THE DEVELOPMENT OF ENHANCED INFORMATION RETRIEVAL STRATEGIES IN UNDERGRADUATES THROUGH THE APPLICATION OF LEARNING THEORY: AN EXPERIMENTAL STUDY

by

KAREN MACPHERSON

A thesis submitted in fulfilment of the requirements for a Doctoral Degree at the University of Canberra

VOLUME II

September 2002

Primary Supervisor:
Professor Belle Alderman
Head, School of Information Management & Tourism
Division of Communication and Education
TABLE OF CONTENTS
VOLUME II

LIST OF TABLES ........................................................................................... iii

LIST OF FIGURES ........................................................................................... v

LIST OF APPENDICES ...................................................................................... vii

9. PHASE 2 - METHOD ...................................................................................... 251

  9.1 Introduction ............................................................................................ 251

  9.2 Research Questions and Hypotheses ..................................................... 252

    9.2.1 Research Question 1 ................................................................. 252
    9.2.2 Research Question 2 ................................................................. 254
    9.2.3 Research Question 3 ................................................................. 254

  9.3 The Study .............................................................................................. 255

    9.3.1 Research Design ........................................................................... 257
    9.3.2 Population and Sample ............................................................... 258
    9.3.3 Variables ....................................................................................... 261
    9.3.4 Timetable for Conduct of Experiment ........................................... 265
    9.3.5 Data Collection ............................................................................. 267
    9.3.6 Limitations .................................................................................... 268

  9.4 Instruments ............................................................................................ 272

    9.4.1 Survey 1 ....................................................................................... 272
    9.4.2 Survey 2 ....................................................................................... 277
    9.4.3 Literature Search Assignment ....................................................... 278
    9.4.4 The Modules ............................................................................... 282

  9.5 Measurement .......................................................................................... 290

10. PHASE 2 - RESULTS ................................................................................... 293

  10.1 Background Variables .......................................................................... 293

    10.1.1 Participants ............................................................................... 293
    10.1.2 Characteristics of Sample ......................................................... 294
    10.1.3 Descriptive Statistics: Surveys 1 and 2 ....................................... 298
LIST OF TABLES

CHAPTER 9
Table 9-1 Summary of Hypotheses (Null Form) and Instruments .... 257
Table 9-2 Phase 2 - Experimental Design ............................................. 258
Table 9-3 Office Management 3 Statistics ............................................. 261
Table 9-4 Phase 2 – Timetable for Conduct of Experiment ................. 266
Table 9-5 Theoretical Underpinning of Survey Questions – Section 3 .................................................................................. 277
Table 9-6 Timetable for Delivery of Modules ....................................... 284

CHAPTER 10
Table 10-1 Gender .................................................................................. 294
Table 10-2 Age ....................................................................................... 295
Table 10-3 Education ............................................................................. 295
Table 10-4 Use of Electronic Databases ................................................ 296
Table 10-5 Completion of Library Tours ................................................ 297
Table 10-6 Hypotheses (Null Form) and Instruments of Measurement ........................................................................ 302
Table 10-7 Descriptive Statistics for Search Strategy Variables by Topic ........................................................................ 308
Table 10-8 Differences in Means between Experimental and Control Groups for Variables Determined by Frequency ... 309
Table 10-9 Significant Differences between Experimental and Control Groups on Variables Determined by Frequency ... 310
Table 10-10 Search Strategy Variables Measured on Nominal and Ordinal Scales ........................................................................ 312
Table 10-11 Topics 1 and 2: Use of Truncation as a Function of Treatment ........................................................................ 312
LIST OF FIGURES

CHAPTER 10

Figure 10-1  Scores on Electronic Database Knowledge
             Questions – Total Sample ...........................................299

Figure 10-2  Scores on Problem-Solving Questions –
             Total Sample ..............................................................300

Figure 10-3  Scores on Survey 2, Electronic Database
             Questions – Total Sample .............................................301

Figure 10-4  Scores on Electronic Database Knowledge
             Pre-test as a Function of Treatment .................................304

Figure 10-5  Scores on Electronic Database Knowledge
             Post-test as a Function of Treatment .................................305

Figure 10-6  Percentage of Incorrect Responses as a
             Function of Age for Seven Most Difficult
             Questions.........................................................................336

Figure 10-7  Percentage of Incorrect Responses as a
             Function of Gender for Seven Most
             Difficult Questions ........................................................337

Figure 10-8  Percentage of Incorrect Responses as a
             Function of Highest Academic Qualification for
             Seven Most Difficult Questions .......................................338

Figure 10-9  Topics 1 and 2 Combined: Time Taken to
             Find Literature as a Function of Treatment ........................347
| Figure 12-1 | Information Retrieval - Stage 1: Neural Network Model of Question Interpretation | 360 |
| Figure 12-2 | Information Retrieval - Stage 2: Information Processing Model of Conducting a Search | 364 |
| Figure 12-3 | A Model of Information Retrieval | 366 |
| Figure 12-4 | A Framework for the Teaching of Information Literacy | 369 |
| Figure 12-5 | Framework and Content for the Teaching of Information Literacy | 370 |
## LIST OF APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix 1</td>
<td>Phase 1 Informed Consent</td>
<td>399</td>
</tr>
<tr>
<td>Appendix 2</td>
<td>Phase 2 Informed Consent</td>
<td>400</td>
</tr>
<tr>
<td>Appendix 3</td>
<td>Phase 1 Survey 1 (pre-test)</td>
<td>401</td>
</tr>
<tr>
<td>Appendix 4</td>
<td>Phase 1 Information Retrieval Assignment (post-test 2)</td>
<td>409</td>
</tr>
<tr>
<td>Appendix 5</td>
<td>Phase 1 Survey 2 (post-test 1)</td>
<td>412</td>
</tr>
<tr>
<td>Appendix 6</td>
<td>Phase 1 Experimental Teaching Module</td>
<td>416</td>
</tr>
<tr>
<td>Appendix 7</td>
<td>Phase 1 Library Liaison Officer's Information Retrieval Demonstration</td>
<td>419</td>
</tr>
<tr>
<td>Appendix 8</td>
<td>Phase 1 Search Worksheet</td>
<td>425</td>
</tr>
<tr>
<td>Appendix 9</td>
<td>Phase 1 Handout for Control Group on Information Retrieval Strategies</td>
<td>426</td>
</tr>
<tr>
<td>Appendix 10</td>
<td>Phase 1 Rating Sheet for Information Retrieval Assignment</td>
<td>432</td>
</tr>
<tr>
<td>Appendix 11</td>
<td>Phase 2 Survey 2 (post-test 1)</td>
<td>433</td>
</tr>
<tr>
<td>Appendix 12</td>
<td>Phase 2 Literature Search Assignment (post-test 2)</td>
<td>437</td>
</tr>
<tr>
<td>Appendix 13</td>
<td>Phase 2 Survey 1 (pre-test)</td>
<td>440</td>
</tr>
<tr>
<td>Appendix 14</td>
<td>Phase 2 Module: Experimental Treatment, Week 6</td>
<td>448</td>
</tr>
<tr>
<td>Appendix 15</td>
<td>Phase 2 Module: Control Treatment, Week 6</td>
<td>453</td>
</tr>
<tr>
<td>Appendix 16</td>
<td>Phase 2 Literature Search Assignment Worksheet</td>
<td>455</td>
</tr>
<tr>
<td>Appendix 17</td>
<td>Phase 2 Module: Experimental Treatment, Week 4</td>
<td>456</td>
</tr>
<tr>
<td>Appendix 18</td>
<td>Phase 2 Rating Sheet for Literature Search Assignment</td>
<td>459</td>
</tr>
</tbody>
</table>
9. PHASE 2 – METHOD

9.1 Introduction

In Volume I of this thesis, the background, literature, theoretical framework, method and results for Phase 1 of this study were described. Results from Phase 1 provided support for the efficacy of concept-based teaching of information retrieval; and for the two-stage model of the process presented in Chapter 5. The theoretical framework discussed in Chapter 5 also introduced the role of critical thinking strategies and skills in the information retrieval process; however, the teaching of such skills was beyond the purview of Phase 1. Phase 1 results suggested that critical thinking skills may indeed be usefully incorporated into a model of the information retrieval process, and the researcher has hypothesised that inclusion of such critical thinking skills in information retrieval instruction should lead not only to improved search strategies, but more importantly, to improved identification of relevant, credible literature.

Further, as described in Chapter 5, the researcher is of the view that the wider framework of information literacy is an important construct to superimpose on information retrieval process modelling and teaching. The final form of that Framework, developed after review of results for both Phases 1 and 2, is presented in Chapter 12.

In this Volume, method and results for Phase 2, a discussion of results for Phases 1 and 2, and a final chapter drawing together all the theoretical and practical elements of this study, are presented.
In the next sections of this chapter, research questions and hypotheses; and method for Phase 2, are reported.

9.2 Research Questions and Hypotheses

Phase 2 hypotheses arose from the results of Phase 1. The researcher suggested that a series of modules utilising concept-based teaching strategies would facilitate the acquisition of some aspects of information literacy, viz: the ability to locate and critically evaluate journal literature relevant to a given topic. Three research questions were proposed; they are discussed below.

9.2.1 Research Question 1

Will type of instruction influence the ability to formulate appropriate search strategies to enable the location of information?

Variables that were measured included: Number of Concepts, Number of Synonyms, Number of Databases accessed, Number of Reformulations, Use of Truncation, Use of Complex Boolean Operators, and Overall Search Success.

Hypotheses relating to research question 1 were:

Hypothesis 1 (null): There is no difference between experimental and control groups on the pre-test measuring electronic database knowledge.

If this hypothesis were able to be accepted, it could be concluded that treatment groups were equivalent in their knowledge of electronic database search terminology.
Hypothesis 2 (null): There is no difference between experimental and control groups on the post-test measuring electronic database knowledge.

If this hypothesis were able to be rejected, it could be concluded that the experimental treatment influenced knowledge of electronic database search terminology. As the sample comprised second year undergraduates, most of whom had completed electronic database introductory tutorials, it was not anticipated that there will be a great difference between performance on the pre-test and on the post-test. What was expected was that actual search strategy formulations, and outcomes, would vary with type of instruction.

Hypothesis 3 (null): There is no difference between experimental and control groups on the pre-test measuring problem-solving ability.

If this hypothesis were able to be accepted, then it could be concluded that both treatment groups were equivalent in terms of their problem-solving ability. This was desirable, as it was expected that the experimental treatment group would acquire more effective problem-solving skills through the concept-based instruction.

Hypothesis 4 (null): There is no difference between experimental and control groups in search strategy formulation.

If this hypothesis were able to be rejected, it could be concluded that the experimental treatment influenced subjects’ ability to formulate suitable search strategies for information retrieval.
9.2.2 Research Question 2
Will type of instruction influence the ability to critically evaluate information located, so that search success is improved?

Variables on which data were collected, enabling measurement of search success, were: Credibility of Source, and Relevance of Article.

Hypothesis 5 (null): There is no difference between experimental and control groups in search success.

If this hypothesis were able to be rejected, it could be concluded that the experimental treatment influenced subjects' ability not only to formulate appropriate search strategies, but also to evaluate information located, thus improving actual search success.

9.2.3 Research Question 3
A final question sought to confirm findings from Phase 1 of this research concerning the role of problem solving in the information retrieval process: Are problem-solving ability and information retrieval effectiveness related?

Hypothesis 6 (null): There is no difference in search strategy formulation depending on problem-solving ability.

Variables that were measured included: Number of Concepts, Number of Synonyms, Number of Databases accessed, Number of Reformulations, Use of Truncation, Use of Complex Boolean Operators, and Overall Search Success.
If this hypothesis were able to be rejected, a tentative conclusion that problem-solving ability influences search strategy formulation could be supported.

Hypothesis 7 (null): There is no difference in search outcome depending on problem-solving ability.

Credibility of source information, and relevance of materials located, were variables that were used to measure search outcome.

If this hypothesis were able to be rejected, it could be concluded that problem-solving ability influenced search outcome. The confirmation of this finding from Phase 1 would be valuable, as problem solving – in the case of information retrieval, a problem-solving heuristic – can be taught.

In the next section, method for Phase 2 is discussed.

9.3 The Study

In the remaining sections of this chapter, the method employed in the conduct of Phase 2 of this research is described. The method chosen was a pre-test/post-test experimental design, using a sample of 70 second year undergraduates at the University of Canberra, Australia. In Chapter 6, the justification for this methodology is provided. The experimental treatment group was given a series of four teaching modules, based on learning theory paradigms, in order to determine whether this concept-based instruction would result in subjects being able to locate and critically evaluate journal literature pertaining to two search topics related to their field of study. The control group was given skills-based instruction only.
This section details the research design, variables, timetable, sample, and issues relating to data collection. In section 6.7, the three instruments used in data collection and measurement are discussed: Survey 1 (pre-test); Survey 2 (post-test 1); and the Literature Search Assignment (post-test 2). Section 9.7 also describes the teaching modules designed as the treatment (independent variable) to enable testing of research hypotheses. Section 9.8 describes measurement issues.

Table 9-1 below summarises the hypotheses that were tested, and the instruments that were used to enable measurement.
Table 9-1: Summary of Hypotheses (Null Form) and Instruments

<table>
<thead>
<tr>
<th>Hypothesis (Null Form)</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is no difference between experimental and control groups on the pre-test</td>
<td>Survey 1, Section 2: Electronic Database Knowledge (pre-test)</td>
</tr>
<tr>
<td>measuring electronic database knowledge.</td>
<td></td>
</tr>
<tr>
<td>There is no difference between experimental and control groups on the post-test</td>
<td>Survey 2: Electronic Database Knowledge (post-test 1)</td>
</tr>
<tr>
<td>measuring electronic database knowledge.</td>
<td></td>
</tr>
<tr>
<td>There is no difference between experimental and control groups on the pre-test</td>
<td>Survey 1, Section 3: Problem Solving (pre-test)</td>
</tr>
<tr>
<td>measuring problem-solving ability.</td>
<td></td>
</tr>
<tr>
<td>There is no difference between experimental and control groups in search strategy</td>
<td>Literature Search Assignment (post-test 2)</td>
</tr>
<tr>
<td>formulation.</td>
<td></td>
</tr>
<tr>
<td>There is no difference between experimental and control groups in search success.</td>
<td>Literature Search Assignment (post-test 2)</td>
</tr>
<tr>
<td>There is no difference in search strategy formulation depending on problem-</td>
<td>Survey 1, Section 3: Problem Solving (pre-test); Literature Search Assignment (post-test 2)</td>
</tr>
<tr>
<td>solving ability.</td>
<td></td>
</tr>
<tr>
<td>There is no difference in search outcome depending on problem-solving ability.</td>
<td>Survey 1, Section 3: Problem Solving (pre-test); Literature Search Assignment (post-test 2)</td>
</tr>
</tbody>
</table>

9.3.1 Research Design

An experimental research design was chosen for the conduct of Phase 2, for, as was the case in Phase 1, the researcher wished to measure the impact of an independent variable on dependent variables; and was able to control assignment of subjects to treatment groups.

The experimental design is summarised in Table 9-2.
Table 9-2: Phase 2 – Experimental Design

<table>
<thead>
<tr>
<th>Random assignment to groups:</th>
<th>Pre-test</th>
<th>Treatment (independent variable)</th>
<th>Post-tests (dependent variable)</th>
</tr>
</thead>
</table>
| Control                     | Standard test to measure knowledge of electronic databases and problem solving skills (Survey 1) | Skills instruction in electronic database use, evaluation of sources and search strategy formulation | 2. Performance on post-test 1 (Survey 2)  
2. Performance on post-test 2 (Literature Search Assignment) |
| Experimental                | Standard test to measure knowledge of electronic databases and problem solving skills (Survey 1) | Skills instruction, plus critical thinking skills, instruction in electronic database concepts, modelling of problem solving heuristic, and evaluation techniques for sources | 2. Performance on post-test 1 (Survey 2)  
2. Performance on post-test 2 (Literature Search Assignment) |

9.3.2 Population and Sample

The nature of the independent variable to be tested - a series of four teaching modules - imposed some limitations on the conduct of the study. For example, in the case of Phase 1, access to a large “service unit” subject for the conduct of the experiment was possible, as the experimental treatment was able to be delivered in one tutorial session. As Phase 2 was designed to examine the impact of a more extensive experimental treatment, the number of academic units available for their implementation was much more limited, as four tutorials - one third of a semester’s tutorial program – would be involved.
However, in order to control intervening variables, the undergraduate cohort used in the study needed to meet a number of criteria:

1. The pre-test would need to be conducted early in first semester, second year.

2. The experimental modules would need to be run as soon as possible thereafter.

3. The cohort would have to be available for five weeks early in first semester, to enable implementation of the surveys and the modules.

4. As large a sample size as possible would be utilised.

5. Random assignment to treatment groups must be possible.

6. The technology necessary to allow the conduct of experiment must be available at the right time.

7. The experimental modules must be integrated into a unit, in order to maximise relevance and understanding.

8. The post-test Literature Search Assignment must be relevant to the unit.

9. The post-test survey must be administered as soon as possible after the experimental modules have been completed.

Accordingly, the researcher approached the lecturer-in-charge of the unit "Office Management ¾” for permission to conduct the study in that unit.
This unit was appropriate because it met the criteria outlined above; and it was the unit in which the researcher’s original observations of end-user searching problems had been made in 1994 and 1995. No Phase 1 respondents were included in Phase 2; Phase 1 respondents were third year students at the time that Phase 2 was conducted with second year students.

This unit was comprised primarily of students from the Division of Communication and Education, but it also drew some students from other Divisions, as some students studied that unit as part of an elective major series of six units. However, as students were primarily from the one Division, the researcher did not believe that it represented the undergraduate University of Canberra population, and so for the purposes of Phase 2, the population was defined as all second year undergraduate students enrolled in the Bachelor of Information Management at the University of Canberra.

Prior to the start of the semester, there were 70 students enrolled in the unit. These students were divided into five tutorial groups, with a maximum number of 15 students per group. Tutorial groups were randomly assigned to either experimental or control treatments by mixing the tutorial dates and times in a container, and then extracting them. The first three tutorials extracted from the container comprised the experimental group. The experimental sample consisted of three daytime (starting times 0830 and finishing by 1630) tutorials. The control group comprised one daytime and one evening (starting at 1530 or later) tutorial.
Table 9-3: Office Management 3/4 Statistics

<table>
<thead>
<tr>
<th>Tutorial Day</th>
<th>Start and Finish</th>
<th>Number of students registered in tutorial</th>
<th>Experimental or control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday</td>
<td>0930 – 1100</td>
<td>15</td>
<td>Experimental</td>
</tr>
<tr>
<td>Wednesday</td>
<td>1100 – 1230</td>
<td>15</td>
<td>Experimental</td>
</tr>
<tr>
<td>Thursday</td>
<td>0930 – 1100</td>
<td>15</td>
<td>Control</td>
</tr>
<tr>
<td>Thursday</td>
<td>1730 – 1900</td>
<td>10</td>
<td>Control</td>
</tr>
<tr>
<td>Friday</td>
<td>1030 – 1200</td>
<td>15</td>
<td>Experimental</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

Demographic data for the sample were gathered in Survey 1, which was administered in the Office Management 3/4 lecture in Week 2. Consent forms (see Appendix 2) had been distributed in the Week 1 lecture, and were collected in the lecture in Week 2, prior to administering Survey 1.

The study was of a "single blind" design. The researcher was aware of which tutorials were experimental treatment groups and which were control; but the subjects were not.

9.3.3 Variables

The independent variable in Phase 2 was the series of four teaching modules designed to determine whether concept-based instruction (as opposed to skills-based instruction alone) would influence the acquisition of some of the skills thought to be involved with information literacy, viz: an understanding of the nature of electronic databases; the ability to analyse a research question;
to select appropriate databases; to formulate a viable search strategy; to distinguish between scholarly and non-scholarly sources; to evaluate information located; and to cite and describe that information accurately.

The dependent variables were performance on the two post-tests: Survey 2 (Appendix 11), designed to measure any change in knowledge of electronic databases; and the Literature Search Assignment (Appendix 12), designed to enable actual search strategies, behaviour and outcomes to be measured. These instruments are described in section 9.4 below.

Intervening variables that the researcher anticipated may impact on the cause-effect relationship between the independent and dependent variables - based on results of Phase 1 - included previous knowledge of electronic database searching, age, gender, and highest existing academic qualification. In order to allow quantification of these variables, the researcher included questions on all of them in the first section of the pre-test (Survey 1 – Appendix 13). These variables were controlled as far as possible by ensuring that the sample size was adequately large, and that assignment of subjects to experimental and control treatments was random.

Other intervening variables for the Literature Search Assignment included guidance from academic and library staff, or help from friends. The researcher addressed these variables by firstly, allocating an appropriate assessment weighting to the Assignment. The researcher was of the view that to ensure the Assignment would be attempted, it had to have some role in the subject’s successful completion of the unit Office Management 3/4. On the other hand, any actual assessment weighting would be inappropriate, as it was expected that subjects in the control group would not complete the Assignment as effectively as those in the experimental treatment. Further, if the Assignment
had an actual assessment weighting, subjects might collaborate in its completion, in order to maximise their grade. The researcher decided therefore to allocate a “Pass or Fail” criterion to the Assignment. That is, subjects were obliged to attempt the Assignment in order to fulfil assessment criteria for the unit, but were not allocated a grade for it. The negative aspect of the “Pass or Fail” weighting was that subjects may not try their best to find scholarly sources for the completion of the Assignment, as they were aware that they would not receive a higher grade for trying harder.

With regard to information from academic or library staff about database searching, other than that obtained prior to the conduct of the experiment, or given as part of the experimental treatment, the researcher accounted for these intervening variables in a number of ways. Firstly, the researcher requested that tutors in the unit Office Management 3/4 did not assist subjects in the completion of the Assignment, beyond answering basic enquiries. Secondly, subjects were instructed that they should complete the Assignment on their own. Finally, subjects knew that completion of the Assignment, although the first stage in an assessable piece of research for the unit, was “Pass or Fail” and that they would be given written feedback on the quality of their research before completing the next, assessable, component of the larger assignment, which was a research report. Therefore, subjects knew that any mistakes they made in the search process would be dealt with before they were penalised through grading. Also, subjects were aware that the Literature Search Assignment was part of the researcher’s experimental study into student search behaviours, and that to seek outside assistance on the completion of the Assignment might influence results. The researcher is of the view that students’ ethical behaviour in this regard should be assumed, as subjects had given their consent to participate in the study.
With regard to intervening variables that may have impacted on the conduct of the experiment generally, the researcher notes that these variables: elapsed time, subject maturation, and the "Hawthorne effect" in which subjects who are given attention from a researcher tend to perform better than those who do not, were addressed in the following ways. Firstly, the timetable for the conduct of the experiment was kept to the minimum possible: ten weeks. This meant that considerations of elapsed time and subject maturation were not likely to be major factors influencing results.

With regard to the Hawthorne effect, two measures were taken: firstly, in the introduction to the research during the Lecture in Week 1, the researcher stressed the value of all subjects' participation and input. The researcher was of the view that the goodwill of the subjects was important to successful completion of the experiment, as it necessitated both intellectual and time investments on behalf of the participants. Subjects were told that the research was about gathering data on factors affecting information literacy, and trialling different teaching techniques to assist students to become better at information retrieval in particular. The number or type of teaching techniques to be used was not discussed, and subjects were not told to which treatment group (if any) they would be allocated.

Secondly, the researcher administered most aspects of the experiment personally, including introducing subjects to the research in the Lecture in Week 1; conducting the experimental modules for two of the experimental groups in Week 3 and 4; and conducting the experimental and control modules in Week 6. In this way, all subjects received considerable attention from the researcher during the course of the experiment.
9.3.4 Timetable for Conduct of Experiment

The timetable for the conduct of the experiment was considered carefully to take into account the many variables likely to impact on the successful implementation of the project. The timetable and experimental design were discussed with the University of Canberra Statistician to ensure that design elements necessary for a rigorous experimental study were incorporated as far as possible. The timetable for the conduct of the study is set out at Table 9-4 below.
Table 9-4: Phase 2 - Timetable for Conduct of Experiment

<table>
<thead>
<tr>
<th>ITEM</th>
<th>STUDENTS</th>
<th>WHEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 1</td>
<td></td>
<td>Lecture, Week 1</td>
</tr>
<tr>
<td>Explanation of study and distribution of Consent</td>
<td>All</td>
<td>Time taken: 10 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Session 2</td>
<td></td>
<td>Lecture, Week 2</td>
</tr>
<tr>
<td>Collection of Consents</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Conduct pre-test</td>
<td>All</td>
<td>Time taken: 30 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sessions 3-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental instruction</td>
<td>Experimental groups</td>
<td>Tutorials: Week 3 – 20 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Week 4 – 1 hour 30 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Week 6 – 1 hour 30 min</td>
</tr>
<tr>
<td>Control group intervention</td>
<td>Control groups</td>
<td>Tutorials: Week 3 – 5 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Week 6 – 1 hour 30 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Session 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students complete Literature Search Assignment</td>
<td>All</td>
<td>Library, in students' own time, prior to Tutorial, Week 10. Time taken: variable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Session 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test</td>
<td>All</td>
<td>Tutorials, Week 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time taken: 20 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Session 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental intervention</td>
<td>Control groups</td>
<td>Tutorials: Week 12 or 13 - 1 hour 30 min</td>
</tr>
</tbody>
</table>

This timetable enabled the shortest possible period for the conduct of the study, whilst balancing the needs of participants to have adequate time to complete their Literature Search Assignments. Subjects were introduced to the
study, and consent forms distributed, in Week 1 of semester. Survey 1 (pre-test) was administered during Week 2, the Consents collected, and the experimental and control modules administered to the treatment groups over Weeks 2, 4 and 6. No modules were administered in Week 5, as Friday of that week was a Public Holiday (Good Friday). As one of the tutorials was held on Fridays, students in that group had been told by their tutor to attend another tutorial that week. Any modules taught in that week, therefore, could have been taught to a combination of experimental and control subjects, and could possibly have had an influence on results. The researcher was of the view that to teach any modules that week would be ill advised. Subjects completed Survey 2 (post-test 1) in tutorials in Week 7. Subjects were given until Week 10 to complete the Literature Search Assignment, as there were other pieces of assessment due for the unit Office Management 3/4 before that time, and it was felt by the researcher that maturation would not make a significant impact on results in those few weeks; also that for reasons already discussed in sub-section 9.2.3 above, intervening variables were controlled as far as possible.

In either Week 12 or Week 13, control group subjects were taught the principles already delivered to the experimental group, by the researcher (in the case of two classes), and by an experienced tutor (in the case of the third class). These sessions were of 1 hour 30 minutes' duration. Handouts distributed to the experimental groups during the conduct of the experiment were distributed to the control groups during these sessions.

9.3.5 Data Collection

Data were collected by means of three instruments: Survey 1 (pre-test); Survey 2 (post-test 1); and a Literature Search Assignment (post-test 2). These instruments are described in section 9.3 below. Survey 1 was completed in the
Week 2 lecture. The Literature Search Assignment was distributed in tutorials in Week 3, and completed assignments were due in Week 10. Survey 2 was completed in tutorials in Week 7.

9.3.6 Limitations

The researcher acknowledges the difficulties inherent in conducting an experiment in a natural setting such as university tutorial sessions, libraries and computer laboratories. Limitations that affected the conduct of Phase 1 of this study have been addressed in Phase 2 as far as possible. Other limitations are noted in Chapter 10, in the context in which they arose; but all limitations are mentioned below.

1. Time constraints. Time constraints were a factor in relation to administering of the pre-test and post-test surveys. This limitation was also a factor in Phase 1, but was not able to be eliminated from Phase 2, due to similar constraints with access to a suitable cohort of participants. Most tests of problem-solving ability take approximately one hour to complete, but the researcher did not have one hour to administer the surveys. Further, these surveys needed to gauge not only problem-solving ability, but also knowledge of electronic databases.

By ensuring high content validity in the instruments used, it was felt that the survey could be limited to approximately 20-25 minutes, and still measure variables sufficiently. A short administration time had the advantage that subjects were more likely to answer questions thoughtfully and honestly, and remain motivated, to complete the entire survey. Further, the second survey did not contain a section on problem-solving ability, as problem solving was measured by responses to the
Literature Search Assignment. The second survey only measured electronic database knowledge, and thus took 15 minutes to complete.

In Phase 1 of the study, a second time constraint had been access to participants for the purpose of administering the experimental treatment. In Phase 2, this time constraint was overcome by accessing a unit to conduct the study in which it was possible to integrate the experimental modules and primary post-test instrument (Literature Search Assignment) into the learning outcomes for the unit. As materials taught in the study were directly relevant to learning outcomes for the unit, more access to the subjects was possible.

2. *Technology.* In Phase 1 of this study, unscheduled computer "downtime" for several days over the weekend before the Information Retrieval Assignment was due to be submitted was one of the limitations of that study, as the researcher was of the view that frustration at not being able to access relevant databases to complete searches may have caused some subjects not to complete all components of the assignment. Despite this problem, response rate was still satisfactory - 78%, although not all participants had completed searches for all three search topics.

However, the time allowed for completion of the Literature Search Assignment was extended from two weeks (Phase 1) to seven weeks (Phase 2), partially in order to forestall any possible problems arising from computer server downtime, but also due to the fact that other pieces of assessment for the unit Office Management 3/4 were due for submission between Week 6 of semester (when the experimental modules were completed) and Week 10. Further, the Literature Search Assignment in Phase 2 required subjects not only to locate citations for
relevant literature, but also to acquire two journal articles, and to summarise them. More time was therefore anticipated to be involved in the completion of the assignment than had been the case in Phase 1.

Another limitation that related to the use of technology during the conduct of Phase 1 of the study was the information available online about the content of databases. At the time the experiment was conducted, the Electronic Reference Library home page contained only a list of computer databases, many of which were identified by acronyms. In the University of Canberra Library, a hard-copy key to those acronyms was available. This list was not available in the Computer Centre. It is not known how many subjects accessed the key to database acronyms. This factor may have affected the number of databases searched by some subjects.

In order to overcome this limitation in Phase 2, databases in which scholarly articles were likely to be found were mentioned in the Unit Guide for Office Management 314. Further, in the Week 6 modules for both experimental and control treatments, the importance of selecting appropriate databases was reiterated.

A final limitation with technology that had been experienced in Phase 1 was that of accessing Electronic Reference Library databases for demonstration purposes during the teaching of the experimental module to several tutorial groups in computer workshops in Week 2. In order to overcome this possible problem, for Phase 2 the researcher developed alternative sample searches that could be demonstrated on Internet search engines, in case the ERL databases could not be accessed.
3. **Instructors.** Due to the fact that four modules had to be implemented with five tutorials over three weeks, and that pre-tests and post-test had to be administered, it was not possible for the researcher to deliver all aspects of the study personally, as had been the case in Phase 1. However, the researcher did teach the most important experimental modules to all tutorial groups except one. The researcher taught critical thinking to two of the three experimental groups in Week 4, and taught all treatment groups in Week 6. Detailed teaching notes were provided to the tutor who taught the third experimental treatment group in Week 4. Control groups in that week were not given any treatment.

Tutors administered Survey 2 in tutorials, but this did not require any teaching. With regard to the Literature Search Assignment, the researcher requested that tutors did not render assistance except where absolutely necessary.

4. **Tutorial Cohorts.** As attendance at tutorials for Office Management 3/4 was compulsory, students were encouraged to attend another tutorial if they missed their scheduled tutorial in any given week. The possibility therefore arose that students from, say, the control treatment group would attend a tutorial for the experimental group in Weeks 2, 3, 4 or 6. No experimental modules were delivered in Week 5 due to the fact that the Friday of that week was a Public Holiday and that students from the Friday class were expected to attend another class. Tutorial rolls for all classes for the other weeks indicated that students attended their allocated classes during those weeks.

In this section, the research design, population and sample, variables, timetable, data collection and limitations have been discussed. In the next
section, instruments used to gather data and to measure variables are described.

9.4 Instruments

The research design adopted for the study was of the pre-test/post-test control group experimental type. Instruments were designed to gather baseline information in the form of a pre-test (Survey 1), to measure participants' levels of knowledge, and to gather essential demographic data.

Two post-tests were designed (Survey 2, and the Literature Search Assignment) to ensure that variables pertaining to participant performance outcomes suggested by hypotheses were measured as accurately as possible. Survey 2 tested the acquisition and recall of basic electronic database facts. The Literature Search Assignment was designed to test whether adequate conceptual knowledge of searches had been acquired, and whether or not subjects could locate and evaluate appropriate information. As the researcher argues that the teaching of conceptual knowledge is central to the acquisition of information literacy, this component was essential. As Bober, Poulin & Vileno (1995, in Martin, ed, 1995:59) remarked, “very few evaluations have attempted to measure student learning at the conceptual level. One possible explanation is that these ‘higher-order cognitive skills of analysis, synthesis and evaluation’ are more difficult to evaluate”.

The three instruments are described below.

9.4.1 Survey 1

In order to meet the requirements for a pre-test/post-test research design, baseline data had to be gathered to enable data generated in the course of the
experiment to be put in context and measured accurately. Survey 1 (Appendix 13) was designed to gather data on a range of matters pertaining to the establishment of baseline data relating to each of the study's hypotheses. Participants were asked to write a "nickname" known only to themselves at the top of the Survey. In this way, comparison of pre-and post-test data for participants was made possible, whilst the anonymity of all participants was protected.

The number of questions in the Survey was determined by balancing the need to gather data sufficient to test hypotheses on the one hand, and practical considerations on the other. These considerations were firstly, time constraints - the researcher did not have unlimited time in which to administer the surveys; they had to be completed within a lecture period in Week 2 of first semester. Secondly, participant motivation was an important factor. In order to increase the probability that all sections would be completed, only questions essential to hypotheses testing were retained in Survey 1. The survey was piloted on a group of 14 honours and post-graduate students at the University of Canberra. Their feedback was incorporated into the final version of the survey.

Section 1 of Survey 1 consisted of five questions requiring boxes to be ticked. The questions were designed to gather background information about the participants. This information was essential in that it provided data on the many intervening variables anticipated to have a bearing on the research results. By gathering this information, correlates relating to performance on the two post-tests (Survey 2 and Literature Search Assignment) could be analysed and trends and significant relationships established.
Question 1.1 of Survey 1 asked the year of birth of the respondent. This variable provided information that helped to generate a profile of the "typical" study participant. The researcher wished to be able to separate these students in data analysis to be able to determine any correlates between age and performance on the post-tests.

Question 1.2 asked the participant to indicate their gender, in order to enable any relationship between gender and information retrieval/analysis and/or problem-solving ability to be identified.

Question 1.3 gathered data on the participants' highest existing academic qualification. This information allowed analysis of questions pertaining to correlations between academic qualifications and information literacy and/or problem solving.

Question 1.4 gathered data on whether or not participants had ever attended an electronic database demonstration at the University of Canberra library.

Question 1.5 established level of use of electronic databases; participants were asked to indicate if they had ever accessed an electronic database, and if so, how often. Database use had been found to be a factor influencing electronic database knowledge in Phase 1 of the study.

Questions relating to computer anxiety and familiarity generally which had been included in the Phase 1 survey, were not included in Phase 2. This was because as Phase 2 was concerned with measuring issues wider than the acquisition of proficiency of electronic database searching, the researcher felt that this question was not sufficiently relevant for inclusion. In any case,
Phase 1 had already provided comprehensive data on computer confidence and anxiety across the University of Canberra undergraduate population.

**Section 2 of Survey 1** comprised 17 straightforward multiple choice questions designed to establish participants' understanding of terminology used in electronic database retrieval. These questions were pertinent to establishing baseline information for the testing of hypothesis 1: *type of instruction will influence acquisition of knowledge of electronic database searching.*

Questions 2.1 – 2.11 were taken from a test bank compiled by Reddy (1988) which was designed to measure knowledge of bibliographic instruction in the areas of database characteristics, search strategy design, concept identification, and the use of truncation, Boolean operators and synonyms in strategy formulation. These variables were used in the data analysis as indicators of search expertise. Questions 2.12 – 2.17 were written by the researcher in order to gather more detailed data than that obtained in Phase 1 on the questions of: identification of concept groups; knowledge of the limitations of electronic databases; issues involved in judging relevance of information located; suitability of databases to a search topic; relevance of articles judged by information provided in a citation; and modification of search strategies.

**Section 3 of Survey 1** gathered data on thinking (cognitive) skills. This data was required in order to establish baseline information for the testing of hypothesis 3: *problem solving ability and information retrieval effectiveness are related.*

The 15 questions in Section 3 were included to test elements relating to four significant aspects of thinking: critical thinking; problem solving; deductive
and inductive reasoning; and logic. Most of the questions in this section had been used in Phase 1, and were used again as they had been found to be useful indicators of problem-solving ability.

Questions 3.3, 3.9 and 3.10 were taken from Bransky, Hadass and Lubezky (1992). Question 3.5 was adapted from Biehler and Snowman (1993). Question 3.8 was adapted from a well-known analogy written by Dunker (1945, in Gick & Holyoak, 1980; Anderson, 1985). Marini & Case (1994) found that for subjects aged 9-19 years, the more “vectors” that were introduced into a problem, the more difficult it was to solve. In that study, subjects improved in performance with age, but at age 19, only 65% could correctly answer problems that contained three vectors; 95% could correctly answer problems containing two vectors, whilst 100% of subjects at that age could solve problems with one vector only. In order to investigate whether such a construct is applicable to older subjects, questions 3.6 and 3.10 on the current survey required manipulation of several vectors; they were therefore expected to be the most poorly answered on the survey. This was in fact, the case.

Questions 3.11-3.15 were taken from the Cornell Critical Thinking Test, Level Z (Ennis & Millman, 1989) and related to manipulation of hypotheses.

Theoretical underpinnings of the survey questions are set out at Table 9-5 below.
Table 9-5: Theoretical Underpinning of Survey Questions - Section 3

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Thinking process</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Problem solving: generating alternative explanations which are plausible for a result</td>
</tr>
<tr>
<td>3.2</td>
<td>Critical thinking: drawing an inference</td>
</tr>
<tr>
<td>3.3</td>
<td>Problem solving: controlling variables</td>
</tr>
<tr>
<td>3.4</td>
<td>Critical thinking: differentiating between opinion and fact</td>
</tr>
<tr>
<td>3.5</td>
<td>Deductive reasoning: using a Venn diagram to show a syllogism</td>
</tr>
<tr>
<td>3.6</td>
<td>Manipulation of multiple vectors: determining relevance</td>
</tr>
<tr>
<td>3.7</td>
<td>Inductive reasoning: causation</td>
</tr>
<tr>
<td>3.8</td>
<td>Inductive reasoning: solving a problem by analogy</td>
</tr>
<tr>
<td>3.9</td>
<td>Logic: “Even more so”</td>
</tr>
<tr>
<td>3.10</td>
<td>Manipulation of multiple vectors; Logic: “Impossible to know”</td>
</tr>
<tr>
<td>3.11</td>
<td>Hypothesis testing: induction – judging conclusions</td>
</tr>
<tr>
<td>3.12</td>
<td>Hypothesis testing: induction – judging conclusions</td>
</tr>
<tr>
<td>3.13</td>
<td>Hypothesis testing: induction – judging conclusions</td>
</tr>
<tr>
<td>3.14</td>
<td>Hypothesis testing: induction – judging conclusions</td>
</tr>
<tr>
<td>3.15</td>
<td>Hypothesis testing: induction – judging conclusions</td>
</tr>
</tbody>
</table>

9.4.2 Survey 2

Survey 2 (Appendix 11) was administered to all participants who were present at tutorials for Office Management 3/4 in Week 7 of Semester 2, 1999. Survey 2 (post-test 1) was designed to gather data to enable testing of hypothesis 1: *type of instruction will influence acquisition of knowledge of electronic database searching*.

To enable meaningful comparisons to be made between results from the pre-test (Survey 1) and post-test 1 (Survey 2), the same format was used for Survey 2 as for Survey 1, although Survey 2 was shorter, and took less time to complete. Participants were asked to use the same “nickname” on their
second survey as they had used on their first. Some data was not able to be linked to pre-test scores, however, as a small number of participants either did not include their “nickname”, or, as several wrote instead, “I’ve forgotten what my nickname was!” Data for these subjects was still able to be used in experimental/control group comparisons.

Survey 2 comprised 18 multiple choice questions designed to measure participants’ understanding of terminology used in electronic database retrieval, and information literacy. If the differences between experimental and control groups in performance on these questions from performance on Section 2 of Survey 1 were statistically significant, then hypothesis 1: type of instruction will influence acquisition of knowledge of electronic database searching would be supported.

Questions in Survey 2 were the same as those appearing in Section 2, Survey 1. One new question was included, to gather further data on subjects' ability to identify concept groups relating to a research question.

9.4.3 Literature Search Assignment

The final data collection instrument in the Phase 2 experiment was a Literature Search Assignment (Appendix 12). This assignment allowed data to be gathered in order to test hypothesis 2: type of instruction will influence information retrieval effectiveness and acquisition of information literacy skills, and hypothesis 3: problem solving ability and information retrieval effectiveness are related.

Although comparison of data gathered from Survey 1 and Survey 2 enabled tentative conclusions to be drawn about the acquisition of knowledge of electronic database concepts and terminology, no conclusions about any
improvement in search *behaviour* was possible unless some sort of assessment of these skills was made. Accordingly, the researcher designed the Literature Search Assignment to assess a number of factors that should vary depending on search ability.

The Literature Search Assignment was handed out to all participants at the beginning of the Week 3 tutorials. Participants were asked to include their "nickname" on the Assignments when they submitted them, to enable data analysis. Participants were asked to complete the Assignment by performing searches of the University of Canberra Electronic Research Library (ERL). Any database, or combination of databases, available through the ERL was able to be used; approximately 50 databases were accessible. Participants were able to try as many different search strategies as they wished.

Participants were directed not to use any of the other databases available, for example, Yahoo, as this was a Web-based search engine and the researcher believed that the databases available needed to be limited in order to control that variable. All information necessary to complete the Literature Search Assignment was available through the ERL. Further, the ERL databases were able to be accessed from not only the University of Canberra Library, but also the computer laboratories in another building, to which students had 24 hour access. They were therefore able to complete the Literature Search Assignment from many different computer terminals. In this way, it was hoped that frustration due to unavailability of computer terminals would be minimised. The Literature Search Assignment had to be completed by Week 10 of first semester. It was felt that seven weeks would be ample time to allow students to complete the assignment.
Completion of the Literature Search Assignment comprised the first stage of the major written assignment for Office Management 3/4. In this way, it was possible to achieve a 100% response rate on this post-test. The Literature Search Assignment was designed by the researcher to enable students to demonstrate their ability to locate and evaluate literature relevant to their major assignment. However, as it was part of an experiment, and it was expected that performance would vary depending on treatment group, for ethical reasons the assignment was graded as “Pass or Fail” status for assessment purposes.

Thus, the research aim of the Literature Search Assignment was to enable the measurement of search behaviours and outcomes, but for the participants it had a real benefit in that it enabled the achievement of one of the subject’s learning objectives: to familiarise students with computer-based search tools.

The Literature Search Assignment consisted of two search questions, and participants were asked to search for five highly relevant journal articles from specified years on both of these topics. Further, subjects had to physically obtain one article on each topic, provide a full citation, and summarise the article’s relevance to the research question. In order to demonstrate that the searches had been undertaken, the participants were asked to hand in computer printouts of the journal abstracts they had located (not the whole article), and a printout of the search history. The search history is a record of the strategies the participant used to access the information required. These strategies, more than the abstracts themselves, revealed the problem-solving strategies engaged in by the participants.

As in Phase 1, in addition to the abstracts and the search histories, Phase 2 participants were asked to complete a brief (one page) sheet which enabled
them to indicate the search terms used (if no search history was handed in), databases searched, and a self-evaluation of their search success for each topic. The self-evaluation questions were included as the literature has indicated that there is quite often a discrepancy between perceived and actual search success with novice searchers. This is known as the phenomenon of the "false positive" (Applegate, 1993); novice searchers often express satisfaction with poor searches.

Two search topics were included, because it was felt that conclusions based on the search of one topic only would necessarily be very tentative. Too many variables might influence the results, rendering them inconclusive; for example, difficulty interpreting the question; different perceptions of the question; database inaccessibility, or computer downtime.

Neither search topic was straightforward. The researcher was of the view that if the searches were too easy, there would be little difference between good searchers and poor searchers in terms of outcomes - all would be likely to be successful. The first search required subjects to recognise the sociological nature of a question relating to the use of computers, and to discriminate between scholarly and "popular" literature on computing.

The second question was straightforward to search, provided that appropriate concepts were identified, and suitable databases selected.

Issues in measurement of relevance of retrieved items are discussed in section 9.4 of this chapter.
9.4.4 The Modules

Whereas Survey 1, Survey 2 and the Literature Search Assignment were designed to enable capture, measurement and interpretation of the variables related to Phase 2, the teaching modules (the “Modules”) were designed as the experimental treatment, or independent variable, that would influence both information literacy knowledge, and information literacy behaviour; they were the vehicles by which these variables would be manipulated, to enable hypotheses to be tested.

The aims of the Modules were to improve participants’ understanding of issues involved in information literacy, specifically their knowledge of critical thinking, analysis, determination of relevance, knowledge of electronic database searching and strategy formulation, and to improve their ability to locate appropriate literature on the databases for the completion of university assignments. In Chapter 3 of this thesis, literature relating to information retrieval was discussed. In Chapter 4, the utility of cognitive psychology in enabling an understanding of the information retrieval process was discussed. Also in Chapter 4, and in Chapter 5, three theories of learning, and the strategies that they suggest for the teaching of concepts and problem solving, were discussed.

Cognitive Flexibility Theory suggests the importance of introductory knowledge acquisition (Jacobson & Jacobson, 1993). All students participating in the study were assumed to have at least a rudimentary knowledge of electronic search procedures, as firstly, the subject they were currently completing was a second-year subject, and all students would therefore have completed the first-year subject, Communication Interface 1, in which basic electronic searching is covered. Secondly, demographic data collected in
Survey 1, Section 1 indicated that 67.7% of the experimental group, and 72.2% of the control group, had attended an electronic database demonstration at the University of Canberra library.

Powerpoint presentations on electronic database searching were presented in Week 6, as Module 3. Although these Modules both dealt with the Electronic Reference Library and performing searches, and all basic information was covered, the teaching strategies used were designed by the researcher to be very different for the experimental and the control groups. The slides used in the Modules may be found at Appendix 14 (experimental treatment) and Appendix 15 (control treatment). The search worksheet used in Experimental Module 3 is included at Appendix 16.

The timetable for delivery of the modules is set out in Table 9-6 below.
Table 9-6: Timetable for Delivery of Modules

<table>
<thead>
<tr>
<th>Week</th>
<th>Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 3</td>
<td>Module 1: Information retrieval assignment - requirements</td>
</tr>
<tr>
<td></td>
<td><em>Experimental Group:</em> Assignment handout distributed; explanation of requirements; questions answered</td>
</tr>
<tr>
<td></td>
<td><em>Control Group:</em> Assignment handout distributed; no discussion</td>
</tr>
<tr>
<td>Week 4</td>
<td>Module 2: Critical thinking</td>
</tr>
<tr>
<td></td>
<td><em>Experimental Group:</em> Analysis of journal article: modelling of thinking strategies; detecting bias; fallacies; evaluating evidence and conclusions = credibility of source</td>
</tr>
<tr>
<td></td>
<td><em>Control Group:</em> Normal tutorial questions and discussion</td>
</tr>
<tr>
<td>Week 5</td>
<td>Easter Holiday - no modules</td>
</tr>
<tr>
<td>Week 6</td>
<td>Modules 3 and 4: Information retrieval instruction (computer labs)</td>
</tr>
<tr>
<td></td>
<td><em>Experimental Group:</em> Module 3: Information retrieval - concept formation Module 4: Information retrieval- question analysis and query design</td>
</tr>
<tr>
<td></td>
<td><em>Control Group:</em> Module on mechanics of the search process</td>
</tr>
</tbody>
</table>

Experimental module components and their theoretical links are discussed below.

*Experimental Module 1: Understanding the Question*

In tutorials in Week 3, a handout explaining the Literature Search Assignment was distributed (Appendix 12). In the experimental treatment groups, the tutor also provided a detailed oral review of requirements, and an
explanation of how the assignment related to the overall aims of the subject. There was a discussion on topics to be searched, including key concepts to be considered. Students' questions were answered as fully as possible. Previous research (Saracevic & Kantor, 1988) had suggested that the poorest search performance with even qualified search intermediaries, had been from a written question statement, with no other explanation given.

These teaching strategies, and the learning theories from which they arise, may be summarised as:

<table>
<thead>
<tr>
<th>Learning Theory</th>
<th>Teaching Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive developmental theory</td>
<td>speculation on outcomes</td>
</tr>
<tr>
<td>Cognitive flexibility theory</td>
<td>introductory stage learning</td>
</tr>
<tr>
<td>Situated cognition</td>
<td>articulation, reflection, confronting misconceptions</td>
</tr>
</tbody>
</table>

The Literature Search Assignment was handed out to the control treatment groups at the end of their tutorials, and no discussion was conducted.

**Experimental Module 2: Evaluating Credibility**

In experimental treatment tutorials in Week 4, the tutor gave an overview of the elements of critical thinking. Thinking strategies (generalisation, problem solving, decision making); critical thinking (eg detecting bias; fact/inference confusion; analogy); and thinking skills (reasoning: deductive and inductive, knowledge, comprehension, application, analysis, synthesis, evaluation) were described.

These thinking strategies and skills were then linked to Office Management 3/4 subject matter. The importance of critical thinking skills in information
literacy (eg determining relevance, and worth, of information found for assignments) was discussed.

Finally, these thinking skills; in particular, the critical thinking skills, were applied to a case example. Students were given an extract from a journal article (Appendix 17), and asked to read it and discuss the validity of conclusions, in small groups. The tutor then led a discussion with the whole class, modelling analysis of the article, evaluating evidence, and challenging assumptions and conclusions. The tutor asked questions such as "What was the aim of the study?"; "What is the conclusion?"; "Do you think the sample used in the study was representative of the population?"; "Having analysed the evidence, do you think that the conclusion is acceptable?" etc.

At the end of the analysis of the case, students were asked to comment on whether their decision as to the validity of the evidence presented in the case was different, after they had applied critical thinking skills to the analysis of the case. Students were asked to frame an acceptable conclusion to the case, using tentative rather than dogmatic wording.

These teaching strategies and the learning theories from which they arise are summarised as:
Control treatment groups conducted discussions relating to readings for that week, based on lecture materials.

Experimental Module 3: Information Retrieval - Concept Formation

This Module was delivered in Week 6 to experimental treatment groups, in computer laboratories where all students had their own computer through which the ERL databases could be accessed. The Module comprised a 30 minute Powerpoint presentation, the aim of which was to encourage subjects to develop a realistic concept of the strengths and limitations of electronic databases, and appropriate search techniques. Details are as for the Phase 1 Module.

The control treatment groups were given a Powerpoint presentation that covered mechanics-based search skills.
Experimental Module 4: Information Retrieval - Question Analysis and Query Design

Following the tutor's presentation on Concept Formation, a module on a conceptual framework for search construction using a problem-solving heuristic, was conducted. A sample search topic was given, and a search worksheet distributed. Subjects were guided through the processes of defining the search question; breaking the topic into main concepts, including the identification of any implied concepts; finding synonyms for each concept; and using Boolean operators.

These teaching strategies, and the learning theories from which they arise, are summarised as:

<table>
<thead>
<tr>
<th>Learning Theory</th>
<th>Teaching Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive flexibility theory</td>
<td>multiple knowledge representations; introduction of complexity; linking abstract knowledge to case examples</td>
</tr>
<tr>
<td>Transforming mental models</td>
<td>experts and multiple mental models; structured knowledge for problem solving; learning as transformation of mental models</td>
</tr>
</tbody>
</table>

After search strategies had been developed for the sample topic, subjects were asked to consider appropriate databases on which to run the search. Searches were conducted by subjects. The tutor demonstrated how the same search executed on different databases yielded very different results. Examples of inappropriate search strategies were shown; and inappropriate truncation. Inappropriate search terms such as “impact of” and “effect on” were discussed. The point was made that expert searchers can spend more time preparing a search than actually executing it.
These teaching strategies, and the learning theories from which they arise, are summarised as:

<table>
<thead>
<tr>
<th>Learning Theory</th>
<th>Teaching Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive developmental theory</td>
<td>speculation on outcomes; experiential learning – “hands on”</td>
</tr>
<tr>
<td>Cognitive flexibility theory</td>
<td>concept inter-relationships; advanced stage learning; multiple knowledge representations; introduction of complexity; linking abstract knowledge to case examples</td>
</tr>
<tr>
<td>Situated cognition</td>
<td>modelling</td>
</tr>
<tr>
<td>Transforming mental models</td>
<td>experts and multiple mental models</td>
</tr>
</tbody>
</table>

Finally, subjects were given several search topics related to Office Management 3/4 issues, that could be used to practice formulation of search strategies (an example of course-integrated instruction).

These teaching strategies, and the learning theories from which they arise, are summarised as:

<table>
<thead>
<tr>
<th>Learning Theory</th>
<th>Teaching Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive developmental theory</td>
<td>speculation on outcomes; experiential learning – “hands on”</td>
</tr>
<tr>
<td>Cognitive flexibility theory</td>
<td>linking abstract knowledge to case examples</td>
</tr>
</tbody>
</table>

After this Module, subjects had four weeks to complete the Literature Search Assignment, which was integrated with Office Management 3/4 teaching aims (course-integrated instruction).
9.5 Measurement: Relevance

In information retrieval, the traditional measure of relevance of retrieved items has been a combination of two factors: precision, and recall. These measures were discussed in Chapter 6 of this thesis. It was concluded at the end of that discussion that although precision and recall are traditional measures of search effectiveness, they may not be very accurate.

In order to classify data gathered in Phase 2, a marking sheet for the Literature Search Assignment was constructed (Appendix 18). Data were classified into three main groups. The first group was Search Strategy data; ie, the thinking processes used by search participants to formulate searches. It was expected that the variables included in the search strategy data would be able to be correlated with firstly, experimental treatment, and secondly, problem-solving ability. Variables included in the search strategy group included: Number of Concepts; Number of Incorrect Concepts; Number of Synonyms; Number of Relevant Databases; Total Number of Databases; Self-evaluation of Search Success; Use of Truncation; Use of Complex Boolean Operators; Number of Search Strategy Reformulations; and overall suitability of Search Strategies.

The second classification of the Literature Search Assignment data was Retrieved Items - variables included: Source of Article (scholarly, credible); and Relevance of Article to search question.

The third classification of the data related to Article Summaries – variables included whether or not the article summarised was Recent, Credible, and Relevant; whether the Citation was Correct, and whether its Summary included Important Information, written in an acceptable Style.
Further, subjects were asked to indicate how long it had taken them to find information on the topic. They could select from a range of 15, 30, 45, 60, more than 60 minutes, or “Other – specify” for their answer.

Subjects were also asked to indicate (No/Yes; If yes, please specify) whether they had encountered any technical problems when doing their searches. This question was included because when the Phase 1 research was conducted in semester 1, 1997, a number of subjects made the comment that their searches had been made very difficult by computer and technical problems, resulting in frustration and less than optimal searches. The researcher is of the view that this user frustration is an area of research that warrants further investigation, as its existence is very real, and can impact quite significantly on student performance at the first stages of research for assignment completion.

The total number of variables generated for each search topic was 24; each one of these variables was coded for both search topics (ie, 48 variables for each Literature Search Assignment). When participants had not completed both search topics, or had, for example, not submitted their search history, the data submitted were coded, and blanks left to indicate information not provided.

In order to minimise subjectivity and rater bias considerations in the data coding, variables scored by evaluation or judgment were minimised. Eight of the ten variables in the Search Strategy group were determined by counting the occurrence of the variable. For example, for search Topic 1, if the participant had identified three concepts for that topic, the number 3 was recorded in the database for that participant for that variable for that topic.
Use of Truncation was rated as either "correct", "incorrect", "some correct, some incorrect" (both correct and incorrect truncation used) or "not used".

Use of Boolean Operators other than the default setting "AND" were counted.

In this chapter, research questions, method, and instruments for Phase 2 have been described. Data analysis and results for Phase 2 will be discussed in the next chapter.
10. PHASE 2 – RESULTS

This chapter reports on the data gathered in the pre-test (Survey 1), Literature Search Assignment, and post-test (Survey 2) for Phase 2 of this research, described in the previous chapter. The first section provides descriptive statistics for a range of background variables and the instruments used. The second section deals with results for each of the hypotheses; and the third reports on correlates not central to the main hypotheses, but nevertheless of interest.

10.1 Background Variables

10.1.1 Participants

Survey 1

Sixty-eight students were enrolled in Office Management 3/4 in first semester, 1999. All students attending the lecture in Week 1 were invited to participate in the study. At the Week 2 lecture, 49 students were present. All signed consent forms and completed Survey 1. As 49 of a possible 68 students completed the survey, the response rate was 72%.

For the 49 subjects who completed Survey 1, 70.7% were female; 58.3% were aged 22 and under. The highest existing academic qualification was usually Year 12 (55.1%), followed by a TAFE qualification (32.7%). Sixty-nine per cent of subjects had attended an Electronic Database Demonstration (usually a requirement in first year). These subjects were distributed quite evenly between experimental (67.7%) and control (72.2%) treatment groups. With regard to Use of Electronic Databases, the majority of subjects (61.2%) used databases "sometimes" (three or four times a year), or "quite often" (several times a semester).
Literature Search Assignment

All 68 students completed the Literature Search Assignment as stage 1 of their major research project for Office Management 3/4 - a response rate of 100%.

Survey 2

The second survey was completed during Week 7 tutorials in Office Management 3/4. Sixty-one students out of a possible 68 completed Survey 2 - a response rate of 89.7%.

10.1.2 Characteristics of sample

Background variables for the participants are described below. In italics after the heading for each category is the question as it appeared on Survey 1. Total number of respondents varies per question, as not all subjects answered all questions.

Table 10-1: Gender

Question: Your gender ......

<table>
<thead>
<tr>
<th>Response Category</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>29</td>
<td>70.7%</td>
</tr>
<tr>
<td>Male</td>
<td>12</td>
<td>29.3%</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Of the 49 participants, 41 completed the gender question; 70.7% of the participants were female.
Table 10-2: Age

*Question: Your year of birth* 

<table>
<thead>
<tr>
<th>Response Category</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977-82 (Age 17-22)</td>
<td>28</td>
<td>58.3%</td>
</tr>
<tr>
<td>1970-76 (Age 23-29)</td>
<td>10</td>
<td>20.8%</td>
</tr>
<tr>
<td>1965-69 (Age 30-34)</td>
<td>2</td>
<td>4.2%</td>
</tr>
<tr>
<td>1960-64 (Age 35-39)</td>
<td>2</td>
<td>4.2%</td>
</tr>
<tr>
<td>Before 1960 (Age 40 and over)</td>
<td>6</td>
<td>12.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>48</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Most participants were in the lowest two age categories: 58.3% were aged under 22 years; and 20.8% were aged between 23-29 years.

Table 10-3: Education

*Question: What is your highest existing academic qualification?*

<table>
<thead>
<tr>
<th>Response category</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 12 or equivalent overseas</td>
<td>27</td>
<td>57.4%</td>
</tr>
<tr>
<td>TAFE</td>
<td>16</td>
<td>34.0%</td>
</tr>
<tr>
<td>Undergraduate degree</td>
<td>2</td>
<td>4.3%</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>4.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>47</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

The highest academic qualification of the majority of participants was Year 12 in Australia, or its overseas equivalent (57.4%). There was also a high percentage - 34% - of students who had completed a TAFE (Technical and Further Education) qualification.

With regard to characteristics of the sample, it is noted that the second control group, the tutorial on Thursday at 5.00 pm (n = 9), represented a slightly different demographic from those of other tutorial groups. That class had five
of the seven subjects over the Age of 35. With regard to Highest Existing Academic Qualification, it had three of the four subjects with an Undergraduate Degree or "Other" (NSW Leaving Certificate or similar, usually completed prior to the mid-1960s). Further, the mean problem-solving score (9.22) for the Thursday 5.00 pm group was the highest of all five tutorials; this may have been the result of a combination of Age, and Academic Qualification characteristics of that tutorial group, as Phase 1 results had suggested that Highest Academic Qualification was associated with problem-solving ability.

Table 10-4: Use of Electronic Databases

Question: Have you ever used an electronic database to search for information?
Yes/No. If Yes, would you say that you have used such a database:

<table>
<thead>
<tr>
<th>Response category</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>6</td>
<td>12.2%</td>
</tr>
<tr>
<td>If Yes: Occasionally (have used once or twice)</td>
<td>9</td>
<td>18.4%</td>
</tr>
<tr>
<td>Sometimes (for three or four assignments a year)</td>
<td>15</td>
<td>30.6%</td>
</tr>
<tr>
<td>Quite often (several times a semester)</td>
<td>15</td>
<td>30.6%</td>
</tr>
<tr>
<td>Regularly (several times a month)</td>
<td>4</td>
<td>8.2%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>100%</td>
</tr>
</tbody>
</table>

Sixty-one per cent of subjects had used an electronic database at least three or four times a year. A further 8% had used an electronic database several times a month. Only 12.2% of subjects responded to this question that they had never used an electronic database to search for information. This range of responses, as it came from a cohort of students in a second year subject, is not surprising, except that six subjects had somehow avoided using an electronic database in their studies to date. Of these six subjects, two were Year 12 graduates, and four had a TAFE qualification. TAFE qualified students often did not have to complete first year subjects; so, even though Office
Management 3/4 was a second year subject, students with a TAFE qualification were often in their first year of undergraduate study. This could explain the fact that they had not used electronic databases.

As expected, this breakdown of responses was quite different from those for the Phase 1 (1997) subjects, who were in the second week of their first year at university. For the 1997 subjects, the modal response for this question was “no” (33.1%); 25.6% of participants had used an electronic database “once or twice” (25.6%); an almost equal number had used an electronic database “no more than several times a year” (24%). Slightly over 17% used an electronic database “several times a month”.

It was anticipated that in Phase 2, because most subjects had at least some experience with electronic databases, that their performance on Survey 1 (pre-test) and Survey 2 (post-test) questions on Electronic Database Knowledge would be somewhat better, and less dependent on type of instruction, than had been the case with Phase 1 subjects. This was in fact the case.

Table 10-5: Completion of Library Tours

*Question: have you ever attended an electronic database demonstration at the University of Canberra library, or at any other university or college (for example: PsychLIT, Sports Discus?*

<table>
<thead>
<tr>
<th>Response Category</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>34</td>
<td>70.8%</td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>29.2%</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Twenty nine per cent of students had not attended a demonstration. Of these, 79% were Year 12 graduates; TAFE, Undergraduate and Other students
represented 7% each. Nearly 71% of subjects had attended a University of Canberra or other library tour relating to electronic databases. This contrasted sharply with the Phase 1 cohort, over 78% of whom had not completed any kind of library tour. In other words, whereas most students in the Phase 2 cohort had attended an electronic database demonstration, most subjects in the Phase 1 cohort had not.

The most usual participant in Phase 2 of this study was a female school-leaver, who had some experience with electronic database searching. The most usual participant in Phase 1 of this study was similarly a female school-leaver, but lacked knowledge of electronic databases. The possible influence of Electronic Database Knowledge on search effectiveness is discussed in a later section of this chapter.

10.1.3 Descriptive Statistics: Surveys 1 and 2

Figure 10-1 below shows the distribution of scores on Survey 1, Section 2: Electronic Database Knowledge questions, The mean score was 10.4 out of a possible 17, with a total number of respondents of 49. As is apparent from the Figure, the distribution approximates a normal curve.
Figure 10-1: Scores on Electronic Database Knowledge Questions - Total Sample

![Distribution of Scores](image)

Std. Dev = 2.33  
Mean = 10.4  
N = 49.00

Figure 10-2 below shows the distribution of scores on Survey 1, Section 3: Problem-Solving questions. The mean score was 8.3 out of a possible 15, with a total number of respondents of 49. As is apparent from the Figure, the distribution approximates a normal curve.
Figure 10-2: Scores on Problem Solving Questions - Total Sample

Figure 10-3 below shows the distribution of scores on Survey 2: Electronic Database Knowledge questions. The mean score was 11.8 out of a possible 18, with a total number of respondents of 61. As is apparent from the Figure, the distribution approximates a normal curve.
As distributions on these three measures approximated the normal curve, *t*-tests were used to determine differences between experimental and control groups.

10.2 Hypotheses
The three research questions to be addressed were discussed in Chapter 8. They are:

1. Will type of instruction influence the ability to formulate appropriate search strategies to enable the location of information?
2. Will type of instruction influence the ability to critically evaluate information located, so that search success is improved?

3. A final question seeks to confirm findings from Phase 1 of this research concerning the role of problem solving in the information retrieval process: are problem-solving ability and information retrieval effectiveness related?

In this section, results for the hypotheses relating to these research questions will be analysed. Hypotheses arising from the research questions, stated in the null form, are listed in Table 10-6 below.

Table 10-6: Hypotheses (Null Form) and Instruments of Measurement

<table>
<thead>
<tr>
<th>Hypothesis (Null Form)</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>There is no difference between experimental and control groups on the pre-test measuring electronic database knowledge.</td>
</tr>
<tr>
<td>2</td>
<td>There is no difference between experimental and control groups on the post-test measuring electronic database knowledge.</td>
</tr>
<tr>
<td>3</td>
<td>There is no difference between experimental and control groups on the pre-test measuring problem-solving ability.</td>
</tr>
<tr>
<td>4</td>
<td>There is no difference between experimental and control groups in search strategy formulation.</td>
</tr>
<tr>
<td>5</td>
<td>There is no difference between experimental and control groups in search success.</td>
</tr>
<tr>
<td>6</td>
<td>There is no difference in search strategy formulation depending on problem-solving ability.</td>
</tr>
<tr>
<td>7</td>
<td>There is no difference in search outcome depending on problem-solving ability.</td>
</tr>
</tbody>
</table>
10.2.1 Research Question 1

The first research question was: will type of instruction influence the ability to formulate appropriate search strategies to enable the location of information?

Hypothesis 1

In order to establish that the experimental and control groups were equivalent in their existing electronic database knowledge, treatment group means on the pre-test (Survey 1, Section 2) were compared using a t-test. A t-test was appropriate as all the assumptions necessary for its application were met, viz: interval scale of measurement; random sampling from the population of interest; and normal distribution of scores.

For the pre-test (Survey 1, Section 2), results indicated no significant difference between means for experimental and control groups on knowledge of electronic databases; although the control group mean (10.00) was higher than the experimental mean (9.29). The decision was therefore made to accept hypothesis 1 (null): there is no difference between experimental and control groups on the pre-test measuring electronic database knowledge.

Hypothesis 2

On the post-test (Survey 2), the difference between means of experimental and control groups also was not statistically significant, even though the mean for the experimental group had risen from 10.19 on Survey 1 to 11.07 on Survey 2. The control group mean remained approximately the same (10.66 on Survey 1; 10.40 on Survey 2). These means were adjusted to take into account the fact that there were 17 questions in the pre-test, and 18 in the post-test. In percentage terms, the experimental group average rose from 58.8% on the pre-test to 66.6% on the post-test; control group averages were 62% and 61% respectively.
The decision was made to accept hypothesis 2 (null): there is no difference between experimental and control groups on the post-test measuring electronic database knowledge.

Figure 10-4 below shows the differences between experimental and control group distribution of scores on the pre-test.

**Figure 10-4: Scores on Electronic Database Knowledge Pre-test as a Function of Treatment**

![Graph showing pre-test scores for experimental and control groups.]

Survey 1 total EDB qns correct

Figure 10-5 below shows how these distributions changed in the post-test. The modal score for the control group is 11, whilst for the experimental group it is 14.
There was no significant difference between experimental and control groups on electronic database knowledge in the pre-test. The experimental group performed better than the control group on electronic database knowledge in the post-test, but not significantly. Even though this result suggests that the teaching Modules may have been useful in improving participants' knowledge of electronic databases, results were not significant, as they had been in Phase 1. However, in Phase 1, 78% of subjects had no knowledge of electronic databases. In Phase 2, approximately 70% of subjects already had knowledge of, and experience with, electronic database retrieval. It is not surprising therefore that performance on tests of electronic database knowledge showed little difference between treatment groups, even though the experimental group did perform slightly better than the control group in the post-test.
Hypothesis 3
Hypothesis 3 (null) was: there is no difference between experimental and control groups on pre-test measuring problem-solving ability.

As results indicated no significant difference between means for experimental and control groups on problem-solving ability, the null hypothesis was accepted. The experimental group mean on the problem-solving questions was 7.93 (n = 31); the control group mean was 8.83 (n = 18). Therefore it could be assumed that the treatment groups were equivalent on this variable.

Given this equivalence in electronic database knowledge, and problem-solving ability, between treatment groups, results for Hypothesis 4 are particularly interesting. They are discussed below.

Hypothesis 4
Hypothesis 4 (null) was: there is no difference between experimental and control groups in search strategy formulation, post treatment.

Results for the variables measured in order to quantify search strategy formulation: Number of Correct Concepts; Number of Incorrect Concepts; Number of Synonyms; Use of Truncation; Use of Complex Boolean Operators; Number of Databases; Access to Appropriate Databases; Number of Search Strategy Reformulations; and Use of Correct Search Strategies, are discussed below. These variables were measured for both research questions which were set for the Literature Search Assignment.

10.2.1.1 Variables Determined by Frequency
Overall, results suggested that there were significant differences between the experimental and control groups in terms of Number of Concepts, Number of
Databases, and Number of Reformulations. These results supported the findings in Phase 1 of this research, that there were significant differences between treatments on Number of Concepts (Topics 1 and 2, and Number of Databases (Topic 3). Table 10-7 summarises descriptive statistics for the variables determined by frequency of occurrence for both search topics separately.

Data were analysed at individual topic level for two reasons. Firstly, the research topics were designed to represent different levels of search difficulty. Topic 1 required identification of concepts not explicitly stated in the question in order to be answered successfully. Topic 2 required correct combinations of concepts to be used in order to find appropriate information. Analysing the different responses of each subject to these different levels of search difficulty was therefore desirable.

As literature reviewed, and results of Phase 1, had suggested that there is no real difference in search performance between good and poor searchers on simple search tasks, a simple search topic was not included in Phase 2.
Table 10-7: Descriptive Statistics for Search Strategy Variables by Topic

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOPIC 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. Concepts</td>
<td>63</td>
<td>2.68</td>
<td>.50</td>
<td>2 (1-3)</td>
<td>.25</td>
</tr>
<tr>
<td>No. Inappropriate</td>
<td>64</td>
<td>1.13</td>
<td>.70</td>
<td>3 (0-3)</td>
<td>.49</td>
</tr>
<tr>
<td>Concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. Correct Databases</td>
<td>61</td>
<td>1.49</td>
<td>.70</td>
<td>3 (0-3)</td>
<td>.49</td>
</tr>
<tr>
<td>No. Databases (Total)</td>
<td>63</td>
<td>3.78</td>
<td>2.49</td>
<td>11 (1-12)</td>
<td>6.21</td>
</tr>
<tr>
<td>No. Synonyms</td>
<td>63</td>
<td>.97</td>
<td>1.69</td>
<td>7 (0-7)</td>
<td>2.87</td>
</tr>
<tr>
<td>No. Reformulations</td>
<td>60</td>
<td>7.15</td>
<td>6.39</td>
<td>29 (1-30)</td>
<td>40.81</td>
</tr>
<tr>
<td><strong>TOPIC 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. Concepts</td>
<td>62</td>
<td>1.98</td>
<td>.71</td>
<td>3 (0-3)</td>
<td>.51</td>
</tr>
<tr>
<td>No. Inappropriate</td>
<td>64</td>
<td>.67</td>
<td>.94</td>
<td>4 (0-4)</td>
<td>.89</td>
</tr>
<tr>
<td>Concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. Correct Databases</td>
<td>62</td>
<td>1.69</td>
<td>.80</td>
<td>3 (0-3)</td>
<td>.64</td>
</tr>
<tr>
<td>No. Databases (Total)</td>
<td>60</td>
<td>3.22</td>
<td>2.23</td>
<td>8 (1-9)</td>
<td>4.99</td>
</tr>
<tr>
<td>No. Synonyms</td>
<td>64</td>
<td>1.61</td>
<td>1.97</td>
<td>9 (0-9)</td>
<td>3.89</td>
</tr>
<tr>
<td>No. Reformulations</td>
<td>59</td>
<td>5.54</td>
<td>4.38</td>
<td>25 (1-26)</td>
<td>19.15</td>
</tr>
</tbody>
</table>

For the 12 variables determined by frequency (six for each of Topics 1 and 2), experimental group means were higher than control group means on 9 of the 12; that is, experimental group means were higher than control group means on 75% of variables. Only the variable "Use of Incorrect Concepts" did not show these differences. For Topic 1, the experimental group mean was lower (1.07) than the control group mean (1.20); for Topic 2, the experimental group mean (0.75) was almost the same as the control group mean (0.54). For Topic 1, "Number of Correct Concepts", the experimental group mean (2.70) was only fractionally higher than the control group mean (2.65). Table 10-8 below summarises these differences.
Table 10-8: Differences in Means between Experimental and Control Groups for Variables Determined by Frequency

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental</th>
<th>Control</th>
<th>Total Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>mean</td>
<td>n</td>
</tr>
<tr>
<td><strong>Topic 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. Correct Concepts</td>
<td>40</td>
<td>2.70</td>
<td>23</td>
</tr>
<tr>
<td>No. Incorrect Concepts</td>
<td>40</td>
<td>1.07</td>
<td>24</td>
</tr>
<tr>
<td>No. Synonyms</td>
<td>39</td>
<td>1.41</td>
<td>24</td>
</tr>
<tr>
<td>No. Correct Databases</td>
<td>38</td>
<td>1.63</td>
<td>23</td>
</tr>
<tr>
<td>No. Databases (Total)</td>
<td>40</td>
<td>4.37</td>
<td>23</td>
</tr>
<tr>
<td>No. Reformulations</td>
<td>38</td>
<td>7.55</td>
<td>22</td>
</tr>
<tr>
<td><strong>Topic 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. Correct Concepts</td>
<td>38</td>
<td>2.02</td>
<td>24</td>
</tr>
<tr>
<td>No. Incorrect Concepts</td>
<td>40</td>
<td>0.75</td>
<td>24</td>
</tr>
<tr>
<td>No. Synonyms</td>
<td>40</td>
<td>2.05</td>
<td>24</td>
</tr>
<tr>
<td>No. Correct Databases</td>
<td>39</td>
<td>1.94</td>
<td>23</td>
</tr>
<tr>
<td>No. Databases (Total)</td>
<td>39</td>
<td>3.82</td>
<td>21</td>
</tr>
<tr>
<td>No. Reformulations</td>
<td>36</td>
<td>6.36</td>
<td>23</td>
</tr>
</tbody>
</table>

Significant results for variables determined by frequency are summarised in Table 10-9 below. Number of Synonyms, Number of Databases (Total), and Number of Correct Databases showed significant differences between treatments for both search topics; results were also significant for Number of Reformulations for Topic 2.
Table 10-9: Significant Differences between Experimental and Control Groups on Variables Determined by Frequency

<table>
<thead>
<tr>
<th>Variable - Individual Search Topics</th>
<th>Procedure (2 tailed)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topic 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Synonyms</td>
<td>t-test</td>
<td>p = .007</td>
</tr>
<tr>
<td>Number of Databases (Total)</td>
<td>t-test</td>
<td>p = .011</td>
</tr>
<tr>
<td>Number of Correct Databases</td>
<td>Mann-Whitney U</td>
<td>p = .05</td>
</tr>
<tr>
<td><strong>Topic 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Synonyms</td>
<td>t-test</td>
<td>p = .020</td>
</tr>
<tr>
<td>Number of Databases (Total)</td>
<td>t-test</td>
<td>p = .002</td>
</tr>
<tr>
<td>Number of Correct Databases</td>
<td>Mann-Whitney U</td>
<td>p = .001</td>
</tr>
<tr>
<td>Number of Reformulations</td>
<td>t-test</td>
<td>p = .05</td>
</tr>
</tbody>
</table>

For Search Topics 1 and 2, the experimental group used significantly more synonyms in planning their search strategies than did the control group. This suggests that the focus of the Modules on the need to identify as many synonyms as possible when designing search strategies, was appropriate.

The Number of Correct Databases used, and the Number of Databases (Total) accessed, was also significantly higher for experimental than control groups on both Topics 1 and 2. This suggests that the emphasis placed on the need to use appropriate databases to find relevant information in the experimental Modules, was effective.

For Topic 2, the Number of Reformulations was significantly higher for the experimental group than for the control group, indicating that the experimental group recognised that a search will be influenced by the
combinations of concepts and synonyms used. Topic 2 was the more complex
topic.

Interestingly, significant differences were not found between Number of
Concepts identified on either search topic - contrary to findings in Phase 1.
However, there were highly significant differences in Number of Synonyms
in Phase 2. It may be that the fact that the typical Phase 2 participant had used
electronic databases several times, and had completed database tours, meant
that they were familiar with the need to identify concepts. However, it may be
that the importance of identifying synonyms had not been learnt.

The more concepts and synonyms identified, the greater the number of
reformulations of strategy that can be made; and on Topic 2, there was a
significant difference between treatments on this variable.

10.2.1.2 Other Variables Measured

Other variables determining success on the Literature Search Assignment
were Use of Truncation; Use of Complex Boolean Operators; and Use of
Correct Search Strategies.

Levels of measurement for these variables are set out in Table 10-10 below,
and results for each variable discussed.
Table 10-10: Search Strategy Variables Measured on Nominal and Ordinal Scales

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measurement</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truncation</td>
<td>Nominal</td>
<td>1 = correct</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = incorrect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = some correct, some incorrect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 = not used</td>
</tr>
<tr>
<td>Complex Boolean Operators</td>
<td>Nominal</td>
<td>1 = no</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = yes</td>
</tr>
<tr>
<td>Correct Search Strategies</td>
<td>Nominal</td>
<td>1 = yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = usually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = no</td>
</tr>
</tbody>
</table>

Truncation

Table 10-11 summarises use of truncation for both search topics, as a function of treatment.

Table 10-11: Topics 1 and 2: Use of Truncation as a Function of Treatment

<table>
<thead>
<tr>
<th>Topic</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td>Correct use of truncation</td>
<td>29</td>
<td>76.3</td>
</tr>
<tr>
<td>Incorrect use of truncation</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Some correct, some incorrect</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Truncation not used</td>
<td>9</td>
<td>23.7</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>100</td>
</tr>
</tbody>
</table>

Topic 2

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct use of truncation</td>
<td>30</td>
<td>88.2</td>
</tr>
<tr>
<td>Incorrect use of truncation</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Some correct, some incorrect</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Truncation not used</td>
<td>4</td>
<td>11.8</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 10-11 indicates that 61 participants in total provided information on truncation for Topic 1; of these, 38 belonged to the experimental group and 23 to the control group. For Topic 2, 58 participants provided information about truncation; 34 belonged to the experimental group and 24 to the control group.

The results suggest that on both search topics, the experimental group used correct truncation more than did the control group. For Topic 1, 76.3% of the experimental group used correct truncation, whilst the only 30.4% of the control group used truncation correctly.

To enable statistical analysis, results were recoded into two categories: any type of truncation used, and no truncation used. A chi-square value of 10.35 was highly significant (p = .001). Pearson's correlation coefficient (r = .412; p = .0009) was also significant.

For Topic 2, 88.2% of the experimental group used truncation correctly, compared with only 45.8% of the control group. The chi-square value of 10.29 was highly significant (p = .001). Pearson's correlation coefficient (r = .421; p = .0009) was also significant.

In both search topics, there is a consistent use by the experimental group of more correct truncation than the control group. It is likely that the experimental Modules' emphasis on the efficacy of truncation in the design of search strategies has led to the experimental group attempting truncation use more often than the control group. These findings support the results on Use of Truncation in Phase 1 of this research.

Approximately the same performance gaps between the experimental group's use of truncation, and the control group's use of truncation, were maintained
across both search topics, which result suggests that for both search topics, the experimental group was attempting to apply truncation in the design of search strategies more so than the control group.

Complex Boolean Operators

In Table 10-12 the use of complex Boolean operators is summarised for both search topics, as a function of treatment (experimental or control) group.

Table 10-12: Topics 1 and 2 - Use of Complex Boolean Operators as Function of Treatment

<table>
<thead>
<tr>
<th>Topic</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td>Topic 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex operators used</td>
<td>7</td>
<td>18.9</td>
</tr>
<tr>
<td>Complex operators not used</td>
<td>30</td>
<td>81.1</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>100</td>
</tr>
<tr>
<td>Topic 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex operators used</td>
<td>12</td>
<td>34.3</td>
</tr>
<tr>
<td>Complex operators not used</td>
<td>23</td>
<td>65.7</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>100</td>
</tr>
</tbody>
</table>

For both search topics, the use of complex operators is higher for the experimental than for the control group, although a chi-square analysis indicated that the differences are not statistically significant. For Topic 1, 18.9% of the experimental group used a complex operator, compared with 12.5% of the control group. For Topic 2, 34.3% of the experimental group used a complex operator, compared with 20.8% of the control group. Although the
use of complex operators rose for both groups on Topic 2, the experimental group's use of complex operators rose more.

In the experimental Modules, the use of complex Boolean operators in the design of efficient searches was discussed.

**Search Strategies**

Participants were rated on the suitability or otherwise of their search strategies for the two research topics. Strategies were coded as "correct", "usually correct" or "incorrect". Table 10-13 summarises results for suitability of search strategies used.

**Table 10-13: Topics 1 and 2: Suitability of Search Strategy as a Function of Treatment**

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td>Topic 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>12</td>
<td>34.3</td>
</tr>
<tr>
<td>Usually Correct</td>
<td>22</td>
<td>62.9</td>
</tr>
<tr>
<td>Incorrect</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>100</td>
</tr>
<tr>
<td>Topic 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct</td>
<td>15</td>
<td>44.1</td>
</tr>
<tr>
<td>Usually Correct</td>
<td>17</td>
<td>50</td>
</tr>
<tr>
<td>Incorrect</td>
<td>2</td>
<td>5.9</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>100</td>
</tr>
</tbody>
</table>

For Topic 1, the experimental group used correct strategies more than did the control group. For Topic 2, although the experimental group did not use as many correct strategies as the control group, overall their performance was
better than the control group as in percentage terms, only 5.9% of the experimental group used incorrect strategies, and 15% of the control group used incorrect strategies.

Hypothesis 4 - Conclusion

Hypothesis 4 (null) was: there is no difference between experimental and control groups in search strategy formulation, post treatment. Results indicated that there were significant differences between the experimental group and the control group on the following variables for both search topics: Number of Synonyms; Number of Correct Databases; Number of Databases (Total); and Use of Truncation. There was also a significant difference in Number of Reformulations for Topic 2.

Of the 18 variables (nine for each search topic) used to measure search strategy formulation, experimental group performance was better than control group performance on 15 of them; that difference was significant on nine (50%).

The decision was made to reject the null hypothesis, and to conclude that search strategy formulation was different depending on type of instruction.

On the variables in which no significant difference was found: Use of Concepts, and Use of Complex Boolean Operators, the experimental group mean for both Topic 1 and Topic 2 was higher than the control mean for Complex Operators. Means for Number of Correct Concepts were almost the same between experimental and control treatments on both Topic 1 and Topic 2. It may be that both treatment groups were able to identify relevant concepts because 69.4% of subjects had completed an electronic database demonstration (in contrast to those subjects in Phase 1, 78% who had not completed such a demonstration); and 69.4% had also reported they used electronic databases at least three or four times a year to complete...
assignments, compared with 41.3% of subjects in Phase 1 who had ever used an electronic database more than three or four times at all.

However, the experiment modules were instrumental in conveying to subjects that synonyms also had to be considered; and this would explain the significant difference between treatment groups on the variable Number of Synonyms, which in turn accounts for the significantly greater Number of Reformulations used by the experimental group on Topic 2.

The results from Phase 1 indicated that, on several important variables - Number of Concepts, Use of Truncation, Number of Databases, and Use of Boolean Operators - search strategy formulations (Information Retrieval Assignment) were different depending on type of instruction.

Results from Phase 2 also indicated that on similar variables - Number of Synonyms, Number of Databases, and Use of Truncation - search strategy formulations (Literature Search Assignment) were also different depending on type of instruction.

The results for Phases 1 and 2 in combination suggest that the experimental treatment resulted in more effective search strategies being formulated irrespective of prior use of electronic databases, or undertaking University of Canberra Library tours - as Phase 1 subjects typically had not done so, and Phase 2 subjects had.

Whether or not the Phase 2 Modules influenced actual search performance, was considered in research question 2, results for which are discussed below.
10.2.2 Research Question 2

Research question 2 was: will type of instruction influence the ability to critically evaluate information located, so that search success is improved?

Hypothesis 5 (null): There is no difference between experimental and control groups in search success.

Search success was measured by credibility of information sources, and relevance of articles located. For both research topics, each of the five articles for which a citation was provided was assessed for relevance to the topic, and credibility of source. Relevance was based on currency (ie year of publication); and relationship to the topic. In response to the question “Is the article topic highly relevant to the research question?” the possible responses were “Yes”, “Marginal” or “No”.

Credibility of source was based on whether or not the source was a scholarly refereed journal, a generalist magazine, or any other non-credible source. Credibility of source was rated as either “Yes” or “No”. A database that recorded article details and how they had been rated for credibility of source and relevance to topic was constructed as the Literature Search Assignments were rated, to ensure that articles encountered more than once were rated consistently. These procedures were followed in order to ensure as far as possible that elements comprising the ratings were quantitative rather than qualitative in nature.

Credibility and relevance measures are discussed below.

Credibility

Table 10-14 summarises data on the total number of credible sources used, as a function of treatment.
Table 10-14: Topics 1 and 2 - Total number of Credible Sources Used, as a Function of Treatment

<table>
<thead>
<tr>
<th>Topic 1 - number of credible sources</th>
<th>Experimental Group</th>
<th>Control Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
<td>Count</td>
</tr>
<tr>
<td>0</td>
<td>6</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>100</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic 2 - number of credible sources</th>
<th>Experimental Group</th>
<th>Control Group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
<td>Count</td>
</tr>
<tr>
<td>0</td>
<td>12</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>12.5</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>7.5</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>100</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

On both Topic 1 and Topic 2 it can be seen that experimental group subjects obtained articles from credible sources more often than did subjects in the control group. The experimental group mean number of credible sources for Topic 1 was 2.05 and the control mean was 1.12. For Topic 2, the experimental mean was 1.77 and the control mean was 1.20. A t-test for equality of means indicated that this difference was statistically significant for Topic 1 (p = .024), but not for Topic 2.

A fact that strengthens the conclusion that the experimental Modules encouraged subjects to locate credible sources is that all subjects had at the beginning of the semester been given a copy of the Subject Guide for the unit Office Management ¾, in which it was stated that two databases, PsychLit
and Sociofile, would be appropriate to use in order to find credible information on the search topics. Despite all subjects having this information, it was still the experimental group that identified more credible sources than did the control group.

Relevance

The next three tables summarise data relating to relevance to the search topic of articles located. Table 10-15 below compares experimental and control group performance on the number of articles found that were “highly relevant” to the search topic.

Table 10-15: Topics 1 and 2 - “Highly Relevant” Articles

<table>
<thead>
<tr>
<th>Topic 1 - no. of article topics “highly relevant”</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>%</td>
<td>Count</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>22.5</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic 2 - no. of article topics “highly relevant”</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>%</td>
<td>Count</td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>17.5</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

The experimental group mean number of “highly relevant” articles for Topic 1 was 2.87; for the control group, the mean was 1.66. An independent samples t-test indicated that there was a statistically significant difference between the
experimental group and the control group in terms of number of “highly relevant” articles located for Topic 1 (p = .002).

For Topic 2, the control group mean for number of “highly relevant” articles located was 3.62; for the experimental group, the mean was 2.95. This difference was not statistically significant. The researcher believes that the higher number of “highly relevant” articles located by control group subjects may be related to the fact that as the teaching modules they were given did not emphasise the importance of credibility of source as much as did the modules taught to the experimental group, the control group located articles that were “highly relevant” to the search topic, but not useful, as their source was not scholarly. The experimental group, on the other hand, was more aware of the importance of source credibility, and therefore they attempted to find “highly relevant” articles within scholarly journals. As the search topics were not entirely straightforward, this sometimes meant that even though sources located were more credible, “highly relevant” information within those source journals was more difficult to locate.

Table 10-16 below provides information on performance of the experimental and control groups on Topics 1 and 2 relating to articles that were “marginally relevant”.
Table 10-16: Topics 1 and 2 – “Marginally Relevant” Articles

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td><strong>Topic 1 - no. of article topics “marginally relevant”</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>1</td>
<td>17</td>
<td>42.5</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>32.5</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td><strong>Topic 2 - no. of article topics “marginally relevant”</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>22</td>
<td>55</td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

The mean number of “marginally relevant” articles for the control group for Topic 1 was 2.16, and 0.66 for Topic 2. The mean number of “marginally relevant” articles for the experimental group was 1.40 for Topic 1, and 0.70 for Topic 2. The difference between experimental and control groups for Topic 1 was statistically significant (p = .009). This result is consistent with the finding for “highly relevant” articles for Topic 1, in which the experimental group performed significantly better than did the control group.

Table 10-17 below summarises data for articles that were “not relevant”.
Table 10-17: Topics 1 and 2 - Articles "not relevant" to Search Topics

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td>Topic 1 - no. of article topics “not relevant”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>27</td>
<td>67.5</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>Topic 2 - no. of article topics “not relevant”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

Findings for “not relevant” articles were consistent with findings for “highly relevant” articles. For Topic 1, the experimental group mean was 0.550; the control group mean was higher, at 1.04. The difference was not statistically significant. For Topic 2, the experimental group mean was 1.15; the control mean was 0.66. Again, the difference was not significant. The difference in performance on Topic 2 does however support the researcher’s comments about the experimental group possibly sacrificing relevance of article for the sake of credibility of source.

*Hypothesis 5: Conclusion*

The experimental group performed significantly better than the control group on Topic 1 for the variables Credible Source, and High and Marginal Relevance. For Topic 2, the experimental group mean for Credible Sources
was higher than the control group, but not significantly. Fifty per cent of the experimental group located only 0 - 1 credible sources, compared to 79.2% of the control group.

With regard to Relevance for Topic 2, there were no significant differences between treatments. The researcher believes it is possible that the experimental group, in attempting to locate credible sources, may have done so at the expense of article relevance.

As the experimental group performed better than the control group on Credibility of Source, and Relevance, for Topic 1, the decision was made to reject the null hypothesis, and to conclude that actual search performance was influenced by type of instruction.

10.2.3 Research Question 3

Research question 3 was: are problem-solving ability and information retrieval effectiveness related?

Hypothesis 6

Hypothesis 6 (null) was: there is no difference in search strategy formulation depending on problem-solving ability.

Correlations between problem-solving score (Survey 1, section 3) and Number of Concepts, Number of Incorrect Concepts, Number of Synonyms, Number of Databases (Correct, and Total), and Number of Reformulations indicated no relationship between problem solving and these variables on either search topic. Only Topic 2 - Number of Reformulations and problem-solving ability approached significance (p = .05).
However, on these 12 variables determined by frequency (six for each search topic), subjects who scored above the mean on problem solving gained higher mean scores on six of the 12 variables. Further, these higher mean scores were concentrated on the more difficult search topic – Topic 2, on which good problem solvers gained higher means on four of the six variables: Number of Synonyms, Number of Databases (Relevant, and Total), and Number of Reformulations.

These results, whilst not significant, do indicate some support for the results of Phase 1 to the effect that problem solving was correlated with Number of Concepts, Number of Synonyms and Number of Reformulations on Topic 2, and with Number of Concepts and Number of Reformulations on Topic 3.

As in Phase 1, log cross ratio analysis was used to examine the odds that problem-solving score above the mean (8.27) affected Use of Truncation, Use of Complex Boolean Operators, and Search Strategies. Only Use of Complex Boolean Operators on Topic 2 showed any change in odds as a function of problem-solving ability (ratio of 2.34). On all other variables for both topics, problem-solving was unrelated.

The decision was made to accept the null hypothesis, as significant results for the variables measured were limited. However, a trend in better mean scores for good problem solvers across half of the variables, and on two-thirds of the variables on the more difficult search topic, seems to indicate some relationship between problem-solving ability and search strategy formulation.

*Hypothesis 7*

Hypothesis 7 (null) was: there is no difference in search outcome depending on problem-solving ability.
Search outcome was determined by measuring credibility of source for the five articles located for each of Topics 1 and 2, and by determining relevance (high, marginal or none) of the articles located.

There were no significant correlations between credibility of sources used, or relevance of articles located, and problem-solving ability. However, t-tests indicated that for Topic 1, there was a significant difference between problem-solving scores above the mean, and scores below the mean, on Relevance of articles located ($p = .045$). For Topic 2, there was a significant difference between problem-solving scores above the mean, and scores below the mean, on Credibility of Sources ($p = .036$). Further, the mean number of relevant articles for Topic 2 was higher for good problem solvers than it was for poor problem solvers.

As Topic 2 was the more difficult of the two search topics, these results support further the results of Phase 1, and findings of literature reviewed, that problem-solving ability whilst not important for easier search topics, does influence search outcome on more difficult search topics.

The decision was made to reject the null hypothesis, and to conclude that problem-solving ability had an effect on search outcome.

The results for hypotheses 6 and 7 regarding the possible relationship between problem-solving score and search strategy formulation, and outcome, when compared to the results for hypotheses 4 and 5 for the treatment groups on search strategy formulation and search outcome, indicate a similar pattern to that found in Phase 1. In Table 10-18 below, mean values for experimental and control treatments on variables determined by frequency (measured for search strategy formulation) and for relevance and credibility (measured for search outcome), are presented.
Table 10-18: Experimental and Control Group Means on Variables Determined by Frequency Measuring Search Strategy Formulation, and Search Outcome

<table>
<thead>
<tr>
<th></th>
<th>Experimental Mean</th>
<th>Control Mean</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topic 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Concepts</td>
<td>2.70</td>
<td>2.65</td>
<td>.719</td>
</tr>
<tr>
<td>Number of Inappropriate Concepts</td>
<td>1.07</td>
<td>1.20</td>
<td>.466</td>
</tr>
<tr>
<td>Number of Synonyms</td>
<td>1.41</td>
<td>0.25</td>
<td>.007</td>
</tr>
<tr>
<td>Number of Relevant Databases</td>
<td>1.63</td>
<td>1.26</td>
<td>.022</td>
</tr>
<tr>
<td>Total Number of Databases</td>
<td>4.37</td>
<td>2.73</td>
<td>.011</td>
</tr>
<tr>
<td>Number of Reformulations</td>
<td>7.55</td>
<td>6.45</td>
<td>.526</td>
</tr>
<tr>
<td>Credibility of Sources</td>
<td>2.05</td>
<td>1.12</td>
<td>.021</td>
</tr>
<tr>
<td>Relevance of Articles</td>
<td>2.87</td>
<td>1.66</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Topic 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Concepts</td>
<td>2.02</td>
<td>1.91</td>
<td>.559</td>
</tr>
<tr>
<td>Number of Inappropriate Concepts</td>
<td>0.75</td>
<td>0.54</td>
<td>.397</td>
</tr>
<tr>
<td>Number of Synonyms</td>
<td>2.05</td>
<td>0.87</td>
<td>.020</td>
</tr>
<tr>
<td>Number of Relevant Databases</td>
<td>1.94</td>
<td>1.26</td>
<td>.000</td>
</tr>
<tr>
<td>Total Number of Databases</td>
<td>3.82</td>
<td>2.09</td>
<td>.002</td>
</tr>
<tr>
<td>Number of Reformulations</td>
<td>6.36</td>
<td>4.26</td>
<td>.05</td>
</tr>
<tr>
<td>Credibility of Sources</td>
<td>1.77</td>
<td>1.20</td>
<td>.186</td>
</tr>
<tr>
<td>Relevance of Articles</td>
<td>2.95</td>
<td>3.62</td>
<td>.080</td>
</tr>
</tbody>
</table>

Variables on which the experimental group mean was higher than the control group mean are shown in bold type. Significant p-values are also shown in bold. Table 10-18 indicates that on the variables listed, the experimental group performed better than the control group on 15 of the 16 variables; nine of these results were significant.

Table 10-19 below presents the same variables as a function of problem-solving score categorised by score above or below the mean.
Table 10-19: Problem-Solving Means on Variables Determined by
Frequency Measuring Search Strategy Formulation, and Search Outcome

<table>
<thead>
<tr>
<th>Topic</th>
<th>Problem-Solving Score Above Mean (&gt;=8.27)</th>
<th>Problem-Solving Score Below Mean (&lt;8.27)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topic 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Concepts</td>
<td>2.78</td>
<td>2.60</td>
<td>.250</td>
</tr>
<tr>
<td>Number of Inappropriate Concepts</td>
<td>1.05</td>
<td>1.04</td>
<td>.963</td>
</tr>
<tr>
<td>Number of Synonyms</td>
<td>0.88</td>
<td>0.91</td>
<td>.963</td>
</tr>
<tr>
<td>Number of Relevant Databases</td>
<td>1.33</td>
<td>1.50</td>
<td>.469</td>
</tr>
<tr>
<td>Total Number of Databases</td>
<td>4.10</td>
<td>3.69</td>
<td>.621</td>
</tr>
<tr>
<td>Number of Reformulations</td>
<td>7.15</td>
<td>7.25</td>
<td>.967</td>
</tr>
<tr>
<td>Credibility of Sources</td>
<td>1.68</td>
<td>2.26</td>
<td>.252</td>
</tr>
<tr>
<td>Relevance of Articles</td>
<td>2.15</td>
<td>3.00</td>
<td>.045</td>
</tr>
<tr>
<td><strong>Topic 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Concepts</td>
<td>1.84</td>
<td>2.04</td>
<td>.387</td>
</tr>
<tr>
<td>Number of Inappropriate Concepts</td>
<td>0.52</td>
<td>0.60</td>
<td>.753</td>
</tr>
<tr>
<td>Number of Synonyms</td>
<td>2.05</td>
<td>1.08</td>
<td>.064</td>
</tr>
<tr>
<td>Number of Relevant Databases</td>
<td>1.73</td>
<td>1.65</td>
<td>.731</td>
</tr>
<tr>
<td>Total Number of Databases</td>
<td>3.63</td>
<td>2.81</td>
<td>.272</td>
</tr>
<tr>
<td>Number of Reformulations</td>
<td>6.89</td>
<td>4.78</td>
<td>.177</td>
</tr>
<tr>
<td>Credibility of Sources</td>
<td>2.15</td>
<td>1.04</td>
<td>.036</td>
</tr>
<tr>
<td>Relevance of Articles</td>
<td>3.73</td>
<td>3.00</td>
<td>.144</td>
</tr>
</tbody>
</table>

Variables on which those subjects with problem-solving scores above the mean were better than those subjects with problem-solving scores below the mean are shown in bold type. Significant p-values are also shown in bold.

Table 10-19 indicates that problem solvers scoring above the mean performed better than problem solvers scoring below the mean on 8 of the 16 variables measured. On Topic 2, the more difficult topic, this difference was apparent for six of the eight variables – that is, two-thirds. Although only two of the results were significant, the fact that they were on variables measuring search outcome – relevance and credibility - is important, as problem-solving
strategies can be taught. Indeed, in the experimental Modules, problem-solving strategies were taught – and as shown in Table 10-18, the experimental group performed better than the control group on many variables, including the search outcome measures of credibility and relevance, for Topic 1.

10.3 Other Correlates

In this section, other correlates not central to the research questions, but nevertheless of interest, are reported. These correlates include the nature of article summaries provided by subjects; problem-solving score and Age, Gender and Highest Academic Qualification, and time spent on the search tasks.

10.3.1 Article Summaries

The final section of the Literature Search Assignment required subjects to obtain one article for each of the two search topics, and to write a 150 summary of each of them, outlining what the article was about, and explaining its relevance to the search topic. A correctly formatted, full citation of the article also had to be provided. As the assignment was only an ungraded Pass/Fail, the researcher believes many subjects used the most easily obtained article, not necessarily the best one, for this part of the Assignment. That is, most articles submitted were from full text databases that provided articles relevant to the topic, but not from credible sources. The data support this view; so do student comments.

In Table 10-20, the credibility of the source of the article obtained for summary is set out.
Table 10-20: Topics 1 and 2 - Credibility of Source of Article Obtained for Summary

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td><strong>Topic 1 - Credible Source</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>No</td>
<td>32</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td><strong>Topic 2 - Credible Source</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>No</td>
<td>30</td>
<td>75</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

The experimental group obtained articles for summary from credible sources more so than did the control group on both Topics 1 and 2, although the differences were not significant.

In Table 10-21, the relevance of the article obtained for review to the research topic is evaluated.
Table 10-21: Topics 1 and 2 - Relevance of Article obtained for Summary to the Research Topic

<table>
<thead>
<tr>
<th>Topic 1 - Relevance</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td>Yes</td>
<td>14</td>
<td>35</td>
</tr>
<tr>
<td>Marginal</td>
<td>21</td>
<td>52.5</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

| Topic 2 | | | |
|---------|---------------------|---------------|
|         | Count | %  | Count | %  |
| Yes     | 25    | 62.5 | 22 | 91.7 |
| Marginal| 11    | 27.5 | 1  | 4.2  |
| No      | 4     | 10  | 1   | 4.2  |
| Total   | 40    | 100 | 24 | 100 |

The finding that the control group tended to obtain more relevant articles for Topic 2 could be related to the observation that experimental group subjects tended to obtain fewer relevant articles, from more credible sources, than did the control group.

With regard to the actual content of the article summaries, data were collected for: Accuracy of Citation; Important Information Included; Relevance to Topic Made Clear; and Appropriate Writing Style. Even though these elements were not taught as part of the Modules, the researcher was of the view that data on these elements may be useful in terms of assessing subjects’ ability to summarise information and to communicate it using accepted academic citation and writing conventions. No differences on these variables were expected, or found, between treatment groups. The exception here was Accuracy of Citation: brief mention of accuracy had been made in Module 2.
The experimental group used a higher number of correct citations for both search topics (50% and 57.5% respectively) than did the control group (43.5% and 47.8% respectively).

With regard to Important Information, between 9.25% and 100% of subjects were able to explain article aims, brief method, and conclusions.

With regard to Relevance to Topic, between 8-22% of subjects did not make clear the article’s relevance for Topic 1 or 2, even though the Literature Search Assignment had stipulated that this was necessary.

With regard to Appropriate Writing Style, between 53% and 58% of subjects used appropriate writing styles. Common errors included such items as punctuation and sentence construction; using the first person, ("I think that …"); and referring to the article being summarised as “the article”, (for example, “the article found that”, rather than “The authors were of the view that …”)

Further research should investigate the efficacy of concept-based teaching methods for the development of written communication skills.

10.3.2 Problem Solving and Age, Gender, and Highest Academic Qualification

Independent samples t-tests revealed no significant differences in mean problem-solving score as a function of tutorial group, experimental treatment, Age, Gender, or Highest Academic Qualification.

Table 10-22 indicates that the lowest means on the problem-solving survey as a function of Age was 17-22 years; for Gender, Male; for Highest Academic Qualification, TAFE. Highest means for problem solving were Age 30 years
and over; and the Highest Academic Qualification of Year 12 or equivalent. These results showed the same trend for lower mean problem-solving score for TAFE students as found in Phase 1.

The largest differences in means occurred on the correlates Year of Study, and Highest Academic Qualification.

Table 10-22: Summary of Means for Age, Gender, and Highest Academic Qualification on Problem Solving Questions

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Problem Solving Questions mean/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE (years)¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17-22</td>
<td>28</td>
<td>8.25</td>
</tr>
<tr>
<td>23-29</td>
<td>10</td>
<td>8.30</td>
</tr>
<tr>
<td>30 years and over</td>
<td>10</td>
<td>8.80</td>
</tr>
<tr>
<td>Total:</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>GENDER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>29</td>
<td>8.44</td>
</tr>
<tr>
<td>Male</td>
<td>12</td>
<td>7.41</td>
</tr>
<tr>
<td>Total:</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>HIGHEST ACADEMIC QUALIFICATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 12 or equivalent</td>
<td>27</td>
<td>8.55</td>
</tr>
<tr>
<td>TAFE qualification</td>
<td>16</td>
<td>7.43</td>
</tr>
<tr>
<td>Undergraduate degree²</td>
<td>2</td>
<td>10.00</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>10.00</td>
</tr>
<tr>
<td>Total:</td>
<td>47</td>
<td></td>
</tr>
</tbody>
</table>

Note: 1. As there were only two subjects in the age groups 30-39, and 6 in the 40 and over group, these groups were consolidated to form a group of "30 years and over".
2. As there were only two subjects who held an Undergraduate Degree, and two who had "Other" qualifications, these two sub-correlates were excluded from the analysis.

Independent samples t-tests indicated no significant differences in mean problem-solving score between any of the variables and their sub-categories.
As was the case in Phase 1, means were lower than expected, as the researcher was of the view that with the exception of perhaps three questions, the problems were not very difficult. This gap between lecturer perception of difficulty, and actual student ability, is one that may occur at both first and second year undergraduate level.

**Question Difficulty and Age, Gender, and Highest Academic Qualification**

Table 10-23 below shows percentage incorrect responses to the 15 problem-solving questions for each of the correlates. The questions appear in column one, ranked by the researcher in terms of expected difficulty. This ranking was based on projections from theories identified in the literature review, and on the previous administering of a similar survey to Phase 1 participants.

**Table 10-23: Problem Solving Questions Ranked in Expected Order of Difficulty from Most Difficult to Least Difficult. Percentage of Incorrect Responses per Correlate sub-Category**

<table>
<thead>
<tr>
<th>Question No</th>
<th>Age 17-22 n = 28</th>
<th>Age 23-29 n = 10</th>
<th>Age over 30 n = 6</th>
<th>Female n = 29</th>
<th>Male n = 12</th>
<th>Year 12 n = 27</th>
<th>TAFE n = 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>88.9</td>
<td>87.5</td>
<td>83.3</td>
<td>85.7</td>
<td>100</td>
<td>88.5</td>
<td>92.9</td>
</tr>
<tr>
<td>6</td>
<td>78.6</td>
<td>60</td>
<td>83.3</td>
<td>75.9</td>
<td>83.3</td>
<td>63</td>
<td>93.8</td>
</tr>
<tr>
<td>8</td>
<td>64.3</td>
<td>70</td>
<td>66.7</td>
<td>65.5</td>
<td>66.7</td>
<td>70.4</td>
<td>81.3</td>
</tr>
<tr>
<td>15</td>
<td>25</td>
<td>42.9</td>
<td>66.7</td>
<td>37.5</td>
<td>37.5</td>
<td>20.8</td>
<td>45.5</td>
</tr>
<tr>
<td>14</td>
<td>48</td>
<td>42.9</td>
<td>33.3</td>
<td>52</td>
<td>12.5</td>
<td>41.7</td>
<td>54.5</td>
</tr>
<tr>
<td>13</td>
<td>48</td>
<td>28.6</td>
<td>33.3</td>
<td>48</td>
<td>50</td>
<td>41.7</td>
<td>45.5</td>
</tr>
<tr>
<td>5</td>
<td>60.7</td>
<td>20</td>
<td>33.3</td>
<td>51.7</td>
<td>33.3</td>
<td>44.4</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>22.2</td>
<td>30</td>
<td>16.7</td>
<td>21.4</td>
<td>33.3</td>
<td>26.9</td>
<td>18.8</td>
</tr>
<tr>
<td>1</td>
<td>42.9</td>
<td>60</td>
<td>16.7</td>
<td>44.8</td>
<td>50</td>
<td>48.1</td>
<td>56.3</td>
</tr>
<tr>
<td>12</td>
<td>26.9</td>
<td>28.6</td>
<td>50</td>
<td>23.1</td>
<td>44.4</td>
<td>32</td>
<td>18.2</td>
</tr>
<tr>
<td>9</td>
<td>42.9</td>
<td>44.4</td>
<td>16.7</td>
<td>48.3</td>
<td>36.4</td>
<td>40.7</td>
<td>46.7</td>
</tr>
<tr>
<td>7</td>
<td>10.7</td>
<td>0</td>
<td>0</td>
<td>6.9</td>
<td>16.7</td>
<td>11.1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>14.8</td>
<td>0</td>
<td>0</td>
<td>7.1</td>
<td>16.7</td>
<td>14.8</td>
<td>6.3</td>
</tr>
<tr>
<td>2</td>
<td>46.4</td>
<td>40</td>
<td>16.7</td>
<td>34.5</td>
<td>58.3</td>
<td>48.1</td>
<td>37.5</td>
</tr>
<tr>
<td>11</td>
<td>18.5</td>
<td>0</td>
<td>0</td>
<td>7.4</td>
<td>11.1</td>
<td>16</td>
<td>8.3</td>
</tr>
</tbody>
</table>
All correlates, and all sub-categories within those correlates, agreed with the researcher’s ranking of question 10 as the most difficult to answer, as measured by the percentage of incorrect responses per sub-category. The one exception to this was TAFE-qualified subjects; however, the percentage of those subjects who answered question 10 incorrectly (92.9%) and question 6 incorrectly (93.8%) was nearly the same. Question 10 required the subject to manipulate several variables, and so to arrive logically at the only correct solution for the given parameters. Although no mathematical knowledge was required, terms such as "volume" and "diameter" were used in the question. Perhaps these terms suggested to students that a quantifiable result could be arrived at, when in fact, the subject had to realise that insufficient information had been given for this to be possible. The correct answer was "it is impossible to know". Between 83.3% and 100% of subjects answered this question incorrectly.

Again with the exception of sub-category TAFE, all correlates and sub-categories ranked question 6 as the next most difficult, agreeing with the researcher's predicted degree of difficulty. This question again required manipulation of several variables, and to answer it correctly, the subject had to determine the relevance of given variables to a decision. Between 60% and 93.8% of subjects could not answer this question correctly.

Figure 10-6 below illustrates how on the correlate of Age, there is a gradual decline in the percentage of incorrect answers for the seven most difficult questions. However, at question 5, subjects aged 17-22 years are still answering incorrectly 60.7% of the time, while the percentage of incorrect responses for subjects aged 23-30 and over 30 had fallen to 20% and 33.3% respectively.
Overall, subjects aged over 30 performed better on problem-solving questions than did subjects from other age sub-categories; they scored the highest percentage of correct answers for six of the 15 questions.

Figure 10-6: Percentage of Incorrect Responses as a Function of Age for Seven Most Difficult Questions

![Figure 10-6: Percentage of Incorrect Responses as a Function of Age for Seven Most Difficult Questions](image)

Figure 10-7 below indicates that for the variable of Gender, Males and Females are roughly similar in their ability to answer the seven most difficult questions, with the exception of Question 14 (a question on a hypothetical situation).

However, when rankings were allocated for the number of times a gender sub-category achieved a lower overall number of incorrect answers than the other, Females were ranked first on four of the seven most difficult questions, and were ranked first on seven of the eight other questions. That is, Females performed better than Males on 11 of the 15 problem-solving questions, although these differences were not significant.
Figure 10-7: Percentage of Incorrect Responses as a Function of Gender for Seven Most Difficult Questions

Figure 10-8 below indicates that for the variable of Highest Academic Qualification, the ability to answer the seven most difficult questions followed a similar pattern for subjects who held a Year 12 qualification, and subjects with a TAFE qualification. The subjects who held a TAFE qualification however, had a consistently higher percentage of incorrect answers.

When rankings were applied, results indicated that Year 12 subjects had fewer incorrect answers than subjects with a TAFE qualification on all of the seven most difficult questions. The mean score for Year 12 subjects on the seven most difficult questions was 3.07; for TAFE subjects, 1.87. This difference was statistically significant (p = .009).

Interestingly, on the eight other questions, TAFE qualified subjects had fewer incorrect answers than did subjects with a Year 12 qualification on six out of eight questions. This result suggests that on questions rated as more straightforward, TAFE qualified subjects performed better, but for questions
rated as more difficult, Year 12 qualified subjects performed consistently better.

Figure 10-8: Percentage Incorrect Responses as a Function of Highest Academic Qualification for Seven Most Difficult Questions

These results suggest that even though overall mean scores on the survey show little difference between correlates, when problems are classified by difficulty, differences between correlates become evident.

Correlate sub-categories that performed least well were Age: 17-22, and Highest Academic Qualification: TAFE.

Summary of Results- Problem Solving Questions

Does mean problem-solving score vary with Age, Gender, and Highest Academic Qualification?

Results suggested that when mean scores were compared, there were no significant differences as a function of Age, Gender, and Highest Academic Qualification for the 15 problem-solving questions when taken together.

Chapter 10: Phase 2 - Results
Does ability to answer more or less difficult questions vary with Age, Gender, or Highest Academic Qualification?

Using the percentage of incorrect responses per correlate for each of the seven most difficult questions, results suggested that for Age, percentage of incorrect responses decreased from 83-89% for question 10, to 20-61% for question 5. For Gender, the decrease was from 86-100% for question 10, to 33-52% for question 5. For Highest Academic Qualification, percentage of incorrect responses decreased from 89-93% for question 10, to 45-50% for question 5. In other words, for all correlates, a large percentage of subjects was still making errors on the seventh most difficult question.

In terms of rankings, subjects with a Year 12 qualification performed better than subjects with a TAFE qualification on all seven most difficult questions. The difference in performance was statistically significant. No other subcategories achieved such a consistent result. These results suggest that Highest Academic Qualification may be the best predictor of subjects' ability to answer the more complex questions in the problem-solving survey.

Results also suggested that subjects were more likely to be able to solve more difficult problems if they were aged over 30 years. Subjects least able to answer questions rated as more difficult held a TAFE qualification.

These results also suggest that the ability to think at a formal level, and to think hypothetically, to manipulate variables, to solve problems by analogy, or to use deductive reasoning, cannot be assumed in younger students, school leavers or TAFE qualified students; indeed, significant percentages of mature aged students could not apply these higher order thinking skills consistently, even in scenarios such as those used in the survey.
10.3.3 Participant Self-evaluation of Time Taken to Complete Searches, and Technical Problems in Completion of Searches

As part of their Literature Search Assignment, participants were asked to indicate how long it took them to find information on their topics, and whether or not they encountered any difficulties with their searches. Figure 10-9 below indicates that over half of the control group (55%) spent 60 minutes or more conducting each of the searches. For the experimental group, 41% spent over 60 minutes to search for each topic; approximately 20% took 30, 45 or 60 minutes.

Figure 10-9: Topics 1 and 2 Combined: Time Taken to Find Literature as a Function of Treatment

The experimental Modules may have assisted subjects to be slightly more effective in conducting their searches.
With regard to technical problems encountered when conducting the Literature Search Assignments, of the 61 assignments in which a response to this question was included, 28 subjects (45.9% of subjects) commented that they had had a problem: 13 subjects reported that the computer server was “slow”; 13 subjects reported that the server “denied access” to databases. Only one subject was unable to connect to the server from home; and one commented that there were not enough computers. The main problems - perceived slowness of access, and access being denied to the databases - appear to have been caused by system overload in terms of the number of students trying to access databases as the same time; or by individual students attempting to access more than the maximum number of eight databases at one time. This maximum number was stipulated on the computer interface at the top of the “select databases” page.

10.3.4 Problem Solving and Electronic Database Knowledge

A log cross product ratio analysis indicated that the odds of scoring above the mean on problem solving are higher by a factor of 3 if electronic database knowledge score is also above the mean (above mean odds: 15/8 = 1.875:1; below mean odds: 10/16 = .625:1; ratio = 1.875/.625 = 3). This result supported the findings in Phase 1 of odds of scoring above the mean on problem solving increasing by a factor of 1.9 if electronic database knowledge score is also above the mean. This relationship is also represented by a correlation coefficient of 0.4598; p = 0.0001.

10.3.5 Use of Electronic Databases and Number of Reformulations

The frequency of use of electronic databases influenced the number of reformulations used. For both Topics 1 and 2, subjects who used electronic databases “quite often” (several times a semester), had a lower mean number
of reformulations than subjects who used electronic databases “sometimes” (three or four times a year).

10.3.6 Other Correlations

Findings for Phase 1 regarding correlations between Number of Reformulations, Number of Concepts and Number of Synonyms were supported in Phase 2. There were correlations in Phase 2 between Number of Reformulations and Number of Synonyms (Topic 1 $r = .40; p = .002$; Topic 2 $r = .48; p = .000$), and Number of Reformulations and Number of Incorrect Concepts (Topic 1 $r = .50; p = .000$).

These findings are to be expected, given that the greater the number of concepts and synonyms identified, the greater the number of combinations of those factors that is possible.

10.4 Summary of Results

Results for Phase 2 are summarised in Table 10-24 below.
Table 10-24: Summary of Results - Phase 2

<table>
<thead>
<tr>
<th>Hypothesis (Null Form)</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is no difference between experimental and control groups on the pre-test measuring electronic database knowledge.</td>
<td>Accept</td>
</tr>
<tr>
<td>There is no difference between experimental and control groups on the post-test measuring electronic database knowledge.</td>
<td>Accept</td>
</tr>
<tr>
<td>There is no difference between experimental and control groups on the pre-test measuring problem-solving ability.</td>
<td>Accept</td>
</tr>
<tr>
<td>There is no difference between experimental and control groups in search strategy formulation.</td>
<td>Reject</td>
</tr>
<tr>
<td>There is no difference between experimental and control groups in search success.</td>
<td>Reject</td>
</tr>
<tr>
<td>There is no difference in search strategy formulation depending on problem-solving ability.</td>
<td>Accept - with provisos</td>
</tr>
<tr>
<td>There is no difference in search outcome depending on problem-solving ability.</td>
<td>Reject</td>
</tr>
</tbody>
</table>

In the next chapter, results for Phases 1 and 2 are compared and summarised.

Conclusions are drawn on the research overall, and suggestions are made for further research, in Chapter 12.
11. PHASES 1 AND 2 - SUMMARY

In this chapter, major findings for Phases 1 and 2 of this research are compared and summarised. Section 1 covers background variables; section 2, findings regarding the experimental treatments and their impact on information retrieval and literacy skills; section 3, differences in knowledge of electronic databases. Finally, in section 4, undergraduate problem-solving ability is discussed.

11.1 Background Variables

Table 11-1 summarises possible intervening variables and correlates that were measured for Phases 1 and 2.

Table 11-1: Correlates - Phase 1 and Phase 2 Comparison

<table>
<thead>
<tr>
<th>Correlate</th>
<th>STAGE 1</th>
<th>STAGE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>GENDER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>167</td>
<td>67.6</td>
</tr>
<tr>
<td>Male</td>
<td>80</td>
<td>32.4</td>
</tr>
<tr>
<td>Total</td>
<td>247</td>
<td>100.0</td>
</tr>
<tr>
<td>AGE (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17-22</td>
<td>154</td>
<td>60.6</td>
</tr>
<tr>
<td>23-30</td>
<td>51</td>
<td>20.1</td>
</tr>
<tr>
<td>31-40</td>
<td>28</td>
<td>11.0</td>
</tr>
<tr>
<td>&gt;40</td>
<td>21</td>
<td>8.3</td>
</tr>
<tr>
<td>Total</td>
<td>254</td>
<td>100.0</td>
</tr>
<tr>
<td>EDUCATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 12 or equivalent</td>
<td>188</td>
<td>75.8</td>
</tr>
<tr>
<td>TAFE</td>
<td>45</td>
<td>17.9</td>
</tr>
<tr>
<td>Undergraduate degree</td>
<td>10</td>
<td>4.0</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>3.2</td>
</tr>
<tr>
<td>Total</td>
<td>251</td>
<td>100.0</td>
</tr>
<tr>
<td>Correlate</td>
<td>STAGE 1</td>
<td>STAGE 2</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>USE OF ELECTRONIC DATABASES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>84</td>
<td>6</td>
</tr>
<tr>
<td>Once or twice</td>
<td>65</td>
<td>9</td>
</tr>
<tr>
<td>Several times a year</td>
<td>61</td>
<td>15</td>
</tr>
<tr>
<td>Several times a semester</td>
<td>n.a.</td>
<td>15</td>
</tr>
<tr>
<td>Several times a month</td>
<td>44</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>254</td>
<td>49</td>
</tr>
<tr>
<td><strong>COMPLETION OF LIBRARY TOURS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>72</td>
<td>34</td>
</tr>
<tr>
<td>No</td>
<td>182</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>254</td>
<td>48</td>
</tr>
<tr>
<td><strong>COMPUTER ABILITY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>43</td>
<td>16.9</td>
</tr>
<tr>
<td>Fair</td>
<td>117</td>
<td>46.1</td>
</tr>
<tr>
<td>Good</td>
<td>85</td>
<td>33.5</td>
</tr>
<tr>
<td>Excellent</td>
<td>9</td>
<td>3.5</td>
</tr>
<tr>
<td>Total</td>
<td>254</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>COMPUTER ENJOYMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very much</td>
<td>62</td>
<td>24.6</td>
</tr>
<tr>
<td>Quite a lot</td>
<td>131</td>
<td>52.0</td>
</tr>
<tr>
<td>Not much</td>
<td>54</td>
<td>21.4</td>
</tr>
<tr>
<td>Not at all</td>
<td>5</td>
<td>2.0</td>
</tr>
<tr>
<td>Total</td>
<td>252</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>COMPUTER ACCESS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At home</td>
<td>20</td>
<td>8.0</td>
</tr>
<tr>
<td>At work</td>
<td>15</td>
<td>6.0</td>
</tr>
<tr>
<td>At school</td>
<td>24</td>
<td>9.6</td>
</tr>
<tr>
<td>Home, work, school</td>
<td>69</td>
<td>27.7</td>
</tr>
<tr>
<td>Home, work</td>
<td>42</td>
<td>16.9</td>
</tr>
<tr>
<td>Home, school</td>
<td>75</td>
<td>30.2</td>
</tr>
<tr>
<td>Work, school</td>
<td>4</td>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Not measured in Phase 2
For the correlate of Gender, although sample size was different (Phase 1, n = 247; Phase 2, n = 41), percentages of Females and Males were nearly equal in both samples.

For the correlate of Age, again the percentages were approximately the same, with the majority of subjects (80.7% in Phase 1, and 79.1% in Phase 2) aged 30 and under.

Gender and Age therefore need not be considered as confounding variables that might influence comparison of Phase 1 and 2 results.

For the correlate of Highest Academic Qualification, there was a difference between the percentage of Year 12 subjects (75.8% in Phase 1, and 57.4% in Phase 2); the difference appears to have been caused by the higher percentage of TAFE qualified subjects in Phase 2 (34%). This is a high percentage of TAFE qualified subjects, and not representative of a typical second year subject. The unit in which the Phase 2 study was conducted was one that is the first subject for TAFE students joining the Bachelor of Information Management degree. Possible ramifications for results on problem-solving scores are discussed in section 4 of this chapter.

With regard to the correlate Use of Electronic Databases, as expected there was a difference in the frequency of use, depending on year of study. Most Phase 1 subjects had used electronic databases no more than several times a year; most Phase 2 subjects had used databases from several times a year to several times a month. In addition to the year of study, the increased usage of electronic databases in the second year cohort may also have been influenced by a wider knowledge of the databases' existence, and consequent encouragement by lecturers of students to use them, between 1997 and 1999. Results for Phase 1 and for Phase 2 suggested that frequency of use of electronic databases influenced the number of reformulations. Subjects who
used electronic databases "regularly" had a lower mean number of reformulations than subjects who used electronic databases less often. These findings suggest some support for expert pattern recognition in information literacy: the more experienced searcher may see a different problem and consequently, a different, more focused solution, than does a novice searcher. Electronic database use did not influence the number of concepts or synonyms identified, or the number and type of databases used.

With regard to Completion of Library Tours, again as expected, Phase 2 subjects had mostly attended a library tour, whereas Phase 1 subjects had not. This variable had no effect on performance in either Phase 1 or Phase 2 on electronic database knowledge.

In Phase 1, Computer Ability and Computer Enjoyment were found to have a positive correlation, but were not related to performance on variables measuring search performance, or electronic database knowledge.

Data were gathered on participant frustration with using computers to retrieve information. Whilst most subjects in both Phase 1 and Phase 2 reported no negative experience with the technology, a significant minority reported frustration arising from the computer server being down, not being able to log on from home, or perceived long waiting periods for databases to be loaded.

Correlates for Phases 1 and 2 indicated that in both phases, the "typical" subject was a female aged 22 years or under, with a Year 12 qualification. The cohorts were very different however, in the number of subjects who had completed Library tours; most of the Phase 1 cohort had not completed such a tour; most of the Phase 2 cohort had. Considering the similarity of the cohorts on demographically important parameters, and their difference on an important possible intervening variable, comparison of results between Phase
1 and Phase 2 was particularly interesting. These results are discussed in the next section.

11.2 Independent Variables

The independent variable in both Phase 1 and Phase 2 of this research was a series of teaching Modules, grounded in learning theory. Dependent variables were measured in order to determine the impact of those modules on the development of, in Phase 1, information retrieval knowledge and skills; and, in Phase 2, information retrieval knowledge and skills, and critical thinking skills thought to improve actual search outcome. In Phase 1, the focus of the single teaching module was information retrieval specifically. Phase 2 sought to widen the range of skills taught to include broader aspects of information literacy – evaluating information to enable more effective search outcomes.

Table 11-2 below summarises significant differences between experimental and control treatment groups for Phases 1 and 2.

Table 11-2: Significant Differences between Experimental and Control Groups for Phases 1 and 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Concepts</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Use of Truncation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Use of Boolean Operators</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Number of Synonyms</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of Databases</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of Reformulations</td>
<td>No</td>
<td>Yes (topic 2)</td>
</tr>
<tr>
<td>Credible Sources</td>
<td>Not measured</td>
<td>Yes (topic 1)</td>
</tr>
<tr>
<td>Relevant Articles</td>
<td>Not measured</td>
<td>Yes (topic 1)</td>
</tr>
</tbody>
</table>

As can be seen from Table 11-2, significant differences on a number of the variables measured in order to determine search formulation, and search success, were apparent. As has been discussed earlier in this thesis,
experimental group means were higher than control group means on 16 of the 21 variables determined by frequency in Phase 1, and on 15 of the 16 variables determined by frequency (including Credible Sources and Relevant Articles, which were not measured in Phase 1), in Phase 2.

These results indicate that the experimental modules were successful in improving search techniques and strategies in both stages of the research. Wider aspects of information literacy - analysis of articles for credibility and relevance - also appear to have been taught successfully when undertaken as part of the experimental treatment for Phase 2.

In terms of the two-stage model of information retrieval proposed in Chapter 5, it would appear that concept-based teaching is effective in developing students' ability to both interpret the research question, and to design effective search strategies, using a problem-solving heuristic. Further, search outcomes can be improved by teaching critical thinking skills.

11.3 Electronic Database Knowledge

In Phase 1, there was a significant difference in post-test scores on Electronic Database knowledge between treatment groups.

In Phase 2, there was no significant difference between experimental and control groups on the post-test (Survey 2, section 1) that measured knowledge of electronic database terminology. Mean scores rose for the experimental group, but remained the same for the control group.

The researcher is of the view that this lack of difference was influenced by the fact that subjects were second year undergraduates, who had by the time of the study had some exposure to using electronic databases for searching; 70%
of all subjects reported in the pre-test that they had attended demonstrations of the use of electronic databases.

This exposure to skills demonstrations did not necessarily mean, however, that subjects had become proficient searchers. Rather, this result would indicate that other factors account for the difference in search success in terms of credibility of sources and relevance that were observed between treatment groups in Phase 2. As all other intervening factors were controlled by the experimental design, it is possible that the experimental Modules could account for the better performance of the experimental treatment group on a number of the variables measured.

11.4 Problem Solving

There are a number of general comments that can be made about the results for Phases 1 and 2 regarding problem solving.

Firstly, the large percentage of subjects that were unable to answer the most difficult questions correctly, suggests that we cannot assume that graduates are capable of solving problems, in a professional context, when they leave university.

The second most difficult problem (question 6, Phase 2), that contained multiple "vectors", or items that required manipulation, was set as a typical decision-making exercise of the type found in everyday professional workplaces. It involved the need to identify which information about computer printers was relevant to the decision to purchase one brand over another. However, the great majority of subjects could not conclude from the facts given in that question which piece of information was irrelevant to the decision to be made.
Another difficult problem required subjects to solve a problem by analogy (Phases 1 and 2). Again, the great majority of subjects was unable to recognise the analogy and apply it to the solution of the new situation. In today's workplace, emphasis is placed on innovation and creative problem solving. The ability to recognise analogous situations in different domains, and to develop a solution to a problem based on that analogous situation, is fundamental to innovation and creative problem solving.

Secondly, the finding that the most difficult problems were ones that contained multiple "vectors", supports the classification of problems according to number of variables to be manipulated, as described by Marini and Case (1994).

Thirdly, with regard to "formal" thinking, as evidenced by the ability to manipulate hypotheses, it would appear that the great majority of subjects was able to judge the validity of conclusions provided that new information was straightforward. However, once the new information became more complex, many subjects had difficulty determining what effect this information would have on the conclusions drawn from the original experiment.

If this is the case, then in the context of doing research for assignments, for example, many undergraduates might have difficulty determining the relevance of what they read to the question they are trying to answer, which would explain why many undergraduates (particularly in first year), complain that they cannot find useful information for assignments.

Results regarding age of subjects, and the ability of older adults to perform better than younger adults on the more difficult questions, support the findings of Phase 1 of this research on this issue, and those of other
researchers, to the effect that the working memory capacity of medium-aged adults is superior to that of children and older adults (Swanson, 1999).

With regard to the correlate of Highest Academic Qualification, results from Phases 1 and 2 provide support the findings of Dickson, Fleet & Watt (2000) that TAFE-qualified students tend not to perform as well in university subjects as do school leavers. TAFE students in the current study performed less well on problem-solving questions than did school leavers, in both stages of this research. It should be noted that Phase 1 was conducted with first-year students, 45 of whom were TAFE qualified (17.9% of sample), and Phase 2 with second-year students, 16 of whom were from TAFE courses (32.7% of sample). These students entered the second-year subject directly from TAFE and were therefore being compared with second-year students, even though they were in their first year of university. Dickson et al (2000) observed that TAFE entry directly into second year university studies could be considered an intervening variable in assessing the possible relationship between TAFE students and academic performance; however, as Phase 1 results also showed the same trend with TAFE students, Dickson & Watt's observation does not appear to hold. Although it was not the purpose of the current study to identify performance differences between TAFE and other students entering university, these results are nevertheless of interest, as the number of TAFE-qualified students admitted to universities in Australia is rising - from 5.6% of admissions in 1991, to 11% in 1996 (Dickson et al, 2000).

In the final chapter, conclusions on the study overall will be drawn, and possible implications for the understanding and teaching of information literacy will be discussed.
12. CONCLUSIONS

In section 1 of this chapter, results of the study are discussed in relation to the issue of whether or not concept-based teaching of information retrieval is effective. In section 2, a model of information retrieval is proposed. Section 3 suggests a framework for the teaching of information literacy. In section 4, areas for further research are outlined; and finally, conclusions are drawn in section 5.

12.1 Concept-based Teaching: is it Effective?

In Chapter 1 of this thesis, it was suggested that: firstly, successful database and internet searching is contingent on a combination of technical skills, and information retrieval conceptual knowledge. The researcher hypothesised that if conceptual knowledge is important to retrieval success, teaching strategies grounded in learning theory may be useful, as they emphasise the development of conceptual knowledge.

Secondly, it was suggested that search strategy formulation may be improved by teaching and modelling a problem-solving heuristic for performing a search.

Literature reviewed showed little empirical research on the efficacy of concept-based teaching in information retrieval; indeed, at the time this study began - six years ago - end-user information retrieval from electronic sources was a new concept itself. Research into teaching strategies was not always rigorous, and, perhaps understandably given the infancy of the computer interface, tended to focus on training for specific databases, rather than on optimal methods for developing deeper conceptual understanding of search processes.

Nevertheless, two characteristics of the future of information retrieval seemed clear - that increasingly, it would be conducted electronically (CD-ROMs,
online databases, internet); and that these searches would be conducted by
novice end-users. Empirical research in the area of teaching of information
retrieval from electronic sources seemed timely. Results of this study have
provided evidence to support the value of concept-based teaching in
information retrieval.

For example, results from this study indicated that teaching strategies
grounded in learning theory, and the use of a problem-solving heuristic, were
effective in developing students' conceptual knowledge, and developing their
ability to interpret research questions, to design search strategies, to locate
credible sources and to retrieve relevant articles. These findings support Sylvia
& Kilman's (1991:46) "professional observation" of the efficacy of conceptually
grounded search strategies.

Through the use of an experimental research design, the study has provided
empirical evidence to resolve the apparent "puzzling display of weak effects of
conceptual models" (Sein & Bostrom, 1989, in Balaraman, 1991:284) in the
teaching of database searching. Results from the current study suggested that
helping students develop a conceptual model of the search process was an
effective instructional tool, with search processes and outcomes being
significantly better for the experimental group than for the control group.

Further, findings of the current study did not support the argument of Dixon
& Gabrys (1991:103) to the effect that the time taken to acquire a "deep
conceptual understanding" of complex computer devices may not be
warranted. It should be noted that Dixon & Gabrys were investigating the
operation of automatic teller machines; the researcher is of the view that a
computer information search application is a much more complex interface
than a banking machine, and therefore their argument is not applicable in the
field of database instruction. However, Dixon & Gabrys (1991:119) did
commend that, even for simple interfaces like automatic teller machines,
"conceptual understanding may aid users ... when the amount of prior learning is small". Certainly a conceptual understanding appears to have assisted novice end-users in the current study to negotiate complex interfaces.

Although different elements of concept-based strategies were utilised, the current study supports findings of an experimental study by Zahner (1992) to the effect that "cognitive strategies" instruction resulted in significantly better research paper bibliographies, than those of the "traditional approach" treatment group.

In addition to providing evidence in support of the efficacy of concept-based teaching strategies in information retrieval, and the utility of teaching concepts as well as skills, results of the study yielded information regarding problem-solving abilities for two cohorts of undergraduate students: first year (n = 249); and second year (n = 68), at an Australian university. These results were summarised in Chapter 11, and whilst the need for caution is acknowledged in terms of avoiding over-generalisation, they suggested a number of implications for teaching and learning in higher education in Australia.

Firstly, results suggested a gap between lecturer perception of difficulty of content with regard to reasoning and problem-solving questions, and actual student ability to understand that content. This gap is one that should be kept in mind when academics are designing curricula for undergraduate students.

Secondly, a majority of students in both the first year and the second year cohorts tested had difficulty with critical thinking and problem-solving skills such as determining relevance, reasoning by analogy and causal reasoning. It may be appropriate for first year lecturers to incorporate modules into their subjects that address the development of these skills explicitly.
Thirdly, because of the possible difficulties with thinking hypothetically, and with determining relevance exhibited by some students involved in the study, lecturers cannot assume that undergraduate students will see the “big picture” regarding the significance of lecture and other teaching material presented. A number of students may benefit from a clear explanation of “why”, rather than just “how” or “what”, which in turn may facilitate students’ developing more complex mental representations of concepts being taught. This, in turn, may assist students to progress in terms of cognitive maturity, from “concrete” to “formal” reasoning (if using Piaget’s taxonomy); or from “dualism” to “full relativism” (if using Perry’s taxonomy – which has been developed specifically to address the issue of cognitive maturation in young adults). The more complex a student’s mental representation, or schema, of a concept, the more likely they are to be able to move beyond the “black and white” thinking that characterises a dualistic thinker, to being able to reason with hypothetical constructs – a characteristic of full relativists.

Investigating the efficacy of concept-based teaching strategies, conceptual models and problem-solving was one thrust of the current research. The second major focus has been a review of theory in the area of information retrieval and literacy, and the development of a two-stage model of the retrieval process. It is to these issues of theory development that the discussion will now turn.

12.2 A Model of Information Retrieval

Saracevic & Kantor (1988) discussed the requirements of a theory of information seeking and retrieving. They suggested that a useful model should include elements of context and content of information, and individual differences in patterns of concept formation. Taking into account these suggested requirements, in Chapter 5 of this thesis a two-stage model of the information retrieval process was proposed, based on principles of cognitive psychology.
Results of Phase 1 of this research suggested that the model was useful both in terms of describing the thinking processes underpinning question identification and interpretation, and in describing the thinking processes drawn on in the formulation of search queries. Results from Phase 1 suggested further that there was a final component required in order for information retrieval strategies to translate into useful search outcomes: the need to use “higher order” thinking skills of analysis, synthesis and evaluation, to determine whether information located actually provided a credible solution to the information need. Results from Phase 2 suggested that incorporating instruction in critical thinking skills did result in an increase in the use of credible sources. This final component draws the wider elements of information literacy into the information retrieval process.

The researcher has revised the two-stage model of the information retrieval process put forward in Chapter 5, to incorporate the role of critical thinking in that process. Two taxonomies for critical thinking have been used to represent these processes; they were reviewed in Chapter 2. Briefly, however, the taxonomy of Bloom (1976) for thinking skills to be taught in the cognitive domain comprises: knowledge; comprehension; application; analysis; synthesis; and evaluation. Analysis, synthesis and evaluation are considered to be “higher order” thinking skills. Beyer’s (1987) classification of thinking strategies and skills is also hierarchical. Thinking strategies include problem solving, decision making and conceptualising. Underpinning these strategies are so-called “critical thinking skills” such as determining relevance; resolving fact/inference confusion; detecting bias; and recognising fallacious arguments. Beyer then describes “micro-thinking skills” of inductive and deductive reasoning, and recall. The revised two-stage model that incorporates these thinking skills is discussed below.
Research in the field of cognitive psychology suggests that there are two types of knowledge representation in human memory. The first is *declarative* - knowledge of concepts and facts. The second is *procedural* - knowledge of a process, or series of steps, that can be followed in order to negotiate a "problem space" from an "initial state" to a "goal state", or problem solution. The researcher suggests that both of these types of knowledge representation are involved in the process of information retrieval from electronic sources.

Again drawing on concepts grounded in cognitive psychology, in information processing terms, the researcher suggests that information retrieval from electronic databases can be represented usefully as a two-stage process. The first stage involves problem recognition, and draws on declarative knowledge. The second stage involves instigating a search, and draws on procedural knowledge. This two-stage process is supported by the concept of the "enterprise schema", which implies that in order for successful understanding and performance in a given domain, "the learner must acquire not just one skill or concept but an entire 'enterprise schema'" (Piette, 1995 in Martin, ed 1995:81, outlining Gagne & Merrill's 1990 construct). If the information retrieval process is an example of an "enterprise schema", then it needs to represent both concept, and skill, development. The two-stage model represents concept development in stage 1 (declarative knowledge) and skill development in stage 2 (procedural knowledge).

Further, if this model is a valid representation of the retrieval process, it would follow that teaching strategies designed to develop conceptual knowledge of information retrieval, and procedural skills of searching - such as a problem-solving heuristic - would improve search performance. Results from the current study provide such evidence, and therefore support the efficacy of the two-stage information retrieval construct.
Figure 12-1 (adapted from Marshall, 1990, in Gagne, Yekovich & Yekovich, 1993), is suggested by the researcher as an illustration of the first stage of the information retrieval process - problem identification; in this case, essay question interpretation. The word “interpretation” is used, as problem identification will depend on the completeness and accuracy of the mental models of a particular end-user, and on their own unique “tangled network” configuration. The student (end-user) has to analyse the problem and identify and categorise issues suggested by that problem, before a search can be implemented. Problem recognition involves the end-user searching his or her existing mental models, or schema - that is, declarative knowledge - for a concept or concepts that match the problem(s) represented in the essay question.

The question “Should we clone humans?” is used as an example of a search query that necessitates interpretation by the end-user in order to identify both explicit, and implied, search terms that would aid the achievement of an effective search outcome. Using the information processing model, input to memory is the search question “Should we clone humans?”. This “input” is represented in working memory as a mental model, or schema, that is then unconsciously compared to a number of schemas in long term memory simultaneously. In information processing, the neural network model of information retrieval (Marshall, 1990, in Gagne, Yekovich & Yekovich, 1993) suggests that information retrieval from declarative knowledge is simultaneous and unconscious. That is, when the end-user engages in problem recognition, the process is largely unconscious and the declarative knowledge “database” is scanned simultaneously, rather in the way that access by a computer to information stored on a CD-ROM is random, rather than sequential, as it would be on a reel to reel tape or cassette. This representation aids in the description and understanding of the way end-users must examine their declarative knowledge in order to be able to understand and interpret the research question with which they have been presented.
Figure 12-1: Information Retrieval - Stage 1: 
Neural Network Model of Question Interpretation

INPUT: Should we clone humans?

OUTPUT: Ethics question

(adapted from Marshall, 1990 in Gagne, Yekovich & Yekovich, 1993)

Perhaps more importantly, it also explains why end-users, when confronted with the same search question, will use a range of keywords and search terms for searching - the naming and labelling problems mentioned by many researchers (Saracevic, 1991; Iivonen, 1995; Chen & Dhar, 1991; Ehrlich & Cash, 1994a). As each end-user's network of schemas, or mental models, is unique, the language used by each end-user to represent those concepts is unique. In
the researcher's view, an understanding of the structure of declarative knowledge and how it is searched, addresses in part the requirements for a model of information seeking and retrieving suggested by Saracevic & Kantor (1988) regarding context and content of information, and individual differences in concept formation. Further, the researcher suggests that an understanding of the processes of declarative knowledge storage and retrieval provides an explanation for the "intriguing vagaries" in human behaviour evident in an information search (Wallace, 1993:239), and also goes some way to addressing the lack of theoretical underpinning for search strategy formulation discussed by Lancaster et al (1994:374):

Although much has been written on the subject of search strategy, little real research has been done on how different people arrive at alternative search approaches for the same research problem. Even Saracevic et al [1988], while they reported significant differences in approaches, did not try to explain why these differences occur.

Networks (schema) of the concept(s) contained in the essay question must be searched. Cognitive psychology suggests that when networks in long-term memory that fit the problem are found (in other words, patterns are recognised), the pattern with the highest level of activation (i.e., the best fit with the problem question) will be selected. In Figure 12-1, the pattern with the highest level of activation is "ethics". If the schema, or pattern, is inadequate for the problem to be understood, the end-user will have difficulty solving the problem. For example, they will not be able to identify concepts essential to the understanding of the search problem, and to generate appropriate search terms and strategies for effective information retrieval from an electronic database.

During the process of declarative knowledge searching, thinking strategies and skills are being used, usually unconsciously. These strategies are shown in Figure 12-1 in the grey strip at the right of the diagram. Thinking strategies are
shown in upper case print; critical thinking skills are shown in lower case.

Initially, the thinking strategy of *conceptualising* is being brought to bear on the question to be identified and “matched” to existing conceptual knowledge in memory. Thinking skills being used that underpin the strategy of conceptualising include *knowledge* (that is, recall of facts) and *comprehension*. Possible interpretations of the question are compared with existing conceptual frameworks in long term memory; here, the “higher order” thinking skill of *evaluating* is being used. Finally, the thinking strategy of *decision making* is used to determine the best meaning of the question in the light of current knowledge. When the closest “match” is found, the subject’s output response (question interpretation) could be medicine, ethics, etc. Those people with the most accurate schemas (mental models) would infer correctly that “should” means “ethics”, even though that concept is not explicitly included in the question.

Once the problem has been “recognised”, the second stage of the information retrieval process is “running” the search, which involves formulating search strategies, conducting the search, and evaluating information found. If the problem has been inadequately recognised or interpreted, this second stage is unlikely to be successful, even if it is correctly executed. The iterative nature of the second stage may however result in the problem later being correctly “recognised”, due to new input that changes the original schema. This is compatible with Ingwerson’s view (1992, in Bystrom & Jarvelin, 1995:191); that is, the cognitive view on information interaction that “potential information gained from information systems may transform the information user’s knowledge structures”.

Newell & Simon’s standard information processing model (1972, in Gagne, Yekovich & Yekovich, 1993) has been adapted by the researcher to represent this process (Figure 12-2). The information processing model when applied to information retrieval suggests that after the problem has been identified; that
is, the concepts central to the search question have been isolated, the end-user will then go through an iterative search process, or production, that is characterised by a number of sequential operations and IF ... THEN decision points (shown as diamond shapes in Figure 12-2). This process may be either partially routinised and unconscious (as in the case of an expert searcher), or conscious (as in the case of a novice searcher). Each decision point represents a point at which the direction of the search may be changed. Examples of questions asked at decision points are: "Do I have a clear understanding of what the question means?" "Have I identified all keywords"? "Have I chosen the right databases?" "Is the information I have found useful?" At this decision point, if information is judged as not useful, the question is reviewed and the search is reformulated and repeated on the same, or different, databases.

The thinking skills underpinning these processes are listed in the grey strip at the right of the diagram. Thinking strategies are shown in upper case print; critical thinking skills in lower case. The "higher order" thinking skill of analysis is used to determine the best path for the development of the information search, and a problem-solving heuristic (if one has been learned) is activated in order to make the search a methodical one. Components of the question are analysed to yield concepts and synonyms for search strategies to be developed; databases are chosen (decision making) after appropriate selection criteria are matched against question parameters. These processes are largely rapid and unconscious for an expert searcher, and tend to be sequential, iterative and conscious for the novice.

After a search has been executed, the "higher order" thinking skills of synthesising and evaluating are used to determine whether materials located meet the information need. If they do, the decision is made to end the search; if they do not, either the search strategy is reformulated, or, if information located in the search is discrepant with the existing conceptualisation of the search question, stage 1 is revisited so that the question can be interpreted in
the light of now-modified knowledge structures. Once this has been done, stage 2 is again engaged.

The processes of question interpretation, and search strategy formulation and execution are underpinned by thinking strategies and skills such as conceptualising and problem solving. These thinking strategies seem to be more developed in those students who are able to think in abstract terms (formal
reasoners) to use the taxonomy of Piaget, or students who have reached the stage of "full relativism" in the terminology of Perry. Regardless of which theoretical perspective is overlaid on the process of information retrieval, the entire process is enhanced by another facility demonstrated by students exhibiting formal reasoning skills – metacognition, or the ability to analyse one's own thought processes.

Figure 12-3 shows both stages of the information retrieval process in sequence, with critical thinking strategies and skills involved at each step of the process in the grey strip at the right of the diagram. Thinking strategies are shown in upper case print; critical thinking skills in lower case. In Figure 12-3, the iterative nature of the search process can be seen in overview. Depending on a searcher's evaluation of their understanding of the search question; the progress of their search; the choice of database; or search results; different stages of the search process can be repeated – even going back to the "input" stage of question interpretation. All major thinking strategies: conceptualising; decision making; and problem solving; are brought to bear during the information retrieval process. As these thinking processes are central to successful information retrieval, it makes sound pedagogical sense to teach these skills explicitly to students, when dealing with information retrieval, and wider aspects of information literacy. Further, results of this study have suggested that the teaching of these skills improves the ability to locate credible and relevant sources.

The researcher is of the view that the teaching of information retrieval and concomitant thinking skills is only one important strand of information literacy, and over the course of this dissertation, has been developing and refining a framework for the conceptualisation and teaching of information literacy. This framework is described in the next section.
Figure 12-3: A Model of Information Retrieval

Stage 1: Question Interpretation

INPUT: Question

OUTPUT: Selected conceptualisation

Stage 2: Conducting the Search

is question understood?

No

develop search

select databases

implement search

assess search

Yes

is it useful?

Yes

end

No

is question understood?

No

Thinking Strategies and Skills

CONCEPTUALISING

knowledge comprehension

evaluating

DECISION MAKING

analysing

PROBLEM SOLVING

DECISION MAKING

synthesising

evaluating

DECISION MAKING

Chapter 12: Conclusions
12.3 A Framework for the Teaching of Information Literacy

Bruce (2000a,b) has noted that theory building in information literacy is not yet well advanced. One theoretical area on which the researcher has reflected during the current study is the relationship between the processes of information retrieval, and the wider elements of information literacy.

The results of the current study have led the researcher to the view that this relationship is not purely hierarchical; that is, information retrieval skills are not subsumed under the wider concept of information literacy. Rather, there is an interaction between the two processes such that information retrieval draws necessarily on those aspects of information literacy—including critical thinking and analysis—in order for the process of retrieval to be effective. In terms of reasoning, critical thinking skills are in effect a "sufficient cause" for successful information retrieval; that is, critical thinking must be present for successful retrieval to occur. An appropriate mental model (declarative knowledge representation) of the information need, and an understanding of the procedures required for query formulation (a problem-solving heuristic; procedural knowledge) are "necessary causes"; that is, they may (and do) contribute to an effective search outcome. Critical thinking skills are the more important of the two clusters however, as they underpin modification of declarative knowledge through the "transforming" of the models as new knowledge is assimilated. With regard to the search process, the function of critical thinking is to support effective judgements, which in turn underpin decision making throughout that iterative process. Again, as new information is gained, it is acted on by thinking skills, which in turn modify search procedures and strategies.

Figure 12-4 represents the researcher's understanding of the elements of information literacy; their inter-relationships; and the content and teaching strategies that are appropriate to the development of each element.
For any given information need, information literacy comprises the ability to locate, analyse and articulate the significance of materials pertinent to that need. Each of these three elements is represented in Figure 12-4 as a separate component. All elements must be present for an individual to be termed “information literate”, as the dotted lines on the diagram indicate. For example, an undergraduate who can perform two stages of the information retrieval process - interpreting the question successfully, and formulating suitable search strategies - is not necessarily going to locate appropriate literature - because the second element of literacy - analysing - must also take place, to establish the credibility of a source relative to information requirements, and actual relevance of citations to the search problem.

These skills in analysis are then used in the communication of the information located, to the particular audience. The interaction between the three elements is represented by the double-headed arrows linking them.

This framework for the understanding of information literacy provides a useful starting point for the development of curricula designed to foster information literacy in undergraduates. The researcher suggests that the framework could work equally as effectively at any learning level, provided that the skills taught were adapted to the age and developmental level of the students being taught.
In Figure 12-5 (below), subject content that develops each of the three main elements of information literacy is listed. Teaching strategies grounded in learning theory: use of analogy; concept development; modelling; scaffolding; are used as appropriate when teaching each element. Further, end-user computing techniques (for example, use of online databases; data manipulation using spreadsheets) to support the development of information literacy are also incorporated into course content as necessary.

With regard to locating information, (Figure 12-5, element 1) teaching strategies developed for Phase 1 of this research were effective in improving subjects’ performance at both stages of the information retrieval process: question interpretation; and search strategy formulation. A problem-solving heuristic; modelling; concept-based teaching; use of analogy; anchoring new material to existing knowledge; all of these methods were useful in the development of information retrieval concepts and skills. Content covered in the teaching of successful information location included the use of the two-stage information retrieval model: analysing a search question; and conducting a search using a problem-solving heuristic. End-user computing
**Figure 12-5: Framework and Content for the Teaching of Information Literacy**

1. **Locating**
   - Two-stage theoretical model:
     - Neural network model – question interpretation;
     - Information processing model – conducting a search
   - Problem-solving heuristic for search process
2. **Analysing**
   - Interplay between domain knowledge, thinking skills and attitude
   - Thinking skills (Beyer, 1987):
     - Thinking strategies: conceptualising, problem solving, decision making
     - Critical thinking skills: fallacious arguments, fact/inference confusion, bias, emotive terms
     - Micro-thinking skills: reasoning, recall
   - Bloom’s Taxonomy of Skills for the Cognitive Domain (1976):
     - Knowledge
     - Comprehension
     - Application
     - Analysis
     - Synthesis
     - Evaluation
   - End-user computing for data manipulation, interpretation and decision support: spreadsheets and databases
3. **Articulating**
   - Communicating significance of information:
     - Selecting communication channels:
       - Written
       - Oral
       - Electronic
     - Constructing logical arguments
     - Writing style and tone
     - Presentation skills
   - End-user computing for communication: email, word processing, and presentation software

---

Chapter 12: Conclusions

Page 370
instruction included hands-on running of trial searches on University of Canberra online databases, and the internet.

Without skills in critical thinking, however, analysis of information located (Figure 12-5, element 2) for relevance and credibility cannot be assumed to occur. The second major area of instruction in information literacy therefore becomes critical thinking, including for example, the introduction of a framework to represent the relationship between thinking processes, domain knowledge, and attitude; followed by a framework that develops an understanding of the various thinking processes. The taxonomy developed by Beyer (1987) has proved useful to the researcher in this regard. Students readily grasp the hierarchical structure of thinking strategies (problem solving, conceptualising and decision making); underpinned by critical thinking skills (detecting bias; fact/inference confusion; fallacious arguments); and finally, types of reasoning: deductive; and inductive.

At this point, introducing an analogy, such as a staircase, to explain a taxonomy of thinking skills (Bloom, 1976) is effective. Using examples throughout to assist the grasping of the differences between these thinking skills - knowledge, comprehension, application, analysis, synthesis and evaluation - has proved useful in explaining these concepts to students. Many students have remarked to the researcher that this explanation of critical thinking skills has been of great assistance to them not only in information retrieval, but in preparing a wide range of assignments for university.

Critical thinking skills are essential to all stages of information literacy, not just the analysis stage. For example, the thinking strategy of conceptualising is drawn on in the first stage of the information retrieval model (question interpretation); problem solving and decision making are utilised in the second stage (search strategy formulation).
End-user computing methodologies that support the development of element 2 competencies include the use of spreadsheets and databases for data input, manipulation, interpretation, and decision support.

The final element of information literacy in the model under discussion is articulating the significance of information located (Figure 12-5, element 3). Again, critical thinking skills are essential. Although articulating the significance of information was beyond the purview of the current study, the researcher has investigated links between critical thinking and written and oral communication in another study, in which results indicated, inter alia, that the teaching of thinking skills favourably influenced second year undergraduate scores on oral and written literature reviews (Macpherson, 1999).

When information is to be conveyed to an audience, the needs of the audience must be analysed; a decision must be made as to the appropriate communication channel (for example, written report, or oral presentation). Frequently, the same information must be adapted to the needs of a number of different audiences, for example, a presentation to peers, followed by a more formal written paper for a tutor. Skills such as establishing the main purpose of the information to be communicated: to inform or to persuade; to underpin decision making; to develop an argument; language choice; writing style and tone; all of these communication skills are subsumed in the wider structure of information literacy.

End-user computing skills that support this stage of information literacy development include the use of computers for communication and presentation purposes: email; wordprocessing; and presentation packages such as Powerpoint.
Providing students with an overview of information literacy as set out in Figure 12-5 above at the start of any first year undergraduate program is likely to enhance significantly their understanding of many of the academic requirements that will be encountered during their studies. For example, providing students with definitions and examples of the difference between "discuss" and "analyse" will assist them to avoid fundamental errors in the level of sophistication of written papers often encountered by tutors and lecturers, particularly at first year level.

Such a program, of course, is not a guarantee of information literacy by the end of undergraduate studies; rather, it is one means by which the development of literacy may be encouraged. Results from Phase 1 of the present study suggested, for example, that the ability of some students to grasp hypothetical constructs, to determine relevance, to reason by analogy, or to solve problems containing multiple "vectors", is influenced by their level of cognitive maturity. Cognitive maturation, in turn, may be encouraged through the utilisation of teaching strategies grounded in learning theory.

Indeed, regardless of possible level of cognitive maturity, results of Phase 1 and Phase 2 of this research suggested that between 50% and 80% of undergraduates tested could not solve problems requiring the use of analogy, or containing multiple vectors, even when these problems were presented in everyday scenarios. Students best able to cope with these types of problems appeared to be aged over 30 years. It is not known whether this better performance was in fact caused by a cognitive maturation process, although evidence does point to the existence of this process. One factor demonstrating its existence may be the finding of Swanson (1999) that working memory capacity is greater in younger adults than it is in children and older adults.

It follows that if not all undergraduates can reason by analogy, and determine relevance, then not all graduates will be able to deliver immediately the
creative problem-solving capabilities that are today sought so keenly by employers in our competitive, frenetically-paced information society.

The researcher notes that the Framework set out in Figure 12-5 aligns with the standards and outcomes described in the first Australian edition of *Information Literacy Standards* for higher education recently published (Council of Australian University Librarians, 2001). In particular, element 1, *locating*, in the researcher's Framework aligns with Standards 1 and 2 (recognising the need for information; accessing information effectively and efficiently). Element 2, *analysing*, aligns with Standards 3 and 4 (evaluating information and its sources critically; storing and manipulating information); element 3, *articulating*, aligns with Standard 5 (expanding, reframing and communicating information). Standards 6 and 7 relate to broader issues of ethical use of information and the recognition of the need for information literacy if lifelong learning is to be pursued.

Whilst the current study has clarified some issues relating to teaching strategies for the development of aspects of information literacy, and has resulted in the researcher's development of conceptual models relating to information retrieval, and information literacy, a number of areas for further research have presented. These areas are described below.

### 12.4 Further Research

The results of the current study indicated that the concept-based teaching of elements of information literacy, in the context of information retrieval, had a significantly favourable effect on short term learning outcomes (the ability to locate relevant journal literature) in two undergraduate student cohorts at the University of Canberra, and as Bundy (1999:241) observed, "what is clearly needed to accelerate interest in information literacy ... is proof that it makes a difference to short and long term learning outcomes".
Further research in several theoretical directions is suggested. Firstly, replication of results of this study using the concept-based teaching strategies, in another higher education setting, would be useful. Testing of results using another educational level, possibly high school students, would be another means of verifying the efficacy of the modules developed, and the utility of the two-stage model of the retrieval process set out at Figure 12-3.

Secondly, a longitudinal study incorporating instruction in the elements of information literacy as summarised in Figure 12-5 would be useful to test the utility of that model.

Research that applies the teaching strategies implemented in this study, in an internet searching environment, would provide information as to whether the strategies are effective in a searching environment that lacks the structure that was required for experimental design reasons in the current study. Further, research that applies the teaching strategies implemented in this study, in another discipline other than information literacy, would provide information on the efficacy of the strategies for teaching in higher education generally.

Implementing the teaching strategies at other educational levels would also provide valuable data; one possible research avenue would be to investigate the extent to which these teaching methodologies had already been used in other educational settings, and to compare and contrast results derived from those other settings with the results of the current study.

With regard to issues of problem-solving ability in undergraduate students, information gathered at another university would enable verification or otherwise of the observation in this study that many first year undergraduates do not have the reasoning and problem-solving skills that they are often assumed to possess on university entry. Further, a question that would be worthwhile investigating is the relationship, if any, between problem solving,
critical thinking, and higher ability students; for example, how do higher ability students differ from other students in terms of problem conceptualisation? Do higher ability students already emulate problem-solving processes of experts?

Another area for research is that of cognitive maturity; in particular, the investigation and description of the development of formal thinking processes in young adults, and how these factors might impact on teaching and learning processes in higher education.

Implications of this study for teaching in higher education generally is the subject of the final section of this thesis.

12.5 Conclusion

As little as ten years ago, information retrieval was regarded as the domain of the expert search intermediary. Technology, however, has brought information to the end-user, and it is for this large group, characterised by a broad range of individual differences and variability in performance, that teaching strategies need to be designed. Today, information is a commodity; it has value, and can be used for strategic purposes. In this context, information literacy, and in particular, information retrieval, is an essential competency to enable students, as future professionals, to function as lifelong learners in the information society.

It is usual for universities in Australia and elsewhere, to develop comprehensive statements as to the generic attributes they expect all students to have acquired on graduation. Such frameworks typically include competencies such as critical thinking, problem solving, the ability to work in teams, and ethical, professional behaviour. In recent years, universities have been modifying these statements to include, in one form or another, information literacy. The Queensland University of Technology Library,
Australia, for example, has developed an information literacy statement to support the generic attributes agenda of that university: “The library’s ultimate goal is to promote information literacy as a key competency for lifelong learning” (Peacock, 2001:34). The University of Canberra, Australia, is reviewing its Teaching & Learning Plan to reflect current thinking on information literacy as a crucial outcome of higher education.

Not only is it important to include information literacy as a generic attribute for any university, it is also important that these frameworks distinguish clearly between information literacy, and information technology literacy. The researcher suggests that these two areas of student competence, whilst related in some of their applications, are nevertheless quite distinct. This difference can be clarified by the adoption and use of appropriate terminology to describe the separate competencies.

For example, language used to describe, and to distinguish, various aspects of computing and technology is evolving. The general term “information technology” skills, in wide use in public debate, does not reflect the types of skills that universities are attempting to describe when discussing generic attributes of students in this regard.

The term “end-user computing” is more accurate a descriptor of the competencies we would expect of all graduates, and enables a useful distinction to be made from those skills of a technical (and course-specific) nature, such as programming.

Further, when taught as “end-user computing”, information technology is put into context, and is able to be understood and appreciated for what it is – a productivity tool for professionals.

The development of information literacy imperatives, and end-user computing requirements, has created new areas for the application of critical thinking.
skills. As the current study has suggested, the inter-dependence of these three generic competencies is a conceptual framework around which instruction can be shaped to good effect.

The recognition of the importance of the inter-relatedness of these competencies is central to determining what, and how, students learn. Of course, as with any other discipline, some students will learn on their own. The majority, however, need to be taught. The findings of the current study suggest teaching methods grounded in learning theory (modelling, analogy, scaffolding), that facilitate the development of aspects of information literacy, critical thinking and end-user computing. These methods appear to have real benefits for introductory knowledge acquisition in an undergraduate population characterised by a pedagogically difficult fusion of large individual differences, and a disinclination to seek instruction in the search process (probably the result of a lack of understanding of the inherent complexity of the task).

When information literacy, critical thinking and end-user computing are viewed as parts of a whole, the issue is not one of “training”, but of education; the aim is not to teach “skills”, but to develop theoretical frameworks for “21st century literacy” (US Congress 21st Century Workforce Commission, 2000) essential for any graduate to possess. In other words, the issue becomes one for a university to address, explicitly, in its course offerings.

As Candy (2000:275-276) observed, Australian universities have an important role in developing “knowledge workers” who possess “those attributes - both generic and discipline-specific - which employers and the professions increasingly claim they expect of graduates.”

All of these concerns can be addressed if information literacy, critical thinking, and end-user computing are taught to first year undergraduates.
Information literacy is necessary not just for successful university study; it is essential to survival in the information age. Medical practitioners, educators, politicians, architects; professionals of every type need the knowledge and skills to be able to make sense of the information environment. "Information overload" is a frequently reported problem within that environment. Even though computer information management systems are able to do some of the sifting, sorting and classifying work that enables information overload to be reduced, they are still only productivity tools.

The key to the cipher of information is information literacy: it is not system-dependent; it is backwards compatible; it is easily transportable and does not suffer system glitches and downtime. Our students need to be taught, with the best methods we are able to use, how to exploit the potential of that most powerful of sense-making instruments - the human mind.

As was stated in the opening sentence of this thesis, "it is axiomatic that information is not useful unless it can be retrieved." This dissertation has contributed towards developing one possible theoretical structure to represent the information retrieval process; to developing teaching strategies that assist in the acquisition of information retrieval knowledge and skills; and to developing an understanding of the role of individual differences in the retrieval process. The framework for the teaching of information literacy is a contribution to current discourse in that area, which is now recognised as an essential outcome of higher education.


BORGMAN, C.L. (1983b) *The User’s Mental Model of an Information Retrieval System: effects on performance*, A Dissertation submitted to the Department of Communication and the Committee on Graduate Studies of Stanford University in partial fulfillment of the requirements for the degree of Doctor of Philosophy, September, USA


Bibliography


Bibliography Page 389

LAWSON, V.L. (1989) Using a computer-assisted instruction program to replace the traditional library tour: an experimental study, RQ, Fall, 71-79


LIPOW, A. (1983) Description of University of California, Berkeley, online catalog user training program, Training Users of Online Public Access Catalogs, Conference, Jan 12-14, San Antonio, Texas, USA, 56-64


ROWE, C. (1994) Modern library instruction: levels, media, trends, and problems, Research Strategies, 12:1, 4-17


WALLACE, P.M. (1993) How do patrons search the online catalog when no one's looking? Transaction log analysis and implications for bibliographic instruction and system design, *RQ*, 33: 2, 239-252


ZAHRNER, J.E. (1992) A Cognitive Strategies Framework for Domain-integrated Process-oriented Library Instruction: the effects on research process orientation, library anxiety, attitudes, and research products of college students, A Dissertation submitted to the Department of Educational Research in partial fulfillment of the requirements for the degree of Doctor of Philosophy, Florida State University, USA
INFORMATION RETRIEVAL – A STUDY

CONSENT FORM

An important skill for students is the ability to locate and evaluate material for the completion of essays, reports and seminars.

I am currently researching the most effective ways of teaching the use of electronic databases as a research tool, and would like your assistance in the study. I will be conducting a survey in class next week, and another in week 8, to enable data relevant to this research to be gathered. Information retrieval strategies will be taught in tutorials in weeks 3-7.

Participation in the research is voluntary, and anonymous. Your names and ID numbers are not required. The questions in the surveys will provide information about students’ knowledge of electronic databases, and your approaches to solving a research problem. Each of the two surveys will take approximately 30 minutes to complete.

The questions are not of a personal nature, but of course every effort will be made to maintain confidentiality. Information will be handled in accordance with the guidelines set down by the Privacy Act 1988. Information collected will be kept either in a locked filing cabinet, or on a password-protected computer, at the University of Canberra.

I am happy to answer any questions you may have regarding the study, and can be contacted at the phone number or email address below.

If you wish to participate, please indicate that you understand the purpose of the study, and agree to participate in the study, by signing at the bottom of this page where indicated. Signed consents will need to be returned in the lecture next week. A collection box will be available.

Karen Macpherson
Associate Lecturer
Faculty of Communication
Phone 6201 2925 (work)
email: kjm@comserver.canberra.edu.au

I have read and understood the information provided and I agree to participate in the research project.

Signature of student
INFORMATION RETRIEVAL - A STUDY

CONSENT FORM

One of the most important skills you will need in order to be successful at university is the ability to find material on topics set for essays, reports and seminars.

I am conducting a study into the most effective ways of teaching the use of electronic databases as a research tool, and will be distributing a survey in tutorials next week which will enable me to gather information relevant to this study.

The questions in the survey will help me determine your current approach to solving a research problem, and what instruction you might already have had in research techniques.

The questions are not of a personal nature, but all information collected will of course be treated as strictly confidential and will be handled in accordance with the guidelines set down by the Privacy Act 1988. Any information which is able to be linked to a particular person, regardless of its nature, will be destroyed once data has been collated.

Although completion of the survey is voluntary, it should take you only about 20 minutes to complete, and the information you provide will assist me greatly in the design of teaching modules that will help students to become more effective researchers.

I am happy to answer any questions you may have regarding the study, and can be contacted at the phone number or email address below.

If you wish to participate, please indicate that you understand the purpose of the survey, and agree to participate in the study, by signing at the bottom of this page where indicated. Signed consents will need to be returned at the beginning of your CI1 tutorial next week (week 2) - a collection box will be available at the tute.

Karen Macpherson
Lecturer
Faculty of Communication
Phone 201 2925 (work)
email: kjm@comserver.canberra.edu.au

............................................................
Signature of student

consent.doc
COMPUTER DATABASES AS A RESEARCH TOOL

This survey has been designed to help me gather information on students' knowledge of problem solving and search techniques. It is not a test, and you will not be penalised in any way if you do not know the answers.

Please answer all questions, and feel free to write any additional comments if you wish.

Your responses to this survey will be kept strictly confidential.

SECTION 1: Background Information
Please indicate your response to the following questions by either ticking the answer that applies to you, or by providing brief information where indicated.

1.1 Are you studying: □ Full-time □ Part-time

1.2 Faculty of Study: □ Applied Science □ Communication □ Education □ Environmental □ Information □ Management □ Design □ Science

1.3 Please state your academic major: ........................................

1.4 Your age group: □ Under 20 □ 20-22 □ 23-30
□ 31-40 □ 41-50 □ 51 or above

1.5 Your gender: □ Female □ Male

1.6 What is your highest existing academic qualification?
□ Year 12 in Australia □ Year 12 equivalent overseas in .......(Country)
□ TAFE qualification (please specify): ..............................................................
□ Undergraduate degree (please specify degree title and university attended)
□ Higher degree (please specify degree title and university attended)

1.7 About your research experience:
(a) Have you completed a library tour at Canberra University? □ Yes □ No
    If Yes, please state: (i) name and duration of course ........................................
    (ii) year undertaken: .................................................................

(b) Have you completed a library tour at school, or at any other university?
    □ Yes □ No
    If Yes, please state: (i) name and duration of course ........................................
    (ii) year undertaken: .................................................................

(c) Have you studied the unit Research Skills which is offered by the Faculty of Communication at this University? □ Yes □ No
    If Yes, please state year in which the unit was undertaken: ..............................
1.8 About your knowledge of electronic databases:

Have you ever used an electronic database to search for information?

☐ Yes ☐ No

If Yes, would you say that you have used such a database:

☐ Occasionally (once or twice)
☐ Sometimes (no more than several times a year)
☐ Regularly (several times a month)

1.9 About your experience with computers:

(a) Have you used a computer:

(tick more than one box if appropriate)

☐ At home
☐ At work
☐ At school
☐ Other (please specify) ........................................................... ...............

(b) In general, would you describe your ability to use a computer as:

☐ Poor
☐ Fair
☐ Good
☐ Excellent

(c) Do you enjoy using computers:

☐ Very much
☐ Quite a lot
☐ Not much
☐ I don't like using computers at all

SECTION 2: The multiple choice questions in this section allow you to indicate your current understanding of the terms used in electronic database retrieval.

Example:

Electronic databases are:

a. Collections of off-line databases stored on compact disc
b. A collection of electronic information databases, both full text and bibliographic, accessed by computer
c. Don't know

circle one answer for each of the questions below.

2.1 A database is:

a. A search field on a document
b. A search strategy
c. A computerised storehouse of indexes or information
d. I don't know
2.2 A database producer is:

a. A company searching databases
b. A company compiling databases
c. A company accessing databases
d. I don't know

2.3 Descriptors are:

a. Citations in an index
b. Search strategies
c. Subject terms used for a document or record
d. I don't know

2.4 A search topic is:

a. A research subject
b. A keyword
c. A list of descriptors
d. I don't know

2.5 Keywords are:

a. Steps in a search strategy
b. Commands used to enter a search
c. Phrases, terms, or concepts describing your search topic
d. I don't know

2.6 A search strategy is:

a. A method used to access a database
b. A plan used when doing a search
c. The results of a search
d. I don't know

2.7 Telling the computer to search for words beginning with specific letters or characters is called:

a. Truncation
b. Abbreviation
c. Search strategy
d. I don't know

2.8 What is the first step in a search strategy once you have identified your search topic?

a. Search the concept groups
b. Identify the concept groups
c. Combine the concept groups
d. I don't know
2.9 The terms OR, AND, and NOT, which are used to search related terms, are referred to as:

a. Index terms  
b. Keywords  
c. Logical connectors  
d. I don’t know

2.10 Look at the following search topic: DISCRIMINATION AGAINST THE HANDICAPPED. Which synonym would be a good choice to use for HANDICAPPED?

a. Disadvantaged  
b. Crippled  
c. Incompatible

2.11 Which logical connector would you use to limit a search term to a defined subject?

a. OR  
b. AND  
c. NOT

2.12 Identify the major concept for the following search topic: HEALTH HAZARDS OF UNDERGROUND WATER POLLUTION

a. Water pollution  
b. Hazards  
c. Underground

2.13 Truncation should be used when searching the term “discrimination”. Which form would you use?

a. DIS*  
b. DISCRIM*  
c. DISCRIMINAT*  
d. I don’t know

2.14 Look at the following search topic: DISCRIMINATION AGAINST THE HANDICAPPED. Which synonym would be appropriate for DISCRIMINATION?

a. Segregation  
b. Exclusion  
c. Both of the above
2.15 Identify the major concept that best describes the following subject: EFFECT OF TERRORISM ON AIR TRAVEL
   a. Effect
   b. Terrorism
   c. Air travel

2.16 Electronic databases:
   a. Contain all information available on any given topic
   b. Contain only well-researched and accurate information
   c. Can be used as a starting point for research
   d. b and c

2.17 The relevance of the information obtained from an electronic database should be evaluated by considering:
   a. The producer of the database
   b. The purpose for which you need the information
   c. How long it will take to obtain the information
   d. a and b

SECTION 3: The multiple choice questions in this section are about problem solving.

3.1 Suppose that you come home from university one afternoon and discover the laundry window is broken. Lying in the garden just near the window is the child next door’s cricket ball. There is a lot of glass under the window outside the house. When you go into the laundry, you see that the broom has fallen over and you pick it up.

Which one of the conclusions listed below can be drawn from the evidence?
   a. The cricket ball broke the window
   b. The child next door broke the window
   c. Nobody broke the window
   d. None of the above

3.2 Suppose that you are reading a magazine article about whether or not all children should be vaccinated against common infectious diseases. In the article there is a quote from a parent who believes vaccination should not be compulsory. They say, “I had all my vaccinations when I was a child, and I was always sick. We haven’t had our two-year-old daughter vaccinated, and she is very healthy. Vaccinations are a waste of time and money and expose children to unnecessary risks.”

The parent’s comments are:
   a. Proof that vaccination is unnecessary
   b. Suggestive that vaccination may be unnecessary
   c. An opinion which is based on limited evidence
   d. Fact
3.3 There are a number of electrical appliances operating at your house: microwave, dishwasher, washing machine, electric heaters etc. There is a thunderstorm raging outside. You turn on the television set and suddenly all the lights in the house go out.

Which of the following alternatives is not a possible cause of the blackout?

a. The distance between the television and the aerial
b. The electricity supply is insufficient for the needs of the house
c. Wiring in the television is faulty
d. The thunderstorm

3.4 Two different amounts of two materials were heated by the same heater. Material A reached 50°C sooner than material B. It may be concluded:

a. Material A is inclined to warm up faster than B
b. The boiling point of A is higher than the boiling point of B
c. The amount of A is smaller than the amount of B
d. None of the above conclusions can be drawn from the experiment

3.5 The government wants to contact all pharmacists, all dentists, and all parents in a town. Based on the following statistics, how many people must be contacted?

Complete the Venn diagram below to assist you.

- Pharmacists ........................................... 10
- Dentists ............................................. 5
- Parents .................................................. 3,000
- Pharmacists who are also dentists ............ 0
- Pharmacists who are parents .................... 7
- Dentists who are parents ........................ 3

Number of people who must be contacted

- a. 2,990
- b. 3,025
- c. 3,005
3.6 Last night you went out to dinner with several friends. This morning you woke up feeling ill. Which of the following statements is true?

a. There is no relationship between your illness and the dinner
b. Your illness was probably caused by something you ate
c. You would need more information in order to determine any relationship between your illness and the dinner

3.7 Suppose that recently you saw a film about a fictitious battle in World War II. In the film, the army has to capture a town, but all the roads leading to it are mined. The mines are set off only by very heavy vehicles. The hero of the film saves the day by ordering the invasion force to approach the town via several roads at the same time, using many small, lightweight vehicles to transport troops.

Now suppose that you read an article about a very effective new form of laser surgery which kills cancerous cells. Unfortunately, as the laser beam passes through healthy tissue surrounding the cancer, this healthy tissue is also destroyed. Do you think that this problem could be solved by:

a. Using chemotherapy instead of laser therapy
b. Using a rapid pulsing laser beam, instead of a continuous beam
c. Using lower strength lasers from a number of different angles simultaneously
d. Using the laser therapy only as a last resort

3.8 Two motorcyclists went straight and without stopping, from Sydney to Canberra (about 300 km). The first one rode faster than the second. The travel time of the first motorcyclist was a little over 3 hours. How long did the second motorcyclist take?

a. Less than three hours
b. More than three hours
c. It depends on the exact speed of the first motorcyclist
d. It is impossible to know

3.9 You have two cylindrical containers equal in height. Assume you pour some water into the first container and it is not filled. Now you take the same amount of water and pour it into the second container. The second container is certain to be completely filled if:

a. The diameter of the second container is larger than the diameter of the first one
b. The diameter of the second container is smaller than the diameter of the first one
c. The volume of the second container is smaller than the volume of the first one
d. It is impossible to know
SECTION 4: This is the final section in the survey.

4.1 Suppose you ask your tutor (a very knowledgeable person!) a question and after some thought s/he says, "I can't answer that question. Sometimes x is right, and sometimes y is right. It depends." Would you think that your tutor:

a. Knows the answer, but wants you to find it out yourself
b. Understands that the question is a complex one and realises that there is no one correct answer
c. Is uncertain of the answer, but doesn't want to sound ignorant
d. Doesn't understand the question

4.2 You have a part-time job to support your studies. For the last two weeks, a normally reliable person at work, Andrew, has been half an hour late every day. At the end of the second week of late arrivals, Andrew's supervisor, Jane, calls him into her office. Five minutes later Andrew leaves Jane's office, looking really angry - he has been fired.

In the light of the above information, do you think that:

a. Jane was right to fire Andrew
b. Both Andrew and Jane were at fault
c. Although both Andrew and Jane were at fault, Jane was definitely justified in firing Andrew
d. Determining who did or did not act correctly depends on the circumstances

4.3 In a lecture, your lecturer explains three different theories about the role of computers in society. Would you expect him or her to summarise the advantages and disadvantages of each theory, and then:

a. Tell you which theory is correct
b. Leave it up to you to decide which theory is best
c. Explain that all the theories are both correct and incorrect, and that it is up to you to decide which one is best
d. Tell you one of their own theories

4.4 You ask a librarian for information on a subject. S/he refers you to several sources. Does this indicate that

a. The librarian wants you to find the answer yourself
b. The librarian isn't sure of the right answer
c. There is nothing specific on your topic in the library
d. None of the above

Thank you for taking the time to complete this survey. Should you have any questions, please contact me.
Karen Macpherson, Lecturer, Faculty of Communication
Phone 201 2925; email: kjm@comserver.canberra.edu.au
COMMUNICATION INTERFACE 1
ASSESSMENT ITEM 1: INFORMATION RETRIEVAL

Due Date: Week 4, in tutorial

Your task: Using any of the databases available through the Electronic Research Library (ERL) server, search for information on the three topics listed on the back of this page. Articles retrieved should be highly relevant.

Deliverables: In your C11 tutorial in Week 4, you need to hand in:

1. This question sheet, with the details overleaf completed where requested.

2. For each topic, submit printouts of search results. Your printouts must include:
   (a) full citation and abstract for each record (full text not necessary); and
   (b) print out of the search history for each topic (select option to print search history when printing search results).

General Instructions: As the ERL server is accessed via CWIS (Campus Wide Information Service), you don't have to go to the Library to perform these searches; you can use any of the Building 10 PC labs.

You may use as many ERL databases as you wish (but don't use any others, eg. Uncover; Firstsearch; or other Internet sources).

A list of the ERL databases which may be used is attached.

Please contact me, not your tutor, should you have any questions regarding this assignment (email: kjm@comserver.canberra.edu.au phone and voicemail: 201 2925).

Karen Macpherson
March 1997
Search Questions


Search terms used: ........................................................................

Database(s) searched: .....................................................................

Evaluation of search success (please circle the response that best describes your satisfaction with the search results):

The records I retrieved from the search were:

Very useful  Quite useful  Not very useful  I couldn't find any useful information

Topic 2: The effectiveness of high altitude training for runners. Find four relevant articles published in 1996.

Search terms used: ........................................................................

Database(s) searched: .....................................................................

Evaluation of search success (please circle the response that best describes your satisfaction with the search results):

The records I retrieved from the search were:

Very useful  Quite useful  Not very useful  I couldn't find any useful information

Topic 3: What impact has the Information Superhighway had on Australian society? Find ten highly relevant articles from scholarly journals.

Search terms used: ........................................................................

Database(s) searched: .....................................................................

Evaluation of search success (please circle the response that best describes your satisfaction with the search results):

The records I retrieved from the search were:

Very useful  Quite useful  Not very useful  I couldn't find any useful information

Don’t forget: Print out search histories with your search results.
Database

You can narrow the list by looking for a term.

ERLserver

□ ABI/Inform

□ ABI/Inform with Fulltext 9/96-10/96
□ ABI/Inform with Fulltext 9/95-8/96
□ ABI/Inform with Fulltext 1/95-8/95
□ ABI/Inform with Fulltext 1994
□ ABI/Inform with Fulltext 1993
□ ABI/Inform with Fulltext 1992
□ ABI/Inform with Fulltext 1991
□ ABI/Inform with Fulltext 1985-1990

AUSTROM

□ AUSTROM:AEI August 1996
□ AUSTROM:AFPD August 1996
□ AUSTROM:AGIS August 1996
□ AUSTROM:ALISA August 1996
□ AUSTROM:APAIS August 1996
□ AUSTROM:ARCH August 1996
□ AUSTROM:ATI August 1996
□ AUSTROM:AUSPORT August 1996
□ AUSTROM:CINCH August 1996
□ AUSTROM:CSI August 1996
□ AUSTROM:DELTAA August 1996
□ AUSTROM:FAMILY August 1996
□ AUSTROM:MAIS August 1996

HERITAGE

□ HERITAGE:AHRR March 1996
□ HERITAGE:AUSCHRON March 1996
□ HERITAGE:CELIS March 1996
□ HERITAGE:ENDANGER March 1996
□ HERITAGE:EPIC March 1996
□ HERITAGE:MIHILIST March 1996
□ HERITAGE:MUSEUMS March 1996
□ HERITAGE:REEF March 1996
□ HERITAGE:STREAMLN March 1996

OTHER

□ Applied Science Index 10/83-8/96
□ CINAHL (R) 1982-8/96
□ Computer ASAP 1994-1995
□ Computer ASAP 1/96-11/96
□ ERIC 1992-6/96
□ Human Nutrition 1991-9/96
□ Human Nutrition 1982-1990

□ MEDLINE (R) 1/96-10/96
□ MEDLINE (R) 1995
□ MEDLINE (R) 1994
□ MEDLINE (R) 1993
□ MEDLINE (R) 1992
□ sociofile 1/74-6/96
□ SPORT Discus 1975-9/96
□ PsycLIT Journal Articles 1/90-9/96
□ PsycLIT Chapters & Books 1/87-9/96
□ SIAL: June 1996
□ SIAL(ILRS): June 1996

Select Databases
COMPUTER DATABASES AS A RESEARCH TOOL - PART 2

Your responses to this survey will be kept strictly confidential.

SECTION 1: Background Information
Please indicate your response to the following questions by ticking the answer that applies to you, and by providing brief information if necessary.

1.1 Have you completed any library tours this semester? ☐ Yes ☐ No
    If Yes, please tick which tour(s) you have completed:
    □ Electronic database demonstration
    □ WWW/Netscape
    □ Library tour and catalogue demonstration
    □ Other (please specify):

1.2 Have you started your Information Retrieval assignment yet? ☐ Yes ☐ No

SECTION 2: The multiple choice questions in this section are about electronic database retrieval.

Circle one answer for each of the questions below.

2.1 The electronic research library (ERL) is a group of databases which:
    a. Contains only well-researched and accurate information
    b. Is like a shopping mall, as each database is like a specialty shop
    c. Contains all the most recent articles available on a range of topics
    d. a and b

2.2 Keywords are:
    a. Steps in a search strategy
    b. Commands used to enter a search
    c. Phrases, terms, or concepts describing your search topic
    d. I don’t know

2.3 A search strategy is:
    a. A method used to access a database
    b. A plan used when doing a search
    c. The results of a search
    d. I don’t know
2.4 Telling the computer to search for words beginning with a specific letter "stem" is called:

a. Truncation  
b. Abbreviation  
c. Search strategy  
d. I don't know

2.5 Synonyms are important to use in developing a search strategy because:

a. American spelling is so common in databases  
b. Different people use different words to describe the same concept  
c. They provide a way to link concepts

2.6 Which of the following logical connectors widens the scope of a search?

a. OR  
b. AND  
c. NOT

2.7 Truncation should be used when searching the term "globalisation". Which form would you use?

a. globalise*  
b. global*  
c. globalisa*  

2.8 For the topic UFOs: FACT OR FICTION, which of the following search strategies would you try?

a. UFO OR unidentified flying objects AND evidence  
b. UFO AND fact OR fiction  
c. UFO AND unexplained phenomena AND evidence

2.9 For the topic SHOULD WE CLONE PEOPLE, which of the following search strategies would best address the question?

a. Cloning AND people AND technology  
b. Cloning AND humans OR people  
c. Cloning AND humans AND ethics

2.10 The relevance of the information obtained from an electronic database should be evaluated by considering:

a. The source of the article (journal or magazine)  
b. The purpose for which you need the information  
c. How long it will take to obtain the information  
d. a and b
2.11 Suppose you are researching an assignment that requires convincing evidence to be provided in support of your argument. You find a citation for an article on the topic, with the author stated as *Anonymous*. Would this suggest to you that the source of the article is:

a. An encyclopaedia  

b. A scholarly journal, possibly suitable for use in your research  

c. A magazine, possibly unsuitable for use in research

2.12 In the topic EFFECT OF WATER POLLUTION ON RECREATION IN THE AUSTRALIAN CAPITAL TERRITORY, which of the following is not a suitable search term?

a. Water  
b. Pollution  
c. Effect  
d. Recreation

SECTION 3: This is the last section of the survey. It is about problem solving, and refers to the following scenario:

An experiment was performed by Drs. E.E. Brown and M.R. Berry in the veterinary laboratory of the CSIRO in Canberra. The doctors were interested in what happens to ducklings that eat cabbage worms. Several cases had been reported to them in which ducklings had "mysteriously" died after being in cabbage patches containing cabbage worms.

Forty-four ducklings were divided into two equal groups. For a one-week period they were provided an approved diet for ducklings. All had this diet, except that one of the groups was provided something more: two cabbage worms daily per duckling. The condition of the ducklings at the end of the week was observed and is reported in the following table:

<table>
<thead>
<tr>
<th>Original no. of ducklings</th>
<th>Regular Diet (22 ducklings)</th>
<th>Regular Diet plus worms (22 ducklings)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Healthy</td>
<td>Sick</td>
</tr>
<tr>
<td>44</td>
<td>18</td>
<td>3</td>
</tr>
</tbody>
</table>

The doctors drew the conclusion that *cabbage worms are poisonous to ducklings.*
For questions 3.1 - 3.5 below, circle A, B or C according to the following system:

A. If true, this information supports the conclusion.
B. If true, this information goes against the conclusion.
C. This information neither supports nor goes against the conclusion.

Example:
The duckling experiment is repeated. The results are similar. ___ A B C

3.1 The experiment is repeated with younger ducklings than the ones used in the original experiment. At the end of the week, two of the regular diet ducklings are dead, and twenty of the worm diet ducklings are dead. ___ A B C

3.2 It is discovered that both groups of ducklings reached through their cages and drank water from a little ditch that ran past both cages. They drank practically no water out of the pans that were in the cages. The water in the ditch was ordinary water. ___ A B C

3.3 The experiment is repeated in New Zealand with twice as many ducklings. None of the ducklings die. At the end of the week, two of the regular diet ducklings are ill, and three of the worm diet ducklings are ill. ___ A B C

3.4 The experiment is repeated in England. At the end of the week, all of the worm fed ducklings are dead, and all of the regular fed ducklings are alive and healthy. But it is discovered that the man who handled the worms had been spraying fruit trees with arsenic and had carelessly transferred some arsenic to the feeding pan of the worm fed ducklings. Arsenic is a deadly poison. ___ A B C

3.5 It turns out that at the time of the original experiment a large oak tree was dropping acorns into the cages of the worm fed ducklings only. The effect of this kind of acorn on the health of ducklings is not known. ___ A B C

Thank you for taking the time to complete this survey.

Karen Macpherson, Lecturer, Faculty of Communication
Phone 201 2925; email: kjm@comserver.canberra.edu.au
INFORMATION RETRIEVAL

INDEX

Electronic research library is like a bank of filing cabinets

排水设计

INFORMATION RETRIEVAL

Jeans, Rebel

Avis & Robertson

David Jones

Gray's

Shopping Mall - lots of specialty shops

INFORMATION RETRIEVAL

Motion

Search Design

INFOM

Fulltext

Facts II

INFORMATION RETRIEVAL

Characteristics of scholarly journals:

- Articles:
  - are signed
  - are written by experts in the field
  - include author's position and institution
  - include references
  - may report new research or review past research
  - contain specialised language

- Journal:
  - often has plain cover
  - may be published by an assocn. or university press

Characteristics of magazines:

- Articles:
  - may be unsigned
  - may be written by someone outside the field
  - do not include references
  - are written for the general public

- Journal:
  - has slick cover
  - is widely distributed
INFORMATION RETRIEVAL

In electronic research libraries:

- CD-ROMs
- Online databases

You are here:

Networks

INFORMATION RETRIEVAL

INFORMATION RETRIEVAL

INFORMATION RETRIEVAL

INFORMATION RETRIEVAL

Analogies

Chunking plus or minus 2 - Miller 1956.

- Remembering sequences eg
  - ABCD -> try saying it backwards
  - Telephone numbers, eg when the number is changed
  - 02 857 3342
  - 02 777 7777

The greater your expertise, the larger the amount in each chunk eg: initially one chunk might be a whole line.

INFORMATION RETRIEVAL

Now think about computers and retrieval:

- They only retrieve what you tell them to...
- They identify a string of characters
- Learn to retrieve what you want, not only what you specified

INFORMATION RETRIEVAL

Students often have problems:

- Choosing synonyms
- Selecting databases
- Using truncation
- Spelling!
Communication Interface 1
3 March 1997

1. Introduction
- what the session will cover: introduction to types of resources for research with a focus on electronic databases
- other sessions available

2. Research strategy
- define terms, do background reading
- identify books: use OPAC - tells you what we have in the Library: what books, authors, journals, videos, etc.
- identify journal articles

3. How to identify articles in journals
- why should you use journal articles?
  - more current, more specific, report research
- you need to use an index: what is an index?
  - lists of journal articles by subject
  - Australian or international
  - print or electronic
- what will you find in an index?
  - citation (author, title, name of journal, volume & issue numbers, year, page numbers, and sometimes abstracts)
  - sometimes the full text of the article

5. Electronic indexes/databases
- 5 minute show about electronic databases and how to search them

6. Demonstration of ABI/Inform
- search topic: information technology in offices
- help and commands function keys, prompts on screen
- concepts: concept 1: information technology
  concept 2: offices
- display of result, marking and printing particular records

7. Summary
- research strategy:
- define terms, background reading
- identify books
- identify journal articles
  - use indexes - either print or electronic - to find articles in journals
Communication Interface 1

Introduction to research strategy with a focus on electronic databases
by Jane Hardy
ISD-Library

Student Training & Awareness sessions
- Library and Computer Centre tours
- demonstrations of OPAC catalogue
- Lab Familiarisation (Computer Centre)
- email
- World Wide Web
  - how to access and print lecture overheads
- Subject-based Electronic Database Demonstrations for Communication students - till Week 7

1. Define terms, do background reading
- use reference collection in Library on Level B
- search subject dictionaries and encyclopedias

2. Identify books
- use our catalogue (OPAC)
  - titles, authors, journals, subjects, etc.
- how do you use it?
  - attend demonstration in Library till Week 2
  - printed guide

3. Identify journal articles
- journal articles are more current, more focussed and report research
- need to use an index

What is an index?
- list of journal articles by subject
- Australian or international
- print or electronic
What will you find in an index?
- often only a citation
- author, title, name of journal, volume & issue numbers, year, page numbers and sometimes abstracts
- sometimes full text

**ELECTRONIC DATABASES**
an introduction

**Advantages of electronic databases**
- faster searching
- range of years
- combination of concepts
- some full text databases are available

**How can you access them?**
- all through the Electronic Database Network in the UC Library
- some through the STUDENT fileserver
- Electronic databases via the Internet
- some through the Internet via CWIS (using Netscape)

**How to start: plan your search**
- describe your topic
- decide on key concepts
- select KEYWORDS
- select a database

**How to select a database**
- Use the printed subject guide and printed alphabetical list of databases
- Information Desk staff will help you
**Searching Databases**

**Combining concepts**

- 'OR' operator
  - broadens a search result

- 'AND' operator
  - narrows/refines a search result

**Truncation**

- keyword stem + truncation symbol
  - e.g.: child* retrieves child, child's, children's...
  - in your results
  - NB: symbols do vary from database to database!

**Sample search**

- **Topic:** the impact of information technology in offices
- **Key concepts:** information technology, offices
- **Keywords:** information technology, office*
- **Database:** ABI/Inform full text
Sample search

Information technology

\(\Box\) and \(\Box\) or \(\Box\) not

office^

Finding a journal article

do a title search for the title of the journal on our catalogue (OPAC)

note the call number, go to the shelves and retrieve the issue you want

Finding a journal article

if it is NOT in our catalogue:
- check full text databases
  * ABILinform full text
  * Computer ASAP
  * BPO
- check Serials in Australian Libraries to see whether another ACT library holds the journal

HELP!!!

ASK STAFF AT THE INFORMATION DESK !!
INFORMATION RETRIEVAL - WORKSHEET

SEARCH TOPIC: ..................................................................................................................

SEARCH TERMS:

<table>
<thead>
<tr>
<th>CONCEPT A</th>
<th>CONCEPT B</th>
<th>CONCEPT C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SELECT DATABASE(S):

SEARCH STRATEGY:
1 ........................................................................................................
2 ........................................................................................................
3 ........................................................................................................
4 ........................................................................................................
5 ........................................................................................................

EVALUATION AND COMMENTS:
........................................................................................................
........................................................................................................
INFORMATION RETRIEVAL
An Introduction to the Electronic Research Library

Students often have problems with essential research techniques, such as deciding which databases to search, evaluating sources of information, and designing search strategies.

This handout provides some simple solutions to these problems.

1. Selecting databases

1.1 What is a database?

Although databases vary widely in content and complexity, essentially they are an electronic version of a card file. Examples of databases include client address information, stock inventories and payroll.

In the context of research, a database is an electronic index of journal articles, and is used in the same way as an index at the back of a book - if you are looking for a subject in a book, you would look for its page reference first in the index to save hours of random searching. When researching assignments, electronic indexes (databases) are a valuable method of identifying suitable articles, conference papers etc. on your topic.

Each database specialises in a particular subject, or group of subjects. The University of Canberra Library offers students access to over 100 such databases. The databases can be either “online” (accessed via networking to other computers, possibly overseas, e.g. Uncover, Firstsearch, Current Contents), or “offline” (the database is stored on compact discs, known as CD-ROMs, which may or may not have to be loaded into the computer terminal you are using, e.g Psychlit, Medline, ABI/Inform).
In addition to being able to access these databases from the Library, some of the databases can also be accessed at other sites around the University (for example, Building 10), via the Campus Wide Information Service (CWIS).

1.2 The Electronic Research Library

One very useful group of databases is available via the Electronic Research Library (ERL) server from both the Library, and through CWIS.

The ERL is like a bank of filing cabinets ......

...... or a shopping mall containing a wide variety of specialty shops.

2. Evaluating Sources

It is important to keep in mind that all articles listed on databases are not suitable for use in research for university assignments. Generally, useful articles
are found in so-called "scholarly" journals, for the reasons set out in Table 1 below.

Table 1: Comparison of Characteristics of Scholarly Journals and Magazines

<table>
<thead>
<tr>
<th>Characteristics of Scholarly Journals</th>
<th>Characteristics of Magazines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articles:</td>
<td>Articles:</td>
</tr>
<tr>
<td>- are signed (so you know who wrote them)</td>
<td>- may be unsigned (so you don’t know who wrote them)</td>
</tr>
<tr>
<td>- are written by experts in the field (so they are more likely to know what they are talking about than people who are not experts)</td>
<td>- may be written by someone outside the field (so you may not be able to rely on the information/opinion they provide)</td>
</tr>
<tr>
<td>- include author’s position and institution (eg Professor J. Jones, University of Sydney - another indicator of expert opinion)</td>
<td>- may not provide any information about the author</td>
</tr>
<tr>
<td>- include references (which are very useful as pointers to other related books and articles)</td>
<td>- do not include references (so you cannot evaluate source of statements/claims made)</td>
</tr>
<tr>
<td>- may report new research or review past research (which summarises important issues on the topic)</td>
<td></td>
</tr>
<tr>
<td>- contain specialised language (often listed in databases and can be used in searching)</td>
<td>- are written for the general public (and so may not contain sufficient detail for a piece of academic writing)</td>
</tr>
</tbody>
</table>

The journal itself:
- often has plain cover
- narrow distribution; may be published by an association or university press

The magazine itself:
- has a slick cover
- is widely distributed (there is of course nothing wrong with this, but often a publication designed for wide distribution will not contain convincing material for use, say, as evidence to support an argument in an essay)

Another important point to remember is that although they are very accessible, databases should not be viewed as the only source of information available. Journal articles alone (ie the main type of resource listed in research databases), although very useful, will usually be insufficient to provide information required; books, newspapers, videos, interviews etc. must also be considered.
3. Conducting a search

Researching an essay or other assignment topic is like solving a problem. You stand a better chance of a successful outcome if you approach it methodically.

Example search: “Should we clone people?”

Two very useful tools for planning a piece of research are the Clockface Diagram, and the Information Retrieval Worksheet (you may have seen one of these worksheets if you have attended a UC library tutorial). For the topic “Should we clone people?”, a clockface diagram of the topic could look like this:


The clockface sets out the sources which combine to form an effective piece of research. Titles of specific books, journals and other references can be written in as you go.

The second tool is the information retrieval worksheet - a very easy way to plan an electronic database search. The worksheet on page 5 has been completed for the topic “Should we clone people?”; explanations of the steps are set out on the back of the worksheet.

4. Summary

Two useful tools for structuring effective research are:

1. The clockface diagram, which helps you identify and keep track of relevant resources; and

2. The information retrieval worksheet, which makes it easier for you to analyse the research topic, identify search strategies and evaluate outcomes.

Karen Macpherson
1997
**INFORMATION RETRIEVAL - WORKSHEET**

**SEARCH TOPIC:** (1) **SHOULD WE CLONE HUMANS?**

**SEARCH TERMS:** (2)

<table>
<thead>
<tr>
<th>CONCEPT A</th>
<th>CONCEPT B</th>
<th>CONCEPT C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLONING</td>
<td>HUMANS</td>
<td>ETHICS (implied)</td>
</tr>
<tr>
<td>REPLICATION</td>
<td>PEOPLE</td>
<td>MORALS</td>
</tr>
<tr>
<td>COPYING</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SELECT DATABASE(S):** (3) `SOCFILE ; MEDLINE ;`

(also `YAHOO`, via `NETSCAPE`, not ERL server) ; others ?

**SEARCH STRATEGY:** (4)

1. `clon* AND human* AND ethic*`  \[ *= trancsh symbol \]
2. `replicat* AND people AND moral*`  \[ AND = Boolean logic \]
3. `others ?`
4. `combine results of sets 1 and 2 .`
5. ` `

**EVALUATION AND COMMENTS:** (5)

---

INFORMATION RETRIEVAL. An Introduction to the Electronic Research Library

© Karen Macpherson 1997
Explanatory Notes:

<table>
<thead>
<tr>
<th>(1) Search topic</th>
<th>Define the problem. Use encyclopaedia etc to define terms. What, exactly, is the question? Are all important issues clearly stated, or are some only implied? Restate the question in your own words.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Search terms</td>
<td>Generate solutions. Make list of search terms - divide into concepts. Identify synonyms (use a thesaurus); use Boolean operators AND, OR, NOT to combine terms that will achieve the desired result.</td>
</tr>
<tr>
<td>(3) Select database(s)</td>
<td>Select database(s) that are appropriate to topic. If you're not sure which to use, check catalogue in library which lists database names and the subjects they cover. It has an alphabetical listing of subjects at the back.</td>
</tr>
<tr>
<td>(4) Search strategy</td>
<td>List possible search strategies. Use truncation (stem of word and *) where necessary to make sure all possible word endings are retrieved. Check your spelling! (Also American spelling alternatives). Remember that an electronic database cannot make value judgments or decisions; it can only retrieve the exact string of characters (words) which you specify.</td>
</tr>
<tr>
<td>(5) Evaluation and comment</td>
<td>Conduct search using strategies and databases identified. Evaluate search results - how relevant are the articles? How recent? Scholarly publication? Can you obtain it? Do the results of the search provide enough information on the topic? If yes, search is concluded; if no, reformulate search and repeat the process.</td>
</tr>
</tbody>
</table>
### APPENDIX 10

**RATINGS SHEET - INFORMATION RETRIEVAL ASSIGNMENT**

*(Key)*

**A. SEARCH STRATEGY**

<table>
<thead>
<tr>
<th>Topic</th>
<th>No. of concepts</th>
<th>Inappropriate concepts</th>
<th>Dbs</th>
<th>Self eval. search success</th>
<th>No. of Synonyms</th>
<th>Truncation</th>
<th>No. of reformulations</th>
<th>Boolean operators</th>
<th>Suitable Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOPIC 1</td>
<td>count</td>
<td>R = relevant</td>
<td>count</td>
<td>correct=1</td>
<td>count</td>
<td>and=1</td>
<td>or=2</td>
<td>Y=1</td>
<td>N=2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I = irrel</td>
<td>incorrect=</td>
<td>2</td>
<td>not=3</td>
<td>&amp; or=4</td>
<td>&amp; not=5</td>
<td>&amp; not=6</td>
<td></td>
</tr>
<tr>
<td>TOPIC 2</td>
<td>T = total dbs</td>
<td>mixed=3</td>
<td>&amp; or, not=5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOPIC 3</td>
<td></td>
<td>not</td>
<td>used=4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. RETRIEVED ITEMS**

<table>
<thead>
<tr>
<th>Topic No.</th>
<th>Item No.</th>
<th>Source (rating)</th>
<th>Currency (rating)</th>
<th>Relevance (rating)</th>
<th>Search per Key</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Topic 1</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Topic 2</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Topic 3</strong></td>
</tr>
</tbody>
</table>

**Student comments**

1. Enjoyable
2. Learned something
3. Frustrating
4. Many hours
5. Computers unavailable
6. Webspirs down
7. More training necessary
8. Other

**KEY:**

0 = inadequate
1 = marginally adequate
2 = adequate
3 = good
4 = superior
COMPUTER DATABASES AS A RESEARCH TOOL

SURVEY 2

This survey has been designed to gather information on students' knowledge of search techniques. It is not a test, and you will not be penalised in any way if you do not know the answers.

Please answer all questions, and feel free to write any additional comments if you wish.

Your responses to this survey will be kept strictly confidential.

The 18 multiple choice questions in this survey allow you to indicate your current understanding of the terms used in electronic database retrieval.

For each of the questions, circle the one answer that you think is most correct.

Example:
Electronic databases are:
- a. Collections of off-line databases stored on compact disk
- b. A collection of databases, both full text and bibliographic, accessed by computer
- c. I don't know

1.1 Descriptors are:
- a. Citations in an index
- b. Search strategies
- c. Subject terms used for a document or record
- d. I don't know

1.2 A search topic is:
- a. A research subject
- b. A keyword
- c. A list of descriptors
- d. I don't know

1.3 Keywords are:
- a. Steps in a search strategy
- b. Commands used to enter a search
- c. Phrases, terms, or concepts describing your search topic
- d. I don't know
1.4 A search strategy is:
   a. A method used to access a database
   b. A plan formulated to conduct a search
   c. The results of a search
   d. I don’t know

1.5 Instructing the computer to search for words beginning with specific letters or characters is called:
   a. Truncation
   b. Abbreviation
   c. Search strategy
   d. I don’t know

1.6 What is the first step in a search strategy once you have identified your search topic?
   a. Search the concept groups
   b. Identify the concept groups
   c. Combine the concept groups
   d. I don’t know

1.7 Which logical connector would you use to combine the concepts discrimination AND handicapped ........... disadvantaged?
   a. AND
   b. OR
   c. NOT
   d. I don’t know

1.8 Which logical connector would you use to limit a search term to a defined subject?
   a. OR
   b. AND
   c. NOT
   d. I don’t know

1.9 Identify the major concept for the following search topic: health hazards of underground water pollution.
   a. Water pollution
   b. Hazards
   c. Underground
   d. I don’t know

1.10 Truncation should be used when searching the term discrimination. Which form would you use to narrow results?
   a. DIS*
   b. DISCRIM*
   c. DISCRIMINAT*
   d. I don’t know
1.11 Look at the following search topic: *discrimination against the handicapped*. Which synonym would be appropriate for *discrimination*?

a. Segregation  
b. Exclusion  
c. Neither of the above; both are aspects of discrimination, not synonyms  
d. I don’t know

1.12 Consider the search topic: *should the death penalty be re-introduced*? Which of the following groups of concepts best capture the nature of the topic?

a. death penalty, religion, behaviour  
b. re-introduction, death penalty, capital punishment  
c. criminal justice, law enforcement  
d. social values, capital punishment  
e. I don’t know

1.13 Electronic databases:

a. Contain all information available on any given topic  
b. Contain only well-researched and accurate information  
c. Can be used as a starting point for research  
d. None of the above  
e. I don’t know

1.14 The relevance of the information obtained from an electronic database should be evaluated by considering:

a. The journal in which the information is published  
b. The year in which the information was written  
c. The purpose for which you need the information  
d. a and c  
e. a, b and c

1.15 Which of the following databases would you use in order to find material suitable for researching an academic essay about *computers and society*?

a. ABI/Inform Fulltext and COMP:CIA (Popular Computing)  
b. COMP:CIA (Popular Computing)  
c. Sociological Abstracts/Sociofile  
d. None of the above  
e. I don’t know

1.16 Consider the topic: *Discuss the role of assertiveness in management*. Which one of the following articles appears to be least relevant as research for an essay?

1.17 Suppose you have to research the topic: *Cultural variations in nonverbal communication*. You use the search terms “variations AND communication” and you get 0 citations from a database on which you would have expected some information. Your next step would be:
   a. Change the search terms
   b. Conclude there is no relevant information in the database
   c. Change databases
   d. Change databases, and if no citations are found, conclude there is no relevant information in that database

1.18 Consider the search topic: *What impact has the Internet had on Australian society?* Which of the following groups of concepts best capture the nature of the topic?
   a. impact, Internet, Australian society
   b. Internet, society, Australia
   c. Telecommunications, Australia, impact
   d. I don’t know

---

Thank you for taking the time to complete this survey.
Karen Macpherson, Associate Lecturer, Division of Communication & Education
APPENDIX 12

OFFICE MANAGEMENT 3/4 1999
RESEARCH REPORT STAGE 1: LITERATURE SEARCH

Due Date: Tuesday, 4 May, 10.00 am, Week 10 (First Semester). Completed assignments should be put in your tutor's assignment box.

Assessment Weighting: Pass or Fail.

Your Task: Using any of the databases available through the Electronic Reference Library (ERL) server, search for information on the two topics listed on page 3 of this assignment sheet. For each topic, find five highly relevant journal citations.

Checklist of Deliverables: To gain a Pass grade, you need to hand in a complete assignment, which contains:

1. The question sheet on page 3 of this handout, with the details completed.

2. Printouts of your search results for both topics. You must include:
   (a) Printout of the search history for that topic.
   (b) Full citations and abstracts for five journal articles for that topic (full text not necessary). The articles should be no earlier than 1993.

3. Two 150 word summaries. For both topics, select the most relevant citation from the five you have printed, and obtain the full article. That is, obtain one article for topic 1, and one article for topic 2.

   For each of these two articles, write a summary in your own words that:
   • outlines what the article is about; and
   • explains its relevance to the search topic.

   At the top of each summary, include a full citation of the article, correctly formatted. Each summary should be no more than 150 words.

4. Copies of both articles you have summarised.

General Instructions:
As the ERL server is accessed via CWIS (Campus Wide Information Service), you don't have to go to the Library to perform these searches; you can use any of the Building 10 computer labs, or a computer off campus, through an internet service provider.

You may use as many ERL databases as you wish, but don't use any other sources, such as ERIC; Uncover; Firstsearch; or Internet.

A list of databases that may be used is on the next page.

Karen Macpherson
March 1999
Database

You can narrow the list by looking for a term.

Please do not select more than 8 Databases at any one time.

ERLserver

**AUSTROM (Australian databases)**
- AUSTROM:AEI (Education)
- AUSTROM:APFD (Policing)
- AUSTROM:AGIS (Law)
- AUSTROM:ALISA (Library & Info Science)
- AUSTROM:APAIS (Public Affairs)
- AUSTROM:ARCH (Architecture)
- AUSTROM:ATI (Tourism)
- AUSTROM:AUSPORT (Sport)
- AUSTROM:ARCH (Architecture)
- AUSTROM:ALISA (Library & Info Science)
- AUSTROM:APAIS (Public Affairs)
- AUSTROM:ARCH (Architecture)
- AUSTROM:ATI (Tourism)
- AUSTROM:AUSPORT (Sport)

**HERITAGE (Australian databases)**
- H&E:AHRR (Historic records)
- H&E:ARCH (Architecture)
- H&E:AUSCHRON (Current, hist. events)
- H&E:ELIXIR (Natural res., environment)
- H&E:ENDANGER (Endangered species)
- H&E:EPIC (Environment & planning)
- H&E:HERA (Australia's heritage)
- H&E:MILIST (Military history)
- H&E:REF (Great Barrier Reef)
- H&E:STREAMLN (Natural resources)

**Computers and Communications (Australia)**
- COMP:ARLIT (Archives & Records)
- COMP:ATIS (Telecommunications)
- COMP:CFIX (Communications Futures)
- COMP:CIA (Popular Computing)
- COMP:OMNCTD (Computer Training-Dist.)
- COMP:OMNCTR (Computer Training-Res.)

**Business Australia**
- BAOD:AATD (Accounting, Taxation)
- BAOD:AEM (Arts Management)
- BAOD:AIMMAT (Mgmt., Training)
- BAOD:GIBLIN (Econ., Finance, Mgmt.)
- BAOD:INTAX (International Tax)

**ABI/Inform**
- ABI/Inform Fulltext 1998/08-1998/11
- ABI/Inform Fulltext 1997/09-1998/07
- ABI/Inform Fulltext 9/96-8/97
- ABI/Inform Fulltext 9/95-8/96
- ABI/Inform Fulltext 1/95-8/95
- ABI/Inform Fulltext 1994
- ABI/Inform Fulltext 1993
- ABI/Inform Fulltext 1992
- ABI/Inform Fulltext 1991
- ABI/Inform Fulltext 1983-1990

**PsycLIT**
- PsycLIT 1987-1998
- PsycLIT 1996-1998/12
- PsycLIT 1993-1995
- PsycLIT 1988-1992
- PsycLIT 1981-1987
- PsycLIT 1967-1980
- PsycLIT 1887-1966

**Sports Discus databases**
- ATLANTES 1980-1996
- CATALOGUE DU MUSEE OLYMPIQUE HERACLES 1975-1997
- SPORT Discus 1975-698

**OTHER**
- AESIS Issue 2 1998
- AUSTRALIT August 1998
- Human Nutrition 1998/01-1998/12
- Human Nutrition 1982-1990
- Library and Information Science Abstracts
- MLA Bibliography 1981-1998/11
- MLA Bibliography 1963-1980
- sociofile 1974-1998/10
- SIAL Serials in Australian Libraries
- ILRS InterLibrary Resource Sharing DB
- TourCD

**Training databases - only samples**
- Training Database: PsycLIT
- Training Database: sociofile
- Training Database: SPORT Discus
- Training Database: MLA Bibliography
Your Tutorial Day and Time .................................................................
Your "nickname" (if you completed Survey in week 2)..........................
OR your ID number (if you did not complete Survey) .........................

SEARCH TOPICS

TOPIC 1:

“What impact has the Internet had on Australian society?”

Main concepts:..................................................................................
.................................................................................................

Possible databases: .........................................................................

How long (approximately) did it take you to find information on this topic?
(circle one answer below)

15 minutes  30 minutes  45 minutes  60 minutes  More than 60 Other (specify)

minutes

Did you encounter any technical problems when doing your searches?
(circle one answer below)

No  Yes  If yes, please specify ......................................................

---

TOPIC 2:

“If listening is more than just hearing or understanding as Bolton (1987) claims, what is it?”

Main concepts:.................................................................................. 
.................................................................................................

Possible databases: .........................................................................

How long (approximately) did it take you to find information on this topic?
(circle one answer below)

15 minutes  30 minutes  45 minutes  60 minutes  More than 60 Other (specify)

minutes

Did you encounter any technical problems when doing your searches?
(circle one answer below)

No  Yes  If yes, please specify ......................................................
COMPUTER DATABASES AS A RESEARCH TOOL

This survey has been designed to gather information on students' knowledge of problem solving and search techniques. It is not a test, and you will not be penalised in any way if you do not know the answers.

Please answer all questions, and feel free to write any additional comments if you wish.

Your responses to this survey will be kept strictly confidential.

SECTION 1
Please indicate your response to the following questions by ticking the answer that applies to you, or by providing the information where requested.

1.1 In what year were you born? .........................

1.2 Your gender: □ Female □ Male

1.3 What is your highest existing academic qualification?
□ Year 12 or final year high school in Australia, or Year 12 equivalent overseas
□ TAFE qualification
□ Undergraduate degree
□ Higher degree/postgraduate qualification
□ Other (please specify) .................................................................

1.4 Have you ever attended an electronic database demonstration at the University of Canberra library, or at any other university or college (for example, PsycLIT, Sports Discus)?............................................................... □ Yes □ No

1.5 Have you ever used an electronic database to search for information? ..................................................... □ Yes □ No

If Yes, would you say that you have used such a database:
□ Occasionally (once or twice)
□ Sometimes (for three or four assignments a year)
□ Quite often (several times a semester)
□ Regularly (several times a month)


Section 2 starts on the next page.
SECTION 2
The multiple choice questions in this section allow you to indicate your current understanding of the terms used in electronic database retrieval.

For each of the questions in this section, circle the one answer that you think is most correct.

Example:
Electronic databases are:
- a. Collections of off-line databases stored on compact disk
- b. A collection of databases, both full text and bibliographic, accessed by computer
- c. I don't know

2.1 Descriptors are:
- a. Citations in an index
- b. Search strategies
- c. Subject terms used for a document or record
- d. I don’t know

2.2 A search topic is:
- a. A research subject
- b. A keyword
- c. A list of descriptors
- d. I don’t know

2.3 Keywords are:
- a. Steps in a search strategy
- b. Commands used to enter a search
- c. Phrases, terms, or concepts describing your search topic
- d. I don’t know

2.4 A search strategy is:
- a. A method used to access a database
- b. A plan formulated to conduct a search
- c. The results of a search
- d. I don’t know

2.5 Instructing the computer to search for words beginning with specific letters or characters is called:
- a. Truncation
- b. Abbreviation
- c. Search strategy
- d. I don’t know
2.6 What is the first step in a search strategy once you have identified your search topic?
   a. Search the concept groups
   b. Identify the concept groups
   c. Combine the concept groups
   d. I don’t know

2.7 Look at the following search topic: discrimination against the handicapped. Which synonym would be a good choice to use for handicapped?
   a. Disadvantaged
   b. Crippled
   c. Disabled
   d. I don’t know

2.8 Which logical connector would you use to limit a search term to a defined subject?
   a. OR
   b. AND
   c. NOT
   d. I don’t know

2.9 Identify the major concept for the following search topic: health hazards of underground water pollution.
   a. Water pollution
   b. Hazards
   c. Underground
   d. I don’t know

2.10 Truncation should be used when searching the term discrimination. Which form would you use to narrow results?
   a. DIS*
   b. DISCRIM*
   c. DISCRIMINAT*
   d. I don’t know

2.11 Look at the following search topic: discrimination against the handicapped. Which synonym would be appropriate for discrimination?
   a. Segregation
   b. Exclusion
   c. Neither of the above; both are aspects of discrimination, not synonyms
   d. I don’t know

2.12 Consider the search topic: should the death penalty be re-introduced? Which of the following groups of concepts best capture the nature of the topic?
   a. death penalty, religion, behaviour
   b. re-introduction, death penalty, capital punishment
   c. criminal justice, law enforcement
   d. social values, capital punishment
   e. I don’t know
2.13 Electronic databases:
   a. Contain all information available on any given topic
   b. Contain only well-researched and accurate information
   c. Can be used as a starting point for research
   d. None of the above
   e. I don’t know

2.14 The relevance of the information obtained from an electronic database should be evaluated by considering:
   a. The journal in which the information is published
   b. The year in which the information was written
   c. The purpose for which you need the information
   d. a and c
   e. a, b and c

2.15 Which of the following databases would you use in order to find material suitable for researching an academic essay about computers and society:
   a. ABI/Inform Fulltext and COMP:CIA (Popular Computing)
   b. COMP:CIA
   c. Sociological Abstracts
   d. None of the above
   e. I don’t know

2.16 Consider the topic: Discuss the role of assertiveness in management. Which one of the following articles appears to be least relevant as research for an essay?
   b. Buchanan and Smith (1999) Supervisors and recruits: closing the gap in communication through assertiveness, Computerworld, page 9

2.17 Suppose you have to research the topic: Cultural variations in nonverbal communication. You use the search terms “variations AND communication” and you get 0 citations from a database on which you would have expected some information. Your next step would be:
   a. Change the search terms
   b. Conclude there is no relevant information in the database
   c. Change databases
   d. Change databases, and if no citations are found, conclude there is no relevant information in that database
SECTION 3
The multiple choice questions in this section are about problem solving. Circle the one answer you think is most correct.

3.1 Suppose that you come home from university one afternoon and discover the laundry window is broken. Lying in the garden just near the window is the child next door's cricket ball. There is a lot of glass under the window outside the house. When you go into the laundry, you see that the broom has fallen over near the window and you pick it up.

Based on the evidence, which one of the conclusions listed below is most likely?
   a. The cricket ball broke the window
   b. The child next door broke the window
   c. The broom broke the window
   d. None of the above

3.2 There are a number of electrical appliances operating at your house: microwave, washing machine, electric heaters etc. There is a thunderstorm raging outside. You turn on the television set and suddenly all the lights in the house go out.

Which of the following alternatives is not a likely cause of the blackout?
   a. The distance between the television and the aerial
   b. The electricity supply is insufficient for the needs of the house
   c. Wiring in the television is faulty
   d. The thunderstorm
   e. I don't know

3.3 Assume that you are doing a science experiment. You have a small tank of water, into which you place two objects of equal volume but different mass. One of the objects floats and the other sinks. Which of the following conclusions is true?
   a. The sink or float phenomenon does not depend on the type of liquid
   b. The sink or float phenomenon does not depend on the type of liquid alone
   c. The sink or float phenomenon depends on the mass of the objects
   d. I don't know

3.4 Suppose that you are reading a magazine article about whether or not all children should be vaccinated against common childhood diseases. In the article there is a quote from a parent who believes vaccination should not be compulsory. They say, "I had all my vaccinations when I was a child, and I was always sick. We haven't had our two-year-old daughter vaccinated, and she is very healthy. Vaccinations are a waste of time and money and expose children to unnecessary risks." The parent's comments are:

   a. Proof that vaccination is unnecessary
   b. Suggestive that vaccination may be unnecessary
   c. An opinion which is based on limited evidence
   d. Fact
   e. I don't know
3.5 The government wants to contact all pharmacists, all dentists, and all parents in a town. Based on the following statistics, how many people must be contacted? Use the Venn diagram below to assist you, if you wish.

- Pharmacists ............................................10
- Dentists ................................................5
- Parents ..................................................3,000
- Pharmacists who are also dentists...............0
- Pharmacists who are parents......................7
- Dentists who are parents ..........................3

Number of people who must be contacted:
- a. 2,990
- b. 3,025
- c. 3,005

3.6 Suppose that you have been employed by a small accountancy firm at Kingston to manage their office. They need a new printer to produce correspondence; the office prints approx. 100 pages per week. For tax purposes, the printer will be replaced in two years.

You find out some details about a laser printer. Which piece of information listed below is not relevant to your decision whether or not to buy this particular printer?
- a. Toner cartridges cost $50 each and are replaced every 1,000 pages
- b. Printer drum needs replacing every three years
- c. Printer drums cost $250
- d. Maintenance costs $25 per year
- e. I don't know

3.7 Every day on your way to and from university you travel along the same 10 kms of road. On each one-way journey, you go through five sets of traffic lights. As you are an observant person, you notice that when you are travelling to university in the afternoon for evening lectures, the traffic lights remain green for a shorter time than they do when you are travelling to university in the morning for early lectures. You decide that this is regulated by:
- a. The number of students attending university
- b. An analysis of traffic flows for the city
- c. The number of people living in nearby suburbs
- d. None of the above
- e. I don't know
3.8 Suppose that recently you saw a film about a fictitious battle in World War II. In the film, the army has to capture a town, but all the roads leading to it are mined. The mines are set off only by very heavy vehicles. The hero of the film saves the day by ordering the invasion force to approach the town via several roads at the same time, using many small, lightweight vehicles to transport troops.

Now suppose that you read an article about a very effective new form of laser surgery that kills cancerous cells. Unfortunately, as the laser beam passes through healthy tissue surrounding the cancer, this healthy tissue is also destroyed. Do you think this problem could be solved by:

a. Using chemotherapy instead of laser therapy
b. Using a rapid pulsing laser beam, instead of a continuous beam
c. Using lower strength lasers from a number of different angles simultaneously
d. Using the laser therapy only as a last resort
e. I don't know

3.9 Two motorcyclists went straight and without stopping, from Sydney to Canberra (about 300 km). The first one rode faster than the second. The travel time of the first motorcyclist was a little over 3 hours. How long did the second motorcyclist take?

a. Less than three hours
b. More than three hours
c. It depends on the exact speed of the first motorcyclist
d. It is impossible to know

3.10 You have two cylindrical containers equal in height. Assume you pour a certain amount of water into the first container and it is not filled. Now you take the same amount of water and pour it into the second container. The second container will be completely filled:

a. If the diameter of the second container is larger than the diameter of the first one
b. If the diameter of the second container is smaller than the diameter of the first one
c. If the volume of the second container is smaller than the volume of the first one
d. It is impossible to know

The last five questions in this Survey refer to the following scenario:

An experiment was performed by Drs. E.E. Brown and M.R. Berry in the veterinary laboratory of the CSIRO in Canberra. The doctors were interested in what happens to ducklings that eat cabbage worms. Several cases had been reported to them in which ducklings had "mysteriously" died after being in cabbage patches containing cabbage worms.

Forty-four ducklings were divided into two equal groups. For a one-week period they were provided an approved diet for ducklings. All had this diet, except that one of the groups was provided something more: two cabbage worms daily per duckling. The condition of the ducklings at the end of the week was observed and is reported in the following table:
The doctors drew the conclusion that cabbage worms are poisonous to ducklings.

For questions 3.11 –3.15 below, circle A, B or C according to the following system:

A  If true, this information supports the conclusion.
B  If true, this information goes against the conclusion.
C  This information neither supports nor goes against the conclusion.

Example:

The duckling experiment is repeated. The results are similar.  

3.11 The experiment is repeated with younger ducklings than the ones used in the original experiment. At the end of the week, two of the regular diet ducklings are dead, and twenty of the worm diet ducklings are dead.  

3.12 It is discovered that both groups of ducklings reached through their cages and drank water from a little ditch that ran past both cages. They drank practically no water out of the pans that were in the cages. The water in the ditch was ordinary water.  

3.13 The experiment is repeated in New Zealand with twice as many ducklings. None of the ducklings die. At the end of the week, two of the regular diet ducklings are ill, and three of the worm diet ducklings are ill.  

3.14 The experiment is repeated in England. At the end of the week, all of the worm fed ducklings are dead, and all of the regular fed ducklings are alive and healthy. But it is discovered that the man who handled the worms had been spraying fruit trees with arsenic and had carelessly transferred some arsenic to the feeding pan of the worm fed ducklings. Arsenic is a deadly poison.  

3.15 It turns out that at the time of the original experiment a large oak tree was dropping acorns into the cages of the worm fed ducklings only. The effect of this kind of acorn on the health of ducklings is not known.
APPENDIX 14

MODULE: EXPERIMENTAL TREATMENT, WEEK 6

Information Retrieval

Electronic Reference Library

+ What it is
+ What it isn't
+ The search process
+ Problem solving

What it is ....

Electronic reference library is like a bank of filing cabinets.

Each drawer is like a different database.

Just Jones
Retail Sport
Angus & Robertson
David Jones
K Mart
Grace Bros
Target

Maidline
SPORT Dossier

退休
Fulltext
Computer
PsychLit
ASAP

Shopping Mall - lots of specialty shops

ERL is like a shopping mall; each db like a specialty shop

Electronic reference library

CD-ROMs offline (SPORT Dossier)

You are here

online (Uncover)

Human Information storage and retrieval

Networks

Collins & Quillen 1988
What it can do ....

Now think about computers and retrieval...

- computers identify a string of characters -
  complex pattern matching routine
- they only retrieve what you tell them to ...
- learn to retrieve what you want,
  not only what you specified

During the search process ....

Students sometimes have problems

- deciding what the question is
- choosing synonyms (what are they?)
- combining terms; using truncation (why? how?)
- selecting databases (which ones are relevant?)
- spelling!
- determining relevance/significance of articles

General problem-solving heuristic

- Define the problem - state it clearly
- Generate solutions - consistent with goals
- Evaluate and select alternatives - systematically
- Decide if you have solved the problem

Problem solving and information retrieval

1. Define problem (question) - restate in own words;
   look for implied terms or concepts - what is the
   question really asking?
Information Retrieval

Neural network model

OUTPUT

Ethics question

LTM units activated simultaneously

Working memory

INPUT

Should we clone humans?

Problem solving and information retrieval cont.

2. Generate solutions (formulate search strategy) - compile list of search terms; keywords; use Boolean operators; truncation; select appropriate databases; list possible strategy reformulations

3. Evaluate and select alternatives - how relevant is the article? how recent? scholarly? available?

4. Evaluate overall search - is the question answered, or do you need to reformulate?

Information processing model - conducting a search (Macpherson, 1994)

Read & interpret question

Network

Develop search strategy

Is question understood?

No

Yes

Redefine question

Implement search

Assess search outcome

"Clockface" diagram

Evaluate sources of information....

Characteristics of scholarly journals:

Articles:
- are signed
- are written by experts in the field
- include author's position and institution
- include references
- may report new research or review past research
- contain specialised language

Journal cover:
- often has plain cover
- may be published by an assocn. or university press

Evaluate sources cont....

Characteristics of magazines

Articles:
- may be unsigned
- may be written by someone outside the field
- do not include references
- are written for the general public

Cover:
- has slick cover
- is widely distributed

Page 3
Evaluating relevance of material located

- How old is it?
  - Current?
  - Classic? Analytically, that should be included?
- Who wrote it?
  - Credible? Expert in field? A rest, is it well researched and written?
- What's the source
  - Journal or monograph, monograph; how long is it?
    - Essential: include some of this
- What is it about?
  - How does it fit with your topic?
  - What are conclusions? And are they valid generalisable?
  - Is the article or book highly relevant to your topic, or marginal?
- How useful is it?
  - Supports/argues against/neutral of your position or other sources
  - Clarifies points, expands background, shows direction of current research

Information Retrieval

Electronic Reference Library - summary

- What it is - a group of bibliographic databases by subject
- What it isn't - the answer to all your research prayers
- The search process - iterative, sequential
- Problem solving - useful approach to research
MODULE: CONTROL TREATMENT, WEEK 6

Information Retrieval
- Assignment
- Electronic Reference Library
- Sample search
- Your own searches

"Clockface" diagram

Indexes
- Usually citations
- Can be print or electronic; electronic not necessarily most current

Electronic Reference Library
- A group of indexes - databases
- Can select years to search; fast
- Not all documents listed are necessarily available
- Can access from building 10, Library or off-campus

Searching with the ERL
- Look at search question and decide on concepts
- Choose a database (index) that you think should be relevant (printed catalogue in library)
- Use the concepts from your research question to search for information

Combining concepts
- Boolean operators: AND, OR, NOT
- AND limits search
- NOT excludes certain information
- OR widens search
Truncation
- Allows retrieval of different word endings
- Using a word stem followed by a *
- Eg manage* - management; manager

Sample search:
high altitude training for runners
- Concepts: altitude, training
- Keywords: altitude, train*
- Database: Sport Discus
- Run search
- Save and print results
- Obtain articles - check library catalogue
- Some databases are full-text eg ABI-Inform

Exercises
Assume a management context.
Perform the following searches on ABI-Inform:
- "teambuilding in the workplace"
- "interpersonal communication skills and management"
- "conflict resolution in the workplace"
INFORMATION RETRIEVAL - WORKSHEET

SEARCH TOPIC: ........................................................................................................
........................................................................................................................................

SEARCH TERMS:

<table>
<thead>
<tr>
<th>CONCEPT A</th>
<th>CONCEPT B</th>
<th>CONCEPT C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SELECT DATABASE(S):
........................................................................................................
........................................................................................................................................

SEARCH STRATEGY:
1 .................................................................................................................................
2 .................................................................................................................................
3 .................................................................................................................................
4 .................................................................................................................................
5 .................................................................................................................................

EVALUATION AND COMMENTS:
.................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
How good is the evidence?

A US study "shows evidence that modern boxers suffer brain damage from their sport. The researchers contacted by telephone 23 former boxers who:

1. Were aged 25 to 60 years,
2. Were currently residing in the New York area,
3. Had not retired from boxing for medical, neurological, or psychiatric reasons,
4. Were retired from boxing for at least one year before the study,
5. Had no known history of neurological, psychiatric, or serious medical illness, and
6. Had no known history of drug or alcohol abuse.

Eighteen former boxers volunteered to participate. The group included two former professional champions and three highly ranked professional contenders, and only one former fighter was primarily a "slugger"; all others were considered to be scientific, artful fighters who practiced self-defence.

Each boxer underwent neurological examinations, a CAT scan of the brain (a measure of atrophy), an electroencephalogram (EEG), and neuropsychological testing. The researchers found evidence of brain damage on at least two of the measures in 13 of the 15 professional boxers, and evidence of subtle brain damage in the three amateur boxers. The authors concluded that brain damage is a frequent result of a career in professional boxing."


Read this article and discuss the evidence with the people in your group. List your comments in the space below.

---

fdkmod doc
DISCUSSION

How good is the evidence?

A US study "shows evidence that modern boxers suffer brain damage from their sport [what does the word "modern" mean? From 1900 on, or last decade?] The researchers contacted by telephone 23 [not a very large sample] former boxers who:

1. Were aged 25-60 years [how many of them were, say, 60? If many were that old, how representative is the sample?]

2. Were currently residing in the New York area [very concentrated sample; affects how generalisable are results; could only really generalise findings to that population; not to say, US overall, or Australia, Turkey etc]

3. Had not retired from boxing for medical, neurological, or psychiatric reasons [how do we know? Is that what the boxers said? Could you expect them to be honest? Was self-reported information cross-referenced with medical records? If so, are ethical considerations mentioned?]

4. Were retired from boxing for at least one year before the study [some might have retired 30 years ago, and never boxed since, some might have boxed for only one or two years; does time boxed and time elapsed since boxing stopped affect the chain of reasoning that researchers are trying to use to show cause-effect between boxing and brain damage?]

5. Had no known history of neurological, psychiatric, or serious medical illness [how is it "known"; define "serious"; how carefully was this checked? Again, was this information obtained from the boxers? Could you really expect them to say "yes, I've been in and out of psychiatric institutions for the past ten years"]?

6. Had no known history of drug or alcohol abuse [ditto question 5; also, if they had such a history and it wasn't known, could these also be variables that would influence the development of brain damage?]

Eighteen former boxers volunteered to participate [motivation may be a factor; were they paid?]. The group included two former professional champions and three highly ranked professional contenders, and only one former fighter was primarily a "slugger" [please! Define professional; slugger; who made these judgements? The boxers? A boxing authority?]; all other were considered [by whom?] to be scientific, artful fighters who practiced self-defence [is this supposed to make a difference to the dangers of boxing? Are the researchers implying that if you're an artful
fighter it doesn’t do so much damage when you’re hit? Sounds like an unstated assumption].

Each boxer underwent neurological examinations, a CAT scan of the brain (a measure of atrophy \[\text{atrophy} = \text{wasting}\], and electroencephalogram (EEG), and neuropsychological testing \[\text{are we to assume these are the appropriate tests to measure brain damage? How do we know? Who else says so?}\]. The researchers found evidence \[\text{how is this evidence quantified? How much evidence?}\] of brain damage on at least two of the measures \[\text{how do we know that evidence on “at least two” of these measures is sufficient to warrant the conclusions that have been drawn?}\] in 13 of the 15 professional boxers, and evidence of subtle \[\text{what do they mean by “subtle?”}\] brain damage in the three amateur boxers. The authors concluded that brain damage is a frequent result of a career in professional boxing \[\text{What other factors may cause such damage - alcohol, Alzheimer’s etc; How are we to know whether other people - non-boxers - would show similar “brain damage” or “subtle” damage at the same age? Not enough information given - a comparison (control) group of people of same age range would make a stronger case; so would a sample taken from other areas that New York. Much more information is need on sample parameters - age, years since last boxed, etc. maybe most people aged 50-60 have some measurable brain atrophy etc}\].


\[\text{note: this is from a credible source; the full article may address a number of the issues we have raised. However - be aware that disbelief should not be suspended; not all research is rigourously conducted; conclusions are not always justified; methodology may not be appropriate etc}\]

The conclusion drawn by the researchers is not justified given the faults in methodology. The conclusion should be worded more tentatively. Ask a student to rephrase the conclusion so that it is more acceptable, something along the lines of “This study may suggest a relationship between boxing and brain damage, but further research is required, using a larger, random sample, a control group, and with intervening variables such as age, and drug and alcohol abuse controlled”.


OFFICE MANAGEMENT 3/4
RESEARCH REPORT STAGE 1: LITERATURE SEARCH
ASSESSMENT SHEET

Student: ................................................
Tute Day and Time: Wed 9.30 Wed 11.00 Thurs 9.30 Thurs 5.00 Fri 10.30

Students please note: this assessment sheet is intended to help you to improve your information retrieval effectiveness. Please discuss comments with your tutor should you have any queries.

TOPIC ONE
1. Correct concepts identified
   (Basic concepts: Internet, Australia, society)
2. Words used incorrectly as concepts: ..........................................
3. Synonyms used
   Yes/No
4. Relevant databases accessed
<table>
<thead>
<tr>
<th>Database</th>
<th>Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sociofile/Sociological abstracts</td>
<td></td>
</tr>
<tr>
<td>ABI/Inform</td>
<td></td>
</tr>
<tr>
<td>AUSTROM:Family</td>
<td></td>
</tr>
</tbody>
</table>
5. Use of truncation
<table>
<thead>
<tr>
<th>Method</th>
<th>Correct</th>
<th>Incorrect</th>
<th>Some correct, some incorrect</th>
<th>Not used</th>
</tr>
</thead>
</table>
6. Boolean operators other than default “and” used
   Yes/No
7. Search strategies correct
   Yes Usually No
8. Number of databases accessed (all years of a database eg ABI/Inform counted as one): 1 2 3 4 5 6 7 8 9 10 other (specify) .......
9. Number of search strategy reformulations used
   Yes/No
10. Number of abstracts submitted
    Source of article: scholarly, credible = appropriate for use in academic research (* see note bottom page 2) Article topic “highly relevant” to research question
    | Abstract | Yes/No | Yes/Marginal/No |
    |----------|--------|-----------------|
    | 11.      |        |                 |
    | 12.      |        |                 |
    | 13.      |        |                 |
    | 14.      |        |                 |
    | 15.      |        |                 |

About the article summary:
16. Is article recent (1993 or later)
   Yes No
17. Is article from credible source
    Yes No
18. Is article relevant to topic
    Yes Marginal No
19. Is citation correct
    Yes No - minor errors No - major errors
20. Length of summary
    Acceptable Not acceptable: long/short
21. Summary includes important information, (eg aims, brief method, conclusions)
    Yes No Main problems:
    Yes No
22. Relevance to topic made clear
    Yes No
23. Appropriate writing style

Lit Search Marking Guide
**TOPIC TWO**

1. Correct concepts identified  
   (Basic concepts: listening, understanding, communicating)  
   
2. Words used incorrectly as concepts:  
   .................................................  

3. Synonyms used  
   
4. Relevant databases accessed  
   PsycLIT  
   Sociological abstracts  
   ABI/Inform  

5. Use of truncation  
<table>
<thead>
<tr>
<th>Correct</th>
<th>Incorrect</th>
<th>Some correct, some incorrect</th>
<th>Not used</th>
</tr>
</thead>
</table>

6. Boolean operators other than default "and" used  
   Yes/No  

7. Search strategies correct  
   Yes  
   Usually  
   No  

8. Number of databases accessed (all years of a database eg ABI/Inform counted as one):  
   1 2 3 4 5 6 7 8 9 10 other (specify)  

9. Number of search strategy reformulations used  
   

10. Number of abstracts submitted  
    

<table>
<thead>
<tr>
<th>Source of article: scholarly, credible = appropriate for use in academic research (<em>see note below</em>)</th>
<th>Article topic “highly relevant” to research question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes/No</td>
<td>Yes/Marginal/No</td>
</tr>
<tr>
<td>Yes/No</td>
<td>Yes/Marginal/No</td>
</tr>
<tr>
<td>Yes/No</td>
<td>Yes/Marginal/No</td>
</tr>
<tr>
<td>Yes/No</td>
<td>Yes/Marginal/No</td>
</tr>
<tr>
<td>Yes/No</td>
<td>Yes/Marginal/No</td>
</tr>
<tr>
<td>Yes/No</td>
<td>Yes/Marginal/No</td>
</tr>
<tr>
<td>Yes/No</td>
<td>Yes/Marginal/No</td>
</tr>
</tbody>
</table>

11. Abstract 1  
12. Abstract 2  
13. Abstract 3  
14. Abstract 4  
15. Abstract 5  

**About the article summary:**  

16. Is article recent (1993 or later)  
17. Is article from credible source  
18. Is article relevant to topic  
19. Is citation correct  
20. Length of summary  

<table>
<thead>
<tr>
<th>Is citation correct</th>
<th>Yes</th>
<th>No− minor errors</th>
<th>No− major errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Main problems:**  

21. Summary includes important information, (eg aims, brief method, conclusions)  
22. Relevance to topic made clear  
23. Appropriate writing style  

*Students please note:* if an abstract does not relate to an article written for an academic journal or other credible “scholarly” source, the article is usually not appropriate material for university assignments, even if it does sound relevant to the topic. For example, short articles written for business magazines are usually not suitable because authors are often not experts in the field under discussion; the material is not covered in sufficient detail to be of use; and the material is not based on properly conducted research.

**General comments:**

Lit Search Marking Guide