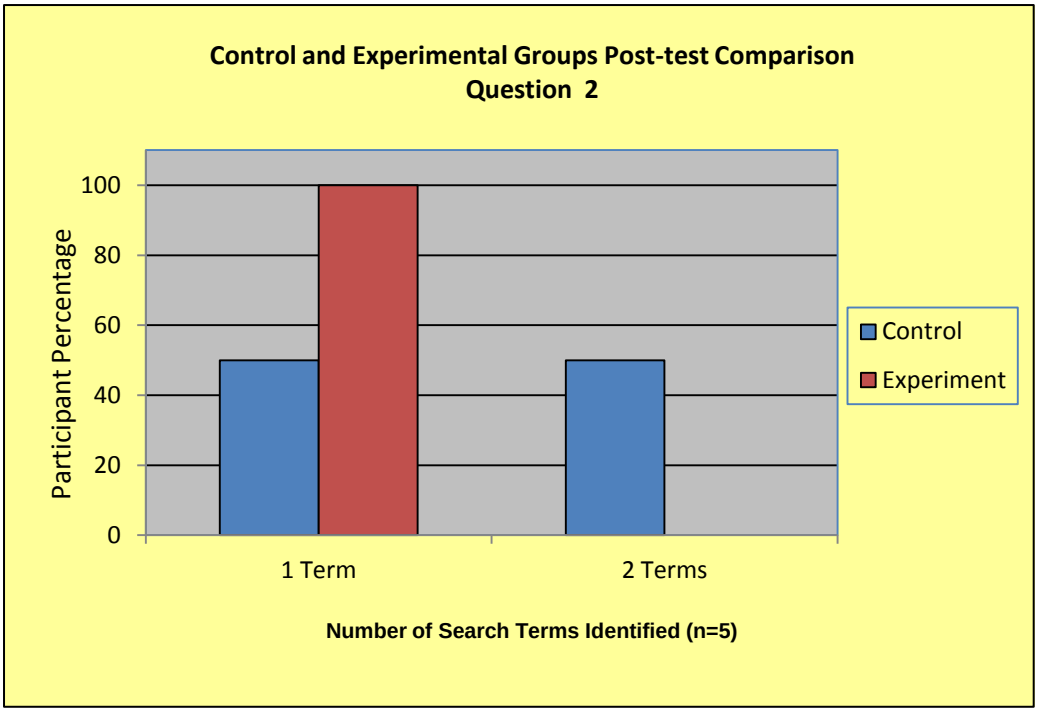


Figure 18: Question 2. Both groups post-test identified search terms

Figure 19. Control and experimental groups post-test Question 2 shows two different search terms were identified. The control group was consistent as one participant (50.0%) identified one search term and the other participant (50.0%) identified two search terms. There were three participants in the experimental group who answered this question and all three (100%) identified one search term.

Question 2. Control and Experimental Groups Pre-test-Post-test Comparison

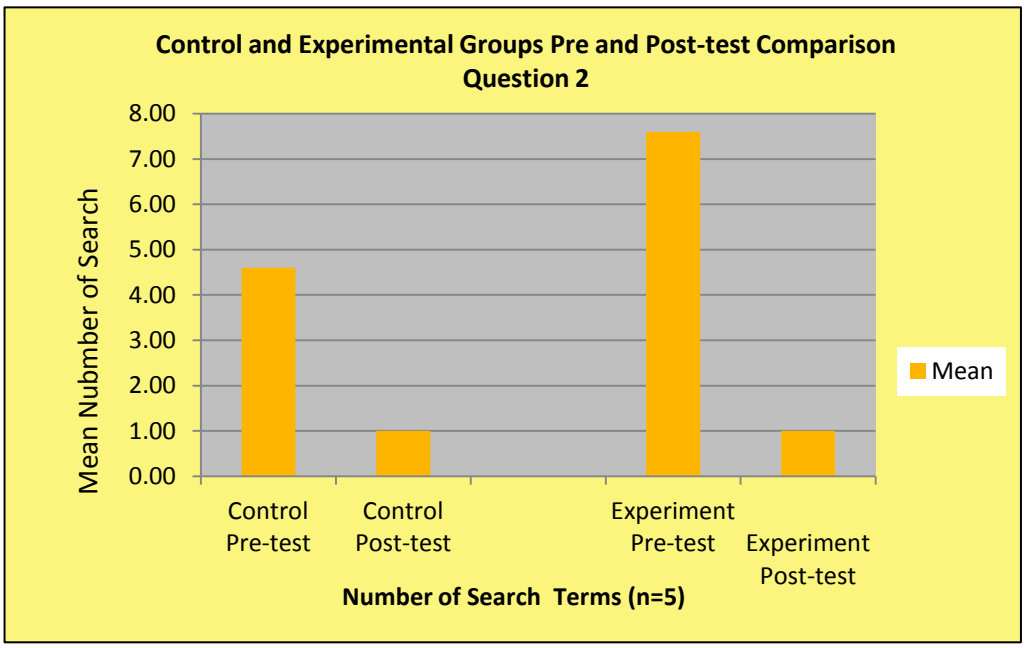


Figure 19: Question 2. Both groups pre-test post-test identified search terms

Figure 20 shows the difference between the control and experimental groups and the pre-test and post-test results. For the control group pre-test there was a mean of 4.6 identified search terms and the post-test mean was 1. This is a mean drop of 3.6 search terms between the pre-test and the post-test for the control group. The experimental group pre-test had a mean of 7.6 identified search terms and a post-test mean of 1 identified search terms. This is a mean decrease of 6.6 identified search terms. Therefore, there was a decrease of identified search terms for both the control and experimental group.

Question 3. All Participants - Identified Search Terms

This section reports on the results for Question 3 for all participants in the control and experimental groups. The question is: 'Can Australia be simultaneously colonial and post-colonial in its attitude to the indigenous population?'

The types of search terms accepted were directly from the research question such as 'Australia colonial attitude indigenous population', 'Australia post-colonial attitude indigenous population', 'Australian attitude colonial and post-colonial indigenous population', 'Australia attitude indigenous population' or a composite of these or other terms and phrases in relation to the research question. This question, being more complex in style, was designed to provide an opportunity for the participants to exhibit critical reflection and demonstrate a higher level of expertise in developing search terms.

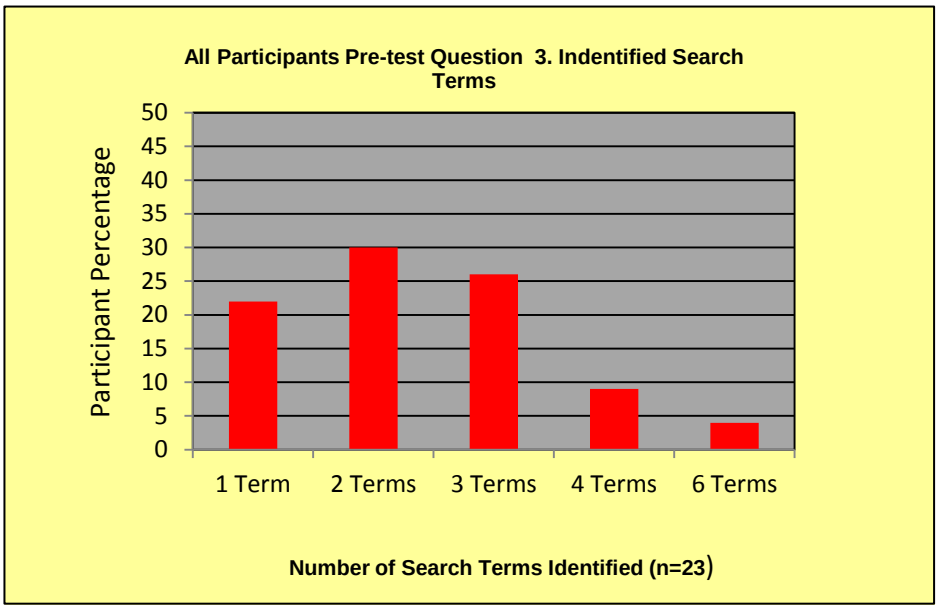


Figure 20: Question 3. All participants pre-test identified search terms

Figure 21. Question 3 identified search terms shows five different search terms were identified. Seven participants (30.4%) identified two terms, six participants (26.0%) identified three terms, five participants (21.7%) identified one term, two participants

(8.6%) identified four and five terms and one participant (4.3%) identified six terms. Fourteen participants failed to identify any search terms.

Question 3 has also drawn surprising results with the number of search terms identified. Considering that the third question was designed to encourage participants to be critically reflective and develop their own search terms for the question rather than have it provided to them, there were two participants who identified four and five search terms for this question.

Because of the increasing complexity of the questions and the search terms being not so obvious in the later questions, deeper critical thought on participants' behalf was needed to develop the search terms. Therefore, as the questions became harder the amount of responses to the questions became less. However, more interesting is that one participant developed a long research term string that was 'Colonial and post-colonial attitude to indigenous Australian population'.

Question 3. Control and Experimental Groups Pre-test

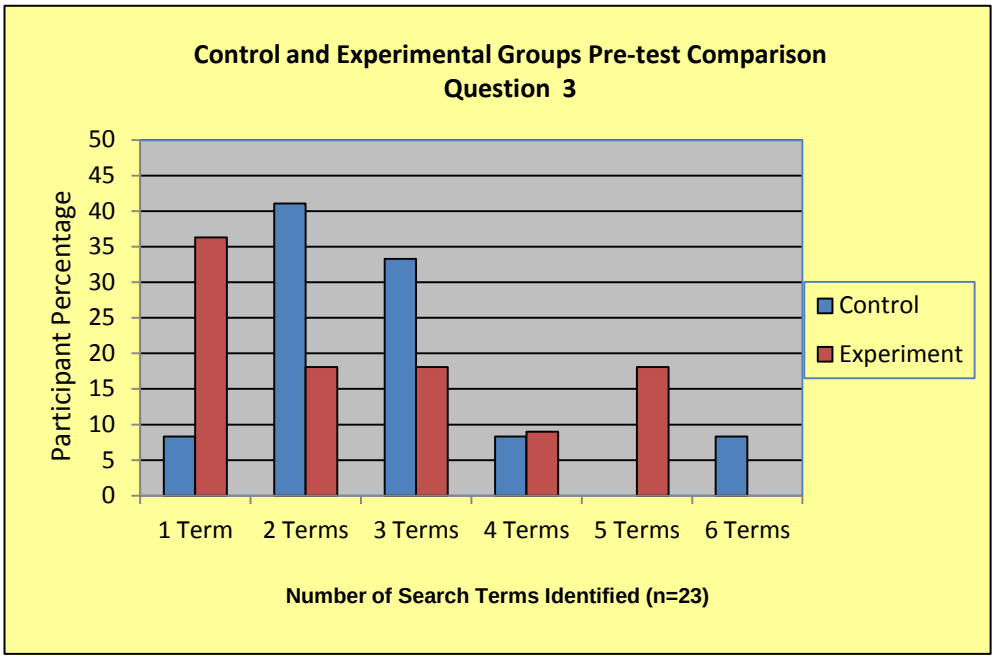


Figure 21: Question 3. Both groups pre-test identified search terms

Figure 22 compares the control and experimental groups pre-test Question 3. The control group identified search terms shows that one participant (8.3%) identified one term, five participants identified (41.1%) two terms, four participants (33.3%) identified three terms, one participant (8.3%) identified four terms and one participant (8.3%) identified six terms.

Of the experimental group, four participants (36.3 %) identified one term, two participants (18.1%) identified two terms with another two participants (18.1%) identifying three terms. One participant (9.0%) identified four terms and two participants (18.1%) identified five search terms. No participant in the experimental group named six terms. Three participants failed to nominate any search terms.

Control and Experimental Groups Post-test Comparison Question 3

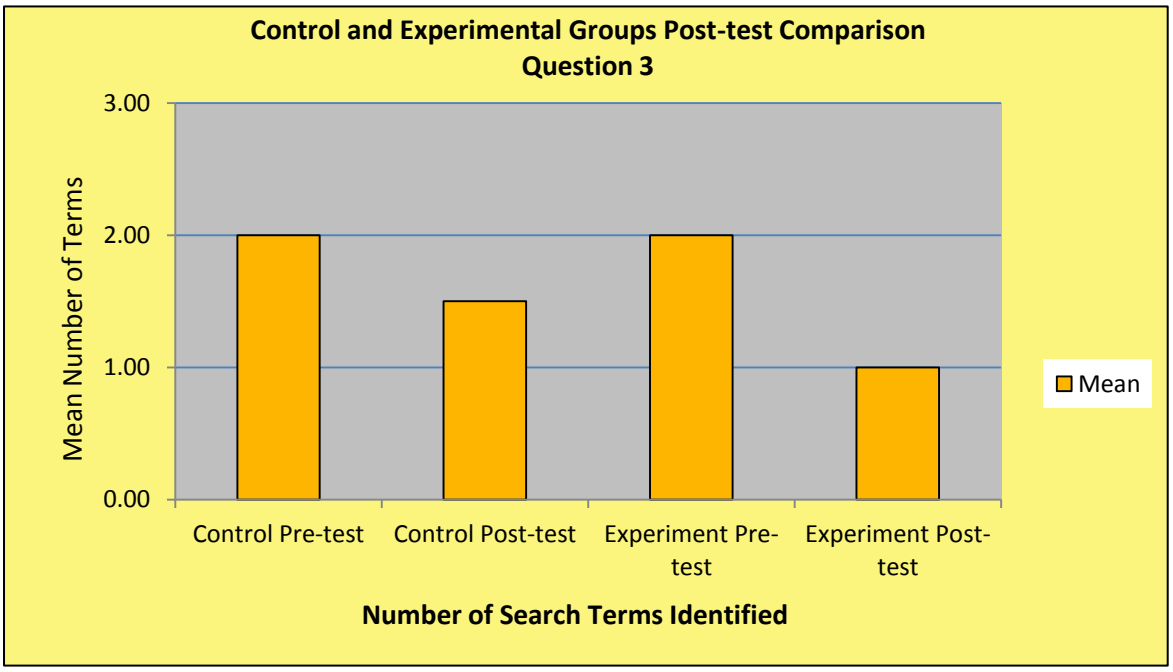


Figure 22: Question 3. Both groups post-test identified search terms

Figure 23. In the post-test, Question 3 few participants identified search terms. The control pre-test mean number of terms was 2.0 and the post-test was 1.5. This is a decrease of 0.5 mean terms. For the experimental group the pre-test number of terms was 2.0 and the post-test was 1.0. This is a decrease of 1.0 mean terms.

An interesting point is that one participant who answered the question 'Can Australia be simultaneously colonial and post-colonial in its attitude to the indigenous population?' wrote down the search terms remembered using as: 'Greenhouse emissions, environment, environmental law, environmental policy'. This participant was also able to identify three of the six steps in information seeking. However, in reviewing the pre-test questionnaire, this participant had added an additional question: 'Q4. and the proposed search terms Environmental Kyoto, Environmental regulation'.

5.7 Control and Experimental Groups Pre-test Post-test Comparison

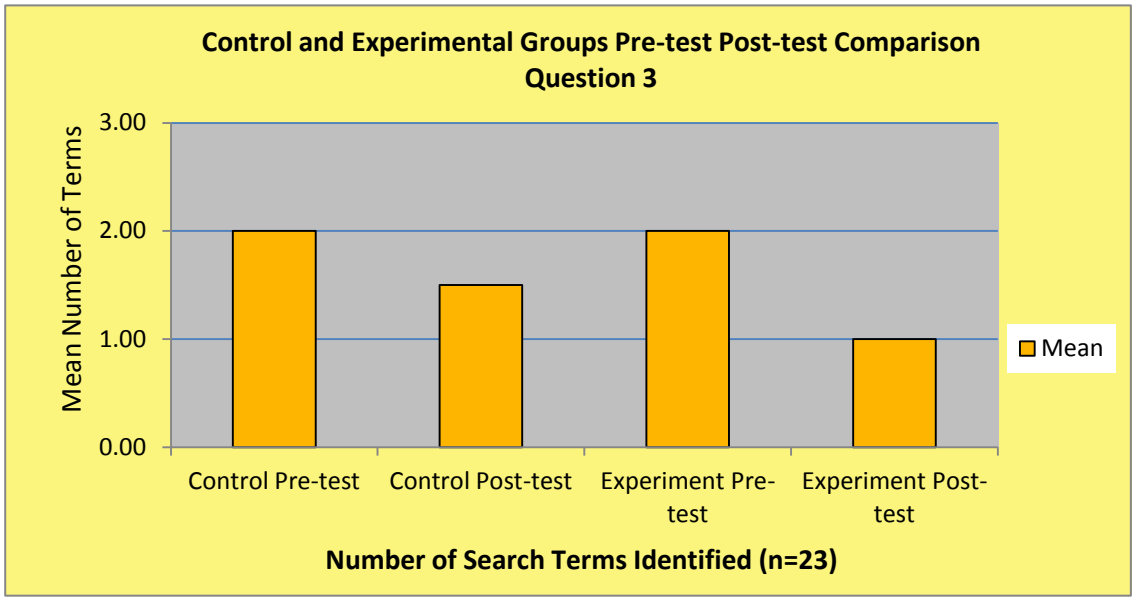


Figure 23: Question 3. Both groups post-test identified search terms

Figure 24 shows the difference between the control and experimental groups and the pre-test and post-test results. In Question 3 the control group pre-test had a mean of 2.4 identified search terms and the post-test mean was 1.5 identified search terms. Thus, there was a mean decrease of 0.9 identified search terms between the pre-test and the post-test. The experimental group pre-test mean was 2.2 identified search terms and the post-test was a mean of 1.0 identified search terms. This was a mean decrease of 1.2 identified search terms between the pre-test and post-test for the experimental group. The results for Question 3 are similar for both the control and experimental groups because there was a consistent drop between the pre-test and post-test results.

5.8 Experimental Group T-test – Search Term Identification Pre-test Post-test Results

The experimental group pre-test and post-test for the identification of search terms paired sample test for comparing participant knowledge search terms shows the t = 1.393. The sig 1 tailed result was p< 0.118. The accepted levels of significance for this experiment was 0.05 and because the probability is p<0.118 this statistically shows that the result of the search terms comparison is not significant.

5.9 Web page Criteria Evaluation for Academic Citation

There were three steps in the experimental research. They were: the Six Steps of Information Seeking, Participant Identification of Search Terms, and Knowledge of Six Criteria to Evaluate Web Pages for Academic Citation.

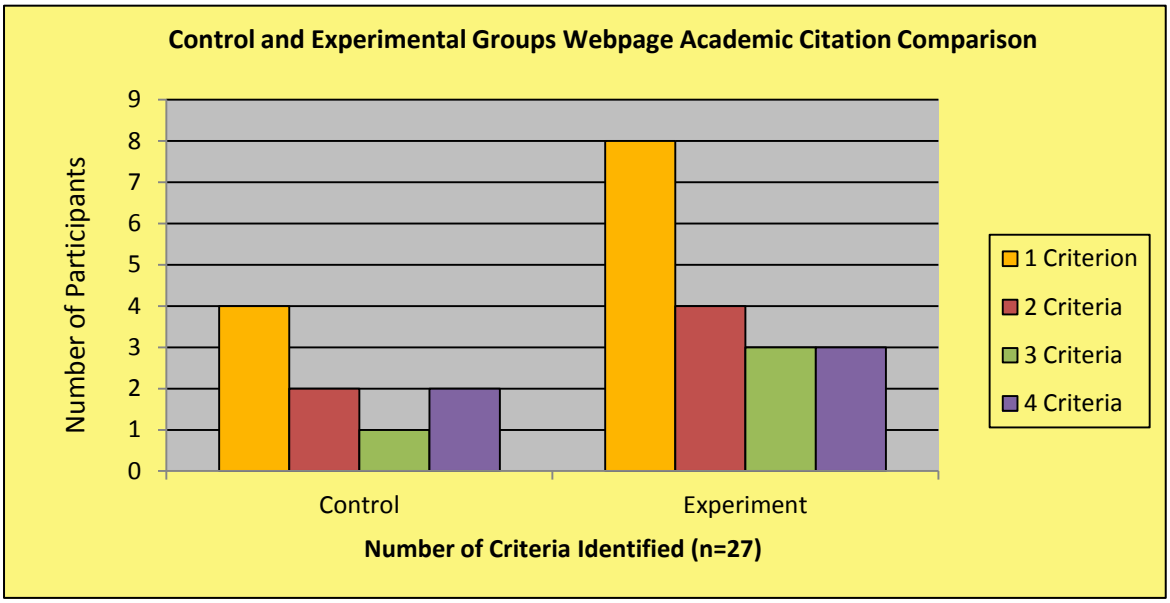


Figure 24: Both groups' criteria for academic citation comparison

Figure 25 shows the comparison between the control and experimental group identification of criteria for online academic citation. Of the experimental group

participants, eight (44.4%) addressed one criterion, four participants (22.2%) addressed two criteria, three participants (16.6%) addressed three criteria and another three participants (22.2%) addressed four criteria.

Of the control group, four participants (44.4%) addressed one criterion, two participants (22.2%) addressed two criteria, one participant (11.1%) addressed three criteria, and two participants (22.2%) addressed four criteria of online academic citation. This indicates that the experimental group performed noticeably better.

5.10 Participant Opinion of the Online Search Tool

The opinions of participants in the experimental group of the online search tool's database and web page were evaluated. As the questions in the pre-test were: 'In your own words, what is your opinion of using computers and the www for information seeking?' and 'In your own words, how comfortable are you of using computers and the WWW for information seeking'; and questions in the experimental group post-test were: 'In your own words, what are your thoughts and opinion of the thesaurus WEB PAGE' and 'In your own words, what are your thoughts and opinion of the core concept THESAURUS?'; the analysis of the data is qualitative. During the sessions participants' other expressions and opinions were mixed. Some expressed the thought that the online core concept thesaural database and web page would be especially good for people who are not studying as they have little idea how to effectively search the www. Other participants expressed the thought it was good but the web page looked too complex to follow. Whilst observing and listening to the participants during the experiment, it seemed obvious that they were trying to follow a logical search pattern whilst using Rootza but because the interface is different and something to which they felt unaccustomed, they tended to click on buttons and urls to see where the links went. Therefore, most participants were using the tool to browse rather than search.

Phase 1 Evaluation Tool

The researcher had previously established the scoring system on the Likert Scale of one to eight to be: 1 = strongly agree, 2= agree, 3= moderately agree, 5= neutral, 6 moderately disagree, 7= disagree.

The semantic differential and presenting pairs of adjectives related to the words and phrases are detailed in Table 32 below.

Table 32: Differential presenting pairs of adjectives

	1	2	3	4	5	6	7	
Important	____:	____:	____:	____:	____:	____:	____	unimportant
irrelevant	____:	____:	____:	____:	____:	____:	____	relevant
useless	____:	____:	____:	____:	____:	____:	____	useful
valuable	____:	____:	____:	____:	____:	____:	____	worthless
beneficial	____:	____:	____:	____:	____:	____:	____	not beneficial
matters to me	____:	____:	____:	____:	____:	____:	____	doesn't matter to me
uninterested	____:	____:	____:	____:	____:	____:	____	interested
significant	____:	____:	____:	____:	____:	____:	____	insignificant
boring	____:	____:	____:	____:	____:	____:	____	interesting
unexciting	____:	____:	____:	____:	____:	____:	____	exciting
appealing	____:	____:	____:	____:	____:	____:	____	unappealing
mundane	____:	____:	____:	____:	____:	____:	____	fascinating
essential	____:	____:	____:	____:	____:	____:	____	nonessential
undesirable	____:	____:	____:	____:	____:	____:	____	desirable
wanted	____:	____:	____:	____:	____:	____:	____	unwanted
not needed	____:	____:	____:	____:	____:	____:	____	needed

Table 32 shows fifteen pairs of adjectival descriptions.

When analyzing these results the researcher transposed the negatively phrased pairs to provide a positive gradient. That is, if ‘important’ was on the left of the scale and ‘unimportant’ on the right as presented to the participants, this was then converted to ensure that all very positive responses, i.e. important, wanted, needed etcetera were given‘1’ on the scale. Correspondingly unimportant, unwanted and not needed etcetera were scored‘7’ being the least positive. Therefore, the figures quoted below consistently use a Likert scale of one to seven, one being Important and seven being Unimportant.

Participant thoughts and opinions of the online core concept thesaurus database revealed that the top five positive responses were; ‘Significant’ 86.37%, ‘Essential’ 86.36%, ‘Useful’ 77.73%, ‘Important’ 72.73% and ‘Interested’ 72.27%. At the other end of the scale the most negative responses were; ‘Fascinating’ 45.45%, ‘Matters to Me’ 54.55% ‘Interesting’ 59.09%, ‘Exciting’ 59.10% and ‘Wanted’ 64.64%.

Participant thoughts and opinions of the core concept thesaurus web page revealed that the top five positive responses were; ‘Useful’ 82.67%, ‘Valuable’ 78.28%, ‘Significant’ 78.26%, ‘Wanted’ 78.26% and Beneficial’ 78.25%. At the other end of the scale the most negative responses were; ‘Fascinating’ 52.17%, ‘Exciting’ 52.18%, ‘Matters to Me’ 56.52%, ‘Needed’ 60.87% and ‘Relevant’ 65.22%.

These results are interesting as there is a positive response from the participants. For both the core concept database and the web page the majority felt that the web page was Significant and Useful.

Core Concept Thesaural Database – Differential Statistics

The differential statistics in the table below are percentage placements of the adjectives in which participants noted their order of placement. They have been worked out using the Likert scale of the core concept database statistics. Each adjective has a percentage factor of Positive, Neutral and Negative. The positive percentages are represented by the participants who saw the individual adjective as a positive, the neutral percentages are the percentages that saw the adjective as neither positive nor negative and the negative percentages are those who thought the adjective was a negative. The differential percentages are the percentage difference between the positive percentage and the negative percentage with the '+' or '-' distinguishing whether the percentage was favourable or unfavourable. The percentage difference was used to quantify the overall placement of the participant opinion of the adjectival term and in turn, the core concept thesaural database.

Adjective	POSITIVE	Neutral	NEGATIVE	% Differential
Significant	78.26	17.39	0.00	+78.26
Wanted	78.26	13.04	4.35	+73.91
Useful	82.67	4.35	8.70	+73.97
Beneficial	78.25	13.04	4.35	+73.90
Valuable	78.28	8.70	8.70	+69.58
Interested	73.97	13.04	8.70	+65.27
Desirable	73.91	13.04	8.70	+65.21
Interesting	73.97	8.70	13.05	+60.92
Appealing	69.57	17.39	8.70	+60.87
Important	69.56	17.39	8.70	+60.86
Essential	69.57	13.04	13.05	+56.52
Needed	60.87	26.09	8.70	+52.17
Relevant	65.22	21.74	13.05	+52.17
Matters to Me	56.52	30.43	8.70	+47.82
Fascinating	52.17	30.43	13.05	+39.12
Exciting	52.18	21.74	17.39	+34.79

Table 33: Participant opinion of Rootza -the online search tool

Table 33 shows that the overall reception of Rootza – the online search tool was positive as none of the positive results were below 52.17%. Participant opinion indicated that 78.26 felt the tool was Significant and there were no negative opinion of the tool.

Participant Opinion

Participant opinion of the online tool's web page design and the thesaurus drew positive and constructive responses. The web page opinions revealed three issues that ranged from good simple design, focused results to inaccuracy of results. The thesaurus revealed two issues which were the thesaurus is good and the thesaurus needs work.

Thirteen participants expressed the opinions that the tool was a good design, simple to use and it saved time. Five participants thought the tool was good for studies and excellent with focused results. Two participants were moderately happy with the design. There were no negative responses.

Generally these results may be divided between the Graphical User Interface (GUI) and the results generated from searches.

The GUI comments were:

'Need larger print for key points';
'The web page was simple and easy to use';
'Easy to understand and use for searching was very clever';
'Easy to understand and find things. Navigation is simple';
'It was a little hard to follow, takes a while to figure out how to search etcetera.';
'Can be simplified for easier use especially the limiting of the search areas/domains';
'Pretty basic which is good in order to help those who are not great at computers';
'Clearly set out';
'The design is good and easy to use';
'Looks good, the search bars should be higher up though for quicker access';
'It is relatively easy to use. It makes using Google much easier';
'I think the layout is fine and uncomplicated so long as it is clear what the functions on the site are, I don't think the layout matters at all';
'Easy to understand and find things. Navigation is simple';
'Saves lots of time'.

These results indicate that generally, participants were happy overall with the web page design but also made comments where the design could be improved. Those suggestions are in the area of size of the fonts, the interface needs to be simplified, and search bars could be more prominent.

The thesaurus tool comments were:

‘Very useful in finding web pages’;

‘Good idea’;

‘Good’;

‘Very useful in finding web pages’;

‘A number of the pages come up in German, otherwise web pages were good – nice not to have promotional material’;

‘Could be very useful, needed a bit more time to find information, would be great for assignments’;

‘As a web page it is more useful but only if you use the correct terms’.

As with the GUI, the responses were generally positive but there was also the addition of suggestions to improve the tool. These comments related to continuing to exclude the tool from commercial web pages and the importance of using the correct search terms. The comment that the tool’s web page is only useful if the correct search terms are used is interesting. It is an interesting comment as this participant recognizes the importance of using correct search terms when information seeking.

The researcher was mindful of all participant comments as this was the factor in redesigning the graphical user interface and refining the tool’s search processes.

Phase 1 Experiment Summary

The earlier experimental statistics detailed the results for all participants. Before participants were sought, and because the subject *International Foundations Studies* in previous years had a large component of international students and mature aged students enrolled, it was hoped that the experiment would have strong representation from these two groups. Additionally, at the design stage of the experiment, after a small amount of empirical evidence had been gathered, it was also expected to source a number of novice information seekers. The sample actually obtained did not reflect the demographics, lacking international, mature and novice information seekers. Accordingly, there was not a sufficient number in the sample to enable satisfactory conclusions to be drawn about these groups. Therefore, demographics in the pre-test questionnaire that consist of nationality and language skills were not able to be used as had been intended. Additionally, since this research commenced there has been rapid growth of computers in private homes, educational institutions and public areas. This growth has resulted in the increased computer skills of students in westernized countries and therefore, there are very few students and other people who may be classified as inexperienced www information seekers. This suggests an increase in digital literacy skills although not necessarily information literacy skills.

Because of ethical issues in the experiment, participants were anonymous and those who had participated were not able to be contacted for a follow up post-experiment evaluation. The following summary of the experiment results reflects the above factors.

Of the three prominent areas of the experiment, participant knowledge of the Six Steps of Information Seeking was the most important. The pre-test results showed that only two participants could name three steps, and one participant named two. Accordingly, at the commencement of the experiment 86.4% of participants could not identify any of the steps however at the end of the experiment this had decreased to 78.4%.

The post-test result revealed an increase from the pre-test to the post-test. That the result of the experiment for the six steps of information seeking revealed an increase

from 13.5% to 21.6% improvement in the knowledge of the Six Steps of Information Seeking which is an increase of 8.1%.

The second prominent area of the experiment was search term identification. There were three research questions of which participants could choose any or all to answer in identifying their search terms.

In summary, the comparison of identification of search terms for the control and the experimental groups with the three questions with the pre-test and post-test results positive for Question 1. Question 1 resulted in a decrease of 0.2 mean terms for the control group and the experimental group increased by 1.0 mean terms. Question 2 resulted in a decrease of 3.6 mean terms for the control group and a decrease of 6.6 for the experimental group. Question 3 resulted in a mean term decrease of 0.5 for the control group and a decrease of 1.0 for the experimental group.

The control pre-test mean number of terms was 2.0 and the post-test was 1.5. This is a decrease of 0.5 mean terms. For the experimental group the pre-test number of terms was 2.0 and the post-test was 1.0. This is a decrease of 1.0 mean terms.

Knowledge of web page academic citation criteria was not considered the most dominant element necessary to answer the research question. The result revealed that eight participants (44.4%) addressed one criterion, four participants (22.2%) addressed two criteria, three participants (16.6%) addressed three criteria and three participants (22.2%) addressed four criteria of academic value. Considering there were twenty-four participants in the experimental group it could be of concern to educators that eight participants could address only one criterion. This is an indication that educators are advised to place more emphasis on the evaluation of research materials.

This researcher held the opinion that users who used library electronic databases all the time or often would be more likely to be experienced information seekers compared to those who used Google or another similar web based tool all the time or often. It must be noted, that at the time of the experiment, Google Scholar was in its infancy and therefore not known to exist by many information seekers.

Some of the independent variables in the study were: age, gender, self confidence, language skill, computer skills, previous knowledge of the subject core concepts, existing knowledge of the subject and educational background, knowledge of the internet, www and search engines such as Google and Excite as well as knowledge of internet interfaces such as, Netscape, Microsoft Explorer, Mozilla and Opera.

Although it was thought the variables would be significant in the research, their effect was not particularly great. Although the participant demographics may have shown that there was a wide variation of age, gender and language skill this did not have a significant impact on the study because the majority of the participants were aged between fifteen to twenty four years, gender was mainly female and the majority of the participants were Australian born and educated in Australia where English was their major language. Computer skills did not play a significant role either, as the majority of participants had computers at home and also used computers throughout the week. Additionally, the majority of participants felt either comfortable or very comfortable using computer technology.

Unfortunately, the age demographics of the sample for the experiment did not align with the age demographics of the University nor were a large number of participants enlisted. The University is generally comprised of mature aged students and the sample age was in the younger age group.

Although the researcher had hoped for a larger number of participants to provide a clearer indication whether the tool would assist information seekers, the results actually obtained have not provided a clear indication. However, the statistics do show an improvement in the naming of the six steps of information literacy as well as a slight increase in the knowledge of the criteria for recognition of online materials for citation. The rationale for implementing Phase 2 was to gain further insight that might add further to the research.

5.11 Findings from Phase 2

5.11.1 An Overview of Phase 2

Phase 2 is a continuation of the research and the evaluation of the online search tool, designed to provide a different perspective from the one identified in Phase 1. Phase 1 was to determine if the search tool would assist information seekers and Phase 2 was designed to ascertain if it was a learning experience. Phase 2 was also to ascertain a deeper understanding of how participants would use the search tool and the steps used and also to determine participant thoughts and opinions of the tool. The evaluation was also an attempt to determine if the changes to the web page design and speed of the database had improved the experience for students.

Because Phase 2 participants came from a variety of backgrounds and education, the inclusion of extra subjects as mentioned in section 5.2 of this thesis provided the Phase 2 participants with a much wider choice of subjects which in turn, could have increased the level of interest.

5.11.2 Population, Sample and Demographics

The average age of the thirty-seven participating students in Phase 1 of the experiment was between 15 and 19 (45.9% of the sample). The average age of the eleven Phase 2 participants was between 16 and 23 (100% of the sample).

Of the Phase 1 participants, many had their primary education in Australia however their further education was undertaken in many countries. Phase 2 participants were predominately educated in Australia. Of the Phase 2 participants, 10 (90.9%) were educated in Australia and one (9.1%) had primary education in Lebanon

Phase 1 participants were all studying the subject *International Studies Foundations* at the University of Canberra whereas the Phase 2 participants were studying a combination of undergraduate degrees at the University of Canberra and the Canberra Institute of Technology (CIT) in courses as diverse as Automotive Engineering, Media

and Library Studies. Two (18.1%) were studying Engineering and a further two (18.1%) were studying Media Production. The other seven, (63.6%) of the sample, were studying Automotive Engineering, Arts/Law, Education, Advertising, Library Studies, Organizational Management and Public Relations.

Gender representation in each stage was reversed with Phase 1 participants consisting of 67.5% females and 32.4% males and Phase 2 was 18.1% female and 81.9% male.

5.12 Assumptions

Phase 1 held four assumptions that were: students have basic computer literacy; prefer to use computers and the internet for research purposes rather than paper artifacts; already have a basic knowledge of their subject area; and they are interested in finding easier and quicker ways of conducting research. Phase 2 assumptions were the same.

5.13 Conduct of the Evaluation

The Phase 2 evaluation tool consisted of three questions. The questions were: 'Did you find the online search tool helpful for finding information on the internet'; 'What do you think you have learnt from using the online search tool'; and 'Would you pay for this service?'

Participants had not previously seen the online search tool and were encouraged to experiment with the search tool and web page which had been updated from one subject during the Phase 1 experiment to ten subjects for the Phase 2 evaluation. The ten subjects were *Education Foundations, Information Systems in Organizations, Information Technology in Education, International Studies Foundations A, International Studies Foundations 2, Organizational Leadership, Organizational Management, Society and World Politics, Sociology in Education and Teaching in Education.*

Participants were asked to search any subject using any search term whilst verbalizing what they were doing and thinking. During the process, the researcher recorded the dialogue with a hand held recorder.

5.14 Question Responses

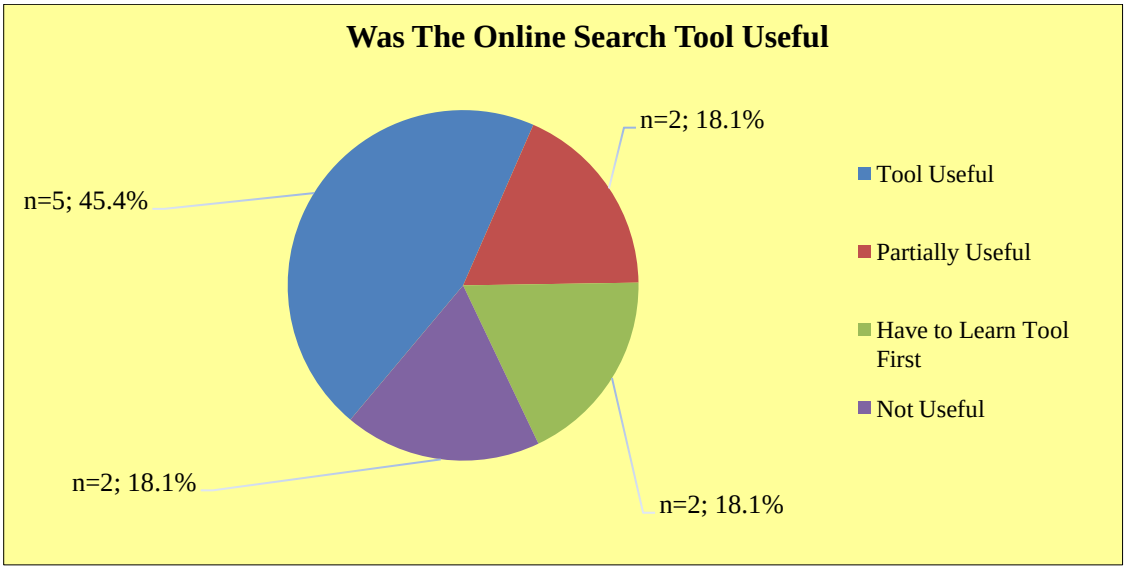


Figure 25: Phase 2 Question 1. 'Was the online search tool helpful?'

Figure 26. The participants were asked 'Did you find the online search tool helpful for finding information on the internet?' Participant thoughts and opinions show that five participants (45.4%) thought the tool was useful, two (18.1%) thought it was partially useful, two (18.1%) expressed the opinion that it is not obviously easy to use, and a further two (18.1%) said it was not useful.

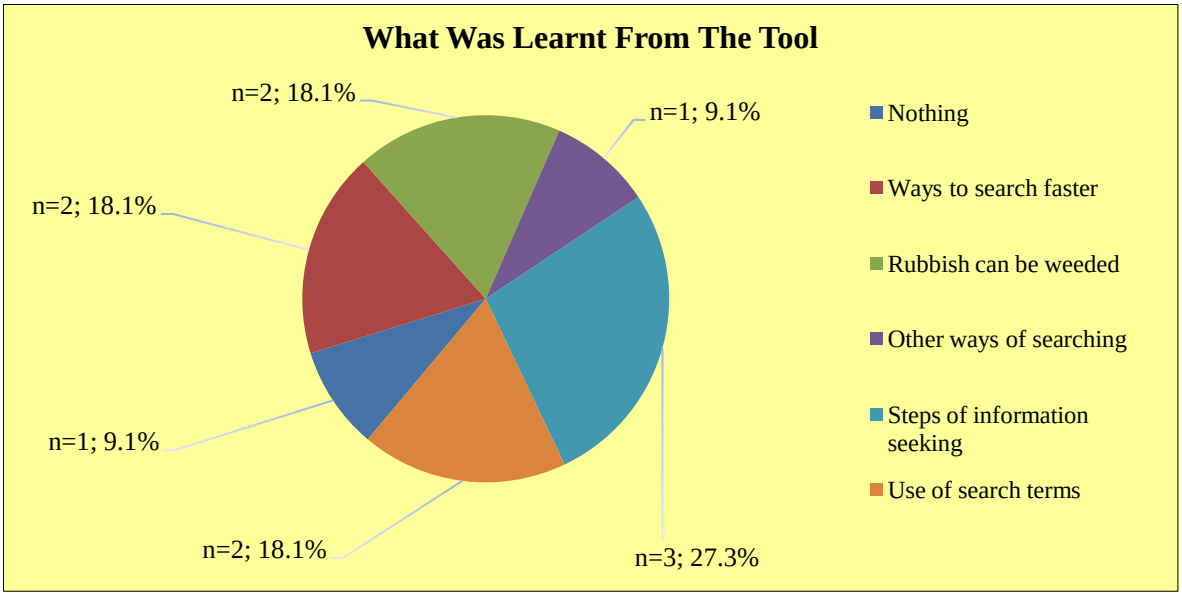


Figure 26: Phase 2 Question 2. What was learnt from the online search tool

Figure 27. Participant opinions of what was learnt from using the online search tool identified six dominant opinions. The figure shows that participants (27.3%) learnt some of the steps of information seeking, two (18.1%) learnt how to use search terms and one participant (9.1%) had learnt other ways of searching. Two participants (18.1%) said they now realized that online 'rubbish' could be weeded out and two participants (18.1%) said they now realized the possibility of making internet searching faster by using different tools. One participant (9.1%) said they had learnt nothing.

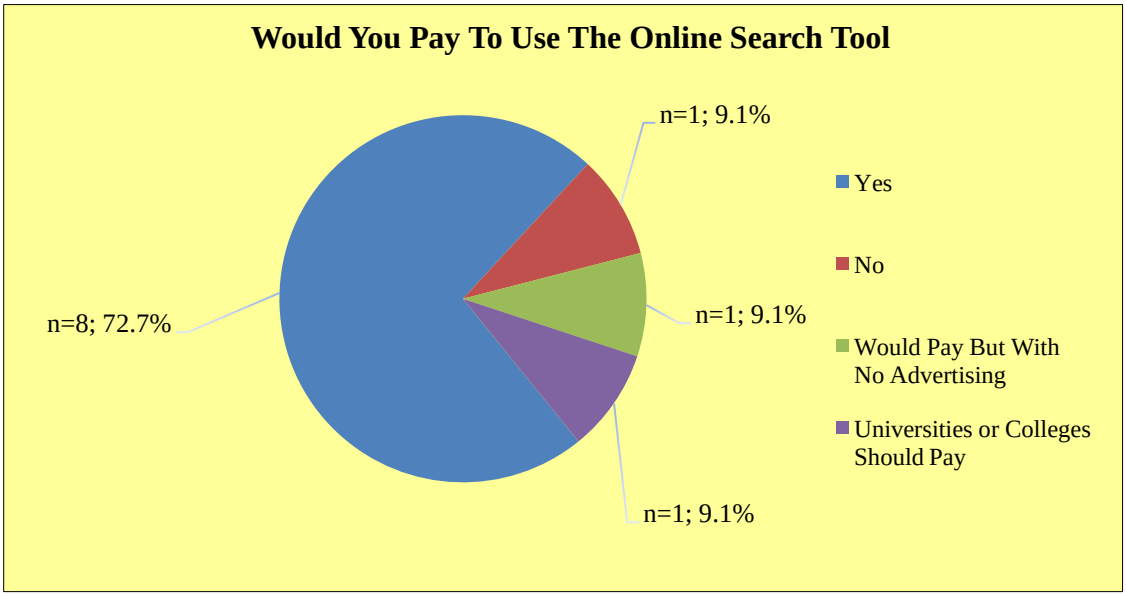


Figure 27: Phase 2 Question 3. Would users pay for using the online search tool

Figure 28 shows whether participants would be prepared to pay for using the online search tool. The question asking whether they would pay for this service drew varied responses. One participant said no, another also said no but expressed the opinion that their colleges and universities should pay. One said they would pay but only if there was no advertising. The remaining eight participants said they would pay and made no other comment.

5.15 Participant Perception of Rootza

At the beginning of the Phase 2 evaluation search process, participants did not state many verbal thoughts. Later during the early stage of the evaluation, it was felt that it was important to wait until participants showed signs of being comfortable with the search tool before eliciting comments. When participants appeared comfortable and relaxed and said something of their own accord, they were gently encouraged them to further explain their thoughts. There were times when they were asked why they were performing a particular action. During this stage they were asked open-ended questions such as: 'Why are you clicking on that?'; 'What are you looking at?' and 'What are you thinking?' The use of open-ended questions was expected to gain insight on their attitudes and opinions of the search tool. A few participants appeared to be reading the screen in depth whilst not doing anything in particular. When asked about this they replied with responses that indicated they were trying to establish how the tool worked. One participant in particular said they did not understand what they were supposed to be doing and they were advised to find a subject of personal interest, select a search term or other possible terms and press the 'Go Rootza' button to start searching on the internet.

When participants found the resulting internet search material was related to their search terms, they commenced reading the results then further used other terms to conduct more internet searches. A number of participants wrote down the URL for their results and a lesser number wrote down the search terms used; two participants wrote down the citations. They were asked why these citations were being written down and the participant responses indicated they would use them in the future.

Generally, the observations and thoughts of the eleven participants appeared to focus on eight issues which were: graphic design of the tool; how the tool works; use of own search terms; search term combination; use of found information; removal of the instructional list; commercial web pages and; lack of interest in the search tool. The issues have been arranged in order to reflect a lineal process of tool use. That is, the

participants' first look at the graphic design to their final conclusion that they were not interested in using the tool.

Issue 1 Design of the tool

A participant who was studying arts/law appeared to be more interested in the physical appearance of the tool and this was expressed with the question:

> *Why aren't the little boxes with the words in bigger?*

Following their question, this participant also expressed other questions that were related to the design of the web page, the colours, why fields were on the left hand side of the screen and not in the middle as well as why the screen background colour was pale yellow. However, this participant added that they liked the green on the Rootza tab and the 'Go Rootza' button. It was interesting that this participant was more concerned with the physical appearance of the web page rather than the search tool itself. The participant making comments on the web page design and colours may be an indication that the search tool colours and page design are not seen as standard or similar to other web pages. It is yet to be determined if the design of the web page, being sufficiently different for a participant to comment on, would be distracting and perhaps off-putting to users.

A participant who was studying engineering appeared more interested in the content of the web page than using the tool. The researcher noted him reading information on the About Rootza page and clicking on various areas of the Blog, Contact, About and Help pages for further information. He continued on with a search that produced results but he concluded his evaluation saying:

> *There is a tab at the top of the screen for blogs but it is all sort of Latin and other pages like that…is it there and faulty or is that only the beginning of it and it will be there later on?*

It is interesting that this participant was not only experimenting with the search tool itself but all the associated web pages as well. The exploration into the Blog, Contact,

About and Help pages was gratifying to the researcher as it indicated that the participant was interested in reading about the search tool in lieu of simply using it to conduct a search. The researcher wondered if this was a normal procedure that this participant followed that is, approaching the new tool and looking at all the pages perhaps to determine what information is available. If so, if this participant follows this procedure when starting new tools or web page, this bodes well for an investigative mind and positive personal growth of information literacy for the individual.

At the end of this participant evaluation, the researcher advised him that the program was at an experimental stage.

Issue 2 How the search tool works

Of the eleven participants, one student who was studying law appeared very interested in the search tool. The researcher was noted that the participant spent much time moving the mouse around and clicking both left and right mouse buttons on various areas of the web page. When asked what he was doing he replied:

> *This looks interesting, but I am first finding out how it works and what it does and how I can use it faster and find short cuts.*

This is an indication that although this participant was interested in finding information on his chosen topic, in order to produce results in a short a time as possible, he was prepared to first spend the time to establish how to use the tool. This may be an indication that this participant had previously used Google or another search facility that is easy to use. It is also possible that this participant may be fluent with using electronic databases as he takes the time to learn how to use tools before commencing a search.

Another participant who appeared very interested in the tool was also experimenting to determine how it worked. This participant spent a substantial amount of time reading the various screens and clicking on various elements such as the Rootza logo, tabs, the six steps of information seeking and the criteria for academic citation.

The participant asked the question:

> *Gee, what happens if I want to type in my own terms, how do I do that, where can I do that?*

Without waiting for an answer the participant then went back to clicking all the pages and the researcher asked 'What are you doing now?' he replied:

> *Trying to find where I type in my own terms because it is frustrating not being able to.*

Whether information seekers develop or use search terms that are based on the Library of Congress Subject Headings or those thesaural terms built into subscription databases is immaterial. The teaching of the use of search terms by academic skills groups, library education programs and the like has created the situation whereby students, before undertaking information seeking, have learnt to locate or develop search terms. However, the success of information seeking and information literacy programs does not necessarily mean that all information seekers or those who are new to information seeking find it easy in developing those search terms.

Issue 3 Use of own search terms

The participant who was enrolled in the subject *Organizational Management* started using the search tool and selected Organizational Leadership. He was typing his own search terms in the first field, then overwriting the pre-programmed search terms in the following two fields. When the 'Go Rootza' button was pressed, the search produced results for the pre-programmed term Autocratic Decision Making instead of the participant's search term which was American Democracy. When the researcher asked whether the search was successful he asked:

> *Um…why is there nowhere where I can type in my own search terms?*

The question was answered by saying that the terms are already pre-programmed into the database. He asked if there was going to be a facility whereby users would be able to use their own search terms and he was advised that this will be made available in future editions of the search tool's program. Being able to type in one's own search terms is important for some information seekers as it allows for more control of the search process. This researcher considers that electronic databases, library catalogues, online search tools, search engines and other such information seeking tools are driven by individual information seeking techniques which users find comfortable.

Again, referring back to the provision of training by academic skills and library programs in information literacy and seeking, some people are accustomed to developing their own search terms. To omit this facility from the online search tool could be deleterious and appears to be a limitation on user friendliness.

Issue 4 Search term combination

> *The showing of the three alternative search terms should be on the same page as when you select the first search term after you select your subject.*

This participant made this comment from the perspective of not only the web page design but also the design of the search tool itself. The tool was originally designed to assist information seekers with learning the six steps of information seeking and also the six criteria for academic citation. Moreover, the development of the online tool was guided by the need for it to also act as a thesaural database whilst providing core and alternative search terms for academic subjects. Thus, it was necessary to design the tool with pages that follow a logical sequence. The first was to show the subject list, the second was to present the core concept terms and the third was to present the alternative search terms. It was necessary for these three steps to logically appear to enable easy location of core and alternative search terms and to make the difference obvious to the user.

Because the online search tool was a newly devised invention, it was necessary to design the first three web pages to be simple, logical and appealing. It was considered preferable to place the subject selection on the first page and the core search terms on the second page. This was to enable ease of reading and scrolling through terms whilst providing a page that was uncluttered. The placing of alternative search terms on the third page was to allow for ease of reading and also to allow for the placement of the six steps of information seeking. The second and third pages listed the six criteria for information seeking. Because the research was based on these two lists, it was necessary to place them in a prominent position. Therefore, the separation of the core concepts and the alternative search terms onto different pages was necessary to allow for the placement of the six steps and six criteria as well as allowing the web page to appear simple to use.

Issue 5 Use of found information

Another participant studying Media Production found a large number of materials related to their search and then asked:

If I find all this stuff how can I use it?

That this question was asked at all indicated to the researcher that perhaps this participant was not familiar with information seeking and the use of materials found. This participant may have been a new student who perhaps had not yet written his/her first assignment. This leads to the question of whether the participant was familiar with some of the elements of information seeking such as determining the topic of the search, what information is to be looked for, where the information may be found, the best tool to use and has the information found provided the required result. However, new students would use the online search tool not only for the provision of search terms but also because of the presence of the six steps of information seeking and the six criteria for citation of online materials.

Issue 6 Removal of instructional list

The participant who was studying automotive engineering at the Canberra Institute of Technology appeared to be in a hurry with the search. The most definite statement he made was:

> *I don't want to look at the list of things like the search list and the citation criteria list, how do I get rid of them and make life simpler?*

This statement is an indication that the participant wanted to use the tool in the easiest way possible and did not see the importance of the six steps of information seeking and citation criteria. However, once information seekers are aware of the steps and citation criteria is it is necessary to permanently have them listed. It may be worth considering the possibility of permitting the use of a 'toggle' facility enabling the presence of the six steps of information seeking and the six criteria for academic citation to be revealed or hidden on the web page as determined by users.

The participant who was studying *Public Relations* also appeared irritated at the pages which listed the six steps of information seeking and the six criteria for citation of online documents.

> *This is an easy thing to use and it finds lots of information I don't think I could find on Google because Google produces sites of businesses selling things but, it would be easier and faster if you did not have those six steps there, they are not needed. Besides, they are on two pages of the web site as well.*

This opinion was previously expressed by another participant. However, it was explained that the tool is designed to help information seekers learn and follow the process of information seeking. That is, establish what you are looking for, use the right tool and also to determine if the material found is appropriate for academic citation.

Issue 7 Commercial web pages

The participant who was enrolled in Library Studies was mainly experimenting with the combination of search terms and the selection of domains of .org, .gov and .edu. When he had tried all combinations of the three search term fields in four subjects and the three selectable domains he asked the question:

Oh ok…yep…but…what if I want the web pages that are commercial?

In education, electronic databases and library catalogues are generally bereft of advertising and commercial promotions. When information seekers revert to using a commercially available tool such as Google to find information, they may view advertisements on websites and some search engines. Because people use these tools regularly for either study or recreation, they become accustomed to them and sometimes find them interesting. Although the online search tool is currently limited to organization, government and education domains, other commercial domains of .net, .com, and education domains of .ac.uk and .ac.nz will be added to the revised version of the tool.

Issue 8 Not interested in the tool, wanted to use Google

A participant who was studying Media Production asked the question:

What good of this is to me? Why am I doing this? Can't I just use Google?

This question prompts the asking of whether the tool is useful for all students or only those who are studying specific subjects. It also prompts the thought that different types of studies for example educational studies that involve mathematics, the environment, arts and philosophy have different subject foci. Mathematics can be highly statistical with numerical analyses being involved whilst being formula and process driven. Environmental studies have the focus on the observable and sometimes not observable physical world. Art subjects can have the focus on history as well as creative design and art techniques and, philosophy has a focus on ideas and conjecture.

Therefore, it is worthwhile considering whether the online search tool is appropriate for information seekers studying in these areas. It would be seen that the answer to this consideration may be positive as all academic and tertiary education has an element of expected theoretical and practical research in which information seeking, collection and collation of materials and analysis of data is compiled prior to writing of academic papers.

5.16 Evaluation Summary

Following further development after Phase 1 of the research, the Phase 2 evaluation of the online search tool was a continuation. The second phase was an attempt to determine if the changes to the tool's web page design, speed and addition of subjects had improved the experience of information seeking for participants.

There were three research questions and the first was to evaluate if participants found the online search tool useful. The data reveals that 45.4% percent thought the search tool useful but 18.2 percent said they would first have to learn to use the tool. This is a positive response as it has provided the Rootza designer and developer a clear picture of what has to be improved. Moreover, it has provided evidence that the continual development and improvements are providing an online search tool that users will find helpful.

The second research question asking participants what they had learnt using Rootza revealed that twenty-seven percent learnt some steps of information seeking and eighteen percent learnt how to use search terms.

The third question asking if they would pay for using the search tool was varied. Overall, the majority said they would pay however one participant suggested that education providers should pay and a second participant said they would pay if there was no advertising.

Within this Phase 2 Research, there were various issues identified by the participants and the themes were: graphic design of the tool; how the tool works; use of own search terms; search term combination; use of found information; removal of the instructional list; commercial web pages and; lack of interest in the search tool. All of the participant thoughts and opinions of the tool have been used in the next developed version (Version 3) of the tool.

Version 3 programming of the online search tool has become simplified in its algorithms as well as providing a mind map representation of the core search terms, sub-topics and related search terms. The instructional list of the six steps of information seeking and the six criteria for citing of online documents has been removed and the mind map representation page also has provision for users to type in their own search terms. The design of the tool's web page is redesigned for easier use to provide more interest and there are also additional domains for user selection including commercial web pages.

While the useful data from Phase 2 has added extra dimension to the research in providing extra information on participant viewpoint of the tool related to the design of the tool, how it works, the use of self developed search terms and combinations, use of information, the instructional list, commercial web pages and, using Google, it has to be acknowledged that the evaluation had limited findings in terms of the research questions (a point to be addressed in the next chapter).

The final chapter of this thesis is the Discussion and Conclusion and it will draw the theoretical, philosophical and experimental elements together.

6 Discussion and Conclusions

6.1 Introduction and Research Problem

This project was designed to answer the research question: 'Can student information literacy knowledge and skills be improved by the use of a purpose built online educational tool designed to find relevant research information on the world wide web?' The question was addressed in two ways. The first was by building and combining the online search tool (Rootza) with a well-established and influential IL model (Bruce). The second was by developing and providing Rootza with core search terms from an academic subject, and then undertaking an experiment to ascertain its effectiveness as an educational tool.

There were three sub-questions:

- *Can an online search tool improve student information seeking knowledge/skills?*
- *Can an online search tool assist student identification of search terms?*
- *Can an online search tool assist student evaluation of appropriate research materials?*

Research Aims and Research Problem

The first aim of providing an online tool to teach the steps of information seeking to improve information literacy was addressed by embedding the Big 6 steps of information seeking in a prominent position on the online search tool's webpage. The six steps were visible on two web pages of the online tool and viewable whilst participants were looking for search terms. The results of the experiment pre-test and post-test questionnaires suggested that experiment participants had learned more steps of information seeking than they had previously identified, although the small number of participants means that this finding is not conclusive.

The other aim of providing a teaching tool for student identification of core search terms was addressed by extracting subject core search terms from subject courseware and entering them into the online search tool database.

The aims were reached by conducting the research in two phases. Phase 1 consisted of the physical development of the online search tool and the experiment with participants who also provided their opinions of the tool. Phase 2 was conducted a year later with additional participants who also provided their opinion of an updated Rootza program and web page. Both Phase 1 and 2 revealed that the majority of the participants held the opinion that the tool's design and method provided for simpler searching whilst achieving more focused results and thereby, saving time. Again, the small number of participants in both phases prevents any strong conclusion from being drawn.

This thesis has argued that the implementation of information seeking tools in the digital environment in higher education may enhance and promote information literacy. The research has addressed the research question through the experimental results. Taking five faces from Bruce's theoretical model and using them as a basis for developing the practical online search tool combined theory and practice in the experiment. There is insufficient evidence to say whether Bruce's model has any empirical value but the positive response from participants suggests that the approach taken in this study merits further investigation.

6.2 Summary of Results

Information Literacy

The research question: *'Can an online search tool improve students' information seeking knowledge/skills?'* was addressed both in the literature review and the experiment. The literature review suggested Bruce (1997) as an appropriate theoretical base to further the research into the development of the online core concept search tool with embedded information literacy instruction. The statistical evidence of this question is addressed via the result that shows an improvement of 13.5% in participant awareness of the six steps of information seeking.

Bruce developed seven categories of information literacy: information awareness; successful retrieval; action and solution; future retrieval; personal knowledge base; new ideas; and wise use. The online core concept search tool's theoretical contribution and tool development has addressed five of these categories - information awareness, successful retrieval, action solution, future retrieval and personal knowledge base. This study therefore attempted to add to Bruce's theoretical design by encapsulating the five categories whilst providing a theoretical conception and development of a method and tool to enhance information literacy.

There were two phases of the practical research. Phase 1 was the experiment and Phase 2 was conducted via talk aloud protocols. There were 37 participants in the experiment but because this was not a significant number it was determined to conduct Phase 2 as an attempt to gain additional numbers. Unfortunately, this drew only 11 participants.

The experiment was expected to gain a large number of international students or those from a NESB background. In previous years the subject International Foundation Studies had a major cohort of these students however at the time of the experiment these numbers were negligible. According to the research demographics, there were 31 Australian born participants representing 83.9% and 1 each from Hong Kong, Lebanon, Macedonia, Poland, Sudan and the United States of America. Thus it was not possible to provide meaningful statistics for international or NESB students.

Of the Phase 2 participants, 10 were Australian and the remaining participant was from Lebanon.

The data collected from the documents students found in the experiment detailed the authoritativeness of the information they found. The examination of documents revealed how many held the date of authorship and/or date updated, name of author, name of organization and whether contact details of the author were provided and so on but because of the small number it was decided to not mention it in the thesis. However, if there were a greater number of participants and more data produced then the data would have better informed the research question.

For the www search conducted for the experiment, it was initially planned to embed research questions into an academic assignment for the subject International Foundation Studies. However, this was not possible because the assessment pieces had already been set. As well, the research design used for the study is a limitation in itself because it failed to generate a large number of participants and this affected the statistical significance of the outcome. Therefore, a better research design was needed.

In terms of successful retrieval, the Phase 2 evaluation revealed that 45.4% of participants found the tool helpful for finding information on the www. Again, sample size prevents any strong conclusion being drawn but the finding suggests that there is an indirect bearing on the research questions. Phase 2 has a lack of relevance to the research questions however, if additional research questions such what effect does the design of an online learning tool to a user have and, what benefits do users gain from using tools such as Rootza and Google etc., this would have added additional information to this research.

Similarly, in the category 'information process', the online core concept search tool's information seeking instruction helped to encourage information seekers to think about their information seeking requirements and how they might be met. The result of the Phase 1 experiment revealed that information awareness of participants, specifically their information awareness of the six steps of information seeking, improved by 13.5%.

In terms of 'information control' and Rootza's provision of alternate search terms for future retrieval, information seekers using the online core concept search tool are not only controlling their searches by using subject core search terms but are creating search terms that in the future, will be added to the online core concept online search tool database. An indication that participants saw a benefit in using the online core concept search tool may be seen in the Phase 1 participant opinions that the online search tool is 'useful'.

There is provision for 'knowledge construction' in the online core concept search tool's support for critical reflection and analysis. This focuses on the information seeker's personal knowledge base as the theoretical model determines that information seeking is a learning experience. The learning experience is enhanced by the practical provision of the online core concept search tool with the six steps of information seeking and the six criteria for citing online materials. Phase 2 participant opinions did not indicate whether or not they had learnt anything about the six criteria for citation of online documents but a component of the Phase 1 experiment was to establish participant knowledge of the six steps of information seeking by using a pre-test, post-test comparison. The results for identification of the six steps of information seeking for the experimental group pre-test revealed that 8.1% of participants could identify some of the six steps of information seeking and the post-test result produced a result of 21.6%. This was an increase in knowledge of the six steps of information seeking by 13.5%.

The t-test result was $p=0.056$, a result that was not statistically significant. Therefore, this result does not provide a clear indication that the online search tool has achieved its aim. A recommendation from Phase 1 is that this type of experimental research needs to be conducted over a longer period, with a questionnaire that has more questions that could based on self evaluation of participants information knowledge and skills whilst incorporating the experiment so it is embedded in the curriculum.

The Phase 2 evaluation was using the updated version of the online search tool with additional students. The final question asked of the participants was: 'What do you think you learned from this experiment?' The participant responses were mainly related to the recognition that the six steps of information existed whereas previously the

participants had not heard of them. There was an informal comment indicating that they were not aware of the amount of information available on educational and government websites. Therefore, this is a positive indication that the students have learnt something from the evaluation and may encourage them to conduct www information seeking in a more considered manner in the future. Although Phase 2 did not directly answer the research question there has been valid relevance and knowledge gained that was not gained in the Phase 1 experiment. The Phase 2 participants provided far more insight on the design of the tool and how they used it. Some of the ideas generated from Phase 2 are; that the tool needs larger print for key points; and that the navigation was simple and easy to use. What was more beneficial to find out however, was that some participants recognized the importance of using correct search terms and in turn, this meant that at least one participant was thinking of search terms. As previously mentioned, Phase 2 shows a lack of relevance to the research questions however there is an indication that some students have a preference to also develop their own search terms, are interested in other methods of www searching and are curious about how some tools work. Additionally, although they have a preference for Google, they are prepared to try other tools for online searching. Phase 2 does not produce evidence that the learning experience provided by Rootza and therefore, further research is required.

6.3 Undergraduate student problems in finding research material

In order to answer the second research question: *'Can an online search tool assist students with identification of search terms?* this was intended to show whether a purpose built tool for student use while conducting an online search would help the student determine appropriate search terms before undertaking a search. In this it was necessary to examine the difficulties that students experience when information seeking and also information seeking behavior. At the commencement of the experiment there were three research questions in which participants were asked to identify search terms. For Question 1, the mean number for the experimental group pre-test was 1.6 this increased to 2.6 in the post test which was an increase of 1.0 which is an improvement. For Question 2, there was a mean of 7.6 identified search terms and a post-test mean of 1.0 identified search terms and this is a mean decrease of 6.6 identified search terms and therefore is not an improvement. Question 3, follows the trend of Question 2 in that the experimental group pre-test number

of terms was 2.0 and the post-test was 1.0. This is a decrease of 1.0 mean terms which tends to suggest that it is dubious that an online tool can help students develop search terms, or, the participants became either bored or tired.

Information seeking as elaborated by Holsher and Strube (2000) and others in the literature review reveal that difficulties are encountered by both experienced and inexperienced information seekers. Additionally, studies by Chapman (2002) at the University of Melbourne and the present researcher's survey at the University of Canberra (2004) shows that information seekers turn to using the www and Google to source information. There are also the added complexities of 'invisible' web pages not being found and differences in the English dialect.

International students who are new to westernized educational methods can experience difficulties when encountering the digital environment. Scholars such as Scheyvens, Wild and Overton (2003) and Badke (2002), advocate that support and additional assistance in various supplementary programs are needed in universities. The additional support may be provided via the introduction of simplified digital search tools such as the online core concept search tool. The online core concept search tool has been designed with the three dialects of British English, Australian English and American English. Jansen, Spink, Saracevic and Tefko (2000) stated that an online tool should have has an academic context. From this one could propose that if the tool is used for searching the www it should have subject core concepts included. Field (1997) expresses the opinion that new communication tools may help international students, a point addressed and, to some extent, supported by this study.

A substantial component of this research was participant search term identification. The three research questions in Phase 1 were designed to provide data following the pre-test and post-test evaluation. An increase in search term identification over the duration of the experiment was expected. Participants identified search terms in the pre-test questionnaire and again in the post-test questionnaire.

Comparing the Phase 1 control and experimental groups in answering the three research questions over the pre-test and post-test shows consistency in the results. Question 1 showed an increase in mean terms. Question 2 showed a decrease as did Question 2.

Question 3 showed a decrease in mean terms. However, the result of the identification of search terms is not statistically significant if both groups are combined.

Past research by scholars such as Weideman and Stumpfer (2004) and Saunders (2004) has shown that students prefer to use Google in preference to subscription databases. The result of this experimental project with the online core concept search tool and the accompanying participant supplied thoughts, opinions and feelings about the tool and the web page design indicated a positive response to the research tool.

The post-test questionnaire for participant opinions for the online search tool in Phase 1 revealed that the top three responses were: Significant 86.37%; Essential 86.36%; and Useful 77.73%. The top three responses for the search tool's webpage were: Useful 82.67; Valuable 78.28% and; Significant 78.26%. That the three top scores are above 78% is an indication that the online search tool may be viewed favourably and therefore, may help address and accommodate information seekers and their online search behaviour which in turn leads to www information seeking success. Even if the small sample size is factored in, there is enough data to justify further work on the online search tool and its evaluation.

6.4 Undergraduate student problems in recognizing authoritative research material

The literature review addressed information seeking behavior and it was shown that information seekers must find online tools easy to use as well as being able to access online information that is credible and holds authority.

To answer the research question: 'Can an online search tool assist students with evaluation of appropriate research materials' is intended to determine if a purpose built tool for student use will help students evaluate whether the information they find is suitable for academic use. To answer this question it was necessary to first examine information literacy tools, build the new online core concept search tool embedded with information literacy instruction and lastly, conduct an experiment to gauge the tool's effectiveness.

To determine the level of success of the instructional mode for the six criteria for online academic citation, the online sourced documents printed by the participants were evaluated. The six criteria – evidence of being refereed; webpage regularly updated; sourced from university/organization/government department; author's credentials; reference or bibliographic list; and contact details of the author or organization responsible for the content – were not strongly represented in the evidence.

Of the experimental group participants, 44.4% addressed one criterion, four participants 22.2% addressed two criteria, 16.6% addressed three criteria and 22.2% addressed four criteria. No participants addressed all six criteria. Thus, the result shows that more participants addressed the criteria than addressed the steps of information seeking and identification of search terms; this indicates that they are more adept at identifying what www found material shows authoritativeness for academic use than they are at information seeking skills and the naming of search terms.

Research on the evaluation of web pages had previously been conducted with academics and doctoral students by Reih and Belkin (2000) who focused their research on dimensions of information quality and information seeker cognition. The Reih and Belkin (2000) research revealed that human reasoning – predictive judgment and

evaluative decision making – plays a part in the evaluation of web pages for academic citation. If materials appear to be from an authoritative source such as a university or scientific organization and also appear to be 'authoritative' and written in an academic style by a recognized authority, this plays a part in the predictive judgment process.

Thus, the provision of an online search tool with the six criteria for citing online materials may be of benefit to information seekers. It was necessary in the online search tool environment and experiment for those information seekers to be able to make value judgments. Over the duration of the experiment the number of criteria addressed by the participants increased.

Participants in the experimental group were measured to determine whether they could identify appropriate online documents to cite in an academic paper. This was measured according to the number of criteria addressed.

The results varied from 22.2% who addressed four criteria to 44.4% who addressed one criterion. No participant addressed five or all six criteria.

The Phase 2 evaluation issues as stated or exhibited by participants did not reveal any mention of the six criteria for identification of citable online documents.

6.5 Studies and evaluations of various solutions

In order to add and answer the main research question: '*Can student information literacy knowledge and skills be improved by the use of a purpose built online educational tool designed to find relevant research information on the world wide web' it* was necessary and prudent to examine other information literacy tools as well as to identify their features, benefits and deficiencies.

The online core concept search tool that was developed for this research addressed information seeking and information literacy problems. There have been a number of information literacy tools and initiatives for transfer of information literacy knowledge. Field (1997) and Scheyvens, Wild and Overton (2003) state that student information seeking behavior may be enhanced by the development of computer programs that teach information seeking within the context of the www.

Even allowing for small sample size, the results of this study suggest that information seeking tools and digital technologies are widely used by students. As the statistics in this research reveal, 32.4% use library electronic databases 'all the time' or 'often' and 16.2% use them 'not often' and 2.7% never use them. It may be considered that 21.62% who used them 'sometimes' are the average information seekers who use a variety of information seeking tools whilst enhancing their information literacy and promote lifelong learning. This supports the decision to develop an educational tool that fosters IL skills and understandings that can be adapted to both the www and subscription databases.

6.6 Implications for Teaching Information Literacy

There is the expectation that students, before being enrolled in a course, have a modicum of skills and experience and are able to interact with computer technology. Although new students may be skilled with basic word processing and browsing the internet, Biggs (1999) and Shuell (1986) asserted a number of years ago that this interaction will be important when higher education places a stronger focus on technology. Marchionini (1995) and Lazonder and Biemans (2000) had established that a novice information seeker is one who has used the www or internet for less than a total of ten hours. Overall, with the increased growth of computer usage, the classification of a novice information seeker has to be altered. This alteration in education ensures that the concept is framed around primary or elementary school children who are embarking on the path of information literacy.

In academia today, some people see Google in a negative way and not worthy of using for academic research. Google is a search engine that a large number of academics and students use as an alternative to electronic databases which indicates that it is indeed worthy if it helps students and other information seekers. Higher education is doing what academics and scholars of information literacy recommend and as seen in the research of Yang, (2004) Kuhlthau, (1995), (1997), (2004) and Bruce, (1997) which is to increase the involvement of information literacy education and more e-engagement to enhance information literate people. This reinforces the need to develop a tool such as Rootza that teaches undergraduate students how to evaluate the material in their search results. Google Scholar has the benefit of providing on average a higher quality of search results than the general Google search engine but not all undergraduate students use Google Scholar as their first port of call.

Development of information seeker knowledge, skill, perception and attitudes is supported by Kuhlthau (1995) and Ellsworth (2001). This support indicates that the path to digital literacy may be becoming well trodden. The results of this experimental research indicate that students searching for academic literature in an online environment may be well placed. Moreover, venturing into the field of digital literacy whilst building a strong relationship with developing technologies enhances the

information seeker relationship with information seeking strategies. However, there is an indication that more work is needed in this area of teaching or informing students of information literacy or e-literacy because of the poor results showing in this research for the six criteria for recognizing the authority of online academic materials.

Within the literature Biggs (1999) and Schuell (1986) both express the viewpoint that it is fundamental to have engaging activities for students to encourage effective learning. It is also important to further the path of information literacy for students by enhancing literacy skills as put forward by Lennox and Walker (1993) and Webber and Johnston (2000). The enhancing of literacy skills was one of the factors driving the research and development of the online core concept thesaural database and search tool.

The literacy standards of the American Library Association's Presidential Committee on Information Literacy and the Association of Colleges and Research Libraries place an emphasis not only on the key areas of information literacy, but also on the development of other tools and theoretical paradigms such as Bruce's seven faces of information literacy. This study has attempted to take theoretical constructs of IL education further in the development of Rootza. The development of the tool is aligned with those existing IL frameworks which encompass a six stage model of information seeking in which information seekers acknowledge a problem exists, identify it and explore it. To rectify the problem, sources and tools are identified and then a decision is made to determine whether the tool is suitable to answer the information seeking question. Following this process, the information seeker collects, assimilates and presents the data. These models informed the practical development of the online search tool used in this study. It is hoped that this development has furthered the field of information literacy and lifelong learning.

6.7 Implications of the Research

The implications of this research are exhibited in the provision of a method to inform users of the steps of information seeking and criteria for the evaluation of online documents in academia. Additionally, the online core concept database and search tool is comprised of academic subject core search terms and suggested alternatives using contemporary language in the dialects of Australian-English, American-English and British-English. These three English language dialects are intended to assist English as a Second Language students' information seeking by using dialects of the English language with which they may be familiar.

It is recognized and agreed that to strive for excellence in academia it is necessary to use academic subject language whilst practicing and encouraging a degree of academic rigor. However, the university sector has changed whereby there are a significant number of courses aimed at educating for the professions. Subjects such as Communication, Management, Marketing or Media and so on do not necessarily use a substantial number of terms that are specific to the subject. Rather, terms used are often a part of contemporary natural language. Additionally, although there can be a large number of terms often used in the media and as common verbal usage, these terms are not necessarily in electronic databases or subject classification lists.

An advantage of the online search tool developed for this study is the provision of subject core search terms and alternatives to those terms. Furthermore, the tool restricts the online search to the three domains of .edu, .gov and .org. This limitation on the domain provides more consolidated results when information seekers resort to using the internet to locate academic materials. The restriction eliminated the need for users to search commercial web pages that may not be particularly rich in academic information. An added value of the tool is the capacity for it to be expandable to any number of academic and non-academic subjects.

Throughout the tool's development and building process, it has become evident that there are others beside the higher education sector that will benefit. Those who may also

benefit are those from NESB backgrounds; people who are image or icon-directed; primary, secondary and tertiary students and educators; corporate, professional and business information seekers; as well as home computer users. The tool has been remodeled, restructured and programmed with a large number of topics and subjects to address the needs of a wide variety of demographics such as age, culture and language.

This thesis has argued that in order to provide up-to-date information seeking tools, it is necessary to ensure they fit in with recent technological developments and that the mores and common contemporary language of humans must be considered when designing such tools.

The online core concept search tool research has effectively achieved its aim and shows some positive results when informing users. Briguglio states (2000) that in a market economy it is necessary to provide education as a high quality product. As such, the online search tool is such a product to support education. Thus, this research has provided an educational product in the form of an ancillary tool that has implications for teaching information literacy.

This research and thesis has also helped to address the concerns of Bruce (1997) in measuring the degree of student 'engagement with information'. The 'engagement with information' in this experiment was measured in the participant identification of search terms and the six steps of information seeking.

6.8 Limitations of the Study

A major limitation within this experimental research has been the low number of participants. Moreover, those participants did not match student demographics of the University of Canberra or Australian undergraduates generally. Another limitation was that the Phase1 experiment was conducted using only one subject area, although Phase 2 was conducted with ten subject areas. Phase 1 was conducted in a computer laboratory and Phase 2 was in the researcher's office. There was a difference in gender representation since Phase 1 was predominantly female and Phase 2 was predominately male. For the www search conducted for the experiment, it was initially planned to use the research questions from an academic assignment for the subject International Foundation Studies. The assessment pieces were already finalized however so other research questions had to be compiled for the experiment and this therefore was a limitation.

Phase 2 of the research failed to provide relevance to the research questions for the study however, changing the focus from student opinion of the tool to examining how undergraduate students evaluate research results would have added to the relevance of Phase 2 to the main research question. Also of benefit could have been the addition of extra sub-questions asking what effect does an online web tool design have on a user and what benefits are derived from using tools such as Rootza and Google might reasonably or partially address this. The researcher was buoyed by the research and development of the inventive new tool and process for simple online academic information literacy and information seeking. While the online search tool may at first appear simplistic, it has taken much time, effort, resources and creative will to obtain this apparent simplicity.

Although the number of participants for the experiment was small, the ensuing experiment and results can act as an encouragement and catalyst for other researchers to develop more and different tools to support student information seeking research.

6.9 Recommendations and Future Research

There are three recommendations suggested by this research and thesis.

The first recommendation is for all educational institutions in their junior and senior curriculum to teach both digital and non-digital information seeking skills that provide the basics such as the 'Big 6' that form the Six Steps of Information Seeking. The second is for those educational institutions to find more effective ways in which to teach the recognition of materials appropriate for academic assignments rather than providing this as an instruction session. One of the ways is to include this in first semester, first year undergraduate academic assignments as an assignment on recognition of appropriate materials for academic use. The third recommendation is to embed the steps of information seeking, recognition and development of search terms and recognition of authoritative materials into a subject and topic areas for each student commencing university for the first time. This will help to alleviate the use of documents from inappropriate sources. The rationale for this is that it will enable students to be better informed and provide them with a head start before commencing college and university.

6.10 Significance and Contribution of the Research

The significance of the research was based on the promotion of information literacy using the digital environment in the higher education sector.

The significance, understanding and knowledge of the theoretical field of information literacy has been advanced through this research. This research has seen the conception, development, building and installation of a new research tool and a theoretical paradigm that, it is intended, complements Bruce's seven categories of information seeking. Thus, it is hoped that other researchers in the future will be open to new, modern and different techniques to conduct online research.

It is also hoped that there will be acceptance of the utilization of people who are not necessarily computer specialists, to think about alternative digital technologies for education as it is those people (such as librarians, academics and students) who may be more versed in the practical side of digital information seeking tools for students. It is often those in the mainstream working environment who know how to simplify tools and to design them in a simple and effective manner. It is wise to consider not unquestionably accepting the norm of expecting specialists to find solutions to problems. Rather, those who can find possible innovative solutions are those with fresh, open and critical minds. It is this that will take education further and faster on the path to information literacy in the field of knowledge and education.

The problem the researcher was attempting to address was initially threefold. These three problems were: student lack of familiarity with the steps of effective information seeking, the recognition of appropriate search terms and the criteria for evaluation of online documents. The research led to a fourth factor, that of the growing use of students using Google or another proprietary computer program or www tools to source academic documents. This research and experiment suggested that the implementation of an online research tool with an informational component would assist students with information seeking techniques and this provides help with the identification of subject core concepts and thereby more comprehensive and relevant results for the student.

To use a variation of the 'horse and trough' philosophy, if horses are indisposed to walk to the trough, is it not easier to entice them by placing the water where they can smell, taste and drink with less effort? The provision of an intuitive online search tool as a positive compromise by library educators who advocate using subscription databases and student researchers who tend to use commercial tools such as Google, would see both entities having their information seeking needs addressed. Library educators are focused on library services and products but students shop around for their information and one of those major shopping centers is the internet.

This discussion has attempted to address some of the broad areas of information literacy, digital technology in education, information seekers and information seeking strategies, the World Wide Web and web searching. This has been in conjunction with

the empirical literature and the experimental results covering the knowledge of the six steps of information seeking, the identification of search terms, the six criteria for citing online materials and participant demographics.

Another contribution to the research on information literacy and information seeking is the development of the online core concept search tool. As the experiment could not be conducted without the development of the online core concept search tool there was a substantial amount of time, work and effort allocated to this task. Time spent developing the online core concept search tool may be seen to be equivalent to the time spent on the empirical study, the experiment and the evaluation in total. Thus, although the experiment may be viewed as not large, the fact that the tool itself was conceived developed and has undergone substantial growth and development and is widely available as an online tool for information seeking, is a substantial component of this research and thesis.

6.11 Concluding Remarks

This research has attempted to address the need for new e-research or digital learning tools in education. It has shown both empirically and experimentally, that this has been addressed in part with the online core concept search tool. It is an indication that heralds well for the growth of information literacy in the digital environment in Australian and international education.

The development of a tool that has achieved ‘greater’ simplicity as postulated by Berners-Lee (2003) is supported by participant opinions and evaluation of the online search tool. The evaluations revealed that participants felt they were interacting with the tool and that it would be of benefit to information seekers. Whether participants thought the online search tool was of possible interest or held an advantage was evaluated and this provided encouraging support for the further development of the online core concept search tool.

The first step involved in organizing the conduct of the experiment was to arrange permission from the University Computing Centre to book a number of computer rooms in which to hold the experiment and have access to the tool provided. The second step

was to consult with the Subject Convener of International Foundation Studies (which was seen as especially relevant to the study) to gain permission and assistance to enlist students enrolled in the subject to participate in the experiment. The third step was to conduct a pilot test to ensure the online software was compatible with the University computers, the design of the questionnaire was appropriate and, the process worked. The fourth step was to enlist participants and the fifth step was to conduct the experiment.

It is clearly acknowledged, as documented below, that the number of participants was disappointingly low. This placed limitations on any conclusions that for the findings.

There would have been more relevance provided to the research questions if additional sub-questions related to Phase 2 were included and both phases conducted again at a later date. With the increased number of participants from other universities and educational institutions, this would produce results that provide more validity than those previously produced.

Alternatively, a different research design could be implemented in the form of an academic assignment as a component of the subject area and student assessment. This therefore means that all students in the subject International Studies Foundation would be participating in the experiment, however, it would be a component of their normal assessment work. Initially, this was put forward to the International Foundations Studies Course Convener and was discounted for two reasons. The first was that the assignments for the semester were already planned and in place and the second was that it was not aligned with the then current curriculum.

As a result of the lack of participants for the experimental phase of the research, an extra phase of data gathering was designed in the form of Phase 2 and this was aimed at establishing what participants thought of the core concept thesaural database and search tool. While the information gathered in Phase 2 could not answer the research questions directly, its relevance to the study is that it has some bearing on student acceptance of the search tool designed for the study and therefore on its potential use as an educational tool and it may suggest how the tool could be refined to increase its educational effectiveness.

To provide relevance to the study, it was hoped that the three sub-questions ‘Can an online search tool improve student information seeking knowledge/skills’, ‘Can an online search tool assist students with identification of search terms’ and ‘Can an online search tool assist students with evaluation of appropriate research materials’ were going to provide some form of answer in Phase 2. Because the Phase 2 students firstly said nothing about the benefits of being provided with search terms instead of developing their own this provided little relevance to the study and research.

In order to gain further understanding and statistical evidence it would be worthwhile conducting the experiment again and use the questionnaire to ask participants if they were interested in learning information seeking skills.

Continual development of the tool is taking place. Besides the programming engineering improvements in the online core concept search tool’s algorithms and structure, there is also the addition of core, sub-topic and related terms being added. There are currently more than fourteen million core, sub-topic and related search terms and more than one hundred and twenty million relationships between those terms. Moreover, the web page is undergoing substantial redesign in order to present an online tool that is vastly different in its application and user appeal while having a strong leaning towards academic and professional fields. With these substantial improvements in the online core concept search tool, and the expected growth of its usage in academia, it is hoped that the limits placed on this research by a lack of participants may be overcome as future studies of this nature are conducted with other newly devised research tools as they become more widely used. Education is a lifelong learning experience, as was this experiment, and this researcher found that the path leading to the development of the tool and experiment provided a major learning experience.

It is hoped that this research will be continued and will see the development of other online tools to assist students, thereby furthering research on information literacy in the higher education sector worldwide.

REFERENCES

Association of College and Research Libraries (ACRL) (2000). *Information Literacy Competency Standards for Higher Education*. Viewed September 18, 2007 <http://www.ala.org/ala/acrl/acrlissues/acrlinfolit/informationliteracy.cfm>.

Australian and New Zealand Institute for Information Literacy. (2004) *Australia and New Zealand Institute for Information Literacy; principles, standards and practice*. [Ed.] Alan Brumby, Second Edition. Adelaide.

Australian Bureau of Statistics. (2007). *Education and Work, Australia, May 2006*. Australian Bureau of Statistics Classification of Qualifications (ABSCQ) Canberra, Australia.

Badke, W. (2002). International students: Information literacy or academic literacy? *Academic Exchange,* Winter, 60-65.

Bates, M. (1986). Subject access in online catalogs: a design model, *Journal of the American Society for Information Science,* 37, 6, 357-376.

Bawden, D. (2001). Information and digital literacies: a review of concepts. *Journal of Documentation,* Vol 57, 208-259.

Berners-Lee T. (1999). *Weaving the web: the past, present and future of the world wide web by its inventor*. London: Orion Business Books.

Berners-Lee, T. (2003). *Spinning the semantic web: bringing the world wide web to its full potential*. Cambridge, Massachusetts: Institute of Technology.

Big6 (2008). Big6 Associates LLC. Viewed 12th December 2008. <http://www.big6.com/>

Biggs J. (1999). Teaching for quality learning at university: what the student does. Constructing learning aligning teaching: constructive alignment. *Society for Research into Higher Education.* Open University Press, 11-32.

Blackboard Inc. (2011) Blackboard Learn. Viewed 26th April 2011 <http://www.blackboard.com/Platforms/Learn/Overview.aspx>.

Borgman, C.L. (1986). Why are online catalogs hard to use? Lessons learned from information retrieval studies. In Macpherson, K. The development of enhanced information retrieval strategies in undergraduates through the application of learning theory: an experimental study. *Journal of the American Society for Information Science,* 37, 6, 387-400.

Briguglio, C. (2000). Language and cultural issues for English-as-a-second/foreign language students in transnational educational settings. *Higher Education in Europe,* XXV, 3, 425-434. Carfax Publishing.

Bruce, C. (1997). *The seven faces of information literacy*. South Australia: Auslib Press.

Burns, R.B. (1991). Study and stress among first year overseas students in an Australian university. *Higher Research and Development,* 10, 1, 61-77.

Buzikashvili, N. (2005). Information searching behavior: between two principles. *Conference Proceedings 5th International Conference on Conceptions of Library and Information Science*, CoLIS June 2005. Glasgow.

Carroll, J.B. (1999). Expert internet information access. In Nachmias, R. & Gilad, A. Needle in a haystack: searching for information on the world wide web. *Journal of Research on Technology in Education,* 34, 4.

Chapman, L. (2002). Russian roulette or Pandora's box: use of the internet as a research tool. V*ictorian Association for Library Automation (ALA) 11th Biennial Conference and Exhibition,* February 2002, Melbourne.

Charles, C.M. & Mertler, C.A. (2002). *Introduction to Educational Research*. 4th Ed. Boston: Allyn & Bacon.

Chu, H. (2003). *Information representation and retrieval in the digital age*. New Jersey: American Society for Information Science and Technology.

Church, G.M. (1999). The human-computer interface and information literacy: some basics and beyond. *Information Technology and Libraries,* March 1999, 18, 1, 3-22.

Concise Oxford Thesaurus (2002). M. Waite [Ed.]. Oxford University Press (2nd Edition).

Cornell University Digital Literacy Resource (2009) Viewed 23rd April 2011. < http://digitalliteracy.cornell.edu/>.

Danino, N. (2001). *Human computer interaction and your site*. Viewed July 11 2007 < http://www.sitepoint.com/print/computer-interaction-site>.

Debowski, S. (2001). Wrong way: go back!: an exploration of novice search behaviours while conducting an information search. *The Electronic Library,*19, 6, 371-382 MCB University Press.

Deibert, R.J. (1998). Virtual resources: international relations research resources on the web. *International Organization,* 52, 1, 211.

Ding, Y., Chowdhury, G.G. & Foo, S. (2000). Incorporating the results of co-word analysis to increase search variety for information retrieval. *Journal of Information Science,* 26, 6, 429-451.

Dix, A., Finlay, J., Abowd, G.D. & Beale, R. (2004). *Human-computer interaction*. 3rd Ed. England: Pearson Education Limited.

Dorner, D.G. & Curtis, A. (2004). A comparative review of common user interface software products for libraries, National Library of New Zealand, Te Puna Matauranga Aotearoa, Wellington. *Library Hi Tech*, 22, 2, 182-197.

Doyle C. (1992) Outcome measures for information literacy within the national education goals of 1990. *Final Report to the National Forum on Information Literacy. Summary of Findings*. ED 351033.

Drewry, J.M. (2007). *Google Scholar, Windows Live Academic Search, and beyond: a study of new tools and changing habits in ARL libraries.*

Edwin, N. (2006).Diagrammatic structure of the database. In Redfern, V. (2010). *World wide web technology: an online core concept search method and tool for educational knowledge enhancement in the world of information literacy*. Canberra.

Eisenberg, M. & Berkowitz, B. (1988). *A curriculum initiative: an agenda and strategy for library media programs*. School of Information Studies, Syracuse University.

Ellis, D. (1998). Paradigms and research traditions in information retrieval search. *Information Services & Use,* 18, 4, 225-242.

Ellis, J. & Salisbury, F. (2004). Information Literacy milestones: building upon the prior knowledge of first-year students. *The Australian Library Journal,* November 2004.

Ellsworth in Hassan, R. (2001). Netresults: knowledge, information and learning on the internet. *Journal of Educational Enquiry,* 2, 4, 44-57.
Feitzer, W. (2002). Integrating Metadata frameworks into library description in C.F. Thomas (Ed) *Libraries, the internet and scholarship: tools and trends converging* New York: Marcel Dekker.

Fensel, D., Hendler, J., Lieberman, H & Wahlster, W. (2003). *Spinning the Semantic Web*. Cambridge, Massachusetts: Institute of Technology.

Field, J. (1997). The adult learner as listener, viewer and cybersurfer. In Field, J. (Ed.), *Electronic pathways: adult learning and the new communication technologies*. Leicester. NIACE.

Fitz-Gibbon, C.T. & Morris, L.L. (1987). *How to design a program evaluation*. California: Sage Publications.

Gardner, H., & Hatch, T. (1989). Multiple intelligences go to school: Educational implications of the theory of multiple intelligences. In Smith M. K. (2002). *Howard Gardner, multiple intelligences and education*. Viewed July 21 2007 <http://www.infed.org/thinkers/gardner.htm>.

Gay, L.R. & Airasian, P. (c2003). *Educational research: competencies for analysis and application*. Upper Saddle River, N.J: Merrill/Prentice Hall.

Grafstein, A. (2002). A discipline-based approach to information literacy. *The Journal of Academic Librarianship,* 28, 4, 197-204.

Gratch. J. (1992). A statistical approach to solving the ebl utility problem in speed-up learning. *Proceedings of the Tenth National Conference on Artificial Intelligence,* 241-248. San Jose, CA: AAAI.

Griffiths J.R. & Brophy, P. (2005). Student searching behavior and the web: use of academic resources and Google. *Library Trends,* 53, 4, 539-554.

Goetsch, L.A. & Kaufman, P.T. (1998). Reading, writing arithmetic, and information competency. *Campus Wide Information Systems*, 15, 5, 158-163.

Guarino, N. & Giaretta, P (1995). In Tho, Q.T., Fong, A.C.M. & Hui, S.C. (2007). A scholarly semantic web system for advanced search functions. *Online Information Review,* 31, 3, 353-364.

Hannafin, M.J. & Hill, J.R. (1997). Student-centered learning and interactive multimedia: status, issues and implication. *Contemporary Education,* 97, 68, 2, 94-99.

Hassan, R. (2001). Netresults: knowledge, information and learning on the internet. *Journal of Educational Enquiry*, 2, 4, 44-57.

Hawkridge, D. (1983). New information technology in education. In Lindsay, W, & McLaren, S. *The internet: an aid to student research or a source of frustration*? London: Croom Helm.

Head, A.J. & Eisenberg M.B. (2009) Project *Information Literacy Progress Report:"Lessons Learned".* The Information School, University of Washington.

Helms-Park, R. & Stapleton P. (2007). A preliminary assessment of Google Scholar as a source of EAP students' research materials. *The Internet and Higher Education* Vol 10, Iss 10 pp 65-76. ScienceDirect, Elsevier.

Hicks, D. & Hartson, H.R. (1993). Developing User Interfaces: Ensuring Usability Through Product & Process. In Stone, D., Jarrett, C., Woodroffe, M. & Minocha, S. (2005). *User interface design and evaluation*. San Francisco: Elsevier.

Holman, L (2010). Millennial Students' Mental Models of Search: Implications for Academic Librarians and Database Developers. *The Journal of Academic Librarianship*, 37, 1, 19-27. January 2011.

Holscher, C. & Strube, G. (2000). Web search of internet experts and newbies. *Computer Networks*, 33, 337-346.

Holzberg, C.S. (2006). Going Ga-Ga for Google. *Technology and Learning.* Viewed 15th October 2011. < http://www.techlearning.com/article/going-ga-ga-for-google/43740>.

Hsieh-Yee I. (1993). Effects of search experience and subject knowledge on the search tactics of novice and experienced searchers. In Shiri, A.A., Revie, C & Chowdhury, G. Thesaurus-enhanced search interfaces (2001) *Journal of the American Society for Information Science*, 44, 3, 161-174.

ILRT JISC (2008) Virtual Training Suite. Viewed 18th April 2008. <http://www.vtstutorials.ac.uk/>.

Jandt, F.E. (2004). *An introduction to intercultural communication: Identities in a global community*. 4th Ed. 146-180. California: Sage Publications.

Jansen, B. & Pooch, U. (2001). A review of web searching studies and a framework for future research. In Buzikashvili, N 'A myth, reality and extremal principles of seeking in different search environments'. *JASIT*, 52, 3.

Jansen, B. J., Spink, A., & Saracevic, T. (2000). Real life, real users and real needs: A study and analysis of user queries on the web. *Information Processing and Management*, 36, 2, 207–227.

Jones-Kavalier, BR & Flannigan, S.L. (2006). Connecting the digital dots: literacy of the 21st century. *No. 2 Educause Quarterly*.

Kappelman, L.A. (1995). *Measuring user involvement: a diffusion of innovation perspective*. Viewed 25th March 2005. <http://courses.unt.edu/kappelman/aboutwork/articles/database.htm>.

Kingrey, K.P. (2002) *Concepts of Information Seeking and Their Presence in the Practical Library Literature.* University of Idaho. Viewed 23rd April 2011 http://www.webpages.uidaho.edu/~mbolin/kingrey.html.

Knapp, S.D. (2000). *The contemporary thesaurus of search terms and synonyms; a guide for natural language computer searching*, 2nd Ed. Phoenix Arizona: Oryx Press.

Knapp, S.D., Cohen, L.B. & Judes, D.R. (1998). A natural language thesaurus for the humanities: the need for a database search aid. *Library Quarterly*, 68, 406-430.

Kuhlthau, C.C. (1995). The process of learning from information. *School Libraries Worldwide*, 1, 1, 1-12.

Kuhlthau, C.C. (2004). Towards collaboration between information seeking and information retrieval. *Information Research,* 10, 2. Viewed 26 January 2005. <http://informationr.net/ir/10-2/paper225.html>.

Lacina, J.G. (2002). Preparing international students for a successful social experience in higher education. *New Directions for Higher Education,* 117, Spring 2002, 21-27.

Lancaster, F.W., Elzy, C., Zeter, M., Metzler, L. & Yuen-Man, L. (1994). Searching databases on CDROM: comparison of the results of end user searching. In Macpherson, K. The development of enhanced information retrieval strategies in undergraduates through the application of learning theory: an experimental study. *Research Quarterly,* 33, 3, 370-386.

Large, A., Lucy, A, Tedd, L.A. & Hartley, R.J. (1999). *Information seeking in the online age*. West Sussex, UK: Bowker Saur.

Lazonder, A.W. & Biemans, H. (2000). Differences between novice and experienced users in searching information on the World Wide Web. *Journal of the American Society for Information Science,* 51, 6, 576-581.

Leder, G.C. & Forgasz, H.J. (2004). Australian and international mature students: the daily challenges. *Higher Education Research & Development,* 23, 2, 183-198.

Lenox, M.F. & Walker, M.L. (1993) Information Literacy in the Educational Process. *Educational Forum,* 57, 3. 312-324.

Lewis, C., & Reiman, J. (1994) *Task-Centered User Interface Design.* Boulder, Colorado, USA: Clayton Lewis and John Rieman.

Library of Congress Subject Headings 26th ed. (not stated). Washington: Library of Congress.

Lindsay, W. & McLaren, S. (2000). The internet: an aid to student research or a source of frustration? *Journal of Educational Media,* 25, 2, 115-128.

McClure, J. (2001). Developing language skills and learner autonomy in international postgraduates. *ELT Journal*, 55, 2, April 2001, 142-148.

McDonald, C. (2000). *Analysing and coordinating the conceptual structures of the information professions: a domain oriented approach*. Thesis. University of New South Wales.

McNaught, C., Phillips, R., Rossiter, D., & Winn, J. (2000). *Developing a framework for a usable and useful inventory of computer-facilitated learning and support materials in Australian Universities.* Evaluations and Investigations Program, Higher Education Division, Commonwealth of Australia.

Macpherson, K. (2002). The development of enhanced information retrieval strategies in undergraduates through the application of learning theory: an experimental study. *Journal of Educational Enquiry*, 3, 1.

Macquarie Concise Thesaurus (2004). J.R.L. Bernard. [Ed.] Dee Why, N.S.W.: Macquarie Library.

Marchionini, G. (1995). *Information seeking in electronic environments*. Cambridge: Cambridge University Press.

Marchionini, G., Dwiggins, S., Katz, A. & Lin, X. (1993). Information-Seeking In Full-Text End-User-Oriented Search Systems: The Roles of Domain and Search Knowledge. *Library and Information Science Research,* 15, 124-133.

Marchionini, G. and Komlodi, A. (1990). *Design of interfaces for information Seeking*. Viewed 29th August 2006. <http://www.ils.unc.edu/~march/arist.pdf>.

Marginson, S. (1997) *Markets in Education*. Allen and Unwin. Sydney.

Matthews, J. & Wiggins, R.W. (2001). Scholarly Sources in a Googley World. *Library Journal*, 126, 15, 35.Monereo, C., Fuentes, M. & Sanches, S. (2000). Internet search and navigation strategies used by experts and beginners. In Nachmias, R. & Gilad, A. Needle in a haystack: searching for information on the world wide web. *Journal of Research on Technology in Education,* 34, 4.

Moore, (1997). In Large, Lucy, Tedd & Hartley (1999). *Information seeking in the online age.* West Sussex, UK: Bowker Saur.

Moore, P. (2003). *An Analysis of Information Literacy Education Worldwide*. July 2002, White Paper prepared for UNESCO, the US National Commission on Libraries and International Science and the National Forum for Information Literacy for the use at the Information Literacy of Meeting of Experts, Prague. The Czech Republic: UNESCO.

Moss, N. & Hale, G. (1999). *Cognitive style and its effect on internet searching: a quantitative investigation.* Proceeding of European Conference on Educational Research, Lahti, Finland 22-25 September 1999.

Nachmias, R. & Gilad, A. (2002). Needle in a Haystack: searching for information on the World Wide Web. *Journal of Research on Technology in Education,* 34, 4, 475-484.

National Library of Australia (2003). Teach yourself online. *Gateways.* No. 62 Viewed 23rd October 2011. < http://www.nla.gov.au/pub/gateways/archive/62/p11a01.html>.

Navarro-Prieto, R., Scaife, M. & Rogers, Y. (1999). *Cognitive strategies in web searching.* Proceedings of the 5th Conference on Human Factors & the Web 1999.

Newell, A., Simon, H.A. (1992). *Human Problem Solving*. Englewood Cliffs: Prentice-Hall. Viewed 1998. <http://zing.ncsl.nist.gov/hfweb/proceedings/navarro-prieto/>.

Osborne, L. (2004). ACMAS's Information Literacy Research. Strategic Research Section Media and Communications, Australian Federal Government, Viewed 4th July 2011. Viewed 4th July 2011. < http://docs.google.com/viewer?a=v&q=cache:Pg-hpHyk-ccJ:www.acma.gov.au/webwr/_assets/main/lib310665/l_osborne_speech_dml_forum.doc+definition+digital+literacy&hl=en&gl=au&pid=bl&srcid=ADGEEShCetZ6WzpFKG49htmVgiIYdlgnRq4CMt-UJlheMdDoWbt7M0m-pMA7fy9daPrWy0snafSvi93yh3p-TUMMjSxmHgPd7yauXBVFan7tkqJxAyWBJZ-ddyiNgli-bq1hmK4_d3Be&sig=AHIEtbTYgiqRIUUHh5adiRMstVIW1A2I2A.

Plattsburgh State University of New York *(Plattsburgh State Information and Computer Literacy Task Force, 2001)*. Viewed 8th June 2011. < *http://www.plattsburgh.edu/library/instruction/informationliteracydefinition.php*>.

Ramburuth, P. & McCormick, J. (2001). Learning diversity in higher education: a comparative study of Asian international and Australian students. *Higher Education,* 42, 333-350.

Redfern, V. (2004). Natural language thesaurus: a survey of student research skills and research tool preferences. *Australian Academic & Research Libraries,* 35, 2, 37-150.

Redfern, V. (2006). Enhanced searching using a thesaurus. AUS Patent 2006/001045.

Redfern, V. (2007). World Wide Web: Online Core Concept Thesaucratic Database Development to Improve Information Seeking. *Web Based Development - International Association of Science and Technology for Development (IASTED) Conference Proceedings*, - Chamonix, France March 2007.

Redfern, V. (2008). 'Y' Generation Information Seeking: Education and the Core Concept Web Search Tool. *International Journal of Learning.*

Reih, S.Y. & Belkin, J (2000). *Interaction on the Web: Scholars' judgment of information quality and cognitive authority*. Paper presented at the Annual Meeting of the American Society for Information Science (ASIS) (63rd, Chicago, IL, November 12-16, 2000).

Saracevic, T. (1971). Selected results from an inquiry into testing of information retrieval systems. *Journal of the American Society for Information Science,* 22, 22, 126-139.

Saunders, S. (2004). *Educational researchers' use of information services on the world wide web: a follow-up report on the PERINE survey of educational researchers in 8 European Nations 2001-2004*. University of Leeds. Viewed 26 January 26 2005. <http://www.leeds.ac.uk/educol/documents/00003672.htm>.

Schedler, C. (2002). *Evaluating and citing online sources*. Transcriptions. University of California - Santa Barbara: Viewed 14 July 2004. <http://transcriptions.english.ucsb.edu/resources/guides/learning/evaluating_citing.asp>.

Scheyvens, R., Wild, K. & Overton, J. (2003). International students pursuing postgraduate study in Geography: Impediments to their learning experiences. *Journal of Geography in Higher Education,* 27, 3, 309-323.

Schneiderman, B., Byrd, D. & Croft, W.B. (1997). Clarifying search: A user-interface framework for text searches. *D-Lib Magazine*, January.

Seiden, P., Szymborski, K., Norelli, B. (1997). In Buzikashvili, N. *'A myth, reality and extremal principles of seeking in different search environments'*. JASIT 52, 3

Sherman, C. & Price, G. (2001). Exploring the invisible web. *Online,* 25, 4, 32-34.

Sherman, C. & Price, G. (2001a.). *The invisible web: Uncovering information sources search engines can't see.* New Jersey: Information Today.

Schuell, T.J. (1986). Cognitive conceptions of learning. Review of Educational Research 56, 411-36. In Biggs, J. (1999). Teaching for quality learning at university: what the student does. *Society for Research into Higher Education & Open University Press*. xi-xii.

Siegfried, S., Bates, M., Wilde, D. (1993). A profile of end-user searching by humanities scholars. In Buzikashvili, N. 'A myth, reality and extremal principles of seeking in different search environments'. *JASIT,* 5, 3.

Spink, A. (1996). Multiple search sessions model end-user behavior: An exploratory study. *Journal of the American Society for Information Science*, 47, 8, 603-609.

Spink, A., Griesdorf, H. & Bateman, J. (1999). A study of mediated successive searching during information seeking. *Journal of Information Science,* 25, 6, 477-487.

Spink, A. & Wilson, T.D. (1999). Towards a theoretical framework for information retrieval (IR) evaluation in an information seeking context. for multimedia information retrieval applications. In Spink, A., Griesdorf, H. & Bateman, J. *A study of mediated successive searching during information seeking*. Proceedings of MIRA 99: Evaluation Frameworks. MIRA.

Tabatabai, D., & Luconi, F. (2004*). Expert-novice differences in searching the web*. Department of Educational and Counseling Psychology, Ontario Canada: McGill University.

TheFreeDictionary (2008) Farlex Inc. Viewed 17th August 2008. <www.thefreedictionary.com>

University of Calgary Library (2009). Information Literacy. Viewed 16th October 2011. www.ucalgary.ca/lib-old/ILG/workdef.html.

University of Canberra Committee on Ethics of Human Research. (2005). *Human Ethics Manual.* Viewed 27th January 2006. <http://www.canberra.edu.au/secretariat/ethics/human_ethics/manual.html>.

University of Idaho Information Literacy Portal (2011) Viewed 23rd April 2011. <http://www.webs.uidaho.edu/info_literacy/>.

University of Queensland, Information Literacy Framework, Information literacy defined. Viewed 16th September 2010. <https://www.library.uq.edu.au/training/info_literacy.html>.

US Congress, Riddle, W.C & Skinner R.R. (2007) *The Elementary and Secondary Education Act, as Amended by the No Child Left Behind Act: A Primer. Title II, Part D: Enhancing Education Through Technology.* Congressional Research Service (CRS) Reports and Issue Briefs, Federal Publications. Viewed 23rd April 2011 <http://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?article=1038&context=crs>

Vakkari P. (2000). *eCognition and changes of search terms and tactics during task performance.* RAIO Conférence Proceedings. Paris, France: Recherche d'Information Assistée par Ordinateur.

Vize, A. (2009). Building literacy skills within the university library. *ALIA,* 30, 9.

Waite, M. (ed). Concise Oxford Thesaurus (2002). Waite, M. (ed). Oxford University Press.

Webber, S. & Johnston, B. (2000). Conceptions on information literacy: new perspectives and implications. 1989 Final Report of the American Library Association's Presidential Committee on Information Literacy. *Journal of Information Science*, 26, 6, 381-397.

Weideman, M. & Strumpfer, C. (2004). The effect of search engine keyword choice and demographic features on internet searching success. *Information Technology and Libraries,* June 2004, 58-65.

Wilson, T. D. (1999); Models in information behaviour research, *Journal of Documentation*, 55, 3 (June), 249-270.

Wilson, T. & Walsh C. (1996). Information behaviour: an interdisciplinary perspective. Viewed 4th May 2005. <http://informationr.net/tdw/publ/infbehav/chap4.html>.

WolframAlpha (2008). Computational knowledge engine. Viewed 6th January 2009. < http://www.wolframalpha.com/> Wolfram Alpha LLC.

Wolfrem, D., Spink, A., Jansen, B.J. & Saracevic, T. (2001). Vox Populi: the public searching of the web. *Journal of the American Society for Information Science & Technology*, 52, 12, 1073-1074.

Yang, K. (2004). Information retrieval on the web. *Annual Review of Information Science and Technology*, 39, 33-81.

APPENDIX 1

Participant Information Form

Project Title: World Wide Web Technology: A Thesaural Method and Tool for Educational Knowledge Enhancement in the Field of Information Literacy

Researcher: Ms Victoria Redfern, Grad.Dip. Professional Development Education, M. Educational Leadership, PhD (Education) Candidate, Division of Communication, School of Education and Community Studies, University of Canberra.

Primary Supervisor: A/Prof Peter Clayton, Library and Information Studies, Division of Communication and Education.

Project Aim: The research aim is to evaluate the educational method and learning benefits of an online information seeking teaching tool when combined with a prototype core concept subject specific contemporary language thesaurus whilst searching the www for academic literature. This thesis is based on the substantive area of information seeking and the development, testing and operationalization of the online thesaucratic database to verify the advantages of the technological tool to the academic research community.

Benefits of the Project: The objective of the research is to develop and test a core concept subject specific thesaurus as a teaching tool which will benefit students overcome the difficulties using databases, library catalogues, on-line journals and the internet because of the lack of consistency in terminology, search terms and various ways of searching for materials.

General Outline of the Project: The experiment on the www and the core concept thesaurus will take place during Semester 1 2006. Only students enrolled at the University of Canberra are permitted to participate.

Before using the online search tool, participants will be asked to complete a post-test questionnaire and after using the tool they will be asked to complete a post-test questionnaire. Results of the experiment will be published in a thesis and lodged in the University of Canberra Library. Participants, if they advise the researcher will be sent a copy of these results if they indicate this on the Consent Form. It is also anticipated that the results may be published in the university publication 'Monitor'.

Participant Involvement: To test the thesaurus, participants will be seated at a personal computer in a computer laboratory at the University of Canberra. Participants will be permitted to research any research question from the research questions in pre-test questionnaire using the online tool. Participants will access the thesaurus database (known as 'Rootza') and access the www to find academic literature on the www.

Participants will be needed for approximately 30 minutes.

All participants will be able to print out any materials they find using the thesaurus database and the www. Additionally, all participants will be provided with a minimum six months free online access to Rootza for the period commencing the date of the experiment.

Explanations of the experiment will be given to participants in both verbal and written form. No marks or academic grading assessment is taken on the questionnaire or the results produced in the experiment. No information on participant 'hits' on web sites will be provided to anyone other than the participant who makes the 'hit'. No participant names are gathered nor used during the enlisting of those participants nor in the results produced. All participants will be allocated a unique number and access passcode for Rootza upon the signing of the Consent Form.

The experiment is voluntary and any participants may, without any penalty, decline to take part or withdraw at any time without providing an explanation, or refuse to answer a question.

Confidentiality: The only person to have access to the documentation is the researcher for this research project.

Anonymity: There will be no names or student identification numbers used. No details of materials accessed on the internet will be passed on to any lecturer, tutor or staff member. All participants will be anonymous.

Data Storage: All documentation will be kept in a locked safe during the experiment and research period after which it will be transferred to a locked filing cabinet in a locked area of the University of Canberra for a period of five years, after which the documentation will be destroyed.

Ethics Committee Clearance: This research project has been approved by the Committee for Ethics in Human Research of the University.

Queries and Concerns: If there are any queries or concerns on the project, the researcher may be contacted via telephone 0403 620074, email; phdaero@optusnet.com.au or fax 6255 1946 or alternatively the researchers supervisor, A/Prof Peter Clayton telephone 6201 5431, Fax, 6201 26530 or email peter.clayton@canberra.edu.au.

APPENDIX 2

Informed Consent Form

Project Title:

World Wide Web Technology: A Thesaucratic Method and Tool for Knowledge Enhancement in the Field of Information Literacy Education

Consent Statement

I have read and understood the information about the research. I am not aware of any condition that would prevent my participation, and I agree to participate in this project. I have had the opportunity to ask questions about my participation in the research. All questions I have asked have been answered to my satisfaction.

Name…… Signature……

Date …….

A summary of the research report can be forwarded to you when published. If you would like to receive a copy of the report, please include your mailing address below.

Name……..

Address……..

……

APPENDIX 3

C1XX

PRE-TEST QUESTIONNAIRE

There are three sections in this questionnaire. The first is to establish your background, the second is to establish your computer experience and the third is to establish your information seeking skills and preferences.

SECTION 1: <u>Preliminary Information</u>

		15-19	20-24	25-29	30-34	35-39	40-44	45-49	50+
1.	What is your age group?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

2. Gender:…….....

3. In what country were you born:…….....

4. In what country did you receive your primary education…….....

5. In what country did you receive your secondary education:…….....

6. In what country do you permanently reside:…….....

7. How many years have you lived in Australia:…….....

8. What course are you enrolled in at the University of Canberra:…….....

9. How many subjects have you completed:…….....

10 Are you a full time or part time student:…….....

11. Were you born and educated only in Australia: Yes [ ] No [ ]

SECTION 2: <u>Participant Expertise - Language</u>

12. What is your first language:…….....

13. What is your second language if any:…….....

14. What language do you speak in your house where you live now…….....

15. (If Applicable) When you arrived in Australia, was your English language skill:

1	2	3
Fluent [ ]	Not so fluent [ ]	No English [ ]

PLEASE CONTINUE TO PAGE 2

ONLY COMPLETE THIS QUESTION IF YOU WERE NOT BORN IN AUSTRALIA

PLEASE TICK ONE RESPONSE FOR EACH QUESTION

1 = Very Good, 2 =Good, 3 = Average, 4 = Poor , 5 = Very Poor

		1	**2**	**3**	**4**	**5**
18.	Is your English now:	[ ]	[ ]	[ ]	[ ]	[ ]
19.	Is your reading ability in your First language:	[ ]	[ ]	[ ]	[ ]	[ ]
20.	Is your writing ability in your First language:	[ ]	[ ]	[ ]	[ ]	[ ]
21.	Is your listening ability in your First language:	[ ]	[ ]	[ ]	[ ]	[ ]
22.	Is your reading ability in your Second language:	[ ]	[ ]	[ ]	[ ]	[ ]
23.	Is your writing ability in your Second language:	[ ]	[ ]	[ ]	[ ]	[ ]
24.	Is your listening ability in your Second language:	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION 3: <u>Computer Technology</u>

25. Do you have a computer at home? Yes [ ] No [ ]

26. On average, how many hours a week is your computer use? [ ] [ ] [ ] [ ] [ ]

Number of hours	1-10	11-20	21-30	31-40	41-50

27. Do you mainly use the computer for study or recreation? (Tick <u>One</u>)

Study [ ] Recreation [ ]

28. On average, how many hours a week do you use it for study or recreation?

	[ ]	[ ]	[ ]	[ ]	[ ]
Number of hours	1-10	11-20	21-30	31-40	41-50

29. Do you use a computer at university? Yes [ ] No [ ]

30. On average, how many hours a week do you use a computer at university?

	[ ]	[ ]	[ ]	[ ]	[ ]
Number of hours	1-10	11-20	21-30	31-40	41-50

PLEASE CONTINUE TO PAGE 3

For Finding Information, do you CURRENTLY use:

(PLEASE TICK ONE RESPONSE FOR EACH QUESTION)

		All the Time	Often	Sometimes	Not Often	Never
		1	2	3	4	5
31.	Library electronic database	[ ]	[ ]	[ ]	[ ]	[ ]
32.	Library electronic journals	[ ]	[ ]	[ ]	[ ]	[ ]
33.	Library e-reserve collection	[ ]	[ ]	[ ]	[ ]	[ ]
34.	Netscape	[ ]	[ ]	[ ]	[ ]	[ ]
35.	Microsoft Explorer	[ ]	[ ]	[ ]	[ ]	[ ]
36.	Google	[ ]	[ ]	[ ]	[ ]	[ ]
37.	Another internet search tool	[ ]	[ ]	[ ]	[ ]	[ ]

(Please write name of other internet tool here…….....)

38. In your own words, what is your opinion of using computers and the WWW for information seeking?

……

……

……

……

39. In your own words, how comfortable are you of using computers and the WWW for information seeking?

……

……

……

……

40. Are you familiar with the steps of information seeking? Yes [ ] No [ ] Sort of [ ]

PLEASE CONTINUE TO PAGE 4

41. Please write down any information seeking steps you know

……

……

……

During the experiment, there are three questions you will be asked to research on the world wide web (www).

In the spaces following the questions below, please write down the search terms you will/might use.

Question 1.

What was is the effect of the White Australia Policy on Australian society in the 20th century?

Search terms:

……

……

Question 2.

What does the concept of intercultural awareness mean to Australians?

Search terms:

……

……

Question 3.

Can Australia be simultaneously colonial and post-colonial in its attitude to the indigenous population?

Search terms:

……

……

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

PLEASE PASS THIS FORM TO THE ORGANISER AND COMMENCE THE EXPERIMENT

APPENDIX 4

E1XX

PRE-TEST QUESTIONNAIRE

There are three sections in this questionnaire. The first is to establish your background, the second is to establish your computer experience and the third is to establish your information seeking skills and preferences.

SECTION 1: <u>Preliminary Information</u>

		15-19	20-24	25-29	30-34	35-39	40-44	45-49	50+
1.	What is your age group?	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

2. Gender:…….....

3. In what country were you born:…….....

4. In what country did you receive your primary education…….....

5. In what country did you receive your secondary education:…….....

6. In what country do you permanently reside:…….....

7. How many years have you lived in Australia:…….....

8. What course are you enrolled in at the University of Canberra:…….....

9. How many subjects have you completed:…….....

10 Are you a full time or part time student:…….....

11. Were you born and educated only in Australia: Yes [ ] No [ ]

SECTION 2: <u>Participant Expertise - Language</u>

12. What is your first language:…….....

13. What is your second language if any:…….....

14. What language do you speak in your house where you live now…….....

15. (If Applicable) When you arrived in Australia, was your English language skill:

1	2	3
Fluent [ ]	Not so fluent [ ]	No English [ ]

PLEASE CONTINUE TO PAGE 2

ONLY COMPLETE THIS QUESTION IF YOU WERE NOT BORN IN AUSTRALIA

PLEASE TICK ONE RESPONSE FOR EACH QUESTION

1 = Very Good, 2 =Good, 3 = Average, 4 = Poor , 5 = Very Poor

		1	**2**	**3**	**4**	**5**
18.	Is your English now:	[ ]	[ ]	[ ]	[ ]	[ ]
19.	Is your reading ability in your First language:	[ ]	[ ]	[ ]	[ ]	[ ]
20.	Is your writing ability in your First language:	[ ]	[ ]	[ ]	[ ]	[ ]
21.	Is your listening ability in your First language:	[ ]	[ ]	[ ]	[ ]	[ ]
22.	Is your reading ability in your Second language:	[ ]	[ ]	[ ]	[ ]	[ ]
23.	Is your writing ability in your Second language:	[ ]	[ ]	[ ]	[ ]	[ ]
24.	Is your listening ability in your Second language:	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION 3: Computer Technology

25. Do you have a computer at home? Yes [ ] No [ ]

26. On average, how many hours a week is your computer use? [ ] [ ] [ ] [ ] [ ]

Number of hours	1-10	11-20	21-30	31-40	41-50

27. Do you mainly use the computer for study or recreation? (Tick One)

Study [ ] Recreation [ ]

29. On average, how many hours a week do you use it for study or recreation?

	[ ]	[ ]	[ ]	[ ]	[ ]
Number of hours	1-10	11-20	21-30	31-40	41-50

29. Do you use a computer at university? Yes [ ] No [ ]

30. On average, how many hours a week do you use a computer at university?

	[ ]	[ ]	[ ]	[ ]	[ ]
Number of hours	1-10	11-20	21-30	31-40	41-50

PLEASE CONTINUE TO PAGE 3

For Finding Information, do you CURRENTLY use:

(PLEASE TICK ONE RESPONSE FOR EACH QUESTION)

		All the Time	Often	Sometimes	Not Often	Never
		1	2	3	4	5
31.	Library electronic database	[ ]	[ ]	[ ]	[ ]	[ ]
32.	Library electronic journals	[ ]	[ ]	[ ]	[ ]	[ ]
33.	Library e-reserve collection	[ ]	[ ]	[ ]	[ ]	[ ]
34.	Netscape	[ ]	[ ]	[ ]	[ ]	[ ]
35.	Microsoft Explorer	[ ]	[ ]	[ ]	[ ]	[ ]
36.	Google	[ ]	[ ]	[ ]	[ ]	[ ]
37.	Another internet search tool	[ ]	[ ]	[ ]	[ ]	[ ]

(Please write name of other internet tool here…….....)

38. In your own words, what is your opinion of using computers and the WWW for information seeking?

……

……

……

……

39. In your own words, how comfortable are you of using computers and the WWW for information seeking?

……

……

……

……

40. Are you familiar with the steps of information seeking? Yes [ ] No [ ] Sort of [ ]

PLEASE CONTINUE TO PAGE 4

41. Please write down any information seeking steps you know

……

……

……

During the experiment, there are three questions you will be asked to research on the world wide web (www).

In the spaces following the questions below, please write down the search terms you will/might use.

Question 1.

What was is the effect of the White Australia Policy on Australian society in the 20th century?

Search terms:

……

……

Question 2.

What does the concept of intercultural awareness mean to Australians?

Search terms:

……

……

Question 3.

Can Australia be simultaneously colonial and post-colonial in its attitude to the indigenous population?

Search terms:

……

……

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

PLEASE PASS THIS FORM TO THE ORGANISER AND COMMENCE THE EXPERIMENT

APPENDIX 5

C1XX **POST-TEST QUESTIONNAIRE**

During the experiment, there were three questions you were asked to research on the world wide web (www).

In the spaces following the questions below, please write down the search terms you remember using for the questions you researched during the experiment.

In the Question areas below, please ONLY write in the area of the question/s you answered

Question 1.

What was is the effect of the White Australia Policy on Australian society in the 20th century?

Search terms you remember using:…..……..…..……

……

Question 2.

What does the concept of intercultural awareness mean to Australians?

Search term you remember using:……

……..

Question 3.

Can Australia be simultaneously colonial and post-colonial in its attitude to the indigenous population?

Search terms you remember using:...……...……

…….

PLEASE CONTINUE TO PAGE 2

4. Please write down the information seeking steps you remember from the experiment:

……

……

……

……

……

……

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

PLEASE PASS THIS FORM TO THE ORGANISER

APPENDIX 6

E1XX **POST-TEST QUESTIONNAIRE**

During the experiment, there were three questions you were asked to research on the world wide web (www).

In the spaces following the questions below, please write down the search terms you remember using for the questions you researched during the experiment.

In the Question areas below, please ONLY write in the area of the question/s you answered

Question 1.

What was is the effect of the White Australia Policy on Australian society in the 20th century?

Search terms you remember using:……..……..

…….……...

Question 2.

What does the concept of intercultural awareness mean to Australians?

Search term you remember using:……

……..…….……...

Question 3.

Can Australia be simultaneously colonial and post-colonial in its attitude to the indigenous population?

Search terms you remember

using:…….....……..…….……...

…….……...

PLEASE CONTINUE TO PAGE 2

4. Please write down the information seeking steps you remember from the experiment

……

……

……

……

……

……

PLEASE CONTINUE TO PAGE 3

Your thoughts, feelings, attitudes and viewpoint of the **Online Core Concept Subject** **THESAURUS** is an important factor to the research

5.0 PLEASE PLACE AN 'X' IN THE PLACE THAT REFLECTS YOUR OPINION

		1	2	3	4	5	6	7	
5.1	Important	____:	____:	____:	____:	____:	____:	____	unimportant
5.2	irrelevant	____:	____:	____:	____:	____:	____:	____	relevant
5.3	useless	____:	____:	____:	____:	____:	____:	____	useful
5.4	valuable	____:	____:	____:	____:	____:	____:	____	worthless
5.5	beneficial	____:	____:	____:	____:	____:	____:	____	not beneficial
5.6	matters to me	____:	____:	____:	____:	____:	____:	____	doesn't matter to me
5.7	uninterested	____:	____:	____:	____:	____:	____:	____	interested
5.8	significant	____:	____:	____:	____:	____:	____:	____	insignificant
5.9	boring	____:	____:	____:	____:	____:	____:	____	interesting
5.10	unexciting	____:	____:	____:	____:	____:	____:	____	exciting
5.11	appealing	____:	____:	____:	____:	____:	____:	____	unappealing
5.12	mundane	____:	____:	____:	____:	____:	____:	____	fascinating
5.13	essential	____:	____:	____:	____:	____:	____:	____	nonessential
5.14	undesirable	____:	____:	____:	____:	____:	____:	____	desirable
5.16	wanted	____:	____:	____:	____:	____:	____:	____	unwanted
5.17	not needed	____:	____:	____:	____:	____:	____:	____	needed

6. In your own words, what are your thoughts and opinion of the core concept thesaurus?

……

……

PLEASE CONTINUE TO PAGE 3

Your thoughts, feelings, attitudes and viewpoint of the THESAURUS **WEB PAGE** is also an important factor to the research.

PLEASE PLACE AN 'X' IN THE PLACE THAT REFLECTS YOUR OPINION

		1	2	3	4	5	6	7	
5.	Important	____:	____:	____:	____:	____:	____:	____	unimportant
6.	irrelevant	____:	____:	____:	____:	____:	____:	____	relevant
7.	useless	____:	____:	____:	____:	____:	____:	____	useful
8.	valuable	____:	____:	____:	____:	____:	____:	____	worthless
9.	beneficial	____:	____:	____:	____:	____:	____:	____	not beneficial
10.	matters to me	____:	____:	____:	____:	____:	____:	____	doesn't matter to me
11.	uninterested	____:	____:	____:	____:	____:	____:	____	interested
12.	significant	____:	____:	____:	____:	____:	____:	____	insignificant
13.	boring	____:	____:	____:	____:	____:	____:	____	interesting
14.	unexciting	____:	____:	____:	____:	____:	____:	____	exciting
15.	appealing	____:	____:	____:	____:	____:	____:	____	unappealing
16.	mundane	____:	____:	____:	____:	____:	____:	____	fascinating
17.	essential	____:	____:	____:	____:	____:	____:	____	nonessential
18.	undesirable	____:	____:	____:	____:	____:	____:	____	desirable
19.	wanted	____:	____:	____:	____:	____:	____:	____	unwanted
20.	not needed	____:	____:	____:	____:	____:	____:	____	needed

21. In your own words, what are your thoughts and opinion of the core concept thesaurus?

……

……

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE AND EXPERIMENT

PLEASE PASS THIS FORM TO THE ORGANISER