No Restrictions
Applying cognitive load theory concepts to the design and evaluation of CBL materials and feedback in teaching introductory accounting

Abdel Karim Halabi

Bachelor of Business (Accounting)
Graduate Diploma in Education (Secondary)
Graduate Diploma in Business (Accounting)
Master of Accounting

Thesis submitted to the Monash University in fulfillment of the conditions for the degree of Doctor of Philosophy

Department of Accounting and Finance
Monash University
Australia

April, 2004
Publications from this research

The following are the list of publications emanating from this research. The list includes the percentage contribution of other authors. The majority of the work has been completed by the first named author. The other authors have mainly provided valuable feedback on various aspects of the work including methodology and interpretations, and also extensions to the actual thesis work.

Referred journals


Contribution by J. E. Tuovinen, 20%; by K. X. Smyrnios, 5%

Referred conference proceedings


Contribution by J. E. Tuovinen, 25%
Presentations at international referred conferences


Presented by A. K. Halabi: Contribution by K. X. Smyrnios, 15%

**Halabi, A.K., & Tuovinen, J. E.** (2001). Designing better CBL than face-to-face tutoring by incorporating teacher-like feedback and guidance. Paper presented at the 7th World Conference on Computers in Education (WCCE), Copenhagen, Denmark, July.

Presented by J. E. Tuovinen: Contribution by J. E. Tuovinen, 25%


Presented by A. K. Halabi: Contribution by J. E. Tuovinen, 20%

Presented by A. K. Halabi: Contribution by J. E. Tuovinen, 20%; by A. A. Farley 5%.


Presented by A. K. Halabi: Contribution by J. E. Tuovinen, 15%; by A. A. Farley 5%.

Paper accepted for publication

Halabi, A. K., Tuovinen, J. E., & Farley, A. A. Empirical evidence on the relative efficiency of worked examples versus problem solving exercises for an introductory accounting topic. Accepted for future publication in Issues in Accounting Education.

Contribution by J. E. Tuovinen, 10%; by A. A. Farley 10%.

Paper completed, but not yet submitted

Halabi, A. K., Tuovinen, J. E. A cognitive investigation: When is feedback germane or redundant in CBL?

Contribution by J. E. Tuovinen, 20%.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Publication/Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publications from this research</td>
<td>i</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>iv</td>
</tr>
<tr>
<td>List of Tables</td>
<td>x</td>
</tr>
<tr>
<td>List of Figures</td>
<td>xiii</td>
</tr>
<tr>
<td>List of Appendices</td>
<td>xv</td>
</tr>
<tr>
<td>Teaching and research grants awarded from this research</td>
<td>xx</td>
</tr>
<tr>
<td>Abstract</td>
<td>xxi</td>
</tr>
<tr>
<td>Statement of Authorship</td>
<td>xxiii</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>xxiv</td>
</tr>
<tr>
<td>Dedication</td>
<td>xxv</td>
</tr>
</tbody>
</table>

## CHAPTER 1: INTRODUCTION

1

## CHAPTER 2: LITERATURE REVIEW

6

2.1 Introduction                                                                 6

2.2 Section A: Cognitive load theory                                             6

2.2.1 Cognitive architecture                                                     6

2.2.1.1 Sensory memory                                                          6

2.2.1.2 Working memory                                                          7

2.2.1.3 Long term memory                                                         7

2.2.2 Cognitive load theory                                                      7

2.2.3 Schema formation and automation                                           9

2.2.4 Types of cognitive load                                                    10

2.2.5 Methods of reducing extraneous cognitive load                             11

2.2.5.1 Problem solving                                                          11

2.2.5.2 Worked examples                                                          12

2.2.5.3 Completion problem effect                                                15

2.2.5.4 Split attention effect                                                   15

2.2.5.5 Redundancy effect                                                        16
2.2.5.6 Prior knowledge and instructional design ........................................... 17
2.2.6 Measurement of cognitive load ................................................................. 17
  2.2.6.1 Techniques to measure cognitive load .................................................. 18
  2.2.6.2 Instructional efficiency ................................................................. 20
  2.2.6.3 Calculating instructional efficiency .................................................... 21
2.2.7 Summary of cognitive load theory ............................................................ 23

2.3 Section B: Feedback research ................................................................. 25
  2.3.1 Introduction .................................................................................................. 25
  2.3.2 Feedback research .................................................................................. 25
  2.3.3 The function of feedback ....................................................................... 26
  2.3.4 Forms of feedback .................................................................................. 27
    2.3.4.1 Praise feedback ............................................................................... 29
  2.3.5 Modes of feedback .................................................................................. 30
    2.3.5.1 Face-to-face feedback ..................................................................... 30
    2.3.5.2 Feedback in printed material ......................................................... 30
    2.3.5.3 Feedback from Computer-Based Learning (CBL) materials ............. 31
  2.3.6 Advantages of CBL feedback ................................................................. 32
  2.3.7 Factors influencing feedback in CBL materials ....................................... 33
    2.3.7.1 Verification or elaboration feedback in CBL materials ..................... 33
      2.3.7.1.1 Verification feedback in CBL materials ....................................... 35
    2.3.7.2 Feedback and student achievement levels ......................................... 36
    2.3.7.3 Feedback and timing ...................................................................... 37
  2.3.8 Summary of feedback research ............................................................... 38

2.4 Section C: CBL use in accounting education .............................................. 40
  2.4.1 Introduction .................................................................................................. 40
  2.4.2 History of computers and accounting education ....................................... 40
  2.4.3 History of CBL use in accounting education ........................................... 42
  2.4.4 Advantages of CBL materials in accounting education ............................ 42
  2.4.5 Evaluating the effectiveness of CBL in accounting education ................. 44
    2.4.5.1 Evaluation based on performance ..................................................... 44
    2.4.5.2 Evaluation based on student attitude ............................................... 50
2.4.5.3 Evaluation based on cost ................................................. 51
2.4.6 Future research in the use of CBL with accounting education ...... 52
2.4.7 Summary of CBL use in accounting education .......................... 52

2.5 Section D: Linking cognitive load theory, feedback research and CBL use in accounting education .......................................................... 54

2.5.1 Introduction ............................................................................ 54
2.5.2 Cognitive aspects of learning ................................................ 54
  2.5.2.1 Mental effort ..................................................................... 54
    2.5.2.1.1 Mental effort and feedback research ......................... 55
    2.5.2.1.2 Mental effort and accounting research .................... 56
  2.5.2.2 Prior knowledge ............................................................... 57
    2.5.2.2.1 Prior knowledge and feedback research ................. 57
    2.5.2.2.2 Prior knowledge and accounting research ............ 58

2.5.3 Accounting education students and cognitive load theory .......... 59
2.5.4 Accounting education and feedback forms .............................. 60

2.6 Chapter summary ....................................................................... 61

CHAPTER 3: DESIGNING AND DEVELOPING THE CBL MATERIALS 63
3.1 Introduction ................................................................................ 63
3.2 Issues in developing the CBL materials ..................................... 63
3.3 Designing the CBL materials with hypertext generated by the Toolbook authoring language .......................................................... 65
3.4 The CBL material and how the feedback worked ....................... 66
  3.4.1 Question types developed by the CBL material .................. 66
3.5 Evaluating the CBL material ...................................................... 70
3.6 Chapter summary ....................................................................... 71

CHAPTER 4: METHODOLOGY ................................................................ 72
4.1 Introduction to the methodology employed ............................... 72
  4.1.1 Overview of individual studies ......................................... 72
4.2 Reliability and Validity in designing the CBL material and feedback ...... 73
4.3 Similar prior studies ................................................................. 73
  4.3.1 CBL use in accounting education studies ...................... 74
4.3.2 Cognitive load theory studies and the Paas & van Merriënboer (1993) seminal study ................................................................. 75
4.4 Addressing reliability in the present study ........................................ 76
4.5 Addressing internal and external validity in the present study ............ 77
4.6 Chapter summary ........................................................................... 79

CHAPTER 5: STUDY 1 – THE EFFECTIVENESS OF FEEDBACK AND CBL MATERIALS WHEN USED BY ACCOUNTING DISTANCE EDUCATION STUDENTS AS MEASURED BY ATTITUDE AND PERFORMANCE .......................................................... 80

5.1 Introduction .................................................................................. 80
  5.1.1 Study materials for distance education students ........................ 80
5.2 Background .................................................................................. 81
5.3 Aims and Hypotheses .................................................................... 83
5.4 Method .......................................................................................... 86
  5.4.1 Instruments ............................................................................... 86
    5.4.1.1 Materials used ................................................................. 87
  5.4.2 Procedure ................................................................................ 87
    5.4.2.1 CBL Material .................................................................. 87
    5.4.2.2 The Computer-Based Learning Evaluation Questionnaire (CBLEQ) ................................................................. 88
  5.4.3 Participants .............................................................................. 89
5.5 Results and Analysis .................................................................... 89
  5.5.1 The CBLEQ – Section (a) Questions relating to all study material .................................................................................. 89
  5.5.2 The CBLEQ – Section (b) Questions relating to the CBL material .................................................................................. 93
  5.5.3 Hypothesis testing ................................................................... 95
    5.5.3.1 Summary of Hypotheses H1 – H16 ..................................... 100
  5.5.4 Qualitative Analysis ................................................................ 101
  5.5.5 Measuring effectiveness of the CBL material by examining performance .............................................................................. 102
5.6 Discussion .................................................................................... 105
  5.6.1 Limitation ............................................................................... 107
CHAPTER 6: STUDY 2 – THE EFFICIENCY OF TWO ALTERNATIVE FORMS OF CBL MATERIALS (PROBLEM SOLVING VERSUS WORKED EXAMPLES) FOR STUDENTS WITH DIFFERING PRIOR KNOWLEDGE

6.1 Introduction ................................................. 112
6.1.1 Designing the CBL material for Study 2 ............... 112
6.2 Aim and Hypotheses ........................................ 115
6.3 Method ......................................................... 118
6.3.1 Instruments ................................................ 118
6.3.1.1 Materials used ........................................ 119
6.3.2 Procedure .................................................. 119
6.3.3 Participants ............................................... 121
6.4 Results and Analysis ....................................... 123
6.4.1 Student attitude to the CBL material .................... 127
6.4.2 Comparisons between CBL in the problem solving format and CBL in the worked examples format .......... 129
6.5 Discussion .................................................... 138
6.5.1 Evaluation of performance ............................. 138
6.5.2 Evaluation based on cognitive load theory principles .. 139
6.5.3 Limitations ............................................... 141
6.5.4 Areas for future research ................................ 142
6.6 Summary of Study 2 ....................................... 143

CHAPTER 7: STUDIES 3 AND 4 – COMPARISON OF PROBLEM SOLVING AND WORKED EXAMPLES CBL WITH RICH OR BASIC FEEDBACK

7.1 Introduction .................................................. 145
7.1.1 Review of feedback research ............................ 146
7.1.2 Designing the CBL material for Studys 3 and 4 .......... 147
7.2 Problem solving CBL Study 3 - Aim and Hypotheses ...... 149
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Table details</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>The verification and elaboration outcomes of the different feedback forms</td>
<td>29</td>
</tr>
<tr>
<td>2.2</td>
<td>Summary of CBL material use in accounting education and comparisons of effectiveness</td>
<td>49</td>
</tr>
<tr>
<td>5.1</td>
<td>Topics, question and feedback types for CBL materials prepared for accounting distance education students</td>
<td>83</td>
</tr>
<tr>
<td>5.2</td>
<td>Frequencies (percentages) of using all the study material supplied to introductory accounting distance education students</td>
<td>90</td>
</tr>
<tr>
<td>5.3</td>
<td>Mean (standard deviations) rankings of most useful study material</td>
<td>91</td>
</tr>
<tr>
<td>5.4</td>
<td>Mean (standard deviations) and median ratings of the usefulness of study material</td>
<td>92</td>
</tr>
<tr>
<td>5.5</td>
<td>First choice, and mean ranking (standard deviations) of the most useful question type in the CBL materials</td>
<td>94</td>
</tr>
<tr>
<td>5.6</td>
<td>Summary of hypothesis and supporting Pearson Chi-Squared tests for Hypothesis H1 – H4</td>
<td>96</td>
</tr>
<tr>
<td>5.7</td>
<td>Summary of hypothesis and supporting Pearson Chi-Squared tests for Hypothesis H5 – H8</td>
<td>97</td>
</tr>
<tr>
<td>5.8</td>
<td>Summary of hypothesis and supporting Pearson Chi-Squared tests for Hypothesis H9 – H12</td>
<td>98</td>
</tr>
<tr>
<td>5.9</td>
<td>Summary of hypothesis and supporting Pearson Chi-Squared tests for Hypothesis H13 – H16</td>
<td>99</td>
</tr>
<tr>
<td>5.10</td>
<td>Final performance by marks of students by CBL use, CBL non use, and where CBL use is not known</td>
<td>103</td>
</tr>
<tr>
<td>6.1</td>
<td>Total participants by gender, mean age, standard deviation, and prior knowledge of accounting</td>
<td>122</td>
</tr>
<tr>
<td>6.2</td>
<td>Diagnostic test mean scores and standard deviation scores of the CBL material and face-to-face teaching groups</td>
<td>123</td>
</tr>
</tbody>
</table>
6.3 Diagnostic test mean and standard deviation scores for three exercises
groups ........................................................................................................... 124
6.4 Diagnostic test mean and standard deviation scores for both CBL types
versus face-to-face, based on prior accounting studies ............................... 125
6.5 Diagnostic test mean scores and standard deviations for the three
exercise groups, based on prior accounting studies .................................... 126
6.6 Mean and standard deviations of student opinion on the CBL material... 128
6.7 Diagnostic test mean scores and standard deviations for the two CBL
types, based on prior accounting studies ................................................... 129
6.8 Effort mean and standard deviations based on the two CBL groups,
and prior accounting studies ....................................................................... 131
6.9 Multiple comparisons (post hoc Scheffe tests) on the relationships
between total effort, effort for the first three adjustments, and effort for
the next five adjustments based on prior accounting knowledge .............. 134
6.10 Mean and standard deviations (SD) of instructional efficiency
measures based on the two CBL groups, and prior accounting studies ....... 135
6.11 Multiple comparisons (post hoc Scheffe tests) on the relationships
between instructional efficiency for the two CBL types based on prior
accounting knowledge .................................................................................. 136
7.1 Diagnostic test mean scores and standard deviations of the problem
solving CBL material with rich or basic feedback ....................................... 153
7.2 Mean effort and standard deviations to complete the problem solving
CBL material exercises with rich or basic feedback ..................................... 154
7.3 Mean Z scores and standard deviations for test marks, effort, and
instructional efficiency for problem solving CBL ....................................... 155
7.4 Diagnostic test mean and standard deviation scores of the worked
examples CBL material with rich or basic feedback ..................................... 160
7.5 Mean effort (and standard deviations) to complete the worked
examples CBL material exercises with rich or basic feedback by the
first three, next five and total transactions ............................................... 162
7.6 Mean Z scores and standard deviations for test marks and effort, and instructional efficiency for worked examples CBL

162
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Figure details</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Three individual topic areas related to this thesis</td>
<td>1</td>
</tr>
<tr>
<td>2.1</td>
<td>The relationship between cognitive architecture and cognitive load theory</td>
<td>8</td>
</tr>
<tr>
<td>2.2</td>
<td>High and low instructional efficiency based on effort and performance...</td>
<td>21</td>
</tr>
<tr>
<td>2.3</td>
<td>Instructional efficiency conditions based on measures of performance and effort.</td>
<td>23</td>
</tr>
<tr>
<td>2.4</td>
<td>The areas of interest within the cognitive load theory topic</td>
<td>24</td>
</tr>
<tr>
<td>2.5</td>
<td>The areas of interest within the feedback research topic</td>
<td>39</td>
</tr>
<tr>
<td>2.6</td>
<td>The area of interest within the CBL use in accounting education topic....</td>
<td>53</td>
</tr>
<tr>
<td>2.7</td>
<td>Linking the areas of cognitive load theory, feedback research and CBL use in accounting education, and the focus of the investigations that follow</td>
<td>62</td>
</tr>
<tr>
<td>5.1</td>
<td>Mean marks by different semesters</td>
<td>105</td>
</tr>
<tr>
<td>6.1</td>
<td>Test mean scores by level of prior knowledge for CBL problem solving (PS), CBL worked examples (WE) and face-to-face instruction (FtoF)</td>
<td>126</td>
</tr>
<tr>
<td>6.2</td>
<td>Marks in the test by CBL type (Problem solving or Worked examples) and prior knowledge</td>
<td>129</td>
</tr>
<tr>
<td>6.3</td>
<td>Instructional efficiency measures examining the most efficient instructional design</td>
<td>137</td>
</tr>
<tr>
<td>7.1</td>
<td>The CBL used in Studies 3 and 4, based on prior knowledge of the subject</td>
<td>147</td>
</tr>
<tr>
<td>7.2</td>
<td>Test mean scores of the problem solving CBL material with rich (PS Rich) or basic (PS Basic) feedback</td>
<td>153</td>
</tr>
<tr>
<td>7.3</td>
<td>Instructional efficiency of problem solving CBL with rich and basic feedback</td>
<td>155</td>
</tr>
</tbody>
</table>
7.4 Test mean scores of the worked examples CBL material with rich or basic feedback ................................................................. 161
7.5 Instructional efficiency of worked example CBL with rich and basic feedback ........................................................................... 163
<table>
<thead>
<tr>
<th>App.</th>
<th>Appendix details</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A screen shot where a blackboard was used to resemble a face-to-face teaching situation</td>
<td>185</td>
</tr>
<tr>
<td>2.</td>
<td>An example of a multiple choice question</td>
<td>186</td>
</tr>
<tr>
<td>3.</td>
<td>An example of an incorrect choice of the multiple choice question, where the correct answer is then provided</td>
<td>187</td>
</tr>
<tr>
<td>4.</td>
<td>An example of the screen layout where a correct multiple choice is made</td>
<td>188</td>
</tr>
<tr>
<td>5.</td>
<td>An example of the screen layout of the true / false question</td>
<td>189</td>
</tr>
<tr>
<td></td>
<td>- An example of the screen layout of the true / false question and the feedback where the correct answer is provided</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td>- An example of the screen layout of the true / false question and the feedback where the incorrect answer is provided</td>
<td>191</td>
</tr>
<tr>
<td>6.</td>
<td>An example of a higher order learning question seeking application competence (complete)</td>
<td>192</td>
</tr>
<tr>
<td>7.</td>
<td>An example of a higher order learning question seeking knowledge competence (&quot;Re-examine&quot;)</td>
<td>193</td>
</tr>
<tr>
<td>8.</td>
<td>Screen shot of a theory type question when a correct response was made (feedback contained verification and task specific elaboration)</td>
<td>194</td>
</tr>
<tr>
<td>9.</td>
<td>Screen layout and feedback where a correct response is made to a theory question</td>
<td>195</td>
</tr>
<tr>
<td>10.</td>
<td>Screen shot of Appendix 8 when an incorrect response was made (feedback contained verification and extra instructional elaboration)</td>
<td>196</td>
</tr>
<tr>
<td>11.</td>
<td>Screen layout and feedback of Appendix 9 where an incorrect response is made to a theory question</td>
<td>197</td>
</tr>
<tr>
<td>12.</td>
<td>An example of the screen layout to complete the initial balance day adjustment general journal entry</td>
<td>198</td>
</tr>
<tr>
<td>13.</td>
<td>An example of the screen layout to complete the adjusted trial balance</td>
<td>199</td>
</tr>
</tbody>
</table>
14. Screen shot used to introduce the practical Topic of “closing the accounts” ................................................................. 200

Second screen shot to introduce the practical Topic of “closing the accounts” ................................................................. 201

Screen shot and feedback when an incorrect response is made in the practical Topic of “closing the accounts” ................................................................. 202

Screen shot and feedback when a correct response is made in the practical Topic of “closing the accounts” ................................................................. 203

Screen shot used to introduce the second part of the practical topic “closing the accounts” ................................................................. 204

15. A copy of the Centre for Computers in Teaching Initiatives - Accounting, Finance and Management (CTI - AFM) CBL evaluation checklist ................................................................. 205

16. The screen layout (with the types of questions) at the beginning of Topic 1 – The Accounting Profession ................................................................. 214

17. The screen layout (with the types of questions) at the beginning of Topic 2 – Basic Concepts ................................................................. 215

18. The screen layout (with the types of questions) at the beginning of Topic 4 – Changes in Owners Equity ................................................................. 216

19. The screen layout (with the types of questions) at the beginning of Topic 5 – Adjusting Entries and Deferrals ................................................................. 217

20. The screen layout (with the types of questions) at the beginning of Topic 6 – Accruals ................................................................. 218

21. The screen layout (with the types of questions) at the beginning of Topic 7 – Closing the Accounts ................................................................. 219

22. The screen layout (with the types of questions) at the beginning of Topic 8 – Computerised Accounting Systems ................................................................. 220

23. The screen layout (with the types of questions) at the beginning of Topic 9 – Australian Corporations Law ................................................................. 221

24. The screen layout (with the types of questions) at the beginning of Topic 10 – Financial Analysis of Companies ................................................................. 222
25. Copy of the Student Computer-Based Learning Evaluation Questionnaire (CBLEQ) used in Study 1 ................................................................. 223
26. Study Guide used for the Introductory Accounting A unit with the instructions for loading and using the CBL materials ........................................ 226
27. An example of a question and answer that was provided in printed format (see Appendix 14 for the question provided in CBL format) .... 236
28. Study 1 timetable for completing the required semesters work for Introductory Accounting A ................................................................. 238
29. Letter sent out with the CBLEQ used in Study 1 ........................................... 239
30. Comparison of two similar screen shots used in Study 1 and Study 2, noting the changes in the Toolbook authoring software versions .... 241
31. - An example of a screen shot used in Study 2 with verification and elaboration feedback (elaboration not attribute isolation). The verification in this instance is knowledge of correct response. .......................... 245
   - An example of a screen shot used in Study 2 with verification and elaboration feedback (elaboration not attribute isolation) ................... 246
32. An example of a screen shot where students are not able to proceed until all entries have been verified as correct (used in Study 2) .......... 247
33. The first screen shot to introduce the topic balance day adjustments used in Study 2 ........................................................................ 248
34. - The first screen display of the instructions to complete the problem solving CBL exercise in Study 2 ................................................ 249
   - The second screen display of the instructions to complete the problem solving exercise in Study 2 .................................................... 250
35. - The first screen display of the instructions to complete the worked examples exercise in Study 2 ...................................................... 251
   - The second screen display of the instructions to complete the worked examples exercise in Study 2 ................................................. 252
36. - First screen shot of the first worked examples adjustment used in Study 2. ................................................................................. 253
- Second screen shot of the first worked examples adjustment used in Study 2. ................................................................. 254
- Third screen shot of the first worked examples adjustment used in Study 2. ................................................................. 255
- Fourth screen shot of the first worked examples adjustment used in Study 2. ................................................................. 256

37. A screen shot where students must complete the problem solving exercise information (compare this to the third screen shot for the worked examples CBL in Appendix 36). ................................................................. 257

38. A copy of the handout used on the face-to-face control group in Study 2, which included the same information completed by the CBL material groups .................................................................................................................. 258

39. The student questionnaire and introductory letter to students regarding Study 2. ................................................................. 259

40. The evaluation and recording of the effort during learning when completing the problem solving CBL material used in Study 2. .......... 262

41. The evaluation and recording of the effort during learning when completing the worked examples CBL material used in Study 2. .......... 266

42. The diagnostic test used in Study 2. ................................................................. 270

43. The introductory lecture on balance day adjustment used for Study 2, Study 3 and Study 4 ........................................................................ 274

44. The consent form used in Study 2 ........................................................................ 283

45. Solutions to the diagnostic test used in Study 2 ................................................................. 284

46. - The variation in the answer until correct with rich feedback used in Studies 3 and 4 where after three tries the answer is provided (screen 1, first incorrect response) ................................................................. 285
    - The variation in the answer until correct with rich feedback used in Studies 3 and 4 where after three tries the answer is provided (screen 2, second incorrect response) ................................................................. 286
- The variation in the answer until correct with rich feedback used in Studies 3 and 4 where after three tries the answer is provided (screen 3, final incorrect response and provision of the correct answer). ............... 287

47. - The variation in the answer until correct with basic feedback used in Study 3 where after three tries the answer is provided (screen 1, first incorrect response) ........................................................................................................ 288

- The variation in the answer until correct with basic feedback used in Study 3 (screen 2, second incorrect response) .................................................. 289

- The variation in the answer until correct with basic feedback used in Study 3 (screen 3, final incorrect response, and provision of the correct answer) ........................................................................................................ 290

48. Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback................................. 291

49. The student questionnaire and introductory letter to students regarding Studies 3 and 4 ........................................................................................................... 304

50. Evaluation of the effort to complete the CBL problem solving material used in Study 3 ........................................................................................................... 308

51. The diagnostic test used in Studies 3 and 4. .................................................. 312

52. The consent form used in Studies 3 and 4 ...................................................... 316

53. Solutions to the diagnostic test used in Studies 3 and 4 .............................. 317

54. Evaluation of the effort to complete the CBL worked examples material used in Study 4 ........................................................................................................... 318

xix
Teaching and research grants awarded from this research

Halabi, A., & Harrington, G., $15,000. Awarded by the Monash University College Gippsland School of Business to develop computer-based learning material for distance education students in Financial Accounting.

Halabi, A., & Smyrnios, K., $2,250 awarded by the Faculty of Economics and Commerce Research Committee at Monash University for the project "First-year distance education students' perceptions on the effectiveness and usefulness of computer-based learning material".

Halabi, A., & Smyrnios, K., $1,600 awarded by the Monash University Gippsland Campus Research and Development Committee for the project "Distance education student perceptions on the Effectiveness of computer-based learning material developed for first-year Accounting".
Abstract

This thesis draws on three theoretical topics to examine the effectiveness, efficiency and use of in-house developed Computer-Based Learning (CBL) materials for an introductory accounting subject.

The three theoretical topic areas related to this thesis are cognitive load theory, feedback research, and the use of CBL materials in accounting education. Drawing on these three topics, the thesis examines the effectiveness of CBL materials as a teaching method in accounting, and then the most efficient instructional design of various CBL formats, as measured using the instructional efficiency procedures derived from cognitive load theory. The thesis also applies cognitive load theory principles to investigate the instructional efficiency of different forms of feedback used within the CBL materials. The major educational issues to be examined in this thesis include the benefit for schema and procedural capacity development in accounting education from employing CBL with different designs, and with various types of feedback.

In this thesis, four studies were employed to examine the effectiveness and efficiency of the in-house developed CBL materials. Effectiveness of the CBL material was initially analyzed in Study 1 by student attitude, and by comparing the performances of CBL material users to groups of non CBL users. The next three studies extend the extant feedback research and CBL use in accounting education literature by measuring the efficiency of the CBL materials and the feedback. The instructional efficiency measure adopted is derived from the well-established cognitive load theory paradigm, where efficiency is determined by an output measure of performance and an internal measure of student effort during learning.

The thesis contributes to the existing literature in all three theoretical topics. The instructional efficiency measures from the cognitive load theory have not previously been applied to the accounting education area, or to the use of CBL materials in accounting. Further, the instructional efficiency measure has not been applied to examine various
forms of feedback in CBL materials. This thesis makes a further contribution to the literature by examining the efficiency of different CBL designs, and different forms of feedback are examined from the important cognitive perspective of a student’s prior knowledge of the accounting subject.

The results from the studies show that CBL materials with feedback are an effective way to teach accounting, and that different CBL designs and feedback forms are more efficient for students with different prior knowledge in accounting.
Statement of Authorship

Except for any works and materials produced by other persons and organisations, which have been duly acknowledged and cited in this thesis, all the works and materials contained herein are the original works and materials of the author.

This thesis including any works or materials in whole or in part, has not previously been submitted for the award of any other degree, diploma, or any other qualification in any other academic institution.

Signed: ____________________________________________

Abdel Karim Halabi

Date: 22/04/04
Acknowledgements

I would like to thank my main Monash University supervisor Professor Alan Farley for his support and assistance in this thesis. I would also like to thank my co-supervisor Dr. Juhani Tuovinen from Charles Darwin University. Juhani has spent a great deal of time with me discussing many issues and has always given me his time, enabling a good friendship to develop and continue. Finally, I would like to acknowledge the assistance of Professor Kosmas Smyrnios for his initial supervisory work.

In developing the CBL material, I would like to thank Geoff Harrington, who worked with me very closely to bring out my teaching style in the comments and feedback. In later versions, I was also assisted by Michael Calagaz. Further, I would like to thank the students for participating in the studies, and for providing their feedback.

I thank Monash University for providing me with the initial teaching grant and the two follow-up research grants to investigate the CBL material. Monash University also allowed me an extended period of leave with which to complete this thesis, and provided financial assistance to attend conferences.

Finally, I would like to thank Beatrice Faust for reading the final version of this manuscript, and Jenny Young who assisted with the final layout and the figures and tables which appear in the thesis.
Dedication

I dedicate this thesis to my wonderful parents. Indeed I have been blessed.
CHAPTER 1
INTRODUCTION

This thesis relates the well-established cognitive load theory to the development and use of Computer-Based Learning (CBL) materials with feedback for introductory accounting education. Cognitive load theory is a subset of cognitive psychology, and cognitive aspects of learning have been a growing area of research both in the feedback and accounting education research literature. Cognitive load theory has been beneficial in many areas of learning, particularly in designing and measuring the efficiency of instructional techniques, and this thesis will apply aspects of cognitive load theory to the development and use of CBL materials with feedback in an introductory accounting subject. This thesis encompasses three theoretical topics, and individually these are portrayed in Figure 1.1.

Cognitive load theory has a history dating back to the 1980s (see Sweller, 1988; Sweller, van Merriënboer & Paas, 1998); feedback research dates back at least to the second decade of the twentieth century (Thorndike, 1913a), while CBL materials have been used in accounting education since the 1970s (see McKeown, 1976). The three

As reported by Bryant and Hunton (2000) there has been some controversy involving terminology related to technology used in education. For example the terms CAI (computer assisted instruction), CBI (computer based instruction) and CAL (computer assisted learning) have all been used to describe educational applications of computer technology. Because CBL (Computer-Based Learning) appears to be gaining in popularity and is considered more general, “CBL” is used throughout this thesis. While Bryant and Hunton (2000) note that CBL is a broad category encompassing many subcategories of computing technology, the Computer-Based Learning (CBL) materials in the context of this thesis refers to computer teaching material used for tutorial assistance. In this instance the CBL material provides teaching support, instruction, assistance and feedback after the students have made a response.
topics continue to be widely researched (for example for cognitive load theory, see Paas, Tuovinen, Tabbers & Van Gerven, 2003; for feedback research see Mason & Bruning, 1999; and for CBL and accounting education see Lane & Porch, 2002), and are therefore topical areas of interest, notwithstanding their established histories.

In Chapter 2, the important theoretical aspects of each topic area presented in Figure 1.1 are reviewed. From these three broad topic areas, the focus of the present study is narrowed. The major issues in the present thesis with respect to cognitive load theory are the ways cognitive load may be reduced to promote efficient learning, and measuring the efficiency of the instructional materials. In the feedback research topic area, the focus of the present thesis is on the different types of feedback, and feedback used in a CBL materials context. Finally, with regards to the CBL used in accounting education topic area, the focus of the present study is on evaluating CBL as a teaching technique. While there is a significant body of research on the broad topics discussed above, this thesis adds to the existing literature by establishing links not previously examined across all three topics.

Established links exist between feedback research, and CBL materials used in accounting education, with the feedback provided in CBL materials being of major benefit (Rawlingson & Sangster, 1992; Sangster, 1992a; 1992b; Togo & McNamee, 1995; Jensen & Sandlin, 1992; McInnes, Pyper, Van Der Meer & Wilson, 1995; McCourt Larres & Radcliffe, 2000; Lane & Porch, 2002). While the there have been some links between cognitive aspects of learning and general feedback research (see reviews by Dempsey, Driscoll & Swindell, 1993; Mason & Bruning, 1999), and cognitive aspects of learning have also been linked with accounting education (see Bonner & Lewis, 1990; Bonner & Walker, 1994; Libby & Tan, 1994; Bryant & Hunton, 2000; Wynder & Luckett, 1999; Rose & Wolfe, 2000), this thesis logically builds and extends these connections, by applying cognitive load theory to feedback research, and also to CBL used in accounting education. Chapter 2 extends this discussion and also outlines the areas of research chosen to investigate in this present thesis.
CBL materials have been shown to be a useful method to teach accounting. Chapter 3 outlines how and why in-house CBL materials were developed, and the feedback that was used in these materials. The feedback (termed “teacher-like” feedback) was intended to typically mimic teacher responses, in that they resembled teacher’s comments that would be provided to students in a normal face-to-face teaching situation. Aspects of cognitive load theory were also applied to the design and development of these CBL materials.

Four studies were conducted on the use, effectiveness and efficiency of the in-house developed CBL materials and the feedback. These studies are featured in Chapters 5, 6 and 7. The participants in the studies were students of an introductory accounting subject. The studies first attempted to determine the effectiveness of the CBL materials, and then compare student attitudes of CBL material to other traditional teaching techniques. The studies then attempted to determine the most efficient design of CBL materials and the form of feedback that would maximise student learning. Prior accounting studies into usage of CBL materials (see for example McKeown, 1976; Groomer, 1981; Sangster, 1992a; Jensen & Sandlin, 1992; McInnes, et al., 1995; Lane & Porch, 2002) have largely focused on evaluating CBL materials in terms of the impact the CBL had on students’ overall performance, and to a lesser extent student attitude (McCourt Larres & Radcliffe, 2000). The present studies enhance the extant accounting education and feedback literature by examining the effectiveness of the CBL materials and feedback by an output measure such as performance, and also the efficiency of the CBL materials and feedback according to cognitive load theory principles which includes measures of output (performance) and input (effort) (Sweller, et al., 1998).

A variety of methodologies and research designs were used in the four studies, and these are outlined in Chapter 4. These research designs were based on the aims and objectives of the individual studies. After the results of each study was analysed, the CBL materials and the feedback was modified. The modifications were conducted by the same investigator responsible for the initial development of the CBL materials, and this same person was in charge of the subject and all the teaching throughout all investigations reported in this thesis.
The conclusions from the four studies are discussed and presented in the final chapter of this thesis.

The remainder of the thesis is set out in the following manner.

Chapter 2 reviews critically the literature with respect to cognitive load theory, the role of feedback research, and the use of CBL materials in accounting education. These are the main theoretical topics underpinning the thesis, and each topic is dealt with in a separate section. From these three broad topics, the focus is narrowed to the relevant sub-topics which form the basis of the present study. The final section of Chapter 2 demonstrates how some prior research has connected aspects of the three topics. From the sub-topics, the further investigations in this thesis are outlined.

Chapter 3 describes the development of the in-house CBL materials, and the types of questions and feedback used. Chapter 4 describes the research methodology undertaken within the four studies in this thesis. The chapter also includes a review of seminal studies relevant to this thesis, and also outlines how reliability and internal and external validity were addressed.

Chapter 5 is the first study, and examines the effectiveness of the in-house developed CBL material. The study compares the usefulness of the CBL material to other traditional study material, and then analyses the effectiveness of the CBL material by student attitude. The study also compares the performance of students who used the CBL material against groups of students who did not use it.

Chapter 6 is the second study that extends the previous examination of CBL effectiveness and usefulness by measuring the instructional efficiency of CBL materials through the principles established in cognitive load theory. In this instance, the prior accounting education literature is extended to measure CBL material by combining an output measure (performance) with an input measure (effort during learning). To enable the CBL material to be more helpful to a wider group of users, the investigation into CBL efficiency was based on students with a different prior knowledge in accounting, and the CBL material was designed in two formats.
Chapter 7 comprises the two final studies that further extend the prior examination of CBL efficiency by focusing on measuring the instructional efficiency of two forms of feedback within the CBL materials. In these two experiments, again the principles established in the cognitive load theory paradigm were used to measure the efficiency of the feedback in the CBL materials. The two studies are again undertaken with students who have different prior knowledge in the accounting subject.

Finally Chapter 8 concludes the thesis discussion, explaining the implications of this research, and specifies further areas of research that may emanate from this series of studies.

The next chapter reviews the literature.
CHAPTER 2
LITERATURE REVIEW

2.1 Introduction
This chapter is concerned with reviewing the three theoretical topics relevant to this thesis. These topics are cognitive load theory, feedback research, and CBL use in accounting education. This chapter is divided into four sections (sections A, B, C & D). The first three sections (A, B & C) review the topics individually, while Section D draws together common aspects of the three topics and narrows the focus of the present thesis.

The first topic discussed is cognitive load theory.

2.2 Section A: Cognitive load theory
This section describes the well-established cognitive load theory. The major issues of importance in this section are the techniques identified in the cognitive load theory to increase learning, and the calculation of efficient instructional techniques based on the instructional efficiency paradigm.

2.2.1 Cognitive architecture
Cognitive load theory is derived from an understanding of our cognitive architecture. Human cognitive architecture consists of the fundamental design specifications of the human information-processing system and involves the manner in which humans acquire new information-processing capabilities, remember these processes, solve problems and learn (Simon, 1998; Stillings, Weisler, Chase, Feinstein, Garfield & Rissland, 1995). Research by Atkinson and Schiffrin (1968), and Roblyer, Edwards and Havriluk (1977) has shown that the architecture of the human mind consists of three basic components: sensory memory, working memory and long-term memory.

2.2.1.1 Sensory memory
Sensory memory is where the human mind receives information from the outside world. Inputs are received through the senses and these inputs are decoded in the sensory memory (Atkinson & Schiffrin, 1968). The sensory memory has the initial task of
transforming the many symbols received from the senses to mental representations. If attention is not focused on the received representation in the sensory memory within about a second, it decays and is lost (Ormrod, 1995)

2.2.1.2 Working memory
Information from the sensory memory is processed in the working memory (also termed primary or short-term memory). Logie (1996) stated that working memory was first viewed as contemplation, or “keeping an idea in mind”.

In 1956, Miller noted the limited capacity of working memory, and that the number of distinct items that humans could hold in working memory was “the magical number seven, plus or minus two”. The exact number of items that can be stored has been shown to depend on a number of factors ranging from age, health, level of fatigue, the type of item, familiarity with the content, and training (Daneman & Carpenter, 1980; Charness, 1976; Simon & Gilmartin, 1973; Baddeley, 1994; Shiffrin & Nosofsky, 1994). The limited nature of one’s working memory has widespread support in the psychological literature (Daneman & Carpenter, 1980; Charness, 1976; Simon & Gilmartin, 1973; Sweller, et al., 1998; Logie, 1996).

2.2.1.3 Long-term memory
Once information is processed in the working memory, it is stored in long-term memory. The capacity of the long-term memory is very large. Long-term memory is not simply a repository of rote-learned facts, but rather it contains sophisticated structures that permit individuals to think and solve problems. The ability to solve problems and recognise appropriate circumstances and the actions required by those circumstances comes from long-term memory (Sweller, 1988). Information in long-term memory can be accessed or activated to help deal with processing in working memory and human intellectual prowess comes from this stored knowledge (Simon & Gilmartin, 1973; Baddeley, 1986; Landauer, 1986; Newell & Simon, 1972; Schneider & Shiffrin, 1977).

2.2.2 Cognitive load theory
Cognitive load theory was developed within the domain of cognitive psychology and cognitive architecture and is based on the assumption that a learner has limited processing capacity, and proper allocation of cognitive resources is critical to learning (Sweller, et al., 1998; Kalyuga, Chandler & Sweller, 2001a). Cognitive load theory where Miller's (1956) work has still been widely quoted (Sweller, 1988; Sweller, et al., 1998; Sweller, 1999), assumes a very limited working memory and an unlimited long-term memory. The connection between cognitive architecture and cognitive load theory can be diagrammatically represented in Figure 2.1.

![Cognitive Architecture vs Cognitive Load Theory Diagram](image)

**Figure 2.1: The relationship between cognitive architecture and cognitive load theory**

Cognitive load theory is relevant to the development of instructional design principles and methods that effectively use people's limited cognitive processing capacity to stimulate their ability to obtain new knowledge and apply acquired knowledge to new situations. Sweller et al., (1998) noted that because working memory is limited, humans are probably only able to deal with two or three items simultaneously when required to process information. An implication of the human working memory limitations is that all of learners' conscious cognitive activity occurs in a structure which seems to preclude all but the most basic processes, and anything beyond the simplest cognitive activities appears to overwhelm working memory. Sweller et al., (1998, p. 253) wrote

"*Prima facie, any instructional design that flouts or merely ignores working memory limitations inevitably is deficient. It is this factor that provides a central claim of cognitive load.*"
Cognitive load theory provides a framework for instructional design and the evaluation of instructional programs. For learning to be efficient, learners must devote mental resources to activities without overloading the limited working memory (Kalyuga, et al., 2001a), and the ease with which information may be processed in working memory is a prime concern of cognitive load theory (Paas & van Merriënboer, 1993; 1994).

2.2.3 Schema formation and automation
The two main mental mechanisms to help overcome the working memory limitations are schema formation and automation (Sweller, 1988).

Sweller (1988) noted that a schema is a cognitive construct that permits people to categorise multiple elements of information as a single element according to the manner in which it will be used (see also Chandler & Sweller, 1991; Kalyuga, et al., 2001a). Schemas are essential to cognitive functioning in the educative process, because schemas reduce the burden of working memory. Schemas provide the means of storing huge amounts of information in long-term memory and away from working memory, and yet still allowing the accomplishment of intellectual tasks.

Once a schema has been acquired, it can undergo a process of automation. An automated process is one that can be carried out with minimal conscious thought, or no cognitive effort, thus reducing the working memory demands or freeing up working memory resources to learn new material (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977). Schneider and Shiffrin (1977) noted that automatic processing stored in long-term memory is triggered by appropriate inputs, and then operates independently of the person’s control.

As one develops better schemas and automation expertise is gained in a given field. Consequently the prime goals of instruction are the construction and automation of schemas. Cognitive load theory has concentrated on the design and evaluation of instructional methods that efficiently use the working memory capacity. Cognitive load theory recognises the concept of cognitive load as a crucial factor in the learning of tasks (Paas, et al., 2003). Failures of learning and performing complex cognitive tasks
can normally be attributed to the task demands that exceed the available cognitive processing capacity, the inadequate allocation of cognitive load, or both. Therefore, crucial to cognitive load theory is the need to assess and predict cognitive load.

2.2.4 Types of cognitive load

Paas et al., (2003) noted that cognitive load is a multidimensional construct that performing a particular task imposes on the learner’s cognitive system. There are three types of cognitive load: intrinsic load, extraneous (ineffective) load and germane (effective or optimum) load. Cognitive load may be affected either by the intrinsic nature of the material, by the manner in which the material is presented, or by the activities required of students.

Intrinsic cognitive load refers to the number of elements (also termed element interactivity) that have to be processed simultaneously for schema construction within working memory (Gerjets & Scheiter, 2003). Where material is to be learned element by element, without relating one element to the other (or where the number of elements that interact is no more than two), such material is low in element interactivity, and low in intrinsic cognitive load. Low element interactivity imposes minimal demands on working memory, and while the elements may be difficult to learn, they can be considered in isolation and so they do not impose a heavy working memory load (Sweller, 1988). High element interactivity is where a high number of elements must be considered simultaneously for the successful execution of a task. Under these circumstances, intrinsic cognitive load is high and understanding is likely to be difficult because it requires elements to be held and manipulated simultaneously in working memory, and working memory limitations can render this process difficult (Sweller, 1988). Intrinsic cognitive load is not readily amenable to alteration in instructional interventions because it is intrinsic to the material being dealt with.

Extraneous cognitive load (also referred to as ineffective load) is caused by mental activities during learning that do not contribute to learning. These activities require cognitive resources that exceed the limits, or are harmful to working memory capacity (Gerjets & Scheiter, 2003; Renkl & Aitkinson, 2003). Extraneous cognitive load is extra load beyond the intrinsic cognitive load and is imposed if instructional materials
contain multiple facets of information that are difficult to integrate with each other. Extraneous cognitive load results from poorly designed instruction.

Germane cognitive load is the optimum, beneficial or effective mental processing level that contributes directly to learning and schema creation (Gerjets & Scheiter, 2003). Germane cognitive load reflects the optimum level of mental resources brought to bear on new schema formation. Learners' attention should be directed towards processes relevant to achieve the germane level of learning, as this leads to the construction and mindful abstraction of schemas.

Both extraneous and germane cognitive load are under direct control of instructional designers. Appropriate instructional designs should decrease extraneous cognitive load, but increase germane cognitive load (Sweller et al., 1998). A core concern of cognitive load theory is the numerous methods to reduce extraneous cognitive load.

2.2.5 Methods of reducing extraneous cognitive load

Cognitive load theory has developed a number of instructional methods to reduce extraneous cognitive load, thereby reducing the processing burden, freeing up working memory, and creating an efficient learning environment. Each of these techniques has shown to have strong effects on learning, and include problem solving; worked examples; the completion problem effect; the split attention effect; the redundancy effect and prior knowledge. Each of these techniques will now be briefly reviewed.

2.2.5.1 Problem solving

One of the most common problem solving techniques is the traditional means-end analysis. This is where a student is provided with a problem and asked to work out an answer in the absence of schema. When employing a means-end analysis, students are comparing the current state of the problem with the final end to be reached and trying to move closer to the final end, stage by stage. To solve the problem, students may work backwards or forwards, and this type of learning has proven to be efficient as it enables students to find their own solutions (Sweller, 1988). Traditional problem solving has proven to be an efficient way of learning, particularly when students have already developed schemas (Kalyuga, et al., 2001a).
Students who study traditional problem solving not only have to attend to the details of the problem but also to the start, end and middle stages. In this context, solving conventionally structured problems may be an inefficient technique for constructing schemas associated with expertise, as they are exceptionally expensive on working memory and impose a heavy cognitive load that may interfere with learning (Sweller, 1988).

The goal-free problem solving strategy is an alternative to the means-end analysis, and can reduce extraneous cognitive load as problem solvers are not permitted to extract differences between a current problem state and the goal state because no end goal state is specified. In goal-free problem solving, students only need to concentrate on the problem itself, and the next stage, so reducing needless search. Students must work forward from the givens, calculating whatever values can be calculated. Problems do not have a specific goal, yet the end result is similar to the means-end analysis. Thus students have more working memory capacity available to develop better schemas for the next material to be learned which is vital for effective learning and transfer, whereas when students are using means-end analysis most of the cognitive capacity is taken up with problem solving rather than schema development (Ayers, 1993; Ayers & Sweller, 1990).

Sweller et al., (1998) summarised research on goal-free problem solving and found that goal-free groups were superior in terms of schema construction, particularly when the conditions of the goal-free problem are identical to equivalent means-end problem solving. Evidence for the effectiveness of goal-free problems is strong, with the effect obtained under a variety of conditions (Sweller, Mawer & Ward, 1983; Ayers, 1993).

### 2.2.5.2 Worked examples

A second method used in the cognitive load theory context to reduce the extraneous cognitive load employs the use of worked examples. Worked examples focus attention on problem states and solution steps, enabling learners to induce generalised solutions or schemas.
In the worked examples approach, students typically study how a large number of problems are solved by either reading through fully worked solutions or watching a tutor demonstrate the solution procedure (Cooper & Sweller, 1987). Students then attempt to solve similar problems from their understanding of the worked examples shown. With worked examples, working memory load in learning is minimised as students have all the problem solving moves provided or explained. As nothing else has to be attended to, extraneous cognitive load should be low.

Many studies (see for example Sweller & Cooper, 1985; Cooper & Sweller, 1987; Zhu & Simon, 1987; Tarmizi & Sweller, 1988; van Merrienboer & Paas, 1990; Ward & Sweller, 1990; Paas & van Merrienboer, 1994; Anderson & Fincham, 1994; Anderson, Fincham & Douglass, 1997; Kalyuga, et al., 2001a; Brown, 1995; Tuovinen & Sweller, 1999; Moreno & Mayer, 2002) have examined worked examples as a learning technique and have found that worked examples improve learning, particularly for high element interactivity materials. The prior studies have come from a number of subject areas including mathematics, (Sweller & Cooper, 1985; Cooper & Sweller, 1987; Ward & Sweller, 1990; Zhu & Simon, 1987), geometry (Paas & van Merrienboer, 1994; Tarmizi & Sweller, 1988), computing (Moreno & Mayer, 2002; van Merrienboer & Paas, 1990) and engineering (Tuovinen & Sweller, 1999; Kalyuga, et al., 2001a). After examining the use of worked examples across these many subject areas, Atkinson, Derry, Renkl and Worthman (2000) concluded that worked examples reduce cognitive load and facilitate learning (see also Kalyuga, et al., 2001a).

Kalyuga et al., (2001a) found that a cognitive structure resulting from instruction emphasising practice with worked-out problems is a more efficient knowledge base for solving problems than one resulting from instruction based on conventional problem solving. This is because the search for solutions in conventional problem solving takes up so much of the students’ working memory, there are not enough cognitive resources available to learn the schema of the new demanding content.
While worked examples have much support in cognitive load theory literature, there are a number of disadvantages noted. Sweller et al., (1998) for instance reported that the heavy use of worked examples could provide learners with stereotyped solutions to problems that may inhibit the generation of new creative solutions. If students are shown how to solve all classes of problems, it could be argued that they will never learn to solve problems themselves, or only solve problems that they have been shown an answer for. Another major disadvantage of worked examples is that they may not force learners to study them and do not induce students to engage in cognitive processes that lead to the construction of schemas. Sweller et al., (1998) for instance stated that, because of this lack of engagement, students might skip quickly over the worked examples. Finally, good instructional design of worked examples may be difficult and some worked examples that integrate different sources of information may yield a high extraneous cognitive load in that they contain sometimes too much, or redundant information (Aitkinson, et al., 2000).

Research is somewhat inconclusive regarding the appropriateness of worked examples for students with various degrees of knowledge. Tuovinen and Sweller (1999) noted that worked examples assist students' learning particularly for students with no prior experience in the subject matter. For students with experience in the domain, the advantage of a worked example was often reduced and other less structured practice approaches (for example problem solving techniques) were equally or more useful (see also Kalyuga, et al., 2001a; Kalyuga, Chandler, Tuovinen & Sweller 2001b). Sweller et al., (1998) however noted that higher ability learners tend to fully process and even elaborate on worked examples, while lower ability learners may only carefully study the worked examples when they encounter problems in solving the conventional problems. Consulting the worked examples at the same time as attempting to solve a problem requires both the worked example and the problem to be simultaneously processed in working memory, and this may be too demanding for lower ability learners.

In comparing problem solving and worked examples, Kalyuga et al., (2001a) noted that generally there is agreement in the literature that some extensive mix of worked examples and problem solving practice is beneficial to most learners.
2.2.5.3 Completion problem effect

An alternative to both fully worked examples and problem solving techniques are completed problems. The completion problem effect is where students are presented with a given state, a goal state and a partial solution and then must complete the remainder. Essentially completed problems overcome the disadvantage where students may skip worked examples by actively engaging students in the problem. Like worked examples, completion problems decrease extraneous cognitive load and facilitate the construction of schemas. Further, like conventional problem solving, completion problems directly encourage students to be active learners (Sweller, et al., 1998; van Merriënboer, Kirschner & Kester, 2003).

A disadvantage of completion problems may be that they are time consuming to construct and instructional designers are left with decisions as to which part of the solution to present to learners (see Sweller, et al., 1998).

2.2.5.4 Split attention effect

The split attention effect was identified in research on worked examples, and involves a learner trying to mentally integrate two or more separate sources of information (for example a diagram and text) for their learning. If a text, for example, is placed strategically on a diagram, it can lead to more effective learning due to the physical nature of the integration of the materials, leading to easier mental integration and reduced working memory load (see Tarmizi & Sweller, 1988; Ward & Sweller, 1990; Kal-uga, Chandler & Sweller, 1999)

Problems exist with the split attention effect if the text and diagram are presented in physically separate locations. In this case, the activity of searching for textual references in a diagram is likely to be too cognitively demanding as learners must read statements about one source of information, hold that in working memory, and then read and hold the second piece of information before completing the problem (Sweller, 1988). On the basis of many experiments under a wide variety of conditions, Sweller et al., (1998) concluded that mentally integrating two or more separate sources of information has negative consequences and should be eliminated wherever possible.
2.2.5.5 Redundancy effect

Following from the split attention effect, if an existing diagrammatic presentation already conveys adequate information, physically integrating more information in a different format may cause problems for learning, particularly if the various types of information presented are fully intelligible in isolation (Sweller & Charier, 1994, Sweller, et al., 1998). This is known as the redundancy effect and indicates learning situations in which eliminating redundant material results in better performance than when the redundant information is included (see Mousavi, Low & Sweller, 1995; Cerpa, Chandler & Sweller, 1996; Kalyuga, et al., 2001a; Mayer, Heiser & Lonn, 2001; Renkl & Aitkinson, 2003). Devoting working memory to redundant information effectively uses up a portion of the learners’ limited cognitive capacity, and should be avoided.

In terms of multimedia research, Mayer et al., (2001) concluded that the redundancy effect is not consistent with the information delivery view of multimedia learning which posits that two ways of presenting words are better than one. Over two experiments, Mayer et al., (2001) concluded that learning from a scientific explanation via a narrated animation was impaired by the addition of on-screen text that contained the same words as in the narration. The detrimental effects of redundant on-screen texts were found both when the onscreen text was an exact copy of the corresponding narration and when it was a summary of the same words as the corresponding narration (see also Moreno & Mayer, 2002; Mayer & Moreno, 2003). Increases in the possibility of redundancy can also be due to higher prior knowledge interfering with schemas (Kalyuga, et al., 2001b; Kalyuga, Chandler & Sweller, 1998; Mayer & Chandler, 2001; Yeong, 1999).
2.2.5.6 Prior knowledge and instructional design

The levels of learner experience are an important factor to consider when determining the efficiency of an instructional design. Prior knowledge of content critically affects a students’ ability to process information, and the assumptions of cognitive load theory provide a basis for explaining instructional design with respect to prior knowledge (Kalyuga, et al., 2001a; Renkl & Aitkinson, 2003).

In the initial phase of cognitive skill acquisition for example, learning from worked examples has been shown to be superior. However, this advantage fades over time and after learners become more familiar with the domain, problem solving can be used to further enhance and extend acquired skills (Kalyuga, et al., 2001b; Renkl & Aitkinson, 2003). Where a learner’s prior knowledge is low, and is confronted with a problem solving strategy, he or she usually adopts a means-end strategy, and this has been shown to involve large cognitive load. In contrast, when studying worked examples, the learner is freed from performance demands and he or she can concentrate on gaining knowledge. However, according to Tuovinen and Sweller (1999), developing low complexity materials (low element interactivity) for students with good prior knowledge may be a waste of resources and could even be counterproductive for learning due to redundancy effects.

2.2.6 Measurement of cognitive load

Cognitive load can be conceptualised as having a task-based dimension (mental load) and a learner-based dimension (mental effort), both of which affect performance (Sweller et al., 1998). Mental load is the aspect of cognitive load that originates from the interaction between task (e.g. format, complexity, time and multimedia) and subject characteristics (age, expertise level). Mental load provides an indication of the expected cognitive capacity demands and can be considered an a priori estimate of the cognitive load (Paas, et al., 2003). Paas et al., (2003, p. 64) stated that

Mental effort is however the aspect of cognitive load that refers to the cognitive capacity that is actually allocated to accommodate the demands imposed by the task; thus it can be considered to reflect the actual cognitive load. Mental effort is measured while participants are working on a task.
Both mental load and mental effort measure what it takes to complete a learning task. Mental load is the best predicted estimate of effort it will take for a group, while mental effort refers to the amount of mental capacity or resources that is actually allocated to accommodate the task demands. Mental effort reflects the quantity of controlled, effortful processing by the individual to complete the task (Sweller, et al., 1998).

To gain an effective understanding of the cognitive load during learning, ways to quantify this load have been developed. Cognitive load is closely aligned to two factors - "performance" in learning; and measuring "mental effort". The intensity of effort being expended by learners can be considered the essential measure of a reliable estimate of cognitive load (Paas & van Merriënboer, 1993).

2.2.6.1 Techniques to measure cognitive load

A number of techniques have been developed and tested for quantifying cognitive load. These measures can be classified into three categories: subjective, physiological, and task-and performance based. A summary of cognitive load studies to date shows that the most popular of these three are the subjective measures (Paas, et al., 2003; Tuovinen & Paas, 2004).

Subjective measures assess cognitive load by rating scales, and are based on the assumption that learners are able to introspect on their cognitive processes and report accurately on the amount of mental effort expended. Gopher & Braune (1984) found that subjects have no difficulty in assigning numerical values to the imposed mental burden or invested mental effort. The use of scales has been found to be valid, reliable and unobtrusive in capturing and reporting effort during learning (Paas, et al., 2003). Paas & van Merriënboer (1993, p. 739) noted that the coefficients of reliability (Cronbach's alpha) on collecting effort measures were "in agreement that subjects can subjectively evaluate their cognitive processes and have no difficulty in assigning numerical values to the imposed mental workload or invested mental effort". Later independent research by Gimino (2002) confirmed that the mental effort rating scales used in cognitive load studies provide decent convergent, construct and discriminate validity and good inter-participant reliability, in that rating scales are consistent across
individuals in given studies and the anchors have the same meaning ($0.853 < \alpha < 0.931$).

Borg, Bratfisch and Dornic (1971) initially used a nine point rating scale to measure mental effort, (see also Bratfisch, Borg & Dornic, 1972) and this was later modified by Paas (1992) for cognitive load theory studies and Paas and van Merriënboer (1993; 1994; see also Paas, van Merriënboer & Adam, 1994). The number of the points on the rating scales has usually varied (Paas, et al., 2003; Marcus, Cooper & Sweller, 1996).

Physiological techniques are based on the assumption that changes in cognitive functioning are reflected in physiological variables. These techniques include measures of heart rate, heart rate variability, eye activity and brain potentials as measures of mental effort. Paas et al., (2003) found that from the cognitive load studies between 1988 and 2002, very few have measured effort through these physiological techniques.

The final category of cognitive load measures consists of the task and performance based indicators. These involve two classes of task being, primary task measurement which is based on learner performance of the task of interest, and a secondary task methodology which is based on performance when a second task is performed concurrently with the primary task. While a learner is working on a cognitive task, he or she is required to carry out a secondary task, which increases the cognitive load on the learner's working memory. The learner's performance in the dual task condition indicates the cognitive load of the original task. Typical performance variables measured are reaction time, accuracy and error rate. Paas et al., (2003) reported that although secondary task performance is a highly sensitive and reliable technique, it has rarely been applied in research on cognitive load theory because a secondary task can interfere considerably with the primary task, especially if the primary task is complex.

After summarising the different techniques to measure cognitive load, Sweller et al., (1998) noted that after 1992, research in the context of cognitive load theory was exclusively concerned with the use of subjective rating scales, and that "subjective rating scale measurement is the most promising technique for research in the context of cognitive load theory" (Sweller, et al., 1998, p, 268). Later research (Paas et al., 2003)
Literature review

has reinforced this finding, and also that the number of categories on the effort rating scales appears not to be critical. Rather, as Gimino (2002) reported, rating scales are sensitive to only relatively small differences in cognitive load and any number of points on the effort scales will show high reliability.

2.2.6.2 Instructional efficiency

The multidimensional character and the complex interrelationships between “performance” and “mental effort” make determining cognitive load challenging. Paas et al., (2003) stated that it is quite feasible for two people to attain the same performance levels by one person working laboriously through a very effortful process to arrive at the correct answer, whereas another person reaches the same answer with a minimum of effort. Consequently, the cognitive costs associated with a certain performance level cannot be consistently inferred from performance-based measures alone. Rather the combination of the intensity of mental effort and the level of performance can reveal more information about cognitive efficiency of a given condition, and is the best estimator of instructional efficiency.

Paas and van Merriënboer (1993, p.738) stated that “according to the efficiency view, learners' behaviour in a particular condition is more efficient if their performance is higher than might be expected on the basis of their invested mental effort, and or, their invested mental effort is lower than might be expected on the basis of their performance.”

Combining mental effort and performance can lead to high or low instructional efficiency. High task performance associated with low effort is called high instructional efficiency, whereas low task performance with high effort is called low instructional efficiency (Paas & van Merriënboer, 1993). This relationship is illustrated in Figure 2.2.
Applying cognitive load theory concepts...

![Diagram](image.png)

**Figure 2.2: High and low instructional efficiency based on effort and performance**

### 2.2.6.3 Calculating instructional efficiency

The seminal computational technique developed by Paas and van Merriënboer (1993) that combines effort and performance has been widely used in the cognitive load theory literature to measure instructional efficiency (see for example summaries in Paas, et al., 2003; Tuovinen & Paas, 2004). In the computational technique, first the measures of both mental effort and task performance are obtained for each student (for example the mental effort during learning is captured by rating scales, while performance is a mark on a test or examination). These raw mental effort and performance measures are then converted to Z-scores thereby standardising those measures across all conditions and all students. The scores have to be standardised across conditions in order to determine differences in relative efficiency of the instructional conditions under investigation.

Paas and van Merriënboer (1993) then used the formula $E = (Z_{test} - Z_{effort}) / \sqrt{2}$ to compute the instructional efficiency condition for each student. In this formula, $E$ is the relative efficiency condition for each student; $Z_{test}$ is the standardised test performance score for each student, and $Z_{effort}$ is the standardised mental effort rating. The scores of each student are then totalled and grouped by treatment. The treatment measures ($E$ scores) were then compared using ANOVAs to conclude whether or not treatments were significantly different.

---

$^2$ Paas & van Merriënboer (1993) used three treatment groups, and so had three measures for instructional efficiency each being the mean of a treatment group as defined by $E$. 

21
Using the instructional efficiency formula, if performance and mental effort rating Z scores are equal ($Z_{test} = Z_{effort}$), efficiency is 0 ($E = 0$); if the performance Z score is higher than the mental effort rating Z score ($Z_{test} > Z_{effort}$), instructional efficiency is positive ($E > 0$), and finally if the performance Z score is lower than the rating Z score ($Z_{test} < Z_{effort}$), instructional efficiency is negative ($E < 0$). $E$ is a standardised statistic with a mean of zero and a standard deviation of one.

The mean Z scores can then be displayed on a cartesian axis, with performance on the vertical and mental effort on the horizontal. This procedure makes it very useful for visualising the difference in mental efficiency of the instructional conditions (see Figure 2.3 for a graphic representation of instructional efficiency). On Figure 2.3, all points on an imaginary line (where $Z_{test} = Z_{effort}$) are assumed to represent the same mental efficiency, and is equal to 0. This is represented as $E = 0$. Shifts to the upper left of the co-ordinate system indicate an increase in efficiency, being higher instructional efficiency resulting from higher performance in relation to less invested mental effort, and shifts to the lower right indicate a decrease in efficiency resulting from lower performance in relation to more invested mental effort.
Applying cognitive load theory concepts ...

Figure 2.3: Instructional efficiency conditions based on measures of performance and effort

The instructional efficiency measure that is calculated for each student (or treatment group) is presented as a perpendicular distance between a point off the diagonal line $E = 0$. The higher the number calculated the greater the efficiency. In cognitive load studies, the highest numerical efficiency condition occurs when performance is maximum and effort minimum. This is in the top left quadrant of the performance - effort axis in Figure 2.3. The lowest efficiency corresponded to the lowest performance and highest effort quadrant (bottom right). The value of the seminal Paas and van Merriënboer (1993) approach has been recognised in many subsequent experimental investigations (see Paas, et al., 2003).

2.2.7 Summary of Cognitive load theory

Cognitive load theory is based on a working memory that is limited with regard to the number of cognitive elements that can be simultaneously held active. Cognitive load theory has been used to measure and then generate efficient instructional techniques. These instructional techniques aim to reduce the extraneous cognitive load and reach a cognitive (germane) level, which results in effective learning, but a level that must be qualified by the need to keep the total load within the cognitive capacity of the students'
working memories. A number of techniques have been developed within cognitive load theory to enhance schema creation, and automation. These include the use of problem solving, worked examples, completion problems, avoiding split-attention effects, taking account of a students' prior knowledge and avoiding redundancy effects.

Cognitive load theory is a prominent theme in the educational literature, and the principles of instructional efficiency are adopted in this research. From the broad topic of cognitive load theory, Section A of this literature review has narrowed the further investigations in this thesis to the instructional methods to reduce cognitive load, and the use of the instructional efficiency measures. This is illustrated in Figure 2.4.

![Figure 2.4: The areas of interest within the cognitive load theory topic](image)

The next section outlines the second topic area, being feedback research.
2.3 Section B: Feedback research

2.3.1 Introduction
This section describes the importance of feedback research in the instructional learning process. The major issues of significance in this topic focus on feedback in a CBL context, and the debate surrounding the most effective form of feedback.

As research into feedback has a long and very widely researched history, the evaluation of the important aspects of feedback that relate to this thesis are drawn largely from prior reviews and meta-analysis studies. Original studies are also used to highlight certain points made in some reviews.

2.3.2 Feedback research
Feedback is a generic term to describe any of the numerous procedures that are used to tell a learner if an instructional response is right or wrong (Kulhavy, 1977). Researchers agree that feedback is unquestionably an essential component in a student's universe of educational experiences (Skinner 1958; Kulhavy, 1977; Butler & Winne, 1995; Mason & Bruning, 1999; Kulhavy & Stock, 1989; Dempsey, et al., 1993; Ross & Morrison, 1993).

Psychological research on the function of feedback dates back the early twentieth century, where Thorndike (1913b - see Bangert-Drowns, Kulik, Kulik & Morgan, 1991, p. 213) articulated the importance of correct and incorrect responses in the following way:

When a modifiable connection between a situation and a response is made and is accompanied or followed by a satisfying state of affairs, that connection's strength is increased. When made and accompanied or followed by an annoying state of affairs its strength is decreased.

Feedback research up until the early 1960's was conceptualised within a behavioural framework (Mason & Bruning, 1999; Kulhavy, 1977). The dominant position on feedback held that the post-response information acted as a type of reinforcer, functioning to increase the probability of a correct response occurring at some later
point in time. In this view, errors did not receive positive feedback and were weakened, while positive feedback was used to strengthen correct responses (Kulhavy & Stock, 1989; Mason & Bruning, 1999). This view of feedback’s functioning, although mechanistic, did emphasise positive consequences for successful performance and helped move educators toward a more positive instructional stance, but also represented a somewhat limited overview of the role feedback might play in learning (Ross & Morrison, 1993; Mason & Bruning, 1999).

Today the main view of the role of feedback is thought to be in providing information to learners about the accuracy of their responses and level of understanding of the material in general, as well as paying close attention to wrong answers (Kulhavy, 1977). Feedback should affect errors in a two-pronged manner: by telling students when they occur, and by allowing them to engage in corrective activity (Kulhavy & Wager, 1993). This view of feedback is consistent with the emergence of information-processing theories in the late 1970’s and early 1980’s that provided a cognitive framework for understanding feedback’s role in learning. From this perspective, errors are not viewed so much as mistakes as they are a source of information about a student’s cognitive processes and are an important resource for learning and teaching (Kulhavy 1977; Kulhavy & Stock, 1989; Butler & Winne, 1995; Mason & Bruning, 1999; Dempsey, et al., 1993; Ross & Morrison, 1993; Bruning, Schraw & Ronning, 1999).

2.3.3 The function of feedback

Kulhavy and Stock (1989) noted that feedback provides the learner with verification and elaboration and both types of information are critical components of effective and successful educational feedback. Verification is a simple judgement of whether an answer is correct or incorrect, and is the most basic element incorporated in most feedback. Elaboration is the informational component providing relevant cues to guide the learner toward a correct answer, or expand the correct answer when one is given. Under conditions where feedback consists of anything more than a “yes/no” or “right/wrong” answer, elaboration occurs. The combination of verification and

---

3 Verification has also been termed simple, basic, or outcome feedback.

4 Elaboration has also been termed richer, complex, elaborative, detailed, task properties feedback or explanatory feedback.
elaboration can highlight response errors, give correct response options, and provide information that both strengthens correct responses and makes them more memorable. Kulhavy and Stock (1989) also identified three types of elaboration in feedback, being:

- task specific, such as a restatement of the correct answer;
- instruction-based, such as explanations of why a certain item is correct, or a representation of the instructional text in which the right answer was contained, and
- extra-instructional, being additional feedback from outside the immediate lesson environment that is relevant to learning or to clarify meaning.

The functions of feedback as reported by Kulhavy and Stock (1989) have almost universal acceptance in the feedback literature (Butler & Winne, 1995; Mason & Bruning, 1999; Dempsey, et al., 1993; Ross & Morrison, 1993; Bangert-Drowns, et al., 1991). In summary, feedback helps learners determine performance expectations, judge their level of understanding, become aware of misconceptions, and provides clues about the best approaches for correcting mistakes and improving performance (Mason & Bruning, 1999).

2.3.4 Forms of feedback

A review of the literature provides the following summary of the different forms that feedback can take (see Mason & Bruning, 1999; Kulhavy & Stock, 1989; Dempsey, et al., 1993; Ross & Morrison, 1993).

**No feedback.** (NF). This condition simply provides learners with the performance score, and no reference to individual test items. This minimal level of feedback contains neither verification nor elaboration, but simply states the learner's number or proportion of correct responses.

**Knowledge of response:** (KOR). This is the simplest form of feedback and tells a learner whether their responses are correct or not, only providing verification. The correct response is not provided if an incorrect answer is provided and students may or may not remain on an incorrect item till it is correct. Examples here are simple "Correct" or "Incorrect" responses.
Answer until correct: (AUC). This is a modification of knowledge of response where the student is required to remain on the same item until the correct answer is selected. Answer until correct allows students to engage in the active processing following errors, and the last response is the correct one—a long-standing principle of learning. An example here is an “Incorrect try again” response until a final “Correct” answer is provided.

Knowledge of correct response: (KOCR). This feedback provides individual item verification, and supplies learners with the correct answer, but no elaborative information. An example here is (when an item is wrong) “Incorrect, the correct answer is…” (when an item is correct) “Correct”.

Topic contingent: (TC). This feedback provides item verification and general elaborative information. After incorrect responses, learners are returned to passages or other learning material where the correct information is found. An example here is “Incorrect, please look at page 5 for further information”.

Response contingent: (RC). This feedback provides both verification and item specific elaboration. In addition to providing knowledge of the correct answer, response contingent feedback gives specific feedback that explains why the incorrect answer was wrong, and why the correct answer is correct. An example when the answer is correct is “Correct, you have understood the relationship between X and Y”.

Bug related: (BR). This feedback provides verification and addresses specific errors. The feedback does not provide learners with correct responses, but can assist in identifying procedural errors, so that self-correction is possible. An example here is “This is not correct. You seem to be struggling with concept X, however if you look again at page 5, you will find information to assist you”.

Attribute isolation. (AI). This feedback provides item verification and focuses learners on key components of the theory to improve general understanding of the target concept. An example here is “This is correct. In your answer you have mentioned X, and this is important in many other ways.”
The identified forms of feedback and their verification and elaboration outcomes (according to Kulhavy & Stock, 1989) are outlined in Table 2.1.

<table>
<thead>
<tr>
<th>Feedback Form</th>
<th>Verification</th>
<th>Table Specific</th>
<th>Elaboration Instruction Based</th>
<th>Extra-Instructional</th>
</tr>
</thead>
<tbody>
<tr>
<td>feedback</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>knowledge of response</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>answer until correct</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>knowledge of correct response</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>topic contingent</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>response contingent</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>bug related</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>attribute isolation</td>
<td>Yes</td>
<td>Yes/No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 2.1: The verification and elaboration outcomes of the different feedback forms

From Table 2.1, it can be seen that some forms of feedback have similar attributes. Knowledge of response, answer until correct and knowledge of correct response all provide verification, but no elaboration, while some type of elaboration is provided by topic contingent, response contingent, bug related, and attribute isolation forms.

2.3.4.1 Praise feedback

Research has also demonstrated that praise feedback has a significant impact on learning outcomes (Cameron & Pierce, 1994; Brophy, 1981; Hoska, 1993). Praise feedback is designed to encourage students to continue and complete tasks, and has been used successfully to promote learning. Brophy (1981) noted that the term “praise” has the same meaning and connotation in feedback research as it does in everyday language - being to commend the worth of or to express approval or admiration. In a meta-analysis of 96 experimental studies, Cameron and Pierce (1994) concluded that praise feedback enhances people’s intrinsic interests, and that teachers should implement incentive systems in the classroom. Hoska (1993) stated that the effect of praise feedback depends on several factors including whether or not the learner felt the
comments were warranted (learners may ignore praise feedback if it is overstated), task
difficulty, and the goal and structure of the learning environment. Brophy (1981) gives
even more detailed guidelines about effective teacher praise; however he is fully
supportive of Hoska’s conclusions on the value of praise in feedback. For example,
Brophy (1981) argues for credibility in praise; praise that specifies the particulars of the
accomplishment and rewards attainment of specified criteria; praise that provides
information to students about competence, and praise that orients students towards
better appreciation of their task-related behaviour.

2.3.5 Modes of feedback
There are a number of ways of providing educational feedback and the most widespread
in instructional settings is by face-to-face learning, printed materials, and also via CBL
materials.

2.3.5.1 Face-to-face feedback
The most common mode of feedback delivery is through teacher and student dialogue in
face-to-face classroom teaching. In this instance, verification and elaboration feedback
can easily be provided by tutors or teachers to students through normal teacher
dialogue. This mode of feedback is potentially the most personalised due to the ability
of teachers to know students individually, analyse their responses and tailor feedback
accordingly. A growing problem in educational institutions, however, is that high
student-teacher ratios severely limit the frequency and quality of the feedback that
individual students can receive (Ross & Morrison, 1993; McInnes, et al., 1995).

2.3.5.2 Feedback in printed material
Feedback can also be provided in printed material. Both correct and incorrect
verification with elaboration and praise can be included in written form providing
feedback at each stage of a completed task. Feedback in printed material is usually
added as margin notes employing the integrated method of information presentation

If printed materials are designed with margin notes, a number of potential problems
could arise. First, the visible verification cues immediately give the students the correct
answers, without them having to engage in an appropriate level of mental processing during problem solving, therefore affecting new schema formation, and negatively affecting the response-evaluation-adjustment process (Bangert-Drowns, et al., 1991). In this situation the benefit of feedback is reduced, leading to poorer schema development. Second, if all the desirable verification and elaboration cues were provided as margin notes, the students may face a very complex text-decoding task. They may have to make sense of a very complex printed layout, where the complexity (or element interactivity) would add to the mental processing load leaving less room for processing the key concepts in limited capacity working memories. Finally, the students may need to read a great deal of information that they have already well understood, and feedback on well understood concepts may be redundant, and interfere with learning (Sweller, 1999). The redundant feedback may add an extra processing load to working memory, reducing the scope for schema formation. Thus the learning value of printed materials with detailed forms of feedback is somewhat suspect, particularly as providing feedback may not actively engage students in the learning process and the critical schema formation process may be crowded out by a number of interfering elements.

2.3.5.3 Feedback from Computer-Based Learning (CBL) materials

An alternative means of providing individualised feedback without face-to-face teacher involvement is through CBL materials. Computer-based feedback delivery can overcome the potential problems of providing feedback in a printed form, and the logistics of adapting the selection of feedback via CBL materials are also considerably easier than for printed material (Azevedo & Bernard, 1995a; 1995b; Fletcher-Flinn & Gravatt, 1995; Morrison, Ross, Gopalakrishnan & Casey, 1995; Cerpa, et al., 1996).

The most frequently cited benefit of using any subject-based CBL material delivery is the opportunity to obtain immediate feedback (see Kulhavy & Wager 1993; Dempsey, et al., 1993; Nicholson, 1997; Mason & Bruning, 1999). Kulhavy and Wager (1993) noted that each screen of computer material can be thought of as a frame of information, and feedback can be effectively incorporated at each stage of instruction to guide students to the next stage of learning without face-to-face teacher support (see also Butler & Winne, 1995; Kulhavy & Stock, 1989). Research linking feedback and CBL materials has shown this teaching method to be effective in developing new schemas, and
Literature review

strengthening already learned associations (Cerpa, et al., 1996; McKeown, 1976; Groomer, 1981; Borthick & Clark, 1987; Sangster, 1992a; Jensen & Sandlin, 1995; McInnes, et al., 1995; Lane & Porch, 2002).

Wager and Wager (1986) present a definition of feedback in a CBL setting that expands its role beyond that found in most non-technologically based instructional situations. With reference to CBL, feedback is any message or display that the computer presents to the learner after a response (Wager & Wager, 1986; Sales, 1988). Like general feedback, instructional feedback provides information as to the correctness, timeliness, efficiency, accuracy or provision of a response (Smith & Ragan 1993). Mason and Bruning (1999) noted that the purpose of feedback in the CBL environment is to shape the perceptions of the learner, and reflects the current thinking in cognitive psychology and information processing theory.

2.3.6 Advantages of CBL feedback

As is the case with research into feedback in traditional settings, there is widespread agreement in the feedback literature about the efficiency of incorporating feedback and active responding into CBL materials (Ross & Morrison, 1993; Cyboran, 1995). CBL materials with feedback afford many advantages once the requisite programming is in place (see Mason & Bruning, 1999; Fletcher-Flinn & Gravatt, 1995; Morrison, et al., 1995; Ross & Morrison, 1993). CBL materials provide feedback that is immediate and specific to individual students. CBL feedback (unlike that provided by a tutor) can remain unbiased, accurate, and non-judgemental, irrespective of the nature of the response. CBL materials allow the opportunity for a 1:1 ratio between the teacher (computer) and the individual learner, therefore improving the quality of feedback the learner receives. The interactive ability of CBL materials encourages participation and activity, which is thought to help improve learning. CBL also has the potential for enhancing the quality and type of specific feedback and elaboration that can be implemented - limited only by the ingenuity and energy of course designers. Finally, CBL materials provide a learning environment in which the student works individually with little human interaction, and therefore attention to feedback is likely to be even more critical than in traditional classroom instruction.
Applying cognitive load theory concepts ...

While CBL can be used for all types of students, the provision of individually responsive practice makes CBL particularly suitable for those enrolled through the distance education study mode (Marland, 1997; Tuovinen, 2000; Tuovinen, 2001).

Sales (1993) noted that a major advantage of CBL materials is that the feedback can be adapted to different learning situations. Adapted feedback is similar to generic feedback in that it is stable within a CBL environment, meaning each individual will see the same feedback as he or she works through the lesson (Sales, 1993). During the design and the development of the CBL material however, special attention is given to the role of feedback, and an effort is made to customise the feedback along one or more dimensions such as the instructional setting in which it will be used; individual learner characteristics (such as ability, aptitude and prior knowledge) who will use it; or the desired learning outcomes. When applied to CBL materials, adapted feedback capitalises on differences in learners (Ross & Morrison, 1993).

2.3.7 Factors influencing feedback in CBL materials
Research undertaken into CBL materials and feedback has identified several key dimensions that may influence feedback effectiveness in CBL materials. These include differences in the types of feedback and in particular the debate between verification or elaboration, student achievement levels and the timing of feedback (Mason & Bruning, 1999; Morrison, et al., 1995). These will now be expanded upon.

2.3.7.1 Verification or elaboration feedback in CBL materials
In terms of verification or elaboration, of considerable research interest is the issue regarding whether learners benefit more from complex or elaborative feedback, or from simple or basic feedback (such as knowledge of response). In terms of general feedback research, a commonly held view is that increments in the complexity of feedback (movements from a simple yes/no response to more elaborative feedback) should act to magnify learning yields (Kulhavy, 1977); however the CBL literature relating to feedback (summarised by Mason & Bruning, 1999; Morrison, et al., 1995) is inconclusive that increases in complexity yields parallel learning benefits.
Several studies have found that providing elaborative feedback within CBL materials results in no significant improvement over simple feedback. However, a larger body of research shows enhanced learning in response to more elaborative feedback (see Mason & Bruning, 1999 for summaries of these studies, and Morrison, et al., 1995; Ross & Morrison, 1993; Smith & Ragan, 1993).

Studies that have found elaborative feedback did not influence student learning include: Hodes (1984-85) who compared learning outcomes after students received knowledge of response with additional information, and knowledge of response with no additional information feedback, and found no significant differences in the feedback effects and performances. Park and Gittelman (1992) examined learning differences in completing electrical circuit skill application. Topic contingent feedback was compared with knowledge of response feedback, and the results measured by a computer-based post-test showed no significant difference between the feedback groups. However, students receiving the knowledge of response feedback were significantly less efficient in solving the post-test problems. Finally, Clark (1993) reported no learning differences after low ability students received either answer until correct feedback, or a combination of bug related and topic contingent feedback.

In contrast to these studies, a somewhat larger number have found enhanced learning in response to more elaborative feedback (see Mason & Bruning, 1999). Whyte, Karolick, Neilson, Elder and Hawley (1995) for instance found that students who received knowledge of correct response plus additional information feedback (also termed response contingent) scored significantly higher on concept acquisition tests than students receiving less elaborate forms such as knowledge of response, and knowledge of correct response. Similarly research by Pridemore and Klein (1995) showed that student learning was higher after receiving elaboration feedback than when receiving verification feedback. The authors noted that presumably the extra information available in elaboration feedback allows students to correct conceptual errors. Pridemore and Klein (1995) concluded that CBL should include elaboration feedback, and this feedback should be designed to give students extra-instructional information to help them relate new information to their current knowledge base. Merrill (1987) examined the effects of attribute isolation and knowledge of response with additional information,
and found there was a trend for higher order questions with attribute isolation feedback to produce increased learning. Finally, Khine (1996) examined secondary school students completing a multimedia presentation and also reported that there was a significant difference between no feedback, and elaborative feedback knowledge, with greater learning resulting from elaborative feedback.

Two meta-analysis studies are worth noting in regards to their conclusions on the debate between verification and elaboration in a CBL context. A forty case study (58 effect sizes, drawn from an original sample of 250 studies) by Bangert-Drowns et al., (1991) found that in relation to conclusions on the type of feedback, the larger effect sizes were attributed to greater or explanation feedback, followed by answer until correct, then knowledge of correct response. The weakest effect was for feedback which only presented right or wrong answers - these responses had virtually no effect on achievement. Bangert-Drowns et al., (1991) noted that when learners are guided to or given the correct answer, the average effect of feedback is higher. A twenty-two case study by Azevedo and Bernard (1995b) also found that the most effective feedback conditions for CBL materials were those that were most elaborate. The achievement outcomes are greater for students receiving CBL material that utilize active responding than for comparison groups with no feedback, suggesting the great potential of CBL feedback intervention.

2.3.7.1.1 Verification feedback in CBL materials

Section 2.3.7.1 has highlighted the debate between verification and elaboration. In terms of studies that have compared the verification types of feedback only, the results also show a preference for verification that provides answers rather than answer until correct.

Morrison et al., (1995) for instance examined how learners use and are affected by different forms of multiple choice feedbacks presented by CBL (answer until correct, knowledge of correct response, delayed, and no feedback) under varying conditions of performance. The study found that for students enrolled in an introductory teacher education course, greater learning was produced by those receiving knowledge of correct response compared to answer until correct and no feedback, and this was
particularly the case for lower level learning. Clariana (1990) also examined the effect of various forms of feedback (no feedback, answer until correct, knowledge of correct response, and delayed feedback) on learning outcomes in CBL using a variety of question types on low ability students. The results also showed that knowledge of correct response was significantly more effective than no feedback and answer until correct. In both these cases, students were assisted more by knowledge of correct responses, as these provided more guidance in learning.

Mason and Bruning (1999) summed up the prior research debating the different forms of feedback and concluded that a larger body of research exists for increased learning in response to more elaborate feedback within CBL material. Mason and Bruning (1999) also stated that the inclination for increased learning in response to more elaborate feedback appears to be mediated by other variables such as student achievement, and the timing of the feedback.

2.3.7.2 Feedback and student achievement levels

Mixed results are found in terms of student achievement (level of expertise) and forms of feedback in CBL materials. In summarising this research, Mason and Bruning (1999) stated that findings indicate that there may be differences in the extent to which lower and higher ability students effectively utilise various types of feedback. While lower ability students may benefit from more immediate specific forms of feedback, higher ability students may gain more knowledge from feedback that allows for active processing by the student.

Morrison et al., (1995) also found that knowledge of correct response feedback may be more beneficial than answer until correct or no feedback for lower level learning, but the feedback effects become weaker when higher order understanding is the learning goal (see also Clariana, Ross & Morrison, 1991). Similarly, Clariana (1990) also noted that low ability students benefited more from knowledge of correct response than from answers until correct, and this is possible because low ability learners do not have the prerequisite knowledge to effectively re-examine and evaluate the options available during answer until correct. Clark (1993) however found no learning differences
Applying cognitive load theory concepts ...

between low ability learners receiving answer until correct, and a combination of bug related and topic contingent feedback.

In terms of prior knowledge, Smith and Ragan (1993, p. 76) concluded that

"the amount of prior knowledge that learners possess on a topic may greatly influence the amount and content of feedback. Learners with extensive prior knowledge may require only correct/incorrect feedback, while learners with limited knowledge may need more extensive information, hints and guidance, that might actually inhibit more informed learners."

2.3.7.3 Feedback and timing

One of the most widely researched areas of feedback related to CBL materials has been the effects of immediate versus delayed feedback, and like general feedback research, the findings are mixed (see Mason & Bruning, 1999, Kulik & Kulik, 1988; Ross & Morrison, 1993 for summaries). Immediate feedback is informative and corrective feedback given to a learner as quickly as the computer's hardware and software will allow during instruction or testing, while delayed feedback is given to a learner after a specified programming delay interval during instruction. Kulik and Kulik (1988) noted that research on feedback timing dates back to the 1920s, extending to the late 1980s, and in spite of the vast amount of attention, researchers still disagree about its conclusions.

The main issue in feedback timing research has been whether or not immediate feedback produces better performance than delayed. While immediate feedback is needed to correct student errors prior to the error being encoded in the memory, some researchers argue that delayed feedback reduces proactive interference which allows the initial error to be forgotten and the correct information to be encoded with no interference (Kulhavy & Wager, 1993). Kulhavy (1977) supported the use of delayed feedback because of a phenomenon referred to as the delay-retention effect, where delaying the presentation of feedback appeared to increase what a student remembered on a retention test (see also Ross & Morrison, 1993).
A 53 case meta analysis (from a pool of 288 studies, see Kulik & Kulik, 1988) however reported that applied studies using actual classroom quizzes and materials usually found immediate feedback to be more effective than delayed feedback. Immediate feedback generally enhanced learning in the classroom, or through programmed instruction where students had questions posed to them, answered the questions and received feedback. Delayed feedback on the other hand was typically effective only in experimental situations such as learning lists that repeated the stimulus word or test content. Kulik and Kulik's (1988) findings point to the formative nature of immediate feedback, especially in mastering intellectual skills.

In terms of a student's prior knowledge, it would appear that low a achieving or low mastery student benefits more from immediate feedback, as immediate feedback enables him or her to correct conceptual errors. High achieving students may better utilise delayed feedback, as long-term retention is enhanced with delayed feedback (see Mason & Bruning, 1999; Gaynor, 1981). Gange and Medsker (1986) however noted that immediate and extensive feedback seems to be necessary for learning cognitive strategies that are not very simple. While the controversy over immediate versus delayed feedback types is complex, Dempsey et al., (1993) reported that in most instructional settings employing feedback such as the CBL method, immediate feedback should be prescribed unless the feedback is delayed systematically for a specialised purpose.

2.3.8 Summary of feedback research

CBL materials are a suitable and effective format to provide feedback, and have a number of benefits over face-to-face teaching, and printed materials. The unique interactive potential of CBL allows instructional designers to incorporate various forms of feedback within CBL materials and for those materials to be modified and adapted to fit the needs of a variety of learners. Similar to feedback research in a traditional setting, feedback related to CBL materials has continually examined the most effective feedback for learning. Findings linking feedback research with CBL materials indicate there is no clear best form of feedback for all learners, and providing effective feedback in CBL requires consideration of students' achievement levels, prior knowledge and the
Applying cognitive load theory concepts ... nature of the learning task in order to determine the most effective feedback type, and the timing of the feedback.

From the broad topic of feedback research, this section of the literature review has narrowed the focus of the investigation in this thesis to the forms of feedback, and to the forms of feedback in CBL materials. This is shown in Figure 2.5.

![Diagram showing areas of interest within feedback research topic]

Figure 2.5: The areas of interest within the feedback research topic

The next section outlines the third topic area, being CBL use in accounting education.
2.4 Section C: CBL use in accounting education

2.4.1 Introduction
This section will outline the use of CBL materials in accounting education. The major issue of importance is related to examining the effectiveness of CBL materials as a teaching method. CBL material has been used in teaching accounting at university level for over thirty-five years (see McKeown, 1976; Sangster, 1992a; 1992b), and recent studies and reviews have continued to emphasise the importance, relevance and contribution (Boyce, 1999; McCourt Larres & Radcliffe, 2000; Bryant & Hunton, 2000; Lane & Porch, 2002).

2.4.2 History of computers and accounting education
Computer use in accounting education began in the early 1960s (see Borthick & Ciark, 1987) in response to calls from the American Accounting Association (AAA). The report of the AAA Committee on Accounting Instruction in Electronic Data Processing (1959) for instance stated that while computers were new and had unproven components of information processing, they should be incorporated in the accounting curriculum. In 1964, the AAA Report of the Committee on Electronic Data Processing in Accounting Education (1964) concluded that accounting students should receive instruction in a basic computer language, and that accounting instruction should incorporate some computer orientated problems and coverage of electronic data processing.

In 1969, the AAA Report of the Committee on the Role of the Computer in Accounting Education (1970) reinforced the need for accounting students to receive instruction about the computer, and also that the accounting student should be provided with a general orientation to the computer environment including computer hardware and software, flowcharting, programming, data processing approaches, and operation and management of the computer data processing. The 1969 Committee however acknowledged that there had been little attempt to harness the potential power of computers to improve the learning environment for students of accountancy in higher education, and that aids for using computers in accounting instruction were not extensive. In the 1970s, the uses of the computer in accounting education included basic accounting information processing models (where students analyze problems, submit punch cards and a computer produces a report); student program cases (where students write programs to deal with processing
Applying cognitive load theory concepts ...

information); statistical analysis, decision simulations, and data banks. Generally, however computer integration into the accounting curriculum was at relatively low levels.

In the 1980s computer use in accounting education remained at low levels (Armitage & Boritz, 1986) and yet the functions of the computer were expanding (Ijiri, 1983). Bhaskar (1982) summarized three different ways that computers were impacting on accounting education; these were:

- in computer science, that is in learning aspects of computer hardware, software, and programming;
- in computer managed learning, that is in assisting teachers with assessment, guidance and record keeping, and
- in CBL where teaching is conducted with the aid of a computer and students interact with the computer for feedback and instruction.

Later research by Er and Ng (1989) expanded these three categories in line with the expanding role of computers. Er and Ng (1989) noted that there were seven categories where computers were used in accountancy courses being:

- computing (basic programming);
- computer simulation and modeling;
- decision support ("what if" analysis);
- business appreciation (how business decisions affect the market);
- mathematical (linear) programming;
- accounting information systems, and
- CBL materials.

By the 1990s, computer use had significantly grown in accountancy courses (Maher, 1993; Togo & McNamee, 1995; Rebele, Apostolou, Buckless, Hassell, Paquette & Stout, 1998a; 1998b; Chang & Chow, 1999), and today computers are well integrated into many aspects of the accounting curriculum (Bryant & Hunton, 2000). Computers are one of a number of effective teaching aids used to achieve learning objectives in accounting education (Saudagaran, 1996; Bonner, 1999).
2.4.3 History of CBL use in accounting education

CBL involves the computer playing some aspects of the role of a teacher. For example, the CBL material might present exercises and problems to the students and feedback on the correctness of the response through a series of questions and answers. The development and use of CBL materials in accounting has been a major function of the computer in accountancy courses (Bhaskar, 1982; Borthick & Clark, 1986; 1987; Togo & McNamee, 1995; Rebele, et al., 1998b). Accounting is a subject area that is well suited to use CBL assistance, as many topics in the subject involve a sequential understanding of material and CBL assists learning in providing information and feedback on a step-by-step basis (Fletcher-Flinn & Gravatt, 1995).

CBL materials can be used in two ways: supplantive and supportive. Supplantive refers to complete lecturer or tutor substitution, and supportive means reinforcing lecturer and tutorial input in addition to conventionally delivered teaching. Most of the CBL materials for accounting education have been used in a supportive manner (see Sangster, 1992a, 1992b; McInnes, et al., 1995; Lane & Porch, 2002).

The use of CBL materials in accounting education can be traced back to 1976 and the seminal work of McKeown (1976). The level of adoption of CBL materials into accounting courses was slow throughout the 1970s. During the 1980s, there was a slight increase in the use of CBL materials for teaching accounting education in the USA, Australia, the UK and New Zealand (see Borthick & Clark, 1987; Kent & Linnegar, 1988; McCall, 1988, Coy, 1987). This increase continued throughout the 1990s (Sangster, 1992a; 1992b; McInnes, et al., 1995), and into the twenty-first century.

2.4.4 Advantages of CBL materials in accounting education

There are many reasons for adopting and using CBL materials to teach accounting. These include increasing student learning outcomes; flexibility and the provision of feedback.

In terms of student learning outcomes, McKeown (1976) stated that use of CBL materials would lead to an improvement in instruction through better student absorption and retention of material, a better level of learning than that achieved by conventional methods, and less instructor time per student while maintaining or improving student learning (see
Applying cognitive load theory concepts ...

also Bhaskar, 1982). McCourt Larres and Radcliffe (2000) reported that CBL is considered to be more interesting and stimulating than other methods of instruction, and a very easy way to learn (see also Lane & Porch, 2002). Rawlingson and Sangster (1992) noted that CBL material is generally easy to use because it breaks information and skills into small packages allowing students to learn at achievable stages (see also Innerd & Williamson, 1992). McCourt Larres and Radcliffe (2000) further stated that CBL encourages students to be independent and active, thus assisting in lifelong learning skills and capabilities, while Bryant and Hutton (2000) stated CBL is an effective tool for engaging the learner. Finally, Boyce (1999) recognized the potential for appropriate CBL to enhance the educational outcomes of students in accounting and also to enhance the students' general educational skills including critical thinking.

In terms of flexibility, a number of researchers agree that CBL materials allow students to proceed at their own pace and in choosing when to study (Sangster, 1992a; McCourt Larres, & Radcliffe, 2000; McKeown, 1976; Rawlingson & Sangster, 1992).

One specific advantage of CBL materials mentioned in the accounting education literature is their provision of feedback. Rawlingson and Sangster (1992), for instance, stated that CBL elementary bookkeeping materials enabled students to better learn as they gained immediate feedback on their performance. Letza (1992) reported that CBL materials allowed students to be in control of their own objectives and methods of learning; and provided students with immediate feedback. Innerd and Williamson (1992) stated that CBL packages offered students immediate, accurate, and tailored feedback on learning, while Benson, Alison, and Arger (1994) stated that the benefits associated with interactive multimedia in learning accounting procedures included students receiving immediate responses to both correct and incorrect procedures and immediate references (see also McKeown, 1976; Sangster, 1992b, McCourt Larres, & Radcliffe, 2000; Kent & Linnegar, 1988; Orpen & Ferguson, 1991; Gallagher, & Tonge, 1994; Borthick & Clark, 1987).

Finally, CBL materials have been shown to be a cost efficient and effective approach to teach accounting particularly in comparison to conventional teaching. CBL materials are more relevant with increasing student numbers and other academic pressures, and they
allow academics time to pursue other duties while still providing a high quality of learning to students (McKeown, 1976; McInnes, et al., 1995; Lane & Porch, 2002).

2.4.5 Evaluating the effectiveness of CBL in accounting education
The resulting increase in the use of CBL to teach accounting has also led to a parallel increase in the amount of research conducted on the effectiveness of CBL materials. The research in this area has involved a number of methods used to measure the effectiveness of CBL materials in accounting education. These include evaluating performance, examining student attitudes, and conducting some cost-benefit analysis studies.

2.4.5.1 Evaluation based on performance
Perhaps the main focus of prior research into CBL material use and accounting education is the debate regarding whether or not the use of CBL affects performance. Borthick and Clark (1987) noted this as the single most important dimension regarding the effects of computer and CBL use in accounting education (see also McCourt Larres & Radcliffe, 2000). The effectiveness of CBL in accounting courses is usually considered in terms of the impact of CBL use or non-CBL use on students’ overall performance, and there are many relevant studies and reviews in this area (see for example McKeown, 1976; Groomer, 1981; Sangster, 1992a; Jensen & Sandlin, 1995; McInnes, et al., 1995). Overall the studies on effectiveness of CBL in this area have found that generally the performance of CBL students did not suffer, or it may have improved when compared to students in a different teaching environment (McCourt Larres & Radcliffe 2000). Some of the major original studies examining performance report subtle differences in the students, results and control group design, and require reviewing.

The seminal work of McKeown (1976) is widely quoted when applying performance as an effective CBL measure. McKeown (1976) designed and used PLATO (Programmed Logic for Automatic Teaching Operations) to teach an introductory accounting subject. McKeown (1976) stated that a rigorous test of the effectiveness of the CBL materials was carried out where students were assigned to an experimental group that used CBL materials to complete homework, and a control group that

5 In the McKeown paper, only one reference is quoted, that being from a science journal, therefore indicating the uniqueness of this type of research in the accounting education field at that time.
Applying cognitive load theory concepts ...

completed homework in the normal manner. The effectiveness of the CBL was measured by comparing the final performance (comprising the marks in three tests, and a final examination) of the control and experimental group. The main hypothesis that students can be brought to at least as good a performance level with less class time and significantly less total student time spent on the course using PLATO as compared to conventional teaching was strongly supported.

It was some five years after the McKeown study that Groomer (1981) conducted a follow-up investigation. Groomer (1981) again used PLATO, this time for introductory accounting tutorials, in conjunction with the traditional lecture/problem solving approach to accounting instruction. Similar to McKeown (1976), the results showed that there was a significant difference between the control and experimental group in terms of assignments and examination, with those completing the CBL performing overall better than those receiving instruction from the human tutor.

Friedman (1981) used computer programs as a teaching aid in an intermediate accounting course and hypothesised that the performance of students using computers as a problem solving tool is not significantly different from those who did not use the computer. The CBL material was used to assist with homework. An experimental and control group was established, where the control group prepared homework assignments in the traditional manner, while the experimental group prepared homework assignments by interacting with the computer. Both groups completed the final achievement test, and results show that students who used the computer as a problem solving tool performed significantly better.

In an intermediate accounting course, Fetters, McKenzie and Callaghan (1986) examined the use of CBL materials (designed using the BASIC programming language) to teach two topics in a supportive way. Again one group of students completed the CBL material, while the other completed extra homework that was designed to approximate the time needed to complete the CBL material. The results of the study showed that there was no significant difference in the performances (results in unannounced quizzes, and examinations on the topic areas) of students completing the CBL or the extra homework in the two topics. The authors also analysed the students
on their performance in the preceding accounting subject and concluded that CBL had a
positive impact on the weaker students in a conceptually difficult area, while for good
students the impact disappeared with time.

Borthick and Clark (1986) examined the use of microcomputers to solve management
accounting problems using a spreadsheet program, and found that performance was
positively related to previous computer experience. Borthick and Clark (1986) also
found that computers are better used to solve larger integrative problems. However
there is no significant difference between students using computers and traditional face-
face-teaching when smaller problems require solutions.

Ryan and Simpson (1988) designed structured CBL material using BASIC
programming language for introductory accounting topics. The CBL was used as an
optional form of instruction to self-study, where students who elected to use the CBL
could do so, however no tutorial support was formally provided. Correlations between
performance and time using the CBL however found no significant relationship. A
limitation of the study was the self-selection bias created by inviting all the students to
complete the CBL if they wished. This self-selection bias leads to conjecture in the
conclusions made that the CBL may have assisted the weaker students.

Kachelmeier, Jones and Keller (1992) evaluated the learning effectiveness of a
computerized illustration of a topic related to employer pension accounting. Computer
spreadsheets were used by students for homework and demonstration purposes in lectures.
A between-subjects treatment-control design was used to compare the performances of the
students over sequential semesters. Analysis found that students in the treatment semester
who used the computerized learning aid in a structured sequential format significantly
outperformed those of a previous semester who did not use the aid.

Rawlingson (1992) introduced commercially available CBL materials to an introductory
accounting subject. The CBL was used in a supportive role, yet use was at the
discretion of the students. The effectiveness of the CBL was not measured in terms of
performance on examinations with the current group of students, but the author noted
that valid comparisons could be made with the present students and a prior year's group
Applying cognitive load theory concepts ...

of students when the CBL was not used. The paper does not report the results of this comparison, but stated that a between subjects research design is a relevant test of CBL effectiveness. Jensen and Sandlin (1992) also compared the performance results of final year accounting majors who were taught a traditional final-year accounting theory course (with lectures and tutorials, using textbooks) with students who took the course two years later in a complete in-house designed CBL format. All aspects of the course were the same, (including the content, final exam, and the instructor) and results found that students who used the CBL materials had significantly higher examination scores, as well as higher quality term papers than students taught in the traditional manner.

Sangster (1992a) used commercially available CBL materials in an intermediate accountancy course in both a supportive and supplantive way. The aim of the study was to determine whether use of the CBL materials in either form was more educationally effective. Success was determined by exam performance and tests showed no significant difference between the CBL taught supplantively and those taught supportively. Performance results also show that those students using the CBL material performed no better or worse than conventional lecture material.

McInnes et al., (1995) conducted two experiments on the use of CBL materials. Study 1 found that when using commercially available CBL materials in a supplantive role in an intermediate accounting course, there was no adverse effect on examination performances of those students who opted to use CBL modules, instead of attending two weekly lectures. The authors concluded that student examination performance in a course such as management accounting is determined by many factors including (possibly) the use of CBL. Study 2 again used commercially available CBL materials in a supportive manner where, in addition to the normal weekly traditional teaching (two lectures and one tutorial), CBL materials were available on a non-compulsory basis. In this case the CBL materials did not improve student performance, although the performance was no worse than the control group.

Finally, Ott, Mann and Moores (1990) compared the exam scores of students instructed by CBL materials with students instructed by the traditional lecture method. The study sought to determine if the method of instruction (CBL or lecture) interacted with four personality
traits to affect student performance in the first elementary accounting subject. The results indicate that two personality traits lead to more effective CBL use, the first being discovery perception by one’s intuition; and the second deciding by thinking. The authors also stated that these two traits are significant in explaining the individual variation in the performance of students who used CBL instruction.

In summarizing, most of the studies have found that CBL use leads to equal or better performance when compared to traditional teaching methods. No study found CBL materials lead to significantly weaker performance. Table 2.2 presents the studies referenced and compares these by a number of factors.
Applying cognitive load theory concepts ...

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Level</th>
<th>Method</th>
<th>Same class randomly divided into treatment and control group</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKeown (1976)</td>
<td>Introductory</td>
<td>PLATO used for homework</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Groomer (1981)</td>
<td>Introductory</td>
<td>PLATO used for tutorials</td>
<td></td>
<td>Yes, students who used the CBL performed significantly better</td>
</tr>
<tr>
<td>Friedman (1981)</td>
<td>Intermediate</td>
<td>Pre-written CBL used for homework</td>
<td></td>
<td>Yes, computer instruction was significantly better</td>
</tr>
<tr>
<td>Fetters et al. (1986)</td>
<td>Intermediate</td>
<td>BASIC designed CBL used for homework</td>
<td></td>
<td>No but CBL was more helpful to weaker students</td>
</tr>
<tr>
<td>Borthick &amp; Clark (1986)</td>
<td>Intermediate</td>
<td>Spreadsheets used in class for problem solving</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Ryan &amp; Simpson (1988)</td>
<td>Introductory</td>
<td>In-house designed CBL used for optional tutorial support</td>
<td></td>
<td>No correlation between use and performance. Perhaps more helpful for weaker students.</td>
</tr>
<tr>
<td>Rawlingson (1992)</td>
<td>Introductory</td>
<td>CBL used at students discretion</td>
<td>Between-subjects comparison suggested</td>
<td>No result</td>
</tr>
<tr>
<td>Jensen &amp; Sandlin (1992)</td>
<td>Final year</td>
<td>In-house designed CBL replaced lectures and tutorials</td>
<td>Between-subjects comparison with prior year</td>
<td>Yes favouring CBL use</td>
</tr>
<tr>
<td>Sangster (1992a)</td>
<td>Intermediate</td>
<td>CBL used to support and replace lectures and tutorials</td>
<td></td>
<td>No. Comparisons were between supportive use and supplantive use.</td>
</tr>
<tr>
<td>Kachelmeier et al. (1992)</td>
<td>Intermediate</td>
<td>Spreadsheets used for homework</td>
<td>Between-subjects comparison with prior year</td>
<td>Yes in favour of computer use</td>
</tr>
<tr>
<td>McLinnes et al. (1995)</td>
<td>Intermediate</td>
<td>CBL replaced lectures and used for optional support.</td>
<td></td>
<td>No difference when replaced lectures. No difference when used as optional support.</td>
</tr>
</tbody>
</table>

**Table 2.2: Summary of CBL material use in accounting education and comparisons of effectiveness**
2.4.5.2 Evaluation based on student attitude

Further to the measures of performance, a number of studies have measured the effectiveness of CBL materials by student attitude. In the study by Borthick and Clark (1986) for instance, students revealed they initially had a strong desire to use computers, yet this enthusiasm diminished after a semester's use. Students however could still see the benefit in the computer when used in this case as a computational tool, and the students also indicated that computers should be used in other accounting subjects. The results of this study must be taken in the context and time of very low computer usage in accounting education and perhaps quite primitive software and hardware designs.

Ryan and Simpson (1988) also examined the student's attitude to structured in-house designed CBL material, and after using the CBL for a semester, the students stated they favoured CBL use over traditional instruction, and that the CBL material had improved their understanding of accounting concepts. Again the problem with this conclusion is that the CBL use was optional as was participation in the returned surveys. Attitudinal research by Rawlingson (1992) also found that students felt positive about attendance at optional CBL sessions, and that CBL would assist learning.

McInnes et al., (1995) asked students to compare the importance of each of their sources of teaching information, being lectures, tutorials, CBL material, private study, and the textbook. Students rated lectures, tutorials, and private study more important than the CBL materials, but the CBL was rated higher than the textbook.

Two recent attitudinal surveys on CBL perhaps indicate a more growing acceptance of CBL materials in accounting education. McCourt Larres and Radcliffe (2000) examined the impact of commercially available CBL material on a professionally accredited third year undergraduate taxation course. The CBL material was used weekly in a supportive manner with the aim of encouraging independent learning. Students felt that CBL was as effective an educational tool as lectures or taught tutorials in helping them achieve the designated learning outcomes of the course, and they also found CBL more interesting and stimulating than lectures and tutorials. McCourt Larres and Radcliffe (2000) argue against effectiveness based purely on the basis of examination performance on a number of grounds. Performance measures alone do not adequately reflect the quality and depth of the learning experience; performance effectiveness in
Applying cognitive load theory concepts ...

examination scores requires a controlled study and this may disadvantage one group and present ethical problems, and finally it may not be possible to ensure that the study patterns for the control groups remained the same throughout the study.

Lane and Porch (2002) examined the impact of using supplantive commercially available CBL material on non-specialist accounting undergraduates. Attitudinal data was collected at the beginning and end of the semester. The questions assessing attitude were the same in both questionnaires, and a five point Likert scale was used with results of the two questionnaires compared. Results show that students are significantly more likely to perceive CBL as easy to use once they have used and been exposed to CBL materials and that overall CBL is as an easy method of learning.

In summarising student attitude, general agreement has been found that students are supportive of CBL use in accounting education.

2.4.5.3 Evaluation based on cost

In his seminal paper, McKeown (1976) stated that cost is a way to measure the effectiveness of CBL materials. While the cost of CBL development is high, this cost can be justified when viewed as a fixed cost and spread over a large number of students.

The cost of CBL materials is an issue that has been raised by many researchers (see Groomer, 1981; Sangster, 1992a; Jensen & Sandlin, 1992; Rawlingson & Sangster, 1992; Bhaskar, 1982; Togo & McNamee, 1995). Jensen and Sandlin (1992) for example noted that CBL can lead to cost effective interactive education and training, and that instructors should try to produce innovative instructional material to be made available to large numbers of students. An in depth analysis on cost structures of CBL material was conducted by McInnes et al., (1995). These authors provided a quantitative assessment of the cost of CBL material when used in a supportive and supplantive way, and compared this cost to the conventional delivery of lectures and tutorials in a one semester period. Costs were calculated on a per student basis, and the analysis showed that as student numbers increase, the costs of CBL material per student decreases. Results showed that the use of CBL to supplant lectures leads to cost savings for classes up to 80 students – the smaller the class the greater the cost savings when compared to
the cost of a lecturer's time. The use of CBL to supplant tutorials leads to cost savings for classes of over 60 students. Supportive CBL will increase costs and not decrease class time sufficiently for academics; supplaiant CBL has the potential to reduce costs - again when compared to a lecturer's time.

2.4.6 Future research in the use of CBL with accounting education

Throughout the development and use of computers and CBL materials in accounting education there have been on-going calls for further research (AAA Report of the Committee on the Role of the Computer in Accounting Education, 1970; McKeown, 1976; Groomer, 1981; Borthick & Clark, 1986; 1987; Helmi, 1986; Kent & Linnegar, 1988; Sangster, 1992a; 1992b; McInnes, et al., 1995; Lane & Porch, 2002). Togo and McNamee (1995) stated three guideline questions for using CBL in the curriculum need to be asked before using CBL materials in the curriculum. These are:

1. will the computer assignment enhance learning of the accounting concepts;
2. will the computer assignment create time conflicts that would adversely affect student learning of accounting concepts, and
3. will students successfully completing the CBL material also improve their grades in the course?

Interestingly, the later question linking CBL use and performance has to a large extent been debated since the creation and use of CBL materials (McKeown, 1976). The same issue also appears in later writings. McCourt Larres and Radcliffe (2000) for example stated that data on student opinions of CBL may reflect an over- or under-estimation of the effectiveness of CBL as a learning tool, and to address this deficiency, future research should be based on results of assessment designed to facilitate objective measurement of the effectiveness of the different learning media. After an extensive CBL literature review, both Rebele et al., (1998b) and Bryant and Hutton (2000) stated that the focus of future research into CBL materials should be on whether, and in what context, the use leads to effective and efficient student learning.

2.4.7 Summary of CBL use in accounting education

CBL has a long history as a teaching method in accounting education and is well suited to teach accounting topics. CBL has proven to be useful and effective for students at all
Applying cognitive load theory concepts...

levels of accounting, and CBL allows learners flexibility and enables students to receive immediate feedback. Extensive prior research has shown that the use of CBL generally does not hinder the performance of students compared to traditional teaching methods, and in many cases performance has benefited when CBL has been used. Generally student attitudes to CBL as a teaching technique have also been positive.

From the broad topic of CBL use in accounting education, this section of the literature review has narrowed and concentrated the focus of the present research to the ongoing calls to measure the effectiveness of CBL materials. This is shown in Figure 2.6.

Figure 2.6: The area of interest within the CBL use in the accounting education topic

The next section draws together the three topics already discussed, and outlines the further areas of research that this thesis will focus on.
2.5 Section D: Linking cognitive load theory, feedback research and CBL use in accounting education

2.5.1 Introduction
The literature in this chapter has to date reviewed the three topic areas related to this thesis. This final section (Section D) draws together common aspects of the three topics and outlines the present areas chosen to investigate.

2.5.2 Cognitive aspects of learning
Recent reviews of educational technology research (summarised in Bryant & Hunton, 2000; and Mason & Bruning, 1999) have noted the progression from behavioural to cognitive psychology. Cognitive theories focus on how learners mentally process instructional materials, and involves not only studying the technology as an independent variable itself (as previously in behaviourism) but also to examining the interaction between the media and the learner, and the mental processes that occur within the learner. Bryant and Hunton (2000) noted that cognitive influences play a very important role in designing instruction, and researchers should consider learner attributes in instructional design particularly when incorporating new technology.

Two key learner attributes that affect learning in educational technological research include mental effort and prior knowledge (Thompson, Simonson & Hargrave, 1992). These attributes have also become important in aspects of feedback research (see reviews by Kulhavy & Wager, 1993; Dempsey, et al., 1993; Hannafin, Hannafin & Dalton, 1993) and accounting educational studies (see review by Bryant & Hunton, 2000; and studies by Bonner & Walker, 1994; Cloyd, 1997; Wynder & Luckett, 1999; Rose & Wolfe, 2000). The cognitive aspects of mental effort and prior knowledge are an important part of cognitive load theory, and are important in the present thesis.

2.5.2.1 Mental effort
Mental effort is a cognitive attribute that affects learning, and prior educational research (noted in Bryant & Hunton, 2000) suggests that higher levels of mental effort can improve learning. Mental effort is an important aspect of cognitive load theory as noted in Section 2.2.6 of this chapter.
2.5.2.1.1 Mental effort and feedback research

While research into feedback has moved from a behavioural to a cognitive view (Dempsey, et al., 1993; Mason & Bruning 1999), a logical extension taken up in the present research, is to link aspects of feedback research to cognitive load theory. Figures 2.4 and 2.5 focus on the important aspects of the future investigations in this thesis within cognitive load theory and feedback research. Drawing on these two topics, the present thesis will apply cognitive load theory principles to feedback research and determine what type of feedback is most efficient in CBL materials. To date no studies have been conducted that investigate the amount of feedback for effective learning in relation to the instructional efficiency paradigm in cognitive load theory (see Paas, et al., 2003; Renkl & Atkinson 2003).

Different feedback types may be evaluated by collecting measures of effort while students are learning via the feedback received. These effort measures can be combined with performance, and compared to determine the most efficient instructional design of the forms of feedback in the CBL materials. The instructional efficiency measure would then provide information contributing to the discussion as to the most appropriate amount of feedback that enhances schema construction and allows students to learn at the germane level in the CBL materials.

Section 2.3.7.1 of this thesis reported that debate exists between the usefulness of verification alone (basic feedback) and verification with elaboration (rich or detailed feedback) when applied to CBL materials. In terms of cognitive load theory, while basic or limited feedback may not overload working memory as it does not involve a great deal of mental processing, does it result in less schema development because of its brief nature? Conversely while detailed or rich feedback may add an extra processing load to working memory, does the detailed nature enhance schema formation? Therefore a major issue in the present thesis is to determine whether some feedback types are more efficient than others in terms of cognitive load theory principles.

A follow-on issue here is whether too much feedback can become redundant. On the basis of existing information about feedback and redundancy (see Kulhavy & Stock, 1989; Sweller, 1999) increasing amounts of feedback may lead to greater chance that
the feedback becomes redundant for the learner, and this issue can be debated in the context of the cognitive load theory paradigm, and the instructional efficiency measure.

2.5.2.1.2 Mental effort and accounting research

In terms of accounting education, a number of studies have noted the importance of effort when analysing how students learn concepts; however desirable opportunities to research mental effort in relation to accounting are also noted (see Libby & Tan, 1994; Rose & Wolfe, 2000; Bryant & Hunton 2000). Libby and Tan (1994) for instance stated that in modelling the determinate of audit expertise, a major omission included the effect of effort on learning. Rose and Wolfe (2000) also acknowledged the importance of effort in the learning process. Rose and Wolfe (2000) recorded effort using time expended on the practical problems, and called this effort "duration of time" (see also Cloyd, 1997). The authors (i.e., Rose & Wolfe, 2000) however reported that the "duration of time" measure for effort was limited and that other measures exist.

As cognitive load theory has effectively measured effort, and shown that the subjective effort measures (Likert scales) are reliable and valid, these same measures can be directly applied to accounting education, and, in the case of the present study, to CBL materials in accounting. Investigations of this type would provide a link between Figure 2.4 dealing with the instructional efficiency measure in cognitive load theory and Figure 2.6 dealing with the effectiveness of CBL materials. The subjective effort measures have proven to be successful across a broad range of subject areas (see Paas, et al., 2003; Tuovinen & Paas, 2004), and applying this effort measurement method to accounting educational CBL materials would be appropriate given the success of the past cognitive load studies, the growing importance of cognitive aspects in accounting education, and the call for more effort measures to be applied to accounting research.

From the subjective mental effort measures, cognitive load theory (with performance measures) can determine the efficiency of CBL materials. Prior accounting research has examined only the effectiveness of accounting based CBL materials largely determined by an absolute performance measure via testing, and to a lesser extert student opinions and cost effectiveness (see Section 2.4.5). Cognitive load theory suggests that more information is provided when efficiency of instruction is measured. Efficiency is
determined by an absolute outcome measure such as performance with an input measure of effort.

In summary, both the accounting educational literature and feedback research is devoid of research which applies the two dimensions of performance and effort to measure the efficiency of instruction. This thesis will fill this void.

2.5.2.2 Prior knowledge
In the cognitive psychology literature, an individual’s overall knowledge set is generally represented by various schemas or organised networks of prior knowledge (Sweller, et al., 1998). Learning occurs when individuals are able to embed new information into existing schemas and create meaningful relationships. In this context, a student’s prior knowledge is the most powerful influence in predicting the extent of subsequent success (Snow & Lohman, 1984; Wager & Mory, 1993). Individuals who possess significantly related prior knowledge generally make better choices, draw conclusions more rapidly, and work faster than those with only a limited related prior knowledge (Hannafin, et al., 1993).

2.5.2.2.1 Prior knowledge and feedback research
In terms of feedback research, Kulhavy and Wager (1993) noted that, while there is no question that feedback increases lesson performance, the debate over the benefits of different feedback forms should include information on the learner’s prior knowledge - that is the learner’s knowledge state at the time of responding should be known. Noteworthy, however, is the absence of research that considers different feedback forms and prior knowledge in CBL materials (see Morrison, et al., 1995; Smith & Ragan, 1993, and Section 2.3.7.2). Hannafin et al., (1993) also stated that emerging learning technologies permit differences in related prior knowledge to be accommodated by adapting the nature and type of feedback, yet studies of this type have not featured in the feedback literature. Hirst and Luckett (1992) further noted that investigating the relative effectiveness of different types of feedback is questionable if the state of knowledge development is not known.
Arguments exist for both basic and rich feedback in a CBL environment (see Mason & Bruning, 1999), with both Hannafin et al., (1993) and Kulhavey and Wager (1993) stating these feedback types should be explored on the basis of students' prior knowledge. This issue provides many opportunities for research. For example, it may be that basic or limited feedback in CBL materials is all that is needed for experts, while for novices basic feedback may not be sufficient. Further, it may be that rich feedback strengthens understanding for both the novice and expert. Alternatively, novices may likely benefit most from feedback that helps to simplify and clarify, while experts may benefit most from feedback that promotes more evaluative deeper processing. Cognitive load theory principles and the measure of instructional efficiency can be used in investigations that compare feedback types with prior learning, and these studies will be dealt with in this thesis.

2.5.2.2.2 Prior knowledge and accounting research

In the accounting education literature the extent to which new information affects learning depends on the learner's extant knowledge of the subject matter (Bryant & Hunton, 2000). In reviews on the influence of prior accounting knowledge, Lane and Porch (2002) stated that a significantly higher number of accounting educational studies have shown that prior accounting knowledge does influence performance in accountancy at tertiary level (see also Keef & Hooper, 1991; Eskew & Faley, 1988; Bartlett, Peel & Pendlebury, 1993; McInnes, et al., 1995; Rankin, Silvester, Valley & Wyatt, 2003). This increased performance is most significant in the first year students at university (Farley & Ramsay, 1988; Keef & Hooper, 1991; Rankin, et al., 2003) and also in graduate accounting coursework (Krausz, Schiff, Schiff & Van Hise, 1999). Bonner & Walker (1994) stated that knowledge gained prior to practising various auditing tasks led to knowledge being acquired more readily and those differences in individual ability result in different levels of learning (see also Libby & Tan, 1994).

While many CBL studies have been conducted, very few have analysed the performances of students based on prior knowledge (see Lane & Porch, 2002 for reviews). Fetter et al., (1986) was one study that analysed the students based on their previous performance in an accounting subject (the subject prior to one being investigated), and concluded that the weaker students were helped more by the
Applying cognitive load theory concepts in a conceptually difficult area. The statistical interpretation used in this study (Johnson-Neyman) was however not widely used in other research. Notwithstanding this study, an important area of research therefore is whether the prior knowledge of a student is an important variable to consider when using CBL materials, and whether students with a prior knowledge of accounting benefit more from CBL materials. The present thesis will deal with this issue.

2.5.3 Accounting education studies and cognitive load theory

A review of the literature on accounting educational studies with aspects of cognitive load theory has shown a dearth of research. Bonner and Walker (1994) however identified worked examples as a potential substitute for understanding rules, and as an effective way of learning. Further, Bonner (1999) noted that of the teaching methods available to accounting instructors, worked examples are frequently used to assist with numerical problems that have a well defined solution, and short questions that have one numerical answer. Wynder and Luckett (1999) also stated that worked examples are of particular interest to novice accountants, as they constitute an important source for understanding and performing various tasks without the need to use detailed verbal and or written instructions (a finding consistent with prior cognitive load studies that demonstrate the benefits of learning from worked examples, see Sweller, et al., 1998; Tuovinen & Sweller, 1999; Kalyuga, et al., 2001a). Wynder and Luckett (1999) found that while worked examples lead to task performance, they may not lead to the establishment of procedural knowledge, as they may not explain the relations between steps or why they are performed.

A small number of studies have associated computer use with aspects of cognitive load theory. In the Kachelmeier et al., (1992) study, a spreadsheet was developed for illustrating and computing employer pension accounting, based on the worked examples learning approach. The study found that students in the treatment semester outperformed those of a previous semester when the aid was not used, and the authors interpret these findings as providing support for the assertion that cognitive processing for difficult material is enhanced by worked examples that provide structure and sequence. A further study by Rose and Wolfe (2000) investigated the location of explanations in a computerised decision aid for teaching taxation and found that decision aids that
promote higher split attention will produce more cognitive load, and less learning; that students with higher problem solving efficiency (higher ability) will expend less learning effort (time), and that decision aid users who expend more learning effort will learn more than users who expend less learning effort.

While these studies have mentioned aspects of cognitive load theory with accounting education (and computer use in accounting) there remains extensive scope for further research. The learning aids mentioned in the studies in this section have involved computers; however research has not associated CBL materials that provide tutorial support and feedback assistance in a teacher-like format to cognitive load theory. The present thesis will therefore fill this void and relate cognitive load theory to CBL materials. The studies relating accounting education and cognitive load theory, have confirmed the usefulness of worked examples as a teaching technique, and the present thesis will extend this literature to investigate worked examples as well as other instructional designs as applied to CBL materials.

2.5.4 Accounting education and feedback forms
Sections 2.3.2 and 2.3.3 of this chapter noted the importance of feedback to the learning process, and this finding is reinforced in the accounting education literature in relation to CBL materials (see Section 2.4.4). Analysis now extends to linking accounting education to forms of feedback.

Accounting education researchers who have examined the effects of practice combined with various types of feedback on the acquisition of knowledge have largely restricted this investigation to comparing two forms of feedback, being outcome and explanatory feedback (see Balzer, Doherty & O'Connor, 1989; Bonner & Walker, 1994; Wynder & Luckett, 1999; Hirst & Luckett, 1992). Outcome feedback provides information about the outcome or correct answer (similar to verification as described by Kulhavy & Stock, 1989), and explanatory feedback provides an explanation of why the outcome occurred (similar to elaboration as described by Kulhavy & Stock, 1989). Hirst & Luckett (1992) noted that some feedback is better than none, and also that outcome feedback when supported with explanatory feedback leads to the most improved learning environment. Bonner and Walker (1994) also noted that outcome feedback does not promote
procedural knowledge acquisition. In contrast, feedback providing an explanation of the properties of the task or such feedback combined with outcome feedback, generally promotes better acquisition of knowledge than outcome feedback alone. This is because people are told why the outcome occurred and they do not infer the explanations from the outcome (see also Balzer, et al., 1989).

While feedback research has examined and tested the most appropriate form of feedback in a CBL context (see Section 2.3.6) and a number of studies have mentioned the importance of feedback in accounting education, there is a deficiency of research on the form of feedback that is most appropriate for CBL materials accounting. Research examining the various forms of feedback in CBL accounting materials would seem relevant given that Section 2.4.4 of this chapter noted that feedback is a major advantage of CBL accounting materials (McKeown, 1976; Sangster, 1992a, McCourt Laras, & Radcliffe, 2000; Kent & Linnigar, 1988; Orpen & Ferguson, 1991; Borthick & Clark, 1987).

The various forms of feedback as used in CBL materials are therefore a major area of research in the present study.

2.6 Chapter summary
A review of the literature on each of the three topics (sections A, B and C), and those topics combined in some form or other (section D) has highlighted a number of issues for further research that will be taken up in this thesis. Cognitive load theory has been widely used to measure the efficiency of different instructional techniques across many subject areas. Applying the same principles of learning would seem appropriate to accounting CBL teaching materials because of the similarity between the structure of accounting and other disciplines. Further, introductory accounting has a history of effective computer use, and a make-up where later learning is strongly dependent on correct previous schema construction.
The present thesis will determine the effectiveness and efficiency of in-house developed CBL materials and forms of feedback used in an introductory accounting course. The investigations will focus on determining the effectiveness of the CBL material based on methods previously used in the accounting education literature, and then extend the literature by determining the efficiency of the CBL material and various forms of feedback according to the principles established through cognitive load theory. As research into students' prior knowledge and various forms of feedback related to accounting CBL materials have not been investigated together, this thesis will also analyse the efficiency of the CBL materials based on these two variables, again applying cognitive load theory principles. From the diagrams presented in Figures 2.4, 2.5, and 2.6, the main area of focus of this thesis is presented diagrammatically in Figure 2.7.

![Diagram](image)

Figure 2.7: Linking the areas of cognitive load theory, feedback research and CBL use in accounting education, and the focus of the investigations that follow

The next chapter outlines the development of the CBL materials.
CHAPTER 3

DESIGNING AND DEVELOPING THE CBL MATERIALS

3.1 Introduction

In accounting education, CBL materials are highly successful with an established history of use that effectively engage students both cognitively and physically (McKeown, 1976; Bryant & Hunton, 2000; Sangster, 1992a; 1992b). The previous chapter (Sections 2.3.5.3 and 2.4.5.1) demonstrated that the CBL form of instruction has been an effective teaching method, providing immediate, corrective and elaborative feedback enabling effective schema creation (Cerpa, et al., 1996; Rose & Wolfe 2000; Bryant & Hunton 2000; Sponder & Hilgenfeld, 1994). This chapter now outlines the development of the educational CBL materials and the feedback used in the present thesis and for teaching the accounting subject.

The in-house developed CBL materials included teacher-like feedback that was intended to resemble a teacher’s comments that would be provided to students in a normal face-to-face teaching situation. The feedback was presented in a variety of forms – that is it may have involved verification (or basic responses), elaboration (more detailed responses involving a variety of task specific, instruction-based, or extra-instructional information), praise, or a combination of these.

The in-house developed CBL materials were used to investigate the effectiveness and efficiency of this teaching method through a number of studies.

3.2 Issues in developing the CBL materials

There are many standard CBL packages that exist for the purposes of teaching accounting (see Nicholson, 1993; Bagranoff, 1993; Jensen & Sandlin, 1995; Nicholson, 1997; Mabey, Topham & Kaye, 1998;) and many of these have been evaluated in prior accounting research (for example see McKeown, 1976; Groomer, 1981; McInnes, et al., 1995; Lane & Porch, 2002). These CBL materials (and the feedback) are standardized in that all students use the same CBL materials.
Designing and Developing the CBL Materials

Accounting education and feedback research suggests that the use of one standardized CBL material package is not optimally appropriate, particularly... this material does not take into account differences in the prior knowledge of students (Bryant & Hunton, 2000). Jensen and Sandlin (1995) noted that hypertext and hypermedia authoring tools can be used to develop materials for use in CBL instruction when commercial aids are neither available nor suitable for a particular course. After evaluating much of the commercially available CBL material, it was decided in this instance to design CBL materials specifically for this introductory accounting course.

While the cost and time required for authoring and developing CBL material are widely acknowledged hindrances (McKeown, 1976; McInnes, et al., 1995; Williams, 1988; Marshall, Samson & Dugard, 1995), a number of grants were received to develop the current CBL material. McInnes et al., (1995) noted that once in-house CBL materials are developed they can become cost effective.

There were many reasons for opting to design in-house CEL materials. The CBL material could be tailored to the particular course and linked directly to the supporting printed material (that is the textbook, and other material supplied by the university), rather than to generic material (Bagranoff, 1993). The in-house designed CBL material would be compatible with the lecturer’s teaching style (e.g., Sangster, 1992a noted an approach adopted in a commercially available CBL package was at variance with what many teachers would do). The information presented by the CBL (and the feedback) could be as close as possible to face-to-face instruction, particularly as in this case, the designer of the CBL material was also the person in charge of teaching the subject. Thus the instructions and the feedback could be based on those provided in a classroom setting, so there is a degree of compatibility between what was designed for the CBL material, and what was taught in a face-to-face situation. The computer teaching material and the feedback could be equally useful to students regardless of whether they were attending class or not, and all students could see the same material in the same uniform way. The CBL material could be completed at any time, and at the student’s own pace, thus providing flexibility in learning. Finally, after development, the CBL could later be updated and customized.

See the beginning of the thesis under the heading “Teaching and research grants awarded from this research” for a list of the grants awarded to develop and research the in-house developed CBL materials.

6
Applying cognitive load theory concepts ...

according to the pedagogical style and preference of the instructor (Jensen & Sandlin 1995).

3.3 Designing the CBL material with hypertext generated by the Toolbook authoring language

The CBL material was designed using the hypertext-based Toolbook authoring language, by a local multimedia development company in conjunction with the subject adviser of the introductory accounting subject. The developer paid particular attention to the aesthetics of interface design, and the subject adviser was concerned with pedagogical issues such as the content, objectives, feedback and learning instructions of the accounting CBL material. Khan (1995) argued both areas were needed to produce good CBL materials and applications, while Harding, Lay and Moule (1996) noted that academics make good courseware authors, and this is particularly the case in accounting education (Holt, Boyce, Carnegie, Lourens & Bigelow, 1995).

The Toolbook authoring language was particularly well suited to develop accounting CBL material, as a common feature of both the accounting subject and hypertext generated by Toolbook is their reliance on structure for effective learning. Introductory accounting in particular is an ordered subject that requires understanding of a number of concepts before new information is introduced. Learning new concepts in accounting is difficult if prior schemas have not been established and new concepts mastered, and future learning should not proceed unless prior conceptual knowledge has been acquired.

Hypertext’s theoretical base also stems from combining schema theory with active structural networks. Instead of using open-ended browsing, appropriate structuring of instructional hypertext offers a form of ordered dialogue between teacher and student (Winter & Harrington, 1994; Lennon & Maurer, 1994). This process involves learning and navigation to a network based system in which the learner essentially follows a teacher’s route through the material, allowing the designer control over the display and the elaboration (Wager & Gagne, 1988). Stanton (1992) noted that users of hypertext tend to be very task specific and hypertext operates well as an educational aid. Hypertext used in a structured format where students have little previous influence over the direction of what is to learned leads to an efficient form of learning (Stanton, 1992).
Toolbook also allows the creation of structured feedback where computer mediated two-way communications occurs whilst accommodating course requirements (Winter & Harrington, 1994). Toolbook-generated hypertext allows feedback to be programmed into CBL materials with both correct and incorrect alternatives, thereby promoting flexibility, and the ordered learning in hypertext means that the materials can be presented to focus on what is to be learnt.

3.4 The CBL material and how the feedback worked

Wager and Gagne (1988) stated that plans and decisions made in designing CBL materials are no different from those that must be made when designing instruction for any other medium. The structured CBL material designed using Toolbook was intended to provide tutorial support with the CBL used in a supportive way to assist students to achieve the objectives of an introductory accounting subject. The computer screen would attempt to some extent resemble printed material or information presented on a blackboard, and the instructions were the teacher's comments on how to complete the exercise (see Appendix 1 for a screen shot where a blackboard was used to attempt to resemble a face-to-face teaching situation).

As students responded to the questions asked by the CBL material, they could check the accuracy of their responses and receive feedback. The feedback provided at least verification, but often verification, elaboration and praise, with both verification and elaboration being the critical components of effective educational feedback (Kulhavy & Stock, 1989). The feedback was instant and immediate, both being important facets of effective and active learning that would promote learner interactivity (Mabey, et al., 1998). The feedback was provided at all stages of the work, so that students could build on small successes and progress from the known to the unknown, providing an increasing degree of learner confidence.

3.4.1 Question types developed by the CBL material

The CBL material utilized many different types of questions to assist in the learning of the individual topics. The tutorial assistance was available through closed multiple choice and true and false questions and open practical and theory questions. The types of questions developed for the CBL material were chosen because they reinforced important accounting
Applying cognitive load theory concepts ...

procedural rules and research has shown that accounting students benefit from repetition and drill and practice (Boyce, 1999; Bryant & Hutton, 2000). The CBL material also sought to provide questions, which developed higher order learning including competence in a number of areas such as knowledge, comprehension, application and analysis (Bloom, 1956). This learning was provided largely through the practical and theory type questions.

In terms of the multiple choice questions, students were provided with problems that either required theory-based or practical (calculation) answers. There were usually four (sometimes five) alternatives with one answer being correct. To complete the multiple-choice questions, students had to select one response (see Appendix 2 for an example of a multiple choice question).

Students who selected an incorrect alternative received teacher-like feedback on a previously hidden screen. The feedback when incorrect could provide the student the correct answer (knowledge of correct response); ask the student to try again (answer until correct or knowledge of response); provide some elaboration such as offering a page reference in the text, indicating a possible (mis-) interpretation of the question; offer a reason for the wrong answer, or elaborate on the correct answer (see Appendix 3 for an example of an incorrect choice of the multiple choice question, where the correct answer is then provided). In structured dialogue that mediates this interaction, the student is not only advised of the wrong answer, but is encouraged to take steps to resolve the learning difficulty. The feedback provides both correct and incorrect responses as described by Kulhavy (1977). For students who chose the correct answer, the teacher-like feedback is similar, as the students could be provided with elaboration and directed to further references, or provided with expanded information (see Appendix 4 for an example of the screen layout where a correct multiple choice is made).

The true and false questions might require calculation answers or be based on theory. After selecting a response, the student is provided with teacher-like feedback that included information about the correctness of the response (verification) and this feedback could be combined with elaboration and praise (see Appendix 5 for an example of the screen layout of a true and false question, and the feedback when a correct and incorrect answer has been provided).
The CBL material also had the ability to evaluate variable responses to open-ended or theory type questions and the feedback responses could be well handled by Toolbook generated hypertext.

An example of a theory question asked in the introductory accounting CBL material was “Define an asset”. In this situation, the Toolbook authoring software allowed key concepts to be surrounded by a range of synonyms and scanned against the content of an answer. Typical theory questions (see Appendix 6 for an example of a theory question seeking application, and Appendix 7 for an example of a theory question seeking knowledge) can be well handled in Toolbook. When a student response sufficiently matches the reservoir of synonyms, a confirmatory response can be provided with or without some elaboration (see Appendices 8 and 9 for examples of a screen layout where a correct response is made to a theory question and the feedback that is provided). Where an inadequate match occurred, a reply can be supplied indicating an incorrect response and the feedback can then provide some encouragement and redirect the student to try again (answer until correct, or knowledge of response) or simply provide the correct answer (knowledge of correct response) both with some elaboration (see Appendices 10 and 11 for examples of the screen layout where an incorrect response is made and the feedback provided).

Finally, because of the nature of the introductory accounting subject, there were many practical types of questions designed and used in the CBL format. Like the other questions, the practical questions attempted as much as possible to resemble those presented in classes, incorporating teacher-like feedback. For example, a major area of work in an introductory accounting course is the completion of balance day adjustments. The CBL material that was created to teach balance day adjustments included developing one screen that would provide the adjustment and the general journal structure with blanks for the student to complete (see Appendix 12 for an example of the screen layout to complete the initial balance day adjustment general journal entry). In each segment, as data was entered the CBL material (when asked) would provide feedback. Because of the structured nature of the topic, students needed to complete all the information correctly before they could proceed to the next stage. The teacher-like feedback used was a

---

7 Balance day adjustments can also be called end-of-period adjustments, particularly in the USA.
Applying cognitive load theory concepts ... 

combination of verification, elaboration and praise, provided at each completion stage. After completing all sections of the balance day adjustment general journal entry correctly, students could then proceed to the next stage, which in this particular case involved updating the adjusted trial balance with the new account balances (see Appendix 13 for an example of the screen layout to complete the adjusted trial balance).

Another example of a practical question devised by CBL material format was the closing of revenue and expense ledger accounts, and the subsequent preparation of an income summary account. In this situation, students were provided with "T" shaped ledger accounts of revenues and expenses on the first screen, with instructions to close these accounts by entering information in the spaces provided. After the "T" ledger accounts were successfully closed, students were then asked to update the income summary account. Through guided instructions and teacher-like feedback at the completion stages, the learning tasks could be completed (see Appendix 14 for five screen shots and the feedback used to introduce this topic, and the feedback for when an incorrect and correct response was made).

Other practical questions that were built into the present CBL materials involved the completion of accounting reports where account names were moved from a trial balance to either a Profit and Loss Statement or a Balance Sheet. For example an account called bank may be "dragged" from the trial balance and "dropped" into the Balance Sheet and more specifically into the current asset section of the Balance Sheet, with guidance and feedback.

In terms of cognitive load theory, the introductory accounting CBL materials provided instructions and feedback that encouraged schema formation by working sequentially through the CBL material in a step-by-step structured format. The chronological nature of the accounting subject (and the way the CBL material was developed in the Toolbook authoring environment) attempted not to overload the working memories of

---

8 An Income Summary account may also be termed a Profit and Loss account, or a Profit and Loss Summary account

9 The Profit and Loss Statement is now referred to as the Statement of Financial Performance. However, Profit and Loss Statement is mentioned in text, to reflect the same name as used in the CBL material.

10 The Balance Sheet is now referred to as the Statement of Financial Position. However, Balance Sheet is mentioned in text, to reflect the same name as used in the CBL material.
the students and keep the total cognitive load within manageable, but germane levels engaging students in the learning. Only relevant information was available on the screens so as not to distract students with redundant information or split attention problems. The feedback while being varied (in that the feedback contained a combination of verification, elaboration and praise) was immediate.

3.5 Evaluating the CBL material

Throughout various development stages, the CBL material was evaluated against a number of tools. One such evaluation instrument that is widely acknowledged as an effective measure for evaluating CBL materials (Nicholson, 1993), and externally devised by the Centre for Computers in Teaching Initiatives - Accounting, Finance and Management (CTI - AFM) was used. The instrument consisted of a set of questions covering the aspects of CBL content, learning procedures, learner activities, interactivity, feedback and evaluation of achieved learning was used (see Appendix 15 for a copy of this checklist). Nicholson (1997) argued checklists are easy to use and if carefully constructed, can guide evaluators to consider many different variables which without a set of prompts would be difficult to keep in mind. The developers of the present CBL material considered and then evaluated the product positively against the CTI-AFM standards. Later the CBL material was pilot tested and then assessed anecdotaly by a small group of introductory accounting students. McCall (1988) noted that literature on integrating computers into accounting education often neglected the responses of students. Kwok and Jones (1995) stated that to understand how to teach people effectively with computers it is necessary to find out what people want and what they expect from computer teaching materials, and the pilot test allowed students' views to be taken into account.

The CBL material was also presented at a number of educational and accounting conferences\(^\text{11}\) and the feedback from educators and academics at these conferences was used to further enhance the material before being made available to students. After these evaluations, modifications were made before the CBL material was used with students in the studies that follow.

3.6 Chapter Summary

\(^{11}\) See details of the presentations at the beginning of the thesis under the heading "Publications from this research".
This chapter has outlined the rationale for developing in-house CBL materials, and the choice of Toolbook as the authoring environment. The chapter also outlined the types of questions developed in the CBL materials, and how the teacher-like feedback operated. Various aspects of the prior research into cognitive load theory, feedback research and general and accounting educational research influenced the development of the CBL material.

The next chapter examines the methodology and research designs used in the various studies in this thesis.
CHAPTER 4
METHODOLOGY

4.1 Introduction to the methodology employed
This thesis involves four related studies with specific aims and objectives, and this chapter will outline the methodologies used in these studies. The studies were carried out to examine the use and test the effectiveness and efficiency of the in-house developed CBL materials with particular formats of feedback when teaching introductory accounting. The methodologies chosen involved a one-shot descriptive study, a between-subjects analysis and a post-test only control group design.

The methodologies used in this thesis were designed to ensure that reliability and validity (internal and external) were sufficiently addressed. Reliability is the degree to which the same event or behaviour produces the same outcome each time it is measured. Internal validity is the extent to which the instrument measures what it is intended to measure, and external validity is the application of the present conclusions to other general situations (Blaikie, 2003). This chapter also outlines the methodologies used in key seminal studies from the use of CBL materials in accounting education, and from cognitive load theory.

4.1.1 Overview of individual studies
Study 1 aimed principally to collect attitudinal and performance data on the in-house developed CBL material. To elicit the large amount of data, Study 1 involved a one-shot descriptive study design, a between-subjects research design, and a post-test only control group design. Study 1 provided the foundations for the subsequent studies as there was some evidence that the CBL material assisted learning outcomes. Studies 2 – 4 then provided more rigorous tests of cause and effect relationships through randomisation in post-test only control group designs (Borg & Gall, 1989). Each methodology chosen in this thesis has recognised benefits. Similar research designs, particularly designs using control groups and randomisation have been used extensively across the three topic areas individually and in combination (see Libby & Tan, 1994; Bonner & Walker, 1994; Wynder & Luckett, 1999; Rose & Wolfe, 2000; Mason & Bruning, 1999).
4.2 Reliability and Validity in designing the CBL material and feedback

There were many consistent aspects that promoted both reliability and validity in the design of the CBL materials.

The subject adviser of the introductory accounting subject initially developed the CBL material. This person had been in charge of that subject for six prior years, and had taught the subject both by distance education and face-to-face modes. That same person also remained in charge of the subject for the entire period of the present series of studies. This promoted consistency in the pedagogical aspects of the course, the CBL material design, and the feedback.

As explained in Section 3.5, when designing the original CBL materials and feedback, various standards were applied in relation to content structuring, learning procedures, learner activities, interactivity, feedback and evaluation of achieved learning (Nicholson, 1993; 1997). The thoroughness of the approach used in the development of the CBL materials meant again that as an independent variable the CBL material would promote reliability and validity.

Except for particular aspects of the CBL materials (such as the appearance of some screens and some feedback modifications, mainly due to newer versions of the authoring software program or variations in the theoretical issues being tested) the CBL material remained largely the same in structure throughout the studies. The CBL material was also to be used on a variety of students, studying in both internal and distance education modes. This student variety helped to confirm reliability of the CBL material effects, and the external validity of the studies themselves.

4.3 Similar prior studies

All studies are unique in their own way, yet designs also exhibit aspects that can be repeated in future cases. Because of this and also noting that a single study will not disclose everything about behaviour, aspects of the design of some prior studies in CBL use in accounting education and cognitive load theory were adapted in the present studies.
4.3.1 CBL use in accounting education studies

The present thesis involved the use of a control group to measure a treatment group that completed the CBL material, against a non-treatment group. This is a commonly adopted experimental design used for identifying causal relationships, and has been widely used in prior accounting studies (see Section 2.4.5, the seminal work of McKeown, 1976, and Table 2.2). Control groups have normally comprised participants from the same class studying at the same time; however prior year students (between-subjects designs) have also been widely used.

Where control groups have not been used, authors have reported this absence as a potential limitation. Lane and Porch (2002) for example examined student attitude to CBL material use, and a limitation of that study was the absence of a control group for comparison purposes. The authors wrote (p.230):

“Given that all students examined in this study were taught using the same teaching method it is difficult to separate out the effect that the use of CBL (sic) has on students' performance. The use of a control group taught using more traditional teaching methods would have enabled a comparison between the performance of students taught using each method...The lack of a control group and the use of the 1-group pre-test post-test design represents a threat to internal validity of the research design.”

McCourt Larres & Radcliffe (2000) also examined the effectiveness of weekly CBL tutorials based on students' perceptions of the CBL materials and concluded that a limitation was an effective comparison based on performance. The authors wrote (p.254):

“It must be acknowledged that the findings of this study are based on self generated data rather than measures of actual performance and, as such, may reflect some over- or under-estimation of the effectiveness...Moreover, reported student preferences may reflect differences in individual learning styles rather than objective measures of efficacy of the different delivery media. To address this deficiency, future research could be based on results of continuous assessment projects designed to facilitate objective measurement of the effectiveness of the different learning media”.
The studies that follow in this thesis focus on testing causal relationships by similar means as those advocated in prior accounting studies (see Table 2.2). Experimental research that compares the educational outcome of different treatments is a well-established procedure and central to the testing of causal relationships is the randomisation of subjects between a treatment and non-treatment group. These designs apply in this thesis.

4.3.2 Cognitive load theory studies and the Paas and van Merriënboer (1993) seminal study
The present studies adapted aspects of the seminal work of Paas and van Merriënboer (1993) in cognitive load theory with regards to assessing the instructional efficiency of educational treatments and designs. This same technique has also been adopted in many studies across a range of subject areas.

Paas and van Merriënboer (1993) used the true experimental research design approach when obtaining information on the efficiency of a number of instructional conditions. The authors collected three sets of randomised effort and performance data. Two of these data sets compared two training conditions (one with partly worked out problem solutions that had to be completed, and the other with worked out solutions that had to be studied), and the other a control group. Section 2.2.6.3 and Figure 2.3 of this thesis provide detailed explanations of the method of calculating instructional efficiency employed by Paas and van Merriënboer (1993). After the relative instructional efficiency of the three conditions was calculated, ANOVAs were used to compare whether significant differences in the three treatments existed, and whether one type of instruction was significantly more efficient that the other.

In the cognitive load studies between 1988 and 2002, the same instructional efficiency approach developed by Paas and van Merriënboer (1993) has been adopted in nearly 70% of the studies (for example Paas & van Merriënboer, 1994; Cerpa, et al., 1996; Marcus, et al., 1996; Kalyunga, et al., 1998; Kalyunga, et al., 1999; Tuovinen & Sweller, 1999; Yeung, 1999; Kalyunga, et al., 2001a; Kalyunga, et al., 2001b). In some
of these cases the measures of effort have come during learning, while others have involved measuring effort when completing a test (Tuovinen & Paas, 2004).

4.4 Addressing reliability in the present study

According to Heiman (2001) all research suffers to some extent from problems of reliability and validity, however the key to minimising a study's weakness is to anticipate potential threats and build in controls that eliminate them. Reliability was addressed in the individual studies in the following ways.

Some of studies (studies 2, 3 and 4) used true randomisation – a genuinely unbiased method to the allocation of the elements or units to the treatment condition, and integral to any true experimental design (Heiman, 2001; Borg & Gall, 1989; Singleton & Straits, 1999). If the participants were assigned to a particular condition based upon some inherent characteristic randomisation was undertaken within these groups (for example in Studies 3 and 4, students were allocated to a CBL format based on their prior knowledge of the subject area, yet within these groups randomisation still occurred).

Studies 1 and 2 in this thesis used control groups. The control group in this instance was a group of participants measured on the dependant variable, but receives zero amount of the independent variable, being the CBL material. The control group for Study 1 was distance education students using only printed material and no CBL material, and the control group in Study 2 was internal students receiving only face-to-face instruction. A control group shows how participants behave without the treatment, and this enables comparisons with the treatment group.

Study 2 in this thesis involved a literal replication, where the initial study was duplicated to obtain more subjects. This was to avoid the chance factors that may have appeared due to low numbers, with the greater sample numbers meaning greater confidence in the results (Heiman, 2001).

Studies 3 and 4 duplicated the conditions and procedures within the methods section of Study 2 in an operational replication (see Borg & Gall, 1989).
4.5 Addressing internal and external validity in the present thesis
Singleton and Straits (1999) and Zikmund (2003) noted several common threats to internal validity, including history, maturation, testing effects, instrumentation, statistical regression, selection, and attrition. The threats to internal validity were handled by the various studies in a number of ways.

Study 1 tested the usefulness and effectiveness of the in-house developed CBL materials. Through a one-shot descriptive study design, the study sought open responses on a large amount of general information on the CBL material. Singleton & Straits (1999) stated that the most appropriate design to elicit attitudinal information is a one-shot case descriptive study, particularly as this was the first time that students had been provided with the CBL materials and this was the first formal evaluation of those materials.

One stated benefit of the one-shot descriptive study design is that no pre-test is used. In studies of attitude, a pre-test may very well alert subjects to the treatment to follow in such a way as to make them more receptive (or resistant) to it and as such the findings would have little external validity (Singleton & Straits, 1999). Attitudinal surveys examining student opinion of CBL material have featured heavily in recent accounting education studies (McCourt Larres & Radcliffe, 2000; Lane & Porch, 2002). Singleton and Straits (1999) however noted that a flaw in the one-shot case study design is that it provides no adequate basis for comparing the findings with other observations, and some process of comparison is essential for scientific inference. To address this, Study 1 also examined the effectiveness of the CBL materials by comparing student performance.

Student performances were compared using a between-subjects research design, where the current group of distance students were compared with the performances of a prior year's group. Further, where the users and non-users of the CBL material from the current semester could be established, these performances were also compared. Independent samples t-tests were used on a number of criteria to determine if the students were similar for comparison purposes.
Methodology

For the between-subjects research design, the threat of history confounding the results is controlled, as the subject content had not changed over time, except that the CBL had been used for the treatment semester. Since there is no pre-test, the threats of testing and statistical regression are absent, and instrumentation is not a problem because the measurements (testing procedures) are equally reliable and valid for all students. Attrition is not an issue because there were sufficient numbers of students who were enrolled and completed the subject and the percentage of students who dropped out from the subject were no different from prior years. Finally maturation factors operated in the same way across the different semesters. The advantage of the between-subjects design was that each score is independent of the other scores, because each participant is measured only once. A disadvantage is that possible confounding variables can lead to individual differences between the groups; however, prior literature suggests the relevant variables were controlled.

For the performance comparisons between the users and the non-users of the CBL material in the current semester, the threats to internal validity are similar to the between-subjects research design. The threat of history confounding the result is again controlled, as all students should experience the same major environmental events – the subject had not changed over the time of the study. Since there is no pre-test, again the threats of testing and statistical regression are absent, and instrumentation again is not a problem because again the measurements are equally reliable and valid for all students. Maturation was also not an issue, as any maturation factors that existed operated in a similar way across the total cohort of student group. Attrition is further not an issue as the percentage of students who dropped out from the subject in the current semester was no different from prior years.

When analysing and comparing the performance of the users and the non-users of the CBL material in the current semester, a potential problem affecting the internal validity is that the use of the CBL materials was optional. This may have led to a self-selection bias. Zikmund (2003) noted self-selection bias may occur particularly in attitudinal studies, and it is possible that students who do participate may be dissimilar to those who do not respond even though they came from the same population cohort. The ideal situation to overcome the potential of self-selection bias would have been to
randomly allocate students to either the CBL or non-CBL conditions; however, ethical and university guidelines prevented an allocation. This issue was taken up in Study 2.

Studies 2, 3 and 4 used a post-test only control group design involving the random assignment of subjects to treatment and control groups thus eliminating any chance factor of self-selection bias. Studies 2, 3 and 4 were carried out over short time periods, minimising external events and threats to history and maturation. Similar to Study 1, the studies did not conduct any pre-test, so the threats of testing and statistical regression were absent. Instrumentation was again not a problem because the measurements were equally reliable and valid for all students, and the instruments had been found to be reliable (Paas, et al., 2003; Gimino, 2002). Finally attrition was not a problem, as sufficient student numbers identified in the various groups participated in all aspects of the study, and those students opting out of the study were few.

The samples selected in Studies 2, 3 and 4 consisted of a homogeneous group, being first year internal university students studying introductory accounting (Study 1 also comprised first year distance university students studying the same subject). Caution must be used to generalise the results of these studies to dissimilar groups. While this represents a possible threat to external validity, the external validity of the studies can best be examined by replication studies with various student populations and in other educational institutions using the same CBL materials. This would increase the confidence of the results. Studies 3 and 4 replicated the methodology used in Study 2, further promoting external validity, and using students enrolled by different modes does increase the applicability of the results reported in this thesis.

4.6 Chapter summary

This chapter has reviewed the methodologies used in the various studies in this thesis. A range of methodologies have been chosen dependant on the individual study objectives. These methodologies have promoted reliability and internal and external validity, when examining causal relationships.

The next chapter outlines the first study (Study 1).
CHAPTER 5
STUDY 1: THE EFFECTIVENESS OF CBL MATERIALS AND FEEDBACK WHEN USED BY ACCOUNTING DISTANCE EDUCATION STUDENTS AS MEASURED BY ATTITUDE AND PERFORMANCE

5.1 Introduction
Study 1 was focused on distance education students enrolled in their first university level accounting subject titled "Introductory Accounting A". Distance education students study by the flexible mode, which is based on independent learning materials and a learning support system reliant on received study materials. In the traditional distance education context, the teacher is not present in the learning situation, and the learning group is scattered and largely unconnected. These circumstances limit dialogue, especially timely and elaborated feedback, and the majority of educational communication between teachers and students occurs non-contiguously (Garrison & Shale, 1987).

Distance students were chosen for this study, as it would seem that this group would benefit most from appropriate and timely feedback that could be provided in a CBL material format (Marland, 1997). Prior to the development of this CBL material, distance students had traditionally only received printed (and audio) materials and relied on written, phone, fax and email contact for their feedback with lecturers and tutors, which generally was not as immediate as the feedback provided in CBL materials.

5.1.1 Study materials for distance education students
In the present study, distance education students were provided with the following range of materials to complete the subject.

The prescribed textbook was used for basic understanding. The textbook was required for essential reading and also to complete tutorial questions, and was to be purchased by the student. The printed materials supplied by the University made regular references to the textbook.
Applying cognitive load theory concepts ...

The subject guide provided important information regarding the objectives and aims of the subject, supplied a timetable to complete the weekly work and outlined the assignments and their due dates. The subject guide was supplied by the University as part of the learning package of printed materials (Monash University, 1998).

The subject book provided a breakdown of the weekly topics, the weekly objectives, a summary of the most important topics to be learnt, and a list of the tutorial questions to complete. The University supplied the subject book.

Accompanying the prescribed textbook in a package was the prescribed textbook study guide. This study guide explained the main objectives of the textbook, and provided additional tutorial questions, some with solutions.

The reader provided a selection of chapters from various textbooks (other than that prescribed). These chapters were related to sections of the course. The reader was supplied as part of the learning materials, and students were instructed when to use these additional references.

The audiotape provided basic information on the subject including the work requirements, the assignments, and general examination information. It was very similar to an introductory lecture given to face-to-face students without discussing any specific subject related topic. The audiotape was supplied by the University as part of the learning materials.

The CBL material provided additional tutorial support with teacher-like feedback in CBL format for nine topics out of twelve. The University supplied the CBL material as part of the learning materials with instructions on when to use the material.

5.2 Background

As stated in Section 3.4, the emphasis of the in-house developed CBL materials was to provide students with step-by-step assistance and feedback at various stages of the work. Feedback was immediate and based on typical teacher teacher-like responses.
Study 1

The sequential nature of the introductory accounting subject enabled the CBL materials and the feedback to build knowledge in stages.

As the individual cognitive characteristics of the potential student group (e.g., their age, gender, location and prior knowledge) using the CBL was largely unknown, it was decided to develop and design one version of the CBL materials with a range of feedback forms.

The CBL materials provided different types of questions, and Section 3.4.1, reviewed these, being multiple choice (MC), true / false (TF), theory (T), and practical (P). The feedback provided included a mixture of verification, being either knowledge of correct response (KOCR), knowledge of response (KOR), and answer until correct (AUC) and elaboration, being either topic contingent (TC) or response contingent (RC). Praise feedback was also used. The decisions on what types of feedback to apply varied and were at the discretion of the subject adviser.

The first year introductory accounting course comprised twelve teaching weeks, and twelve topics (also called study guides) with one topic taught each week. Cost and time issues resulted in the CBL being developed for only nine of these topics. A summary of the topics and the types of questions covered is provided in Table 5.1 (see also Appendices 16 - 24 for the screen layouts at the beginning of each topic).
<table>
<thead>
<tr>
<th>Topic</th>
<th>Question/Concept</th>
<th>Verification</th>
<th>Elaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The Accounting Profession</td>
<td>MC, TF, Fill in Blanks (MC)</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
<tr>
<td>2 Basic Concepts</td>
<td>Entity Assumption (MC), MC, TF, Classification (P)</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
<tr>
<td>4 Changes in Owners Equity</td>
<td>MC, TF, Profit-Loss Account (P), Cash vs Accrual (P)</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
<tr>
<td>5 Adjusting Entries and Deferrals</td>
<td>MC, P</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
<tr>
<td>6 Accruals</td>
<td>MC, P</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
<tr>
<td>7 Closing the Accounts</td>
<td>MC, TF, Closing entry stages (P), P</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
<tr>
<td>8 Computerised Accounting Systems</td>
<td>MC, TF</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
<tr>
<td>9 Australian Corporations Law</td>
<td>MC, TF, Statement Analysis (P)</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
<tr>
<td>10 Financial Analysis of Companies</td>
<td>MC, Ratio Analysis (P)</td>
<td>KOCR, KOR,</td>
<td>TC, RC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUC</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.1: Topics, question and feedback types for CBL materials prepared for accounting distance education students

5.3 Aims and Hypotheses

The study had two principal aims:

- to evaluate students’ attitudes regarding the usefulness of the in-house developed CBL material and the feedback, and to compare the CBL material to other traditional teaching material, and
- to compare the performance a group of students who used the CBL material against other groups of students who did not use the CBL material.
Because of the largely descriptive objective of the study, a number of hypotheses were developed from these aims. These hypotheses were broad in that they investigated all aspects of the CBL material. The hypotheses were:

In terms of measures of usefulness of the CBL, the following hypotheses (H1 – H4) were posed:

**H1.** The age of the students has no significant effect on student's rankings and rating of CBL material usefulness.

**H2.** The gender of the students has no significant effect on student's rankings and rating of CBL material usefulness.

**H3.** Previous experience of using computers has no significant effect on student rankings and ratings of CBL material usefulness.

**H4.** Students' area of residence had no significant effect on the ranking and ratings of the CBL material usefulness.

In terms of students CBL adoption the following hypotheses (H5 – H8) were tested:

**H5.** The age of the students has no significant effect on students' adoption of the CBL material, and the frequency of use.

**H6.** The gender of the students has no significant effect on students' adoption of the CBL material, and the frequency of use.

**H7.** Previous experience of using computers has no significant effect on students' adoption of the CBL material, and the frequency of use.

**H8.** Students' area of residence had no significant effect on students' adoption of the CBL material, and the frequency of use.
In terms of whether the instructions on the CBL were easy to follow, the following hypotheses (H9 – H12) were posed:

**H9.** The age of the students has no significant effect on whether students felt the instructions on the CBL material were easy to follow.

**H10.** The gender of the students has no significant effect on whether students felt the instructions on the CBL material were easy to follow.

**H11.** Previous experience of using computers has no significant effect on whether students felt the instructions on the CBL material were easy to follow.

**H12.** Students' area of residence had no significant effect on whether students felt the instructions on the CBL material were easy to follow.

In terms of the feedback provided to students, the following hypotheses (H13 – H16) were examined:

**H13.** The age of the students has no significant effect on whether students felt the feedback on the CBL material was satisfactory.

**H14.** The gender of the students has no significant effect on whether students felt the feedback on the CBL material was satisfactory.

**H15.** Previous experience of using computers has no significant effect on whether students felt feedback on the CBL material was satisfactory.

**H16.** Students' area of residence had no significant effect on whether students felt the feedback on the CBL material was satisfactory.
In terms of performance, the following hypotheses (H17 - H19) were posed and studied:

**H17.** That the final performance of students who used the CBL is not significantly different to other distance education students who did not use the CBL in the current semester.

**H18.** That the final performance of students who used the CBL is not significantly different to other distance education students who did not use the CBL in the two prior semesters.

**H19.** That the final performance of students who used the CBL more often is not significantly better than the students who did not use the CBL, or used the CBL less.

### 5.4 Method

#### 5.4.1 Instrument

The instrument used in this study was the student Computer-Based Learning Evaluation Questionnaire (CBLEQ). The student CBLEQ was specifically developed and sought to satisfy the aims of the study. The CBLEQ comprised 19 questions, and was divided into two sections (see Appendix 25 for a copy of the CBLEQ). Section (a) of the CBLEQ dealt with demographics and usefulness of all the study material provided to the distance students; and section (b) dealt specifically with the use and effectiveness of the CBL material.

All the distance education students who were enrolled in the introductory accounting subject were asked to complete section (a) as this provided information on all study materials. Comparisons of the CBL material could then be made with the traditional (printed and audiotape) teaching material. Analysis of this section was confined only to comparing rankings and ratings of the CBL against other study material, rather than any of the specific hypotheses. Section (b) of the CBLEQ was only to be completed if the distance education students had used the CBL material during the semester. The questions dealt with the computer literacy of the students, the frequency of use (as evidenced by the number of CBL study guides completed), what students felt about the computer instructions, the usefulness of the types of questions, the students' views on
Applying cognitive load theory concepts ... the feedback, and finally the screen layouts. The questions in this section related specifically to the hypotheses.

While the CBLEQ did allow for student anonymity, about a half of the students included their names on the questionnaire so that they could be sent the aggregate results of the findings. With students identifying themselves, it was possible to examine the second aim this study. The total cohort of identified students could be divided into those students who used the CBL material during the semester, and those who did not use the CBL material (the later group of students would have been identified as they only completed section (a) of the CBLEQ). Tests could then be conducted on whether the use of the CBL materials resulted in a different outcome (performance). Further as the subject had not altered from the prior year (except in the use of the CBL material) a between-subjects design could be implemented, comparing the current semester performance with prior years. This analysis replicated prior study designs that have been successfully used in other accounting studies (see Table 2.2).

5.4.1.1 Material used
Section 5.1 lists all the study materials used by the students (being the printed, audiotape and CBL material). The item used to test the hypotheses was the actual CBL material (see Chapter 3, for details of the CBL development and Table 5.1 of this chapter for the types of questions that were asked).

5.4.2 Procedure
5.4.2.1 CBL material
The CBL material was distributed to all distance education students at the beginning of the semester and included was information on how to install and use the CBL material and guidelines on when to apply the CBL to the overall course (see Appendix 26 for a copy of the Study Guide used for the subject, and the instructions for loading and when to use the CBL materials). The students also received the traditional distance education materials comprising printed material and an audiotape.

The CBL material was viewed as a supplement to the written material and provided optional tutorial assistance. The CBL material was not intended to replace the traditional
printed material but rather to provide additional accounting practice in an alternative teaching mode. CBL materials have been used in a similar supportive manner when teaching accounting (see McKeown, 1976; Sangster, 1992a; McLnnes, et al., 1995; Lane & Porch, 2002).

The supportive role of the CBL materials was adopted because the specific textbook and other printed material were essential sources of conceptual and theoretical knowledge, and the CBL provided students with an extra choice in teaching method. A clear statement was made on the literature sent with the CBL material that "the CBL software provided an alternative way to learn accounting" and that the CBL material provided optional tutorial assistance (see again Appendix 26 for a copy of this). For the students who did not have access to a computer, the questions and solutions in CBL material format were available in printed format; however, the step-by-step feedback was not available (see Appendix 27 for an example of a question and answer that was provided in printed format).

Students worked through the conventional study material and the CBL material at their own pace, although a suggested timetable was provided to complete the entire course (see Appendix 28 for an example of the timetable for completing the required semester's work).

5.4.2.2 The Computer-Based Learning Evaluation Questionnaire (CBLEQ)
The CBLEQ was distributed to all distance education students enrolled in the introductory accounting subject after week nine of the semester. There were a total of thirteen weeks in the semester (twelve teaching topics over twelve weeks and a revision week). Week nine was chosen as the most appropriate time to distribute the CBLEQ as this would have allowed students sufficient time to become familiar with the CBL material and complete the CBL exercises.

All students who were enrolled in the introductory accounting subject through distance education were mailed a copy of the CBLEQ. Names of students were taken from the enrolment records at the beginning of semester. In total there were 250 questionnaires distributed (see Appendix 29 for a copy of the letter sent out with the CBLEQ).
Applying cognitive load theory concepts ...

responses were returned in return-paid envelopes over a 6-week period (this 6-week period coincided with the end of the semester and the completion of the examination in the subject). Of the CBLEQ's returned, 103 were useable. The size of the entire cohort of distance education students who had studied the introductory accounting subject in the semester and that had obtained a final mark and grade was 222. Therefore the response rate for the survey was 46% (41% if based on the number of questionnaires distributed). The total student attrition rate from the beginning to the end was typical of prior semesters.

5.4.3 Participants
Demographic information showed that of the 103 respondents, 51 students were male and 52 female. The students came from a wide geographical area (e.g., within the local area (N = 10); from other areas of the state including the state capital (N = 40); interstate (N = 49), and overseas N = 4). The ages of the respondents ranged between 18 and over 46 years (median age group = 26-35 years) and all the students voluntarily agreed to participate in the data collection. The distance education students received only one questionnaire and an outline of the survey's objectives. No follow-up mailing was undertaken.

The analysis of the CBLEQ was based on the responses of 103 students. Of this cohort, 43 students had identified themselves as either using the CBL material (N = 36) or not using the CBL material (N = 7). All 43 had completed the subject and obtained a final mark.

5.5 Results and Analysis
Data were analysed using quantitative and qualitative procedures. Quantitative procedures were used on the forced-choice questions. The qualitative data were subjected to contextual analysis and analysed to identify major and minor themes.

5.5.1 The CBLEQ - Section (a) Questions relating to all study material
Descriptive statistics (such as the mean, median and standard deviation) were used to report on the questions comparing all study material.
The first question in the CBLEQ examined how frequently all students (N = 103) used the range of study materials supplied. The options on frequency of use were more than once per week, once per week, once per fortnight, once per month, once per half semester, once per semester, or not at all. Table 5.2 shows the breakdown of the most frequently used study materials, by percentages.

<table>
<thead>
<tr>
<th>Frequency of Use</th>
<th>SUBJ 1</th>
<th>SUBJ 2</th>
<th>SUBJ 3</th>
<th>SUBJ 4</th>
<th>SUBJ 5</th>
<th>SUBJ 6</th>
<th>SUBJ 7</th>
<th>SUBJ 8</th>
<th>SUBJ 9</th>
<th>SUBJ 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Once weekly</td>
<td>41</td>
<td>51</td>
<td>86</td>
<td>56</td>
<td>18</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once weekly</td>
<td>26</td>
<td>28</td>
<td>7</td>
<td>22</td>
<td>26</td>
<td>1</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once fortnightly</td>
<td>18</td>
<td>16</td>
<td>6</td>
<td>11</td>
<td>23</td>
<td>3</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once monthly</td>
<td>14</td>
<td>6</td>
<td>1</td>
<td>7</td>
<td>22</td>
<td>17</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once per half semester</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>34</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once per semester</td>
<td></td>
<td>3</td>
<td>5</td>
<td>40</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not used</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.2: Frequencies (percentages) of using all the study material supplied to introductory accounting distance education students

Table 5.2 shows that the most frequently used study material was the textbook, with 86% of students stating they used it more than once per week. Table 5.2 also shows there was a relatively high percentage (21%) of students that stated they had not used the CBL material. An open-ended question included later in the survey asked why students did not use the CBL materials, and the major responses given were that students did not have computer access (48%), they lacked the time (14%), or preferred using printed material (10%). This issue will be re-examined in greater detail later. Of the students who did use the CBL material, usage was spread across all frequencies, with most using the C3L material weekly or fortnightly. Most of the subject material tended to have usage concentrated within three or four of the frequencies. The
Applying cognitive load theory concepts ...

audiotape had a very high percentage of use only once per semester, however the information was intended to be used at the start of semester.

The next question was forced choice and asked students to *rank* all the study materials in terms of the most useful (1) to the least useful (7). To avoid self-selection bias (where some students may have ranked a study material high or low, but actually did not use it) the analysis of this question is restricted to students who used that study material. For example one student who had ranked the CBL the least useful stated "...the only reason I found it least useful is that I hadn’t access to a computer and could not use it — what a pity". Such a ranking was not included in the analysis. Table 5.3 shows the number of students who used the material, and the mean rankings and standard deviations in parenthesis (SD) for the usefulness, noting that the lower numerical values indicate the more useful the material.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>N</th>
<th>MEAN RANKING (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescribed textbook</td>
<td>103</td>
<td>1.3 (.72)</td>
</tr>
<tr>
<td>Subject book</td>
<td>103</td>
<td>2.9 (1.5)</td>
</tr>
<tr>
<td>Subject guide</td>
<td>103</td>
<td>3.5 (1.6)</td>
</tr>
<tr>
<td>Prescribed text subject guide</td>
<td>102</td>
<td>3.1 (1.6)</td>
</tr>
<tr>
<td>CBL material</td>
<td>81</td>
<td>4.5 (1.5)</td>
</tr>
<tr>
<td>Reader</td>
<td>100</td>
<td>4.6 (1.5)</td>
</tr>
<tr>
<td>Audiotape</td>
<td>100</td>
<td>5.7 (1.4)</td>
</tr>
</tbody>
</table>

Table 5.3: Mean (standard deviations) rankings of most useful study material

Table 5.3 shows that the students indicated that the prescribed textbook was the most useful study material in terms of ranking having received the lowest average mean. The CBL material was on average ranked higher than both the reader and the audiotape.

The next question asked students to *rate* all the materials in terms of usefulness. For this question a Likert scale was used where 1 = very useful, 2 = useful, 3 = neutral, 4 = not very useful and 5 = useless, and again to avoid any self-selection bias, students
were eliminated if it was shown they did not use that study material (there was a rating of 6 to further indicate if the study material was not used). The results for the mean and median ratings of usefulness are displayed in Table 5.4, with standard deviations (SD) in parenthesis, and also the number of students who used that study material (indicated again by the N column). Again, the lower numerical values for the mean and medians indicate the more useful material.

<table>
<thead>
<tr>
<th>Study Material</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescribed textbook</td>
<td>103</td>
<td>1.13 (.44)</td>
<td>1.00</td>
</tr>
<tr>
<td>Subject book</td>
<td>103</td>
<td>1.59 (.69)</td>
<td>1.00</td>
</tr>
<tr>
<td>Subject guide</td>
<td>103</td>
<td>1.58 (.63)</td>
<td>1.00</td>
</tr>
<tr>
<td>Prescribed text subject guide</td>
<td>102</td>
<td>1.74 (1.1)</td>
<td>1.00</td>
</tr>
<tr>
<td>CBL material</td>
<td>81</td>
<td>2.26 (.81)</td>
<td>2.00</td>
</tr>
<tr>
<td>Reader</td>
<td>100</td>
<td>2.43 (1.1)</td>
<td>2.00</td>
</tr>
<tr>
<td>Audiotape</td>
<td>100</td>
<td>2.84 (1.2)</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Table 5.4: Mean (standard deviations) and median ratings of the usefulness of study material

Table 5.4 shows that the prescribed text was again the most useful study material. Analysis of Table 5.4 also shows that all the study materials were considered “useful” in some way as they all had mean ratings around 1 (very useful) or 2 (useful). The consistency between Tables 5.3 and 5.4 demonstrates that the prescribed textbook was clearly considered most useful. In terms of the CBL material, both Tables 5.3, and 5.4 report similar results where the CBL material is rated, and ranked higher than the reader and the audiotape.

In summary, comparisons of Tables 5.2, 5.3 and 5.4 clearly show that the prescribed textbook was considered the most useful of all the material used by the distance education students. This is not surprising as the textbook was an essential source of information for understanding the objectives of the subject, for completing the required tutorial questions, and was the primary tool for schema creation. Other printed material was also considered important and useful. The analysis of all the study material demonstrated that a productive and beneficial place does exist for CBL material, and the
result of the CBL ranking and ratings are encouraging given that the CBL was used for the first time, and that distance education students had traditionally relied on printed material for their understanding.

5.5.2 The CBLEQ - Section (b) Questions relating to the CBL Material

Section (b) of the CBLEQ gathered data specifically related to the CBL material. Only the students who had used the CBL material were required to answer these questions. From the total sample of N = 103, 79% of responses (N = 81) had used the CBL. The descriptive statistics and analysis that follows is based on these 81 responses.

The first question asked of students concerned their computer literacy. Three alternatives were available and results showed that 12% (N = 10) of students rated themselves as beginners; 43% (N = 35) as intermediate, and 45% (N = 36) as advanced. The next question asked how many of the CBL topics the students had used. Nine topics had been developed for the subject (see Table 5.1), and a large percentage 59% (N = 49) reported using the CBL for all these topics, while 14% (N = 11) reported using only one or two CBL related topics.

Students were then asked to rank the different types of questions in the CBL material in terms of usefulness. This was a forced choice question with four alternatives. Table 5.1 illustrated the types of questions related to each topic, and these question types were divided into four categories, being “practical questions”, “multiple choice”, “true and false”, and “theory questions”. The ranking scale was from (1) to (4) with (1) being the most useful, through to (4) the least useful. To again avoid any self-selection bias, students were eliminated from the analysis, if they did not complete topics involving all types of questions. This left N = 70 for analysis purposes. The mean of the results and standard deviations in parenthesis (SD) of question type usefulness are displayed in Table 5.5. Note again that the lower numerical value for the mean indicates the more useful material.
A question was asked whether students felt the instructions for the CBL material were easy to follow. An overwhelming number of students (93%, N = 75) indicated that the instructions were easy to follow, compared to 7% (N = 6) who stated no to this question. In terms of the screen layouts, 94% (N = 76) of students reported these were easy to follow, while 6% (N = 5) disagreed. Both these findings were important as they demonstrated that the quality controls used in developing the CBL material were of a high standard and this was maintained throughout the material.

A major aim of developing the CBL material was to provide students with feedback as they progressed through the tutorial work. A number of questions sought information on the efficiency of this feedback. In relation to the feedback received from the CBL material, 91% (N = 74) of students noted that the feedback provided in the CBL material was satisfactory, compared to 9% (N = 7) who thought that the feedback was not. The feedback was modelled to mimic typical teacher's comments, and a question asked “Do you think the feedback was the type you would expect to receive in a classroom (i.e., did it successfully mimic a human tutor), and 66% (N = 53) said it was typical, while 34% (N = 28) said it was not. A follow-up open-ended question asked students to expand only if they had stated the feedback was not typical of that provided in a classroom. Most responses focused on the limited interactive nature of the computer compared to humans, and that there was no opportunity to ask further

### Table 5.5: First choice, and mean ranking (standard deviations) of the most useful question type in the CBL materials

<table>
<thead>
<tr>
<th>Question Type</th>
<th>First Choice Ranking (%)</th>
<th>Mean Ranking (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>47</td>
<td>2.01 (1.05)</td>
</tr>
<tr>
<td>Multiple choice</td>
<td>28</td>
<td>2.17 (0.96)</td>
</tr>
<tr>
<td>True and false</td>
<td>16</td>
<td>2.55 (1.18)</td>
</tr>
<tr>
<td>Theory</td>
<td>9</td>
<td>2.87 (1.12)</td>
</tr>
</tbody>
</table>

Table 5.5 shows that the practical questions were considered the most useful question type and theory questions least useful.
Applying cognitive load theory concepts ...

questions after the CBL material provided feedback. This theme is summed up in the following comments:

"In the classroom the student has the ability to ask further questions to assist in the understanding of the subject"

"Computer feedback, in my opinion can not be a substitute for classroom interaction. i.e., it is not interactive, getting continual feedback and ideas"

"Nothing can replace human interaction and positive feedback. This is far more encouraging than from a computer".

A question was asked if students felt using the CBL material would lead to a better mark in the subject. Three alternatives were provided, being “yes”, “no” and “no opinion”. The results showed that 42% (N = 34) felt that CBL usage would lead to a better mark, while 44% (N = 35) had no opinion, and 16% (N = 12) stated no. Further, 75% (N = 61) indicated that the package led to reduce telephone contact between the student and teachers, while 25% (N = 20) indicated it did not lead to reduce contact.

Finally 78% (N = 63) of students reported that having been provided with CBL in this subject, they would like to see more CBL material developed for future accounting subjects, compared to 1% (N = 1) who stated that CBL should not be further developed, while 21% (N = 17%) had “no opinion”. Following on with this theme, 62% (N = 50) of students indicated greater preference for future development of the CBL material compared with 21% (N = 17) who said they preferred weekend schools, while 17% (N = 14) stated they had no opinion. For the distance education students, there were a total of four non-compulsory weekend schools offered, and attendance was usually from those in the local area or other areas of the state.

5.5.3 Hypotheses testing

To further analyse the usefulness of the CBL material and the feedback, cross tabulation and Pearson Chi-Squared tests at the 5% significance level were conducted to test the
hypotheses. Where the cell count was too low for efficient cross tabulations, categories were collapsed.

For Hypotheses H1 – H4, the student ratings and rankings of usefulness of CBL was used as the dependent variable to test against the independent variables of age, gender, computer literacy and area of residence. The results of H1 – H4 are displayed in Table 5.6.

<table>
<thead>
<tr>
<th>Hypotheses (H)</th>
<th>Pearson Chi-Squared Tests</th>
<th>Hypothesis Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: there was no significant difference in the usefulness of the CBL in relation to age</td>
<td>rating: $\chi^2(20) = 28.7, p = 0.09$ ranking: $\chi^2(28) = 28.7, p = 0.16$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H2: there was no significant differences in the usefulness of the CBL in relation to gender</td>
<td>rating: $\chi^2(5) = 7.9, p = 0.16$ ranking: $\chi^2(7) = 3.5, p = 0.82$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H3: there was no significant difference in the usefulness of the CBL in relation to computer literacy</td>
<td>rating: $\chi^2(10) = 13.3, p = 0.21$ ranking: $\chi^2(14) = 12.1, p = 0.60$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H4: there was no significant difference in the usefulness of the CBL in relation to area of residence</td>
<td>rating: $\chi^2(20) = 3.6, p = 0.09$ ranking: $\chi^2(28) = 29.5, p = 0.38$</td>
<td>Not rejected</td>
</tr>
</tbody>
</table>

Table 5.6: Summary of hypotheses and supporting Pearson Chi-Squared tests for Hypotheses H1 – H4

In summary as we consider Hypotheses H1 - H4 the results in Table 5.6 cannot reject that the CBL material ratings and rankings do not differ amongst the age, gender, computer literacy or area of residence of the student population.

The frequency of CBL use (Hypotheses H5 – H8) was tested against the independent variables of age, gender, computer literacy and area of residence. The results of H5 – H8 are displayed in Table 5.7.
Applying cognitive load theory concepts ...

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Pearson Chi-Squared Tests</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5: there was no significant difference in the frequency of CBL use in relation to age</td>
<td>$\chi^2(28) = 25.5, p = 0.60$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H6: there was no significant difference in the frequency of CBL use in relation to gender</td>
<td>$\chi^2(7) = 6.6, p = 0.46$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H7: there was no significant difference in the frequency of CBL use in relation to previous computer experience</td>
<td>$\chi^2(14) = 10.5, p = 0.72$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H8: there was no significant difference in the frequency of CBL use in relation to students area of residence</td>
<td>$\chi^2(28) = 22.3, p = 0.76$</td>
<td>Not rejected</td>
</tr>
</tbody>
</table>

Table 5.7: Summary of hypotheses and supporting Pearson Chi-Squared tests for Hypotheses H5 - H8

In summary Hypotheses H5 - H8 from Table 5.7 cannot reject that the frequency of using the CBL material do not differ when considering the age, gender, computer literacy or the area of residence of the student population.

Hypotheses H9 - H12 investigated whether or not the instructions of the CBL material were easy to follow, and these hypotheses were tested against the independent variables of age, gender, computer literacy and area of residence. The results of H9 - H12 are displayed in Table 5.8.
Study 1

Table 5.8: Summary of hypotheses and supporting Pearson Chi-Squared tests for Hypotheses H9 – H12

Cross tabulations were also conducted on whether the screen layouts were easy to follow, and there was no significant difference among the students on the basis of age \( \chi^2(4) = 3.42, p = 0.12 \); gender \( \chi^2(1) = 0.84, p = 0.35 \); previous computer experience \( \chi^2(2) = 3.21, p = 0.20 \), or area of residence \( \chi^2(4) = 1.13, p = 0.88 \). While no hypotheses were formulated on screen layouts, these cross tabulations assist in analysing H9 - H12.

In summary Hypotheses H9 – H12 from Table 5.8 (and the further analysis on screen layout) cannot reject that the CBL material instructions (and the screen layouts) were easy to follow, and these conclusions did not differ when considering the age, gender, or area of residence of the student population. In terms of computer literacy, however the advanced students felt the instructions were easier to follow.
Applying cognitive load theory concepts ...

Hypotheses H13 – H16 investigated whether or not the students felt the CBL feedback was satisfactory, and these hypotheses were tested against the independent variables of age, gender, computer literacy and area of residence. The results of H13 – H16 are displayed in Table 5.9.

<table>
<thead>
<tr>
<th>Hypothesis (H)</th>
<th>Pearson Chi-Squared Statistic</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>H13: there was no significant difference between students based on age, whether they felt the CBL feedback was satisfactory</td>
<td>$\chi^2(3) = 2.47, p = 0.48$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H14: there was no significant difference between students on the basis of gender, whether they felt the CBL feedback was satisfactory</td>
<td>$\chi^2(1) = 0.049, p = 0.82$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H15: there was no significant difference between students previous according to previous computer experience, whether they felt the CBL feedback was satisfactory.</td>
<td>$\chi^2(2) = 3.67, p = 0.16$</td>
<td>Not rejected</td>
</tr>
<tr>
<td>H16: there was no significant difference between students on the basis of area of residence, whether they felt the CBL feedback was satisfactory</td>
<td>$\chi^2(2) = 4.02, p = 0.13$</td>
<td>Not rejected</td>
</tr>
</tbody>
</table>

Table 5.9: Summary of hypotheses and supporting Pearson Chi-Squared tests for Hypotheses H13 – H16

To evaluate further the feedback hypotheses (H13 - H16) cross tabulations were also conducted between whether students felt the feedback would reduce telephone contact and the variables of age, gender, computer literacy and area of residence. This analysis showed there was no significant difference between whether students felt the feedback would reduce telephone contact on the basis of their age $\chi^2(3) = 1.78, p = 0.62$; gender $\chi^2(1) = 0.049, p = 0.83$; previous computer experience $\chi^2(2) = 1.5, p = 0.46$; or area of residence $\chi^2(4) = 1.92, p = 0.75$. The final feedback cross tabulation was conducted between whether students felt the feedback was typical of that provided in a classroom and the variables of age, gender, computer literacy and area of residence. This analysis also showed there was no significant difference between whether students felt the feedback was typical of that provided in a classroom and students on the basis of age.
Study 1

\[ \chi^2(2) = 2.87, p = 0.24; \text{ gender } \chi^2(1) = 0.49, p = 0.52; \text{ previous computer experience } \chi^2(2) = 2.47, p = 0.29; \text{ or area of residence } \chi^2(2) = 2.84, p = 0.24. \]

In summary Hypotheses H13 – H16 from Table 5.9 and the further feedback analysis cannot reject that the student population felt that the feedback was not satisfactory and this satisfaction did not differ when considering their age, gender, computer literacy or area of residence.

Even though no hypotheses were formulated, cross tabulations were conducted between students’ preferences for CBL materials or weekend schools and the variables of age, gender, computer literacy and area of residence. This analysis showed there was no significant differences in students’ preferences for CBL materials or weekend schools on the basis of age \( \chi^2(6) = 2.73, p = 0.84; \text{ gender } \chi^2(2) = 2.42, p = 0.29; \) or previous computer experience \( \chi^2(6) = 5.75, p = 0.45, \) however in terms of residence, there was a strong preference for CBL materials from areas outside the state to where the subject originated and where the face-to-face weekend schools were held \( \chi^2(6) = 26.9, p < 0.001. \)

Finally, on the issue of whether CBL should be developed for other subjects, no significant difference was found on the basis of the age of the respondents \( \chi^2(4) = 1.18, p = 0.88; \text{ gender } \chi^2(2) = 2.34, p = 0.64; \text{ previous computer experience } \chi^2(4) = 1.43, p = 0.83; \) or area of residence \( \chi^2(4) = 2.41, p = 0.65. \)

5.5.3.1 Summary of Hypotheses H1 – H16

Summarising the cross tabulation and Pearson Chi-Squared tests, the analysis cannot reject that the CBL material provided good teacher like feedback, the feedback reduced the need for teacher - student contact, the screens and instructions were easy to follow, and the CBL was judged equally useful by students irrespective of their age, gender, location and whether the students were beginners or advanced in terms of computer literacy. The survey demonstrated that in terms of the instructions in the CBL material, there was a significant difference based on students’ previous computer literacy. Students who were advanced computer users considered the instructions were easier to follow. This general finding has highlighted those students who are new to computers
Applying cognitive load theory concepts ...

(beginners) and experienced computer users could be better serviced by different instructions.

5.5.4 Qualitative Analysis

The CBLEQ provided students with an opportunity to make an open comment on any part of the subject and N = 43 responded, with a wide variety of comments received. The most frequent responses (N = 14) focused on the lack of time to complete the CBL material and also the lack of time to complete the subject itself; others (N = 7) stated they had no computer and so could not complete the CBL material; a number (N = 6) noted various ways in which the CBL could be improved; some (N = 6) provided a positive comment about the CBL material; and finally others (N = 3) thought the printed material sufficiently taught the subject and were not interested in the CBL materials.

A sample of these open comments is provided below:

In terms of the lack of time to complete the CBL material:

"I have heavy work commitments and a lack of time. The only revision I completed were past exam papers and questions suggested by the teacher in the mail out. I didn’t feel the need for extra revision, but it was nice knowing the CBL material was there"

In terms of how the CBL could be improved particularly with respect to feedback:

"With the computer-based learning in some modules if an answer was not correct you had to keep guessing. If I did not get the answer right I had to exit the module as sometimes the program wouldn’t let me pass without the correct answer. Perhaps after three tries the answer is automatically supplied"

In terms of being positive about the CBL, particularly with respect to feedback aspects:

"I am a novice to PC’s, using one for the first time this year. I had no problems with the CBL package and thoroughly enjoyed it. Instant feedback is one of its greatest advantages - something we miss with distance ed......Many thanks"
"The computer-based learning software and the feedback were excellent. The feedback...added a personal touch"

"I thought the comments were excellent. They were friendly and added a personal touch to distance education"

In terms of preferring printed material over the CBL:

"Having a PC was not the problem. I prefer books, holding something physical in my hand and flicking through pages appeals more. I would like to point out that Computer-Based Learning has great potential, but it is just not me"

5.5.5 Measuring effectiveness of the CBL material by examining performance

While the CBLEQ requested anonymity (to comply with the requirements of the University ethics committee) the final section did provide students with the opportunity to receive a copy of the aggregate findings by completing their names and addresses in the appropriate section. This then allowed a group of students to be identified as CBL users and another group to be identified as non-CBL users, and for analysis to be conducted on the final performances of these independent groups. Of the 103 useable responses, N = 46 had included their names, and of these N = 43 had received a final assessment and also the questionnaire. From this, N = 36 were identified as CBL users and N = 7 stated they had not used the CBL. Three students who completed some of the CLBEQ had not completed the subject, and were withdrawn for comparison purposes.

In total there were 222 distance students who had completed the subject for assessment purposes in the current semester. Table 5.9 identifies three groups that obtained a final performance mark, being those who used the CBL (N = 36), those who did not use the CBL (N = 7) and those remaining students whose CBL use was not known (N = 179). The mean marks (out of 100) and standard deviations (SD) for these three groups is presented in Table 5.10.
Applying cognitive load theory concepts ...

<table>
<thead>
<tr>
<th>CBL use</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBL used</td>
<td>36</td>
<td>74.86</td>
</tr>
<tr>
<td>CBL not used</td>
<td>7</td>
<td>72.71</td>
</tr>
<tr>
<td>CBL use not known</td>
<td>179</td>
<td>63.26</td>
</tr>
<tr>
<td>Total</td>
<td>222</td>
<td>65.44</td>
</tr>
</tbody>
</table>

Table 5.10: Final performance by marks of students by CBL use, CBL non-use, and where CBL use is not known

Table 5.10 shows that out of the three identifiable groups, the distance students who had been positively identified as using the CBL had obtained the highest mean mark.

Hypothesis 17 (H17) asked if there was a significant difference in the marks of students who used the CBL material (N = 36), compared to those who did not use the CBL (N = 7) in the current semester. A t-test was conducted and the results showed there was no significant difference $t(41) = 0.25, p = 0.77$ between the two groups. This comparison however does not appear useful because of the lower power of the test resulting from the very small number who identified themselves as not using the CBL.

A t-test was then used to compare the marks of the students on the basis of whether CBL was used (N = 36) and whether CBL was not used and not known (N = 186 being the groups where CBL was not used + CBL use was not known) and the results showed there was a significant difference $t(220) = 2.96, p = 0.003$ in the mean marks of these two groups. While this comparison does not show conclusive evidence that the use of the CBL materials led to better grades, it perhaps indicates an increasing trend. Zikmund (2003) however stated that a problem frequently seen in mail surveys is that those who are likely to be involved in an issue are more likely to respond. In the present situation, self-selection may have biased the results as it appears those students who liked the CBL material and benefited by its use were overrepresented, pushing up the average mark of the CBL users relative to the entire group. The results in Table 5.10 demonstrate that those who returned the evaluations, and had used the CBL materials scored significantly better than the rest of the student cohort on their final assessment. As such, a conclusion that CBL use led to increased performance should be treated with caution.
Hypothesis 18 (H18) examined whether the final performances of students who used the CBL material in the present semester was different to the performances of other distance education students in the two prior semesters (one semester prior N = 128; two semesters prior N = 121).

The two prior semesters were useful control groups because with the exception of the distribution of the CBL material, all other printed material and aspects of the course remained the same. The same lecturer was in charge of the subject, the same textbook was used, and the same supporting printed material was supplied, as were the same tutorial questions and the same answers. The assignments and examinations were different, but their weighting in terms of importance was the same. Thus the semesters were equalized in all aspects except for the use of the CBL materials. To test the similarity of the two control groups, independent sample t-tests were conducted on the gender of the participants and their final performances, and showed no significant differences in gender $t(247) = 0.209$, $p = 0.834$; or for final performance $t(247) = -1.45$, $p = 0.15$. Other variables such as age, and location of the respondents could not be elicited.

Analysis was conducted comparing all the distance education students in the treatment semester where the CBL was used (N = 222), with the students in the two prior semesters that did not receive any CBL materials (N = 248) on the basis of gender. The two prior semesters were combined as these student performances and gender was not significantly different. An independent samples t-test confirmed no differences in gender across the present semester and the combined control group $t(469) = -0.575$, $p = 0.565$.

An independent samples t-test was then conducted on the basis of performances and found there was a significant difference $t(469) = 0.365$, $p < 0.001$ in the average performance of the semester where the CBL was used (mean = 65.44; SD = 20.98) and the combined control groups (mean = 57.85; SD = 23.81). Finally, an ANOVA was conducted, where the two control groups were separated, and on the basis of performance there were significant differences between the groups $F(2, 468) = 7.871$, $p < 0.001$. Scheffe post hoc comparison tests found these differences significant ($p = 0.001$).
between the current semester (mean = 65.44; SD = 20.98), and the second pre-ceeding semester (mean = 55.59; SD = 23.47), while a non-significant difference (p = 0.092) was found between the current semester (mean = 65.44; SD = 20.98), and the pre-ceeding semester (mean = 59.98; SD = 24.01). On the basis of these performance comparisons, Hypothesis 18 (that the final performances of students who used the CBL material in the current semester is not significantly different to other distance education students in the two prior semesters) is rejected when compared to the total control group, yet not rejected when the groups are divided and compared separately. Comparisons of the average mean performances in the marks are shown in Figure 5.1.

![Figure 5.1: Mean marks by different semesters](image)

Hypothesis 19 (H19) examined whether increased use of the CBL material in the current semester, had an effect on students’ final performance. A t-test was used comparing the means of marks of students completing all nine study guides (N = 26; mean = 76.04, SD = 9.07) with the students who completed no CBL or only or two topics (N = 11; mean = 70.64, SD = 15.78), and while the marks in the students using all the CBL was higher, the difference was not significant t(35) = 0.016, p = 0.19. To eliminate the possibility of bias, the students who used more than two study guides and fewer than all nine were eliminated from this analysis.

5.6 Discussion

Study 1 was a broad study to examine the use and effectiveness of the in-house developed accounting CBL material and feedback for distance education students. The
CBL material was developed and used to support the printed material. The CBL material was applied to distance education students, as these have traditionally lacked the immediate feedback and contact available to internal on-campus students in face-to-face tutorials. In terms of comparisons with other study materials, the distance students had a preference for the prescribed textbook, as this provided the basic declarative and procedural subject information, and thus was an essential component of the course. Students generally thought the CBL material was useful, and rated and ranked it higher than some traditional material.

The results of the study show that students who used the CBL material were positive about the resource. There was overwhelming satisfaction with the usefulness of the material, and students felt that the feedback was satisfactory and similar to face-to-face tutorial feedback. Students' views of the CBL and feedback usefulness did not differ according to their age, gender, area of residence, or previous computer experience. The CBL materials and the feedback enabled students to complete the accounting tasks with generally reduced teacher support. The results also showed that in terms of future developments, many students stated similar material should be adopted for other accounting subjects. They also felt that there should be greater reliance placed on the use of CBL materials rather than on human interaction in the form of weekend schools, especially for those students who could not readily attend the weekend schools.

The present study also compared the performances of students in the current semester who could be explicitly identified as having used the CBL, with students who did not use the CBL and no significant differences were found in mean marks. A further comparison in the form of a between-subjects treatment control design found significant differences in the performances of the cohort of students that used CBL materials compared to two groups of students in the prior semesters where CBL was not used. Finally, there is some evidence that students' final marks may have improved as a result of using more CBL materials.

Summarising Hypotheses 1 – 19 (H1 – 19) the student attitude to the CBL material is positive, and there is some evidence that performance may have improved.
5.6.1 Limitations

The main limitation of this broad study involved the comparisons used to explore whether a causal relationship existed between the performances of the students who used the CBL material and those who did not use the CBL material. In the present semester, the comparison between the number of students who returned the surveys and were known to be CBL users (N = 36), and the CBL non-users (N = 7) was small, so the power of the t-test was limited. To reach a more substantive conclusion examining a causal relationship between performance and CBL use, the number of respondents should have been higher. Unfortunately university ethics regulations meant that allocation of students to the treatment conditions could not be undertaken, and also the use of the CBL materials was optional, as was the return of the CBLEQ.

One limitation affecting all mail surveys is that researchers know that those who are most involved in the subject are more likely to respond (Zikmund, 2003), leading to self-selection bias. While a number of techniques were used to encourage respondents to reply to eliminate this bias (such as a covering letter with a diagram, postage paid return envelopes, easy wording of questions, and the opportunity to receive the results), the non-response bias remained a potential problem. In the present study, it would appear that the average performances of students completing the CBL material was higher as a subset of the entire cohort (see Table 5.10), with the bias maybe being due to students being comfortable with computers and CBL material. Because of this, the study accepts a high degree of self-selection bias. Therefore, the results that infer CBL usage led to greater performance in the current semester must be treated with some caution and require further investigation.

Comparisons on the basis of performance were also made in a between-subjects research design. This test was more conclusive and free from self-selection bias, particularly as there were large numbers of students whose final marks were analysed. The comparison of the final marks showed significant improvement in overall performance in the semester where the CBL was used, even though a limitation of the between-subjects design is that high variability can lead to individual and situational differences.
Even though this study has shown some correlation between the CBL material use and better performance, it is too early to postulate a clear causal link between. A stricter control group design with randomisation is need to properly examine causality, and to overcome any self-selection bias that may have been the result of the increased performance of the CBL users in the present study.

5.6.2 Areas for future research
Because of the wide range of attitudes of the students in the present study, there are a number of directions where future research can be pursued.

Table 5.10 for instance indicated better performance by CBL users, and notwithstanding the issue of bias, further research can investigate whether various cognitive factors, such as greater effort, better prior learning or greater motivation, may also have contributed to this better performance. These factors have shown to be an important consideration in feedback research and the accounting education literature (see Section 2.5.2).

The majority of distance students felt the CBL material was well produced. A number of open comments were however provided regarding how the CBL could be improved. For example, the following two comments show the usefulness of the CBL materials to students with varying backgrounds.

"some questions appeared to be directed towards students with some accounting background, rather those without any"

and

"I used it but rarely. The ones I did use were too elementary and did not seem to greatly assist with my learning. Perhaps you could make the questions a little more challenging. The screen layouts were very user friendly. I do hope that this computer-based learning will be further developed"

These comments suggest there may have been better ways to present some aspects of the CBL materials to cater for the needs of different learners. Cognitive load theory
Applying cognitive load theory concepts ... suggests that different instructional design can lead to better learning and schema creation, and this is an area for further research. Further, Hypothesis 11 (H11 — that previous experience of using computers has no significant effect on whether students felt the instructions on the CBL material were easy to follow) was rejected as some students who had advanced computing experience felt the instructions on the CBL material were easier to follow those those who were beginning students. Different CBL formats may be more appropriate for different levels of learning experience, and previous research in accounting education and CBL has not examined different forms of CBL material on students with different knowledge levels, although cognitive factors have been shown to be important to learning (see Section 2.5.2).

This study has also shown that some forms of feedback are regarded as more useful than others. The feedback used in the CBL materials primarily consisted of answer until correct (AUC), knowledge of response (KOR) and knowledge of correct response (KOCR) verification, with varying degrees of elaboration and praise. A number of open comments were critical of the use of AUC, for example one student wrote:

"I would much prefer to just be told if I am correct or not. If correct, move to the next automatically. If not, tell me why and let me try again. We have limited time and I would prefer to use it answering questions and not waiting"

Alternatively, some students thought the CBL could provide more elaboration cues, for example another student wrote:

"in some cases the feedback was too specific, in that it just restated the answer, rather than explaining it in practical terms"

The variety in these responses confirms prior feedback research, and specifically feedback in a CBL context (see Mason & Bruning, 1999) that investigated whether detailed elaboration or basic verification is more useful. Future studies of the CBL materials and the type of feedback could explore which of these feedback options are more appropriate.
Finally, the future development and use of the CBL materials ought to take into account the types of questions students considered assisted them most with their learning. Students in the CBLEQ felt that practical questions were most useful, as the following qualitative comments demonstrate:

"I think there should be lots of practical questions as it is the easiest way to understand a concept"

"the step-by-step adjustments accruals was good"

and

"the practical questions were easily the most useful"

5.7 Summary of Study 1

Study 1 was a broad study to examine student opinion of the in-house developed CBL materials and feedback, and other study materials. Results show that the majority of the students were positive towards the CBL’s development and use. The CBL material instructions were easy to follow, the screen layout good, and the feedback assisted learning. There was also some evidence that the CBL assisted with understanding of the subject material, particularly when comparing the final marks of semester when the CBL was used against the two prior semesters.

This research was considered a first step necessary in the development of any future program of research. As the results have shown that student attitude to the CBL material was positive and future use encouraged, and some results shown a significant advantage in performance when CBL was used, further studies are warranted. In particular a randomised research design would investigate if a causal relationship exists between CBL use and performance. This design was difficult to implement in the current study.

Other desirable research issues include whether varying the instructional design of the CBL leads to greater learning, whether the prior knowledge had a major impact on the
Applying cognitive load theory concepts ...

design of the CBL materials, and whether different feedback forms are more beneficial than others, can be extended from this initial investigation.

The next chapter outlines a follow-up study.
CHAPTER 6
STUDY 2: THE EFFICIENCY OF TWO ALTERNATIVE FORMS OF CBL MATERIALS (PROBLEM SOLVING VERSUS WORKED EXAMPLES) FOR STUDENTS WITH DIFFERING PRIOR KNOWLEDGE

6.1 Introduction
Study 1 established that the CBL material was useful and assisted learning, and the present follow-up study was designed to build and extend these findings. The present study not only measured CBL effectiveness, but also applied cognitive load theory to measure the instructional efficiency of the CBL material. The present study introduces the cognitive aspect of a student's prior knowledge to the use of CBL materials. The present study also included a controlled randomised study where subjects were allocated to treatment conditions, to more clearly measure a causal relationship between the use of the CBL materials and learning outcomes.

6.1.1 Designing the CBL material for Study 2
When designing the CBL material and the feedback for the second study, a newer version of the Toolbook authoring language was available and used. This led to some changes in screen layout (see Appendix 30 for comparisons of two similar screen shots noting the different versions of Toolbook used in Studies 1 and 2). The modifications in the CBL material and feedback were undertaken by the same people who had initially designed the CBL material used in Study 1. Alterations to the CBL material and feedback were generally of a minor nature and were made because of the responses from the students in Study 1, and cognitive load theory research, and because some of critical issues suggested by educational theories could now be investigated.

The CBL material in Study 2 was presented in two formats. Traditionally, commercially available CBL accounting material had not been produced in different versions, nor did they cater for the different needs and prior knowledge of students in the same class (Nicholson, 1997; Jenson & Sandlin, 1992). The quantitative and qualitative analysis of Study 1 indicated that a major learning issue associated with the
CBL is that one standard version of the CBL material may have resulted in some material being too easy and other material being too difficult. In accounting research, Bryant and Hutton (2000) noted that individual characteristics of the learner should be taken into account in instructional design.

Cognitive load theory has shown that differently designed instructional material can benefit different participants. For the present study, two versions of CBL materials were developed and these were in worked examples and problem solving formats. These approaches were selected, as previous cognitive load theory research have shown these to be the potentially most powerful to benefit highly structured areas of learning such as mathematics, physics, computer programming, which could be argued have a fairly similar learning structure as introductory accounting (see Sections 2.2.5.1 & 2.2.5.2). Both worked examples and problem solving are effective techniques for learning and can reduce extraneous cognitive load to create good teaching environments. The use of worked examples has been shown to be a more effective form of guided practice for difficult content than problem solving (see Sweller et al., 1998), yet worked examples may not engage students completely in the subject material, and so may not be as effective as the traditional problem solving exercises (see Sweller, 1999). Worked examples have also been shown to be more beneficial for students with no prior knowledge, while problem solving exercises have traditionally been more beneficial for students with a prior knowledge of the subject or a higher level of learning (see Tuovinen & Sweller, 1999; Kalyuga, et al., 2001b). Study 2 therefore responds to the learning issue raised in Study 1, where some students found the CBL material may have been too easy, while others found it too difficult.

Study 2 also introduces the concept of worked examples into the CBL materials. Worked examples have featured in accounting education research and the use of computers (Kachelmeier, et al., 1992; Wynder & Luckett, 1999) and have proven to be an effective learning method (Bonner, 1999).

The immediacy of the feedback remained the same as Study 1. The form of feedback in Study 2 again contained verification comprising answer until correct, knowledge of response and knowledge of correct response. There was little change in the feedback
type used from Study 1 to Study 2, except that there was slightly more emphasis on knowledge of correct response, and less on answer until correct. This was in response to issues raised by students in open comments from Study 1, where some students found schema creation difficult when they had to remain on the same question and ended up guessing their answers. The elaboration cues contained a little more information, but however did not extend to attribute isolation (see Appendix 31 for examples of the elaboration feedback). Praise feedback was again incorporated into the responses. Again the structured nature of hypertext generated by the Toolbook authoring language ensured the teaching was provided in an ordered and structured manner. Students could not proceed to the next stage of the work, if they had not verified prior answers as correct (see Appendix 32 for an example of a screen shot where students are not able to proceed until all entries have been verified as correct).

Study 1 had used nine CBL study guides (weeks) but only one topic was used in Study 2. Students in Study 1 had indicated a strong preference for CBL practical questions, and the topic chosen in Study 2 was based on its sequential features that highlighted the important practical aspects of accounting, and had received good feedback in Study 1. The CBL material topic chosen for the second study was balance day adjustments (see Appendix 33 for the first screen shot to introduce the topic of balance day adjustments used in Study 2).

In the CBL material for Study 2, students had to complete a balance day adjustment exercise in general journal format, then post these new balances to the trial balance and update the trial balance with the new balances. There were eight adjustments to be completed as well as the related postings to the trial balance.

For the problem solving exercises, students had to complete all (eight) balance day adjustments and their related postings into the trial balance, based on their understanding from the lecture material, the computer instructions and in some cases prior knowledge (see Appendix 34 for screen displays of the instructions for the problem solving exercise). As the students completed these tasks, they received immediate feedback as to whether their entries were right or wrong.
Applying cognitive load theory concepts ...

In the worked examples exercises, the first three balance day adjustments and their related postings into the trial balance were provided so that participants could observe how the process should be completed. After observing these three adjustments and solutions, the participants then completed the remaining five adjustments and postings (see Appendix 35 for screen displays of the instructions for the worked examples). Like the problem solving exercises, after the students completed the adjustments, they received immediate feedback from the computer and the feedback was the same as in the problem solving exercises.

The two CBL material designs comprised the same question. The only difference was that the first three adjustments for the worked examples CBL contained the question and the answer (see Appendix 36 for four screen shots of the first worked examples adjustment. Also see Appendix 37, for a screen shot where students must complete the problem solving exercise as a direct comparison to the final screen shot in Appendix 36).

6.2 Aim and Hypotheses

The second study had one principal aim: to determine the most efficient CBL instructional design technique for understanding the balance day adjustments topic, based on a students' prior accounting knowledge. The study also sought to compare CBL material learning with traditional face-to-face teaching. This involved a comparison based on performance alone - similar to Study 1. The definition of “prior knowledge” adopted in this study is that students should have completed and passed an accounting subject during the prior year, being at school (or a level below this tertiary subject) before entering this university (see Farley & Ramsay, 1988; Keef & Hooper 1991; Krausz, et al., 1999).

The CBL material was used with internal students as the participants. Using the CBL on a different cohort of students was expected to reinforce and broaden the applicability of the conclusions of Study 1. A randomised control group that received traditional face-to-face instruction (with printed materials) for their learning was also established (see Appendix 38 for a copy of the handout, being the same information completed by the CBL materials that was also used on the face-to-face control group). This
randomisation would enable tests for causality to be conducted and allocation of subjects to treatment conditions to investigate whether the CBL was an effective and efficient form of instruction.

The present study was modelled largely on the seminal work of Paas and van Merriënboer (1993) with regard to the measurement of instruction efficiency. Those measures have been repeated in many studies (see Paas, et al., 2003, Tuovinen & Paas, 2004) and have proven to be reliable and valid (Gimino, 2002) across a range of subject disciplines. The computation and comparison of instructional efficiency is measured by a combination of both performance and effort. Therefore a key factor in the present study was the reporting of an effective effort measure by Likert scales. Both feedback research and accounting education literature have noted the importance of effort to learning (see Section 2.5.2).

Study 1 had measured effectiveness of the CBL in terms of performance alone. While this measure is traditionally useful, cognitive load theory has demonstrated that efficiency should include both performance and effort. Study 2 has therefore moved beyond Study 1 and other accounting education research investigating CBL materials. Study 2 measures CBL materials by an output measure (performance) combined with an input measure (effort).

To achieve the one broad aim of this study, where various CBL types are compared based on a students' prior knowledge, the following hypotheses were tested.

The first six hypotheses (H1 - H6) compare only the performances of the students completing both the CBL types (worked examples and problem solving exercises) with the face-to-face (control) group.

**H1:** That there is no significant difference in the test performance of those students completing both the CBL material compared to those completing the face-to-face tutorial work.
Applying cognitive load theory concepts ...

**H2:** That there is no significant difference in the test performance of those students completing the worked examples CBL material compared to those completing the problem solving CBL, and those completing the face-to-face tutorial work.

**H3:** That there is no significant difference in the test performance of the students with a prior knowledge of accounting completing the CBL based materials or the face-to-face tutorial.

**H4:** That there is no significant difference in the test performance of students with no prior knowledge of accounting completing the CBL based materials or the face-to-face tutorial.

**H5:** That there is no significant difference in the test performance of students completing either the worked examples CBL, or the problem solving CBL and the face-to-face tutorial, based on a prior accounting knowledge of accounting.

**H6:** That there is no significant difference in the test performance of students completing either the worked examples CBL, or the problem solving CBL and the face-to-face tutorial, based on no prior accounting knowledge of accounting.

The next three hypotheses (H7 - H9) concern the performance of the two CBL types only.

**H7:** That there is no significant difference in the test performance of those students completing the worked examples CBL material compared to those completing the problem solving CBL.

**H8:** That there is no significant difference in the test performance of students depending on whether they do, or do not have prior accounting knowledge.

**H9:** There is no interaction between CBL type and prior accounting knowledge in determining student performance.
The next three hypotheses (H10 – H12) concern students’ effort during learning.

**H10:** That there is no significant difference in the effort of students completing the worked examples CBL material compared to those completing the problem solving CBL.

**H11:** That there is no significant difference in the effort of students depending on whether they do or do not have prior accounting knowledge.

**H12:** There is no interaction between CBL type and prior accounting knowledge in determining student effort.

The final three hypotheses (H13 – H15) concern the instructional efficiency.

**H13:** That there is no significant difference in the instructional efficiency of those students completing the worked examples CBL material compared to those completing the problem solving CBL.

**H14:** That there is no significant difference in the instructional efficiency of students depending on whether they do or do not have prior accounting knowledge.

**H15:** There is no interaction between CBL type and prior accounting knowledge in determining instructional efficiency.

These hypotheses will be tested using t-tests, and one or two-way ANOVAs at the 5% significance level.

### 6.3 Method

#### 6.3.1 Instruments

Three instruments were developed for this study. The first was a questionnaire (comprising 27 questions) that sought key demographic information including the prior education of the participants, whether they had studied accounting previously, their
attitude to the subject, and their computer experiences (see Appendix 39 for a copy of this questionnaire, and the introductory letter to students).

The second instrument was an evaluation of the effort expended in completing the CBL material. This was a printed handout and was completed as the students worked on the CBL exercise during their tutorial. The subjective effort measures used to estimate effort were based on a Likert scale of 1 = very low, 2 = low, 3 = middle, 4 = high, and 5 = very high effort. At each stage of the tutorial work, the students introspected the amount of effort expended to complete the eight balance day adjustments, and then again introspected the amount of mental effort expended to complete the related postings into the trial balance (see Appendix 40 for a copy of the instrument used in the problem solving CBL material, & Appendix 41 for a copy of the instrument used in the worked examples CBL material). This second instrument also collected information on the students' opinions of the CBL material.

The final instrument was a diagnostic test (see Appendix 42 for a copy of the diagnostic test). The test was based on the balance day adjustments topic and comprised two sections. In the first section, students were presented with a trial balance and five balance day adjustments for which they had to prepare the correct general journal entry. The second section provided a list of selected accounts and these had to be updated with the correct balances based on the completed balance day adjustment from the first section.

6.3.1.1 Materials used
The materials used in this study to examine the hypotheses comprised the printed and the CBL material. The CBL material was developed in two formats – as worked examples, and as problem solving exercises. The CBL material was completed in place of normal face-to-face tutorial class, and the printed material was used in the face-to-face class.

6.3.2 Procedure
The study was conducted over three weeks in three stages. During the first stage all students were given a lecture on the balance day adjustments topic (see Appendix 43 for a copy of the lecture). During this lecture, the participants were told that the tutorial
work to follow the lecture would involve some students completing CBL material, and others completing normal face-to-face tutorials. Students were told at that point that participation in the forthcoming study was voluntary, and that the choice of method to complete the tutorial was to be made by the instructor on a random basis. To minimise treatment related refusals, participation was restricted to only those students who agreed at the outset to complete any condition that they were assigned into.

Those students who elected to participate were told that there would be consent forms (see Appendix 44 for a copy of the consent form) to be completed and that ethics approval had been granted for the study to be undertaken. The students who elected to participate completed the first instrument (the questionnaire) at this point. After the lecture, all students were asked not to prepare any work for the forthcoming tutorial, as the work would be provided in the class.

During the second stage, the students who had attended the tutorials were again reminded that a study was to be conducted and that participation would involve completing the tutorial work in either the normal face-to-face manner, or by CBL materials. To avoid any self-selection bias, those participating students in the tutorial were then randomly assigned to either remain in the face-to-face tutorial or to complete the tutorial work by computer using the worked examples CBL material or the problem solving CBL material. The randomisation of the students into these three groups occurred using the random digits table (see Rosnow & Rosenthal, 1999). Singleton and Straits (1999) stated that for studies where subjects were to be randomly assigned to more than two groups, random digits table were recommended, and this randomisation was sufficient to ensure approximate equivalence of the group sizes.

The students who went to the computer lab were then given a CD ROM, and an evaluation sheet to record their effort. This evaluation sheet coincided with the type of CBL material (either problem solving or worked examples) they had been randomly assigned into. All students completing the CBL material then worked through the tutorial at their own pace and completed the evaluation sheet. The students in the computer lab worked individually with their own CBL materials. The administrator instructed that there be no collaboration, though students could ask questions of the
Applying cognitive load theory concepts ...

tutor. Before beginning the computer exercise, the instructor physically checked that
the version of CBL (that is whether it was problem solving CBL or worked example
CBL) the students were completing coincided with the evaluation sheet. When the
students completed the CBL exercise, they handed in the evaluation sheets, and left the
room. There were no teacher instructions provided, except that students should work on
the material at their own pace. Students read the material from the computer and
completed the CBL exercises and the evaluation sheet. The same tutorial work that was
completed using the CBL material was also completed by students attending the face-
to-face class (see again Appendix 38 for a copy of the printed handout).

In the week following the tutorials (that is during the third week), a diagnostic test was
conducted during the lecture time. This test was based on the lecture topic and tutorial
work (that is the CBL material, and the work covered in the face-to-face exercise). All
students in the lecture were invited to complete the diagnostic test, as it was designed to
provide the students with some feedback on their understanding of the topic. This
applied even if some students had not agreed to participate in the other two stages of the
study, or had missed one stage of the study. Students were asked not to study for this
test as it would not contribute to their grade, and in order to isolate any outside
interference on the tutorial work. As students completed the test, they were asked a
number of questions at the end including whether the students had attended the lecture,
completed the CBL material and attended the face-to-face tutorial, if they had some
prior knowledge of accounting and also if they had studied for the test (see Appendix 42
for a copy of the test and these additional questions). The diagnostic test lasted for
around half an hour, was collected by the lecturer and later marked and returned to the
students (see Appendix 45 for a copy of the solutions to the diagnostic test).

6.3.3 Participants
The total number of participants in this study was 128. These were all on-campus
students enrolled in the “Introductory Accounting A” subject. Demographic
information showed that N = 58 were male and N = 70 female, and their ages ranged
between 17 and 35 years (mean age 19.96 years).
The subjects were drawn from two separate groups of students who were studying the same subject at the same university. Table 6.1 provides a breakdown of the groups by gender, mean age (SD = standard deviation in parenthesis) and whether the students had a prior knowledge of accounting.

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th>Mean age (SD)</th>
<th>Prior knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Male</td>
<td>Female</td>
<td>Yes</td>
</tr>
<tr>
<td>First Group</td>
<td>17</td>
<td>25</td>
<td>19</td>
</tr>
<tr>
<td>Second Group</td>
<td>41</td>
<td>45</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>58</td>
<td>70</td>
<td>67</td>
</tr>
</tbody>
</table>

Table 6.1: Total participants by gender, mean age, standard deviation, and prior knowledge of accounting

The same study was replicated twice. Borg and Gall (1989) stated that replication is the process of repeating a research study with a different group of subjects using the same methods. The replication was repeated to build up the number of observations in the individual cells and to promote external validity and relevance of the results. Borg and Gall (1989) noted that statistical power tests increase automatically with sample size, where the larger the sample, the smaller the difference needed to reject or accept the hypotheses. Also the initial study was of a scale that allowed it to be easily replicated with another group of students. While the replication was done at a different time and on a different sample, the demographics of the students were similar in that they were all first year accounting students. Independent sample t-tests were conducted to determine if there were any differences in the two groups of students that made up the total cohort, and the results showed there were no significant differences in terms of age $t(126) = 1.39$, $p = 0.17$; gender $t(126) = 0.76$, $p = 0.44$, and the students' prior knowledge of accounting $t(126) = 0.87$, $p = 0.39$.

All the procedural aspects of administering the study and the replication were exactly the same, as was the person in charge of administering both studies. The prescribed textbook was the same, and the subject and the topic of the CBL material tutorial had
not altered in any way. The experiments were conducted at the same time of the year, so there was no difference in the familiarity of the students with the University.

6.4 Results and Analysis

For the purposes of this study, students were eliminated from the analysis if they did not attend the lecture and the tutorial or complete the diagnostic test. If students had studied prior to the diagnostic test they were also eliminated. The results and analysis are based on 128 students from both the original study and the replication.

While some attrition occurred (a total of 23 students who had completed the initial questionnaire did not complete the test) this was primarily because students were absent on the days that the studies were undertaken, rather than the disenchantment of participating in the study. No student that began the tutorial work in either CBL format or the face-to-face class left the study. Statistical validity was not threatened as there were still good numbers of students who completed all stages of the study.

In terms of the marks obtained by the student groups in the diagnostic test, Table 6.2 compares the mean marks (out of 15) and standard deviations (SD) of both types of CBL (as a single treatment group) and the face-to-face tutorial practice (as the control group).

<table>
<thead>
<tr>
<th>Type</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>All CBL material</td>
<td>93</td>
<td>9.17</td>
<td>2.25</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>35</td>
<td>8.62</td>
<td>2.87</td>
</tr>
<tr>
<td>Total</td>
<td>128</td>
<td>9.02</td>
<td>2.43</td>
</tr>
</tbody>
</table>

Table 6.2: Diagnostic test mean scores and standard deviation scores of the CBL material and face-to-face teaching groups

Table 6.2 shows that on average students completing the CBL material performed slightly better than those students completing the face-to-face teaching. To test Hypothesis 1 (H1) the performance marks were compared using a t-test, and the result showed that there was no significant difference between the CBL material and the
normal face-to-face tutorial teaching with printed materials in the marks of the diagnostic test: $t(126) = 1.12, p = 0.26$. Hypothesis H1 therefore is not rejected.

Further analysis on the mean test and standard deviations (SD) results for the two types of CBL material and the face-to-face teaching is shown in Table 6.3.

<table>
<thead>
<tr>
<th>Exercise Type</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving CBL</td>
<td>44</td>
<td>9.02</td>
<td>2.53</td>
</tr>
<tr>
<td>Worked examples CBL</td>
<td>49</td>
<td>9.31</td>
<td>1.98</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>35</td>
<td>8.62</td>
<td>2.87</td>
</tr>
<tr>
<td>Total</td>
<td>128</td>
<td>9.02</td>
<td>2.43</td>
</tr>
</tbody>
</table>

Table 6.3: Diagnostic test mean and standard deviation scores for three exercises groups

Table 6.3 shows that on average students completing the worked examples CBL performed better than problem solving CBL and the face-to-face CBL. Comparison using standard one-way ANOVAs however indicated no significant difference amongst the total means of the three groups: $F(2, 125) = 0.79, p = 0.46$. The post hoc Scheffe test confirmed also no differences between the three groups, and thus Hypothesis (H2) is not rejected.

Further analysis was conducted on the performances of students who completed the CBL material (as one group) compared to the face-to-face tutorial based on their prior accounting knowledge. The mean results and standard deviations (SD) of this analysis are presented in Table 6.4.
Applying cognitive load theory concepts...

<table>
<thead>
<tr>
<th>Exercise type</th>
<th>Prior knowledge</th>
<th>No prior knowledge</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
</tr>
<tr>
<td>All CBL material</td>
<td>10.31</td>
<td>2.14</td>
<td>48</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>10.33</td>
<td>2.61</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>10.31</td>
<td>2.24</td>
<td>65</td>
</tr>
</tbody>
</table>

Table 6.4: Diagnostic test mean and standard deviation scores for both CBL types versus face-to-face, based on prior accounting studies

Table 6.4 shows the mean performances of students with a prior knowledge of accounting are very similar between the combined CBL material group and face-to-face teaching. A t-test confirmed this $t(62) = -0.21$, $p = 0.84$. Therefore Hypothesis 3 (H3) is not rejected.

When comparing the performances of the combined CBL material group and face-to-face teaching students who had not completed any prior accounting studies, the difference was not significant $t(62) = 1.74$, $p = 0.087$, and therefore Hypothesis 4 (H4) is also not rejected.

Analysis was then conducted comparing both CBL material types, and the face-to-face control group. Table 6.5 shows the mean marks and standard deviations (SD) of the diagnostic test based on the three treatment groups and on their prior accounting knowledge.
Table 6.5: Diagnostic test mean scores and standard deviations for the three exercise groups, based on prior accounting studies

Table 6.5 shows that the mean performances for students with prior accounting was very similar, yet for students with no prior knowledge of accounting, the CBL performance was better, with worked examples being the highest numerically. The results from Table 6.5 are diagrammatically presented in Figure 6.1.
Hypothesis 5 (H5) examined if there was no significant difference in the test performance of students with a prior knowledge of accounting completing either the worked examples CBL, the problem solving CBL, or the face-to-face tutorial. A one-way ANOVA comparing these three groups showed there were no significant differences in the marks, F(2, 66) = 0.099, p = 0.906. The post hoc Scheffe interaction comparisons illustrated no individual group differences, and on the basis of this analysis, Hypothesis 5 (H5) is not rejected.

Hypothesis 6 (H6) then examined if there was no significant difference in the test performance of students with no prior knowledge of accounting completing either the worked examples CBL, the problem solving CBL, or the face-to-face tutorial. A one-way ANOVA comparing these three groups showed there were no significant differences in the marks, F(2, 59) = .099, p = 0.061. The post hoc Scheffe interaction comparison however illustrated there were significant individual group differences between the worked examples CBL and the face-to-face teaching (p = 0.032), and on the basis of this analysis, Hypothesis 6 (H6) is not rejected for problem solving CBL, but is rejected for worked examples CBL.

In summarising Hypotheses 1 – 6 (H1 – H6), it could not be rejected that the CBL was equally effective as normal face-to-face teaching. For students with no prior knowledge of accounting, the worked examples version of the CBL resulted in significantly greater performance than face-to-face teaching. These results help to confirm Study 1 where students regarded the CBL as useful, and effectiveness as measured by the output of performance was not weakened from CBL use. In the case of students with no prior knowledge of accounting, worked examples CBL was significantly better than face-to-face teaching.

6.4.1 Student attitude to the CBL material

Three questions soliciting the student’s attitudes to the CBL material were asked after the students had completed the CBL tutorial work. The questions were closed, and sought to obtain information similar to Study 1, regarding usefulness, future development, and how best to use the CBL material (see Appendices 40 & 41 for a copy of these questions).
The first question asked how useful was the CBL material, and this was answered on a Likert scale of 1 = very useful, 2 = useful, 3 = neutral, 4 = not very useful, and 5 = useless. The next question asked should the CBL material be developed for other subjects, and this was answered on a scale of 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree. The final question asked how should the CBL material be used, and three alternatives were offered, being 1 = instead of face-to-face teaching, 2 = with face-to-face teaching and 3 = not used at all.

This section of the questionnaire was completed by 42 students and the results analysed according to whether the students had prior accounting knowledge. Table 6.6 shows the means and standard deviations (SD) for the first two questions. Note that the lower numerical values for the means indicate the more useful the CBL material in the first question, and more agreement that the CBL should be further developed in question two.

<table>
<thead>
<tr>
<th>Question</th>
<th>Prior knowledge</th>
<th></th>
<th>No prior knowledge</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How useful was the CBL material?</td>
<td>19 2.15 0.74</td>
<td>23 2.32 0.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Should CBL be developed for other subjects?</td>
<td>19 2.38 0.66</td>
<td>23 2.56 0.87</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6.6: Mean and standard deviations of student opinion on the CBL material

Table 6.6 shows that irrespective of their prior accounting knowledge, students generally felt the CBL material was useful and that it should be developed for other subjects. These conclusions were again quite similar to Study 1.

In terms of the final question on student attitude, overall 70% of respondents felt that the best way to use the CBL materials was with face-to-face teaching.

Because of the low response rate to these questions, further analysis was not undertaken based on whether students completed the problem solving or worked examples CBL.
6.4.2 Comparisons between CBL in the problem solving format and CBL in the worked examples format

The remainder of the analysis is restricted to comparisons between the problem solving CBL and worked examples CBL. Table 6.7 again shows the diagnostic test performances of these two CBL types based on whether the students had some prior knowledge of the subject.

<table>
<thead>
<tr>
<th>CBL exercise type</th>
<th>Prior knowledge</th>
<th>No prior knowledge</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
</tr>
<tr>
<td>Problem solving</td>
<td>10.45</td>
<td>2.37</td>
<td>22</td>
</tr>
<tr>
<td>Worked examples</td>
<td>10.17</td>
<td>1.96</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>10.30</td>
<td>2.14</td>
<td>48</td>
</tr>
</tbody>
</table>

Table 6.7: Diagnostic test mean scores (and standard deviations) for the two CBL types, based on prior accounting studies

Table 6.7 demonstrates that for students with a prior knowledge, performance was on average better with problem solving CBL, while for students without a prior knowledge, performance was better with worked examples CBL. The test performance results are illustrated in Figure 6.2.

Figure 6.2: Marks in the test by CBL type (Problem solving or Worked examples) and prior knowledge
To test Hypothesis 7 (H7) a one-way ANOVA was undertaken and revealed there was no significant difference in the total performances of those students completing the worked examples CBL as compared to those completing the problem solving CBL, $F(1, 91) = 0.36, p = 0.54$. Hypothesis 7 (H7) is therefore not rejected.

To test Hypothesis 8 (H8) a one-way ANOVA was also undertaken and revealed there was a significant difference in performances of those students based on prior knowledge $F(1, 91) = 33.1, p < 0.001$. Hypothesis 8 (H8) is therefore rejected, as students with a prior knowledge in accounting performed significantly better than those without prior knowledge in the total assessment.

A two-way ANOVA test was then conducted to test Hypothesis 9 (H9) and determine whether there were any interaction effects between CBL type and prior accounting knowledge. The results showed that there were significant interaction effects in the marks of the four groups, $F(3, 89) = 11.9, p < 0.001$, therefore rejecting H9.

An important measurement in cognitive load theory is the mental effort exerted by students during learning. At each stage of the tutorial work, the students introspected the amount of mental effort expended to complete and understand the eight balance day adjustments, and then again introspected the amount of mental effort expended to complete the related postings into the trial balance on a Likert scale (see Appendices 40 & 41). Because mental effort data was collected on sixteen different occasions, the total responses were combined and averaged. The mean and standard deviations (SD) for the levels of effort required to carry out the exercises for the two CBL types, based on prior accounting knowledge, are shown in Table 6.8. Table 6.8 presents results for effort by three categories, being the first three adjustments ("first 3"); the next five adjustments ("next 5"), and the total effort ("Total"). This information is presented because the worked examples CBL had the first three answers provided, and also to perhaps suggest if conclusions could be reached on whether worked examples actively engaged students.
Applying cognitive load theory concepts ...

<table>
<thead>
<tr>
<th>CBL type</th>
<th>Accounting knowledge</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prior knowledge</td>
<td>No prior knowledge</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>Problem solving first 3</td>
<td>3.4</td>
<td>0.17</td>
<td>22</td>
<td>3.8</td>
</tr>
<tr>
<td>Problem solving next 5</td>
<td>3.0</td>
<td>0.23</td>
<td>22</td>
<td>3.4</td>
</tr>
<tr>
<td>Problem solving Total</td>
<td>3.2</td>
<td>0.13</td>
<td>22</td>
<td>3.6</td>
</tr>
<tr>
<td>Worked examples first 3</td>
<td>3.1</td>
<td>0.18</td>
<td>26</td>
<td>3.3</td>
</tr>
<tr>
<td>Worked examples next 5</td>
<td>3.3</td>
<td>0.18</td>
<td>26</td>
<td>3.6</td>
</tr>
<tr>
<td>Worked examples Total</td>
<td>3.2</td>
<td>0.17</td>
<td>26</td>
<td>3.5</td>
</tr>
<tr>
<td>Total</td>
<td>3.2</td>
<td>0.15</td>
<td>48</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Table 6.8: Effort mean and standard deviations based on the two CBL groups, and prior accounting studies

The results from Table 6.8 show that within the sample the total effort was generally higher for students with no prior knowledge of the subject. Further, the learning effort was lower for worked examples compared to the problem solving in the first three adjustments, but was higher than the problem solving in the next five adjustments.

Hypothesis 10 (H10) was concerned with the total effort of all students irrespective of prior knowledge, and a one-way ANOVA revealed there was no significant difference in the total effort of those students completing the worked examples CBL as compared to those completing the problem solving CBL, $F(1, 91) = 2.6, p = 0.11$. There were however significant differences in effort based upon CBL type of students when completing the first three adjustments, $F(1, 91) = 52.3, p < 0.001$, and again when completing the next five adjustments $F(1, 91) = 22.0, p < 0.001$. In the case of the first three adjustments, the problem solving CBL required more effort than the worked
examples CBL (3.6 versus 3.2), while for the next five the worked examples CBL required more effort than the problem solving CBL (3.5 versus 3.2). Hypothesis 10 (H10) is therefore not rejected when measured by total effort, but rejected when the effort was analysed by the first three adjustments and again for the next five.

Hypothesis 11 (H11) was related to the effort based on prior knowledge, and again a one-way ANOVA was used and revealed there was a significant difference in the total effort of students based on prior knowledge $F(1, 91) = 67.2, p < 0.001$. The total effort for those with no prior knowledge was 3.2 compared to those with no prior knowledge which was higher at 3.5. There were also significant differences between the effort of students when completing the first three adjustments, $F(1, 91) = 29.7, p < 0.001$, and there were also significant differences with the mean effort for students with no prior knowledge being higher than those with prior knowledge (3.6 versus 3.2). Finally there were significant differences between the effort of students when completing the next five adjustments $F(1, 91) = 35.3, p < 0.001$, and again the mean effort for students with no prior knowledge was higher than those with prior knowledge (3.5 versus 3.2). Based on this analysis of effort, Hypothesis 11 (H11) is rejected.

A two-way ANOVA was then conducted to test Hypothesis 12 (H12) and it revealed there were significant interaction effects in the total effort, $F(3, 89) = 26.1, p < 0.001$, effort for the first three adjustments $F(3, 89) = 50.2, p < 0.001$, and effort for the next five adjustments $F(3, 89) = 29.2, p < 0.001$. Hypothesis 12 is therefore rejected. Table 6.9 shows all these interactions by group. Table 6.9 shows that the differences in most groups are the result of the main effect, being prior knowledge.
Applying cognitive load theory concepts ...

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>(D) Group 1</th>
<th>(D) Group 2</th>
<th>Mean difference (95%CI)</th>
<th>Sig.</th>
<th>F rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effort for First Three</td>
<td>Problem solving with prior accounting</td>
<td>problem solving with no prior accounting</td>
<td>-.41</td>
<td>0.06</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with prior accounting</td>
<td></td>
<td>.25</td>
<td>0.05</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td>.06</td>
<td>0.06</td>
<td>0.719</td>
</tr>
<tr>
<td></td>
<td>Problem solving with no prior accounting</td>
<td>worked examples with prior accounting</td>
<td><strong>.41</strong></td>
<td>0.06</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td><strong>.65</strong></td>
<td>0.05</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td><strong>.47</strong></td>
<td>0.06</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Worked examples with prior accounting</td>
<td>worked examples with prior accounting</td>
<td><strong>.25</strong></td>
<td>0.05</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td><strong>.65</strong></td>
<td>0.05</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td><strong>.18</strong></td>
<td>0.05</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>Worked examples with no prior accounting</td>
<td>worked examples with prior accounting</td>
<td><strong>.06</strong></td>
<td>0.06</td>
<td>.719</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td><strong>.47</strong></td>
<td>0.06</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td><strong>.18</strong></td>
<td>0.05</td>
<td>0.013</td>
</tr>
<tr>
<td>Effort in next five</td>
<td>Problem solving with prior accounting</td>
<td>problem solving with no prior accounting</td>
<td><strong>.34</strong></td>
<td>0.06</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with prior accounting</td>
<td></td>
<td><strong>.29</strong></td>
<td>0.06</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td><strong>.54</strong></td>
<td>0.06</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Problem solving with no prior accounting</td>
<td>problem solving with prior accounting</td>
<td><strong>.34</strong></td>
<td>0.06</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td>.04</td>
<td>0.06</td>
<td>0.861</td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td></td>
<td><strong>.20</strong></td>
<td>0.06</td>
<td>0.011</td>
</tr>
</tbody>
</table>
Table 6.9: Multiple comparisons (post hoc Scheffe tests) on the relationships between total effort, effort for the first three adjustments, and effort for the next five adjustments based on prior accounting knowledge

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>(I) Group</th>
<th>(I) Groups</th>
<th>Mean difference</th>
<th>Std. error</th>
<th>Sig. †</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worked examples with prior accounting</td>
<td>problem solving with prior accounting</td>
<td>* .29</td>
<td>0.06</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>problem solving with no prior accounting</td>
<td>* .04</td>
<td>0.06</td>
<td>0.861</td>
<td></td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td>* -.25</td>
<td>0.06</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Total Effort</td>
<td>Problem solving with prior accounting</td>
<td>problem solving with no prior accounting</td>
<td>* -.36</td>
<td>0.05</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>worked examples with prior accounting</td>
<td>.00</td>
<td>0.05</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td>* -.23</td>
<td>0.05</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>problem solving with no prior accounting</td>
<td>* .36</td>
<td>0.05</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>worked examples with prior accounting</td>
<td>* .36</td>
<td>0.05</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td>.13</td>
<td>0.05</td>
<td>0.069</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worked examples with prior accounting</td>
<td>problem solving with prior accounting</td>
<td>.00</td>
<td>0.05</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>problem solving with no prior accounting</td>
<td>* -.36</td>
<td>0.05</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>worked examples with no prior accounting</td>
<td>* -.23</td>
<td>0.05</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worked examples with no prior accounting</td>
<td>problem solving with prior accounting</td>
<td>* .23</td>
<td>0.05</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>problem solving with no prior accounting</td>
<td>-0.13</td>
<td>0.05</td>
<td>0.069</td>
<td></td>
</tr>
<tr>
<td></td>
<td>worked examples with prior accounting</td>
<td>* .23</td>
<td>0.05</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

* The mean difference is significant at the .05 level.

Note that some rounding has occurred to two decimal points †, and three decimal points ‡.
The different instructional efficiency values were calculated using the instructional efficiency measure computation method commonly used in cognitive load theory and devised by Paas & van Merrienboer (1993). The instructional efficiency measure combines the test scores and the total mean effort measures of each student and then standardises these across groups. The instructional condition efficiency score is computed using the formula: \( E = \frac{Z_{\text{test}} - Z_{\text{effort}}}{\sqrt{2}} \) using only the mean total effort values. The results of this analysis are presented in Table 6.10.

<table>
<thead>
<tr>
<th>CBL type</th>
<th>Prior knowledge</th>
<th>No prior knowledge</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
</tr>
<tr>
<td>Problem solving</td>
<td>0.84</td>
<td>0.70</td>
<td>22</td>
</tr>
<tr>
<td>Worked examples</td>
<td>0.76</td>
<td>0.65</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>0.79</td>
<td>0.67</td>
<td>48</td>
</tr>
</tbody>
</table>

Table 6.10: Mean and standard deviations (SD) of instructional efficiency measures based on the two CBL groups, and prior accounting studies

Information from Table 6.10 is used to test Hypotheses 13 – 15 (H13 – H15). In terms of whether there was a difference in the instructional efficiency of participants completing the two CBL types (Hypothesis 13, H13), a one-way ANOVA test was performed and revealed there was no significant difference in the instructional efficiency of those students completing the worked examples CBL as compared to those completing the problem solving CBL, \( F(1, 91) = 1.94, p = 0.16 \). Hypothesis 13 (H13) is therefore not rejected.

To test whether there was a difference in the instructional efficiency of participants based on prior knowledge (Hypothesis 14, H14), a one-way ANOVA test was also performed and revealed there was a significant difference in the instructional efficiency of those students based on prior knowledge \( F(1, 91) = 111.1, p < 0.001 \). Hypothesis 14 (H14) is therefore rejected, as again students with a prior knowledge in accounting had a significantly better instructional efficiency mean than those without prior knowledge.
To examine the interaction effects, a two-way ANOVA revealed that there were statistically significant effects between the four groups $F(3, 38) = 43.3, p < .001$. Hypothesis 15 (H15) is therefore rejected. Table 6.11 outlines the post hoc Scheffe tests that revealed these interactions.

<table>
<thead>
<tr>
<th>(I) Group</th>
<th>(J) Group</th>
<th>Mean difference $(t)$</th>
<th>Std. error</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving with no prior accounting</td>
<td>Problem solving with prior accounting</td>
<td>2.03</td>
<td>0.22</td>
<td>0.000</td>
</tr>
<tr>
<td>Worked examples with no prior accounting</td>
<td>Worked examples with prior accounting</td>
<td>0.08</td>
<td>0.21</td>
<td>0.983</td>
</tr>
<tr>
<td>Worked examples with no prior accounting</td>
<td>Worked examples with no prior accounting</td>
<td>1.37</td>
<td>0.22</td>
<td>0.000</td>
</tr>
<tr>
<td>Problem solving with no prior accounting</td>
<td>Problem solving with prior accounting</td>
<td>-2.03</td>
<td>0.22</td>
<td>0.000</td>
</tr>
<tr>
<td>Worked examples with prior accounting</td>
<td>Worked examples with prior accounting</td>
<td>-1.94</td>
<td>0.21</td>
<td>0.000</td>
</tr>
<tr>
<td>Worked examples with no prior accounting</td>
<td>Worked examples with no prior accounting</td>
<td>-.65</td>
<td>0.22</td>
<td>0.033</td>
</tr>
<tr>
<td>Worked examples with prior accounting</td>
<td>Problem solving with prior accounting</td>
<td>-.085</td>
<td>0.21</td>
<td>0.983</td>
</tr>
<tr>
<td>Problem solving with no prior accounting</td>
<td>Problem solving with no prior accounting</td>
<td>1.94</td>
<td>0.21</td>
<td>0.000</td>
</tr>
<tr>
<td>Worked examples with no prior accounting</td>
<td>Worked examples with no prior accounting</td>
<td>1.29</td>
<td>0.21</td>
<td>0.000</td>
</tr>
<tr>
<td>Worked examples with no prior accounting</td>
<td>Problem solving with no prior accounting</td>
<td>-1.37</td>
<td>0.22</td>
<td>0.000</td>
</tr>
<tr>
<td>Problem solving with no prior accounting</td>
<td>Problem solving with no prior accounting</td>
<td>.65</td>
<td>0.22</td>
<td>0.033</td>
</tr>
<tr>
<td>Worked examples with prior accounting</td>
<td>Worked examples with prior accounting</td>
<td>-1.29</td>
<td>0.21</td>
<td>0.000</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the .05 level

Note that some rounding has occurred to two decimal points †, and three decimal points §  

Table 6.11: Multiple comparisons (post hoc Scheffe tests) on the relationships between instructional efficiency for the two CBL types based on prior accounting knowledge

136
Table 6.11 shows that while significant differences existed between the four groups, there was no interaction between problem solving CBL with prior accounting, and worked examples CBL with prior accounting (p = 0.983); yet there was a significant difference between problem solving CBL with no prior accounting, and worked examples CBL with no prior accounting (p = 0.033).

The results from Table 6.11 are presented in Figure 6.3.

![Learning Efficiency Graph](image)

**Figure 6.3: Instructional efficiency measures examining the most efficient instructional design**

**Key:**
- PS w prior Acc = Problem solving CBL exercises with a prior knowledge of Accounting.
- PS wo prior Acc = Problem solving CBL exercises without a prior knowledge of Accounting.
- WE w prior Acc = Worked Examples CBL exercises with a prior knowledge of Accounting.
- WE wo prior Acc = Worked Examples CBL exercises without a prior knowledge of Accounting

Figure 6.3 shows a diagonal line known as neutral efficiency condition, where standardised Performance = standardised Effort and Efficiency = 0. The formula Efficiency = (Z test – Z effort) / \( \sqrt{2} \) is used to calculate the perpendicular distance from this neutral condition. Figure 6.3 shows that of the four groups, the numerically most efficient means of instruction was problem solving CBL exercises for students with a prior knowledge of the accounting subject. This group had the highest performance in
relation to less invested mental effort. The most inefficient instructional group was problem solving CBL exercises for students without a prior knowledge of the accounting subject, evidenced by combining the higher effort and lower performance.

6.5 Discussion

The major aim of this study linking accounting and CBL materials with feedback research and cognitive load theory was to determine the most efficient CBL instructional technique from either problem solving CBL, or worked examples CBL for students with different backgrounds in accounting. The study also sought to confirm the effectiveness of the in-house developed CBL materials based on performance and attitude from Study 1.

6.5.1 Evaluation of performance

Comparisons of both formats of CBL materials with the controlled face-to-face teaching group on the basis of effectiveness measured by performance alone (see Tables 6.2, 6.3, 6.4 and 6.5, Figure 6.1, and Hypotheses 1 – 6) indicate that the CBL materials (supported by some tutor assistance during the CBL) was just as effective as conventional face-to-face teaching. The present study found that for students with a prior knowledge of accounting, the highest performance was obtained by CBL problem solving exercises (see Table 6.5) yet there was no significant difference in the performances of the students with either CBL format or the face-to-face teaching group. For students without a prior knowledge of accounting, there was no significant difference between the combined CBL group and the control (face-to-face instruction) group, however the worked examples CBL was significantly better than the face-to-face teaching (see Hypothesis H6, and Table 6.5).

The finding based on the measures of performance alone supports and validates the results of Study 1, which found that students who used the in-house developed CBL also benefited in terms of performance. Using a randomised study design, Study 2 found that the in-house developed CBL materials could mimic good teacher scaffolding, and feedback, and overall students performed just as well and sometimes better than standard face-to-face tutorials. The present study enhances the external validity of Study 1 on CBL usefulness, and this is important particularly as Study 1 and 2 were
conducted on different cohorts of students. Further, the randomisation of subjects across the CBL and face-to-face control group in Study 2 strengthened the internal validity, and was sufficient to test causality.

The present study also supports prior studies into CBL use in accounting education which have found that the performance of CBL students did not suffer, or it may have improved when compared to traditional teaching techniques (e.g., McKeown, 1976, Groomer, 1981; Sangster, 1992a, Jensen & Sandlin, 1992; McInnes, et al., 1995; McCourt Larres & Radcliffe, 2000; Bryant & Hunton, 2000). This study has also shown that students who have some prior knowledge of accounting perform better than students who have no prior knowledge. This finding holds true whether students are instructed by CBL material or in traditional face-to-face learning.

Finally on the measures of effectiveness, this study has found that the attitude of the students to CBL use is positive, again supporting Study 1 and prior accounting research (McCourt Larres & Radcliffe, 2000).

6.5.2 Evaluation based on cognitive load theory principles

The present study introduced a number of issues from the well-established cognitive load theory literature into the evaluation of the in-house developed CBL materials.

The CBL material was re-designed from Study 1 and presented in two formats - problem solving and worked examples. Designing two formats of the CBL material was an attempt to adapt the CBL materials to satisfy differences in student ability. The study determined instructional efficiency of the two CBL materials using performance and effort measures, rather than simply measuring effectiveness by performance alone. This study therefore extends the prior analysis of CBL use and accounting education to a measure that combines inputs and outputs. Effort measures during learning were collected in a similar manner to those used in other cognitive load studies. The study also collected data on a student's prior knowledge. Both effort and prior knowledge have been widely acknowledged as being important factors in the accounting education literature.
For students with a prior knowledge of accounting, the problem solving CBL students performed slightly better than the worked examples CBL in the diagnostic test (10.45 versus 10.17, see Table 6.7) yet statistically the difference was not significant. The total mean effort between these two groups was the same (3.2 mean for problem solving CBL, and 3.2 mean for worked examples CBL, see Table 6.8); however there were significant differences in mean effort between students completing the CBL problem solving and the CBL worked examples for the first three adjustments (p < 0.001), and again for the next five (p < 0.001). The lower mean effort on the first three transactions in the worked examples CBL (3.1 versus 3.4 for problem solving CBL) may suggest that students were less engaged in the worked examples.

The instructional efficiency measures for the students with prior accounting knowledge (as reported in Table 6.10) showed that problem solving exercises were numerically more efficient (0.84 efficiency versus 0.76 for worked examples); however statistically this difference was not significant (Table 6.11, p = 0.98). The benefit of worked examples was not as evident for students with a prior knowledge of the subject, and this would also confirm prior research that as students become more experienced, the advantage of a worked examples procedure reduces (Kalyuga, et al., 2001a; Kalyuga, et al., 2001b).

For students with no prior accounting studies, the worked examples CBL students performed better than the problem solving CBL in the diagnostic test (8.32 versus 7.59 see Table 6.7), yet again statistically the difference was not significant (p = 0.35). In terms of the total effort (see Table 6.8), the problem solving CBL group required greater effort (3.6 versus 3.5); however this difference was not significant (p = 0.069). There were significant differences between those completing the problem solving CBL and the worked examples CBL in the mean effort for the first three transactions (p < 0.001), where the mean was higher for problem solving CBL (3.8 versus 3.3), and the next five transactions (p = 0.011) where the mean effort was higher for worked examples CBL (3.5 versus 3.2).

The instructional efficiency measures for students with no prior knowledge (as reported in Table 6.10) showed that worked examples CBL were more efficient (-0.53 efficiency
versus -1.1 for problem solving), and statistically this difference was significant (Table 6.11, p = 0.033). Students with no prior accounting knowledge benefited more from worked examples and this finding reinforced prior cognitive load studies showing that students with no prior experience benefit most from the worked examples (Tuovinen & Sweller; 1999; Kalyuga, et al., 2001a).

The positive instructional values (see Figure 6.3) were gained by students with a prior knowledge of accounting who had completed both the problem solving, and worked examples CBL. Problem solving exercises for students with no prior accounting experience was shown to be the least efficient learning approach, as these students performed at the poorest instructional efficiency measure. It would seem that if a student has very little or no schema associated with the area of study, deciding what steps to take to reach the solution, as well as building a mental structure of the content area, may be too cognitively demanding on the working memory.

This study was conducted using a post-test only control group design involving randomisation, making the findings more internally valid and reliable. The Cronbach alpha examined the internal reliability of the three effort measures used in the study, being the total effort, effort in the first three and effort in the next five. These three effort measures were subjected to a principal components analysis, with varimax rotation, culminating in a one factor of $\alpha = 0.77$, indicating a high level of reliability in the effort measures.

6.5.3 Limitations
Notwithstanding the randomised research design and the reliability in the effort measures, a number of limitations exist in the present study.

The students without a prior knowledge of accounting obtained two negative instructional efficiency measures meaning both the worked examples CBL and the problem solving CBL were regarded as inefficient instructional techniques. The inefficient calculation was primarily because all the students' performance and effort measures were standardised into Z scores irrespective of prior knowledge, and through the process of standardisation, some instructional efficiency measures had to be positive.
Study 2

and the others negative. The calculation of instructional efficiency grouped and compared all students (those with prior knowledge and those without) and a limitation may have been analysing all four groups together. A different approach may have been to calculate two separate instructional efficiency measures, one for students based on some prior knowledge and the other for student with no prior knowledge. This would seem appropriate, particularly as Hypothesis 8 (H8) has shown that there is a significant difference between students with and without a prior knowledge of accounting in terms of performance, and Hypothesis 11 (H11) that showed there were also significant differences in the effort of students based on prior knowledge. Therefore the negative instructional efficiency for students without a prior knowledge of accounting was to have been expected, when compared to students with prior knowledge since instructional efficiency is a standardised relative measure.

6.5.4 Areas for future research

There are a number of areas for further research that ought to be explored from these results and those from Study 1.

To date the feedback used in both studies has been a combination of answer until correct, knowledge of response, and knowledge of correct response, with a variety of elaboration and praise. The main focus of Study 2 was in comparing the alternative designs of the CBL (that is worked examples and problem solving) rather than an analysis of the various types of feedback. Two open comments from Study 1 noted the importance of different feedback forms. Comment one supports basic type of feedback (such as being told if a response is correct or incorrect) and comment two requests elaboration feedback.

Comment one:

"I would much prefer to just be told if I am correct or not. If correct, move to the next automatically. If not, tell me why and let me try again. We have limited time and I would prefer to use it answering questions and not waiting"
Applying cognitive load theory concepts ...

Comment two:

"in some cases the feedback was too specific, in that it just restated the answer, rather than explaining it in practical terms"

These opposing views also summarise the reviews of prior feedback research, which are inconclusive as to the best form of feedback for CBL learning (see Section 2.3.7.1, and Mason & Bruning, 1999). While the feedback literature is extensive, no links have yet been made to measure the instructional efficiency of feedback based on the principles of cognitive load theory (see Paas, et al., 2003). Instructional efficiency measures could add further to the debate concerning how much and what type of feedback is most suitable for learning. Cognitive load theory can assist in determining whether CBL materials provide too much, or not enough feedback and the amount of feedback also raises the issue of redundancy. Research in this area would seem appropriate as both Dempsey et al. (1993) and Mason and Bruning (1999) both noted that feedback research should include more cognitive information.

6.6 Summary of Study 2

This study has confirmed that for the balance day adjustments topic in introductory accounting, CBL materials with good teacher-like feedback and instructions assist learning. When compared with face-to-face teaching and printed materials, the CBL method is equally effective when measured solely by performance. In fact this study has found that the provision of CBL worked examples for students who have not previously studied accounting was more helpful than both the problem solving exercises and students completing the face-to-face teaching. This study also found that problem solving exercises are as appropriate as worked examples for students who have a prior knowledge in accounting; however numerically within the sample (in terms of the instructional efficiency calculation) problem solving is better.

The findings from this study are important as previous studies on CBL used in accounting have not distinguished the effectiveness of CBL materials on the basis of a student's background knowledge, or examined how CBL material can be adapted to different users. Prior research has been restricted to applying one version of the CBL
Study 2

Materials to all students. This study also goes beyond those in the accounting education literature (see Section 2.4.5.1) as CBL materials are measured using both performance and effort, rather than simply relying on an effectiveness measure such as performance.

The present study has listed a number of areas that can be examined in further research, particularly in relation to feedback. The next chapter outlines two follow-up studies.
CHAPTER 7
STUDIES 3 AND 4 – COMPARISON OF PROBLEM SOLVING AND WORKED EXAMPLES CBL WITH RICH OR BASIC FEEDBACK

7.1 Introduction
This chapter extends the analysis from Study 2 into the most efficient CBL type for students with different backgrounds in accounting. This chapter describes two further studies where the main focus is to examine efficiency in terms of the amount of feedback in CBL materials based on principles of cognitive load theory. The present studies continue the theme of examining how CBL material can be adapted to the needs of different users.

The present two studies (titled “Study 3” & “Study 4”) build on the results of prior studies in this thesis. Those studies found that in-house developed CBL material and feedback were useful for schema creation (Studies 1 & 2) and that the numerically more efficient type of CBL for students with a prior knowledge consisted of problem solving exercises, and the significantly more efficient type of CBL for students with no prior knowledge was worked examples (Study 2). Based on these results, the present studies concentrate on using CBL designed problem solving exercises for students with prior accounting knowledge (Study 3), and CBL worked examples for students with no prior accounting knowledge (Study 4).

The student cohort was separated based on prior accounting knowledge in response to a limitation in Study 2, where all student’s effort and performances were standardised and instructional efficiency calculated regardless of prior knowledge. This resulted in two negative instructional efficiency values but these were due largely to a lack of previous prior knowledge and because instructional efficiency is a standardised relative measure. Students in the following studies were considered to have a “prior knowledge” of accounting using the same criteria as in Study 2.

Both Studies 3 and 4 replicated many aspects of Study 2 in terms of the procedures and the research design.
7.1.1 Review of feedback research

As stated in Section 2.3.2, feedback is widely acknowledged as an important part of the educational learning process of a student and its relevance to learning is undisputed (see reviews by Kulhavy & Stock, 1989). Prior research (see Section 2.3.7.1, and 2.3.7.11) has shown the amount of feedback suitable for schema creation has been widely debated in the feedback literature and also within feedback for CBL materials. Several studies have found that providing elaborative feedback within a CBL unit did not influence students' knowledge of the material, and a larger body of research showing enhanced learning from more elaborative feedback (see Mason & Bruning 1999 for summaries of these studies, and also Cyboran, 1995; Whyte, et al., 1995, Azevedo & Bernard, 1995b; Morrison, et al., 1995). Study 1 in this thesis also highlighted that students have differing views on the appropriateness of various forms of feedback, particularly verification versus verification and elaboration.

From the cognitive load perspective, basic feedback may not overload working memory as it does not involve a great deal of mental processing, but basic feedback may not add sufficiently to schema development because of its brevity. Basic feedback may or may not be sufficient for students to operate at the optimal, or germane, cognitive load level. Detailed or rich feedback may add an extra processing load to working memory. However provided the learners have sufficient working memory capacity to cope with the rich feedback, its detailed nature may enhance schema formation, as students are encouraged to engage with the content at the optimal level and they experience the germane cognitive load.

The anticipated gains of detailed feedback may be counterbalanced by the threat of processing overload due to having to attend to possible redundant information (see Section 2.2.5.5). Redundancy indicates learning situations in which eliminating redundant material results in better performance than when the redundant information is included (see Kalyuga, et al., 2001a; Mayer, et al., 2001; Renkl & Aitkinson, 2003). Applying the redundancy theory, detailed feedback may actually interfere with learning. Smith and Ragan (1993, p.76) stated
Applying cognitive load theory concepts ...

"the amount of prior knowledge that learners possess on a topic may greatly influence the amount and content of feedback. Learners with extensive prior knowledge may require only correct/incorrect feedback, while learners with limited knowledge may need more extensive information, hints and guidance that might actually inhibit more informed learners".

7.1.2 Designing the CBL Material for Studies 3 and 4

The present studies used the same CBL topic as Study 2, being balance day adjustments. The similarity of the topics meant that the results of present studies would again add to the external validity. The in-house CBL material and the feedback was again varied by the person who had designed the CBL materials in Study 1 and 2.

For the present studies, both the problem solving CBL material and worked examples were used on students with different prior knowledge of accounting. Both CBL format were developed in two versions - one with rich feedback comprising verification, elaboration and praise, and the other with basic feedback comprising verification only. This is shown in Figure 7.1.

![Figure 7.1: The CBL used in Studies 3 and 4, based on prior knowledge of the subject](image)

Similar to Study 2, participants completing the problem solving CBL had to complete all (eight) balance day adjustments in general journal format and also the related postings into the trial balance. The participants completing the worked examples CBL
were again provided with the solutions to the first three balance day adjustments and their related postings, and were then required to complete the remaining five transactions.

The layout for entering the answers was again provided in both CBL types, and participants completed the required information. From the on-screen instructions, students were guided in stages on how to complete all the information for the balance day adjustments and postings. The stage-by-stage filling-in of the computer screen with guidance was again meant to benefit students who only had to process a small number of elements at a time. Again the structured nature of hypertext and the Toolbook authoring package ensured the teaching was provided in an ordered manner and in manageable sized amounts.

The feedback provided in the present study was structured in either “basic” or “rich” types. The basic feedback simply provided “incorrect” or “correct” responses to the answers with no elaboration or praise. The richer feedback contained verification, elaboration and praise. In terms of verification, the present studies used a variation of both answer until correct and knowledge of correct response. When students made an error in the rich feedback case, the CBL material asked students to try again, with several clues provided to assist. If after the third try, students still did not get the correct answer, the answer was provided, as well as further explanations (see Appendix 46 for three screen shots showing the variation in the answer until correct with rich feedback used in Studies 3 and 4 where after three tries the answer is provided). When students made an error in the basic feedback case, the CBL asked students to try again, however no clues were provided. If after the third try, students still did not get the correct answer, the answer was provided with an instruction to go to the next stage, but no explanations for correct or incorrect responses were given (see Appendix 47 for three screen examples of this type of answer until correct feedback). In terms of elaboration, the present studies contained a little attribute isolation, which focused learners on key components of the concept to improve general understanding of the target concept and also response contingent. This provided response specific feedback that explains why the incorrect answer was wrong, and why the correct answer is correct (see Appendix
Applying cognitive load theory concepts...

48 for screen shots where examples of rich feedback including attribute isolation are provided in comparison to basic feedback).

Both the correct and incorrect answers (for both the problem solving and worked examples CBL) were given immediately at the completion of a task.

7.2 Problem solving CBL Study 3 - Aim and Hypotheses

The aim of Study 3 was to determine the most efficient amount of feedback for students with a prior knowledge of accounting who were to complete a topic in introductory accounting using problem solving CBL materials. Two feedback types were analysed, and the efficiency of each of the feedback instructional methods was measured using cognitive load theory principles.

The study sought to examine the following three hypotheses.

H1: That there is no significant difference in the performances of the students with prior knowledge of accounting depending on whether they completed the problem solving CBL with either the rich or basic feedback.

H2: That there is no significant difference in the effort of students with prior knowledge of accounting depending on whether they completed the problem solving CBL with either the rich or basic feedback.

H3: That there is no significant difference in the instructional efficiency of students with prior knowledge of accounting depending on whether they completed the problem solving CBL with either the rich or basic feedback.

These hypotheses were tested on participants with a prior knowledge of the accounting subject and t-tests were used, with significance tested at the 5% level.
7.2.1 Method

7.2.1.1 Instruments
Three instruments were developed for Study 3. The first was a questionnaire that comprised 28 questions and sought key information including the prior education of the participants, their background knowledge of accounting, their computer experiences and their attitude to computers (see Appendix 49 for a copy of this questionnaire, and the introductory explanatory letter).

The second instrument was a survey form where students recorded the amount of effort expended in completing the CBL material. This was completed as the students worked on the CBL exercise during their tutorial. The subjective effort measures used to estimate effort were again based on the same Likert scale used in Study 2, where 1 = very low, 2 = low, 3 = middle, 4 = high, and 5 = very high effort. The participants introspected the amount of mental effort expended to complete both the general journal entry and the adjusted trial balance (see Appendix 50 for a copy of this evaluation).

The final instrument was a diagnostic test that examined the students’ understanding of the topic area (see Appendix 51 for a copy of the diagnostic test). The test comprised two sections. In the first section the students were presented with a trial balance and five balance day adjustments for which they had to prepare general journal entries. In the second section a list of selected accounts were presented and these needed to be updated with the correct balances. On the diagnostic test, students were also asked whether they had attended the lecture and completed the tutorial work, and how much time they had spent studying for the test. This test was very similar to that used in Study 2 in terms of the type of question asked, the marks, the marking scheme, and the standard.

7.2.1.2 Material used
The item used to test the hypotheses was the CBL material in the problem solving format. The CBL was produced with two different forms of feedback, one being with rich feedback, and the other with basic feedback. Participants completed this CBL material during their normal tutorial classes.
7.2.1.3 Procedure

Study 3 followed a similar procedure to Study 2. The study was conducted over three weeks and in three stages. The first stage involved students attending a lecture on the balance day adjustments topic (see again Appendix 43 for a copy of this lecture). Before the lecture had begun, the students were told that a study would be undertaken over the next three weeks on the use of CBL materials, and that student participation was voluntary. Previous research results on the use of this particular CBL were supplied as background information. After it was stressed that the students' consent was needed to participate in the study (see Appendix 52 for a copy of the consent form), the first instrument was distributed to those who had agreed to participate. The instrument was completed in the lecture and then returned. After the lecture, the students were reminded that the following week's normal tutorial work (that is in the form of face-to-face teaching) would be replaced by a CBL exercise. Students were asked not to prepare any work for the tutorial.

At the beginning of the second stage, students were again reminded that participation in the study was voluntary. The students who did not wish to complete the CBL material were allowed to leave; however no student took this option. The students were then randomly assigned to complete either the problem solving CBL material with either the rich or basic feedback. The randomisation in this instance occurred by the simple toss of a coin, a system that was sufficient to ensure approximate equivalence of the groups (see Rosnow & Rosenthal, 1999). All the participating students were then taken to the computer lab, given a CD-ROM and an evaluation sheet to record their effort, and then asked to work through the CBL tutorial at their own pace while completing the effort evaluation.

The students worked individually in the computer lab. The administrator instructed there to be no collaboration between students when completing the CBL, though students could ask questions of the staff member. Before beginning the computer exercise, the instructor physically checked the version of the feedback (that is rich or basic) the students were assigned to, and noted this at the top of their evaluation sheet. When the students completed the CBL exercise, they handed in the evaluation, and left the room. There were no teacher instructions provided, except that students should
work on the material at their own pace. Students read the material from the computer and completed the exercises and the effort evaluation. Tutor assistance was available in the lab, yet as all participants had some prior knowledge of the accounting subject, very little was required.

During the third stage, a diagnostic test was conducted. This test was based on the lecture topic and the CBL tutorial exercise. Students were asked not to study for this test, as it would not contribute to their grade, and it to isolate any outside interference from the lecture and tutorial work. After students completed the test, they were asked a number of questions, being whether the students had attended the lecture; whether they completed the tutorial work; how much extra time they had devoted to studying for the test; and whether they had studied accounting previously. The diagnostic test lasted for around half an hour. The test was collected and marked after the lecture (see Appendix 53 for a copy of the solutions to the diagnostic test).

7.2.1.4 Participants
This study was conducted with 41 students who were enrolled in the introductory accounting subject. Demographic information showed that N = 22 were male and N = 19 female, and their ages ranged between 17 and 25 years (mean age = 19.70 years). All these students had some prior knowledge of accounting before enrolling in this subject.

While some attrition occurred (a total of 7 students who had completed the initial questionnaire did not complete the test), this was primarily because students were absent on the days that the study was undertaken, rather than disenchantment with participating in the study. The statistical power of the testing was not threatened as there were still good numbers of students who completed all stages of the study, and strong internal validity existed as these participants were randomised across the two treatment groups.
7.2.2 Results and Analysis

The results and analysis are based on 41 students who completed all aspects of the study that is, they attended the lecture, completed the CBL tutorial work, sat the diagnostic test, and had not completed any extra studying for the test.

Table 7.1 shows the mean performance mark on the diagnostic test (marked out of 15) for the problem solving CBL students with rich or basic feedback, and standard deviations (SD).

<table>
<thead>
<tr>
<th>Feedback</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>With rich feedback</td>
<td>21</td>
<td>11.14</td>
<td>3.38</td>
</tr>
<tr>
<td>With basic feedback</td>
<td>20</td>
<td>10.85</td>
<td>2.96</td>
</tr>
</tbody>
</table>

Table 7.1: Diagnostic test mean scores and standard deviations of the problem solving CBL material with rich or basic feedback

Table 7.1 shows that for the problem solving CBL, performance was slightly better for students receiving rich feedback. This is also presented diagrammatically in Figure 7.2.

Figure 7.2: Test mean scores of the problem solving CBL material with rich (PS Rich) or basic (PS Basic) feedback
To test whether there was a significant difference based on performance (Hypothesis 1 - H1), a t-test was used and the value obtained was not significant $t(39) = -0.291$, $p = 0.77$. Based on this analysis Hypothesis 1 (H1) is not rejected.

The mean measures of learning effort and standard deviations (SD) are shown in Table 7.2, with results being displayed for the total effort. The effort rating scales were required to be completed on eight occasions (once after each adjustment comprising the general journal adjustment and the related trail balance posting) and the total averaged.

Table 7.2: Mean effort and standard deviations to complete the problem solving CBL material exercises with rich or basic feedback

<table>
<thead>
<tr>
<th>Problem solving CBL exercises</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>With rich feedback</td>
<td>21</td>
<td>3.27</td>
<td>0.12</td>
</tr>
<tr>
<td>With basic feedback</td>
<td>20</td>
<td>3.33</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Table 7.2 shows the effort to complete the problem solving CBL exercises with the basic feedback was slightly higher than the rich feedback. To test whether there was a difference (H2), a t-test was used and the value obtained was not significant $t(39) = -1.30$, $p = 0.20$. Based on this analysis, Hypothesis 2 (H2) is not rejected, as there was no significant difference between the efforts of the two groups.

The instructional efficiency of the two feedback types are determined by the formula $\text{Efficiency (Eff)} = \frac{(Z \text{ test} - Z \text{ effort})}{\sqrt{2}}$. Using total effort values, the mean and standard deviations (SD) are reported in Table 7.3.
Applying cognitive load theory concepts ...

Table 7.3: Mean Z scores and standard deviations for test marks, effort, and instructional efficiency for problem solving CBL (some rounding has occurred)

Table 7.3 shows that the more efficient means of instruction (the higher mean efficiency) was the problem solving CBL with rich feedback. These results from Table 7.3 are displayed in Figure 7.3.

Figure 7.3: Instructional efficiency of problem solving CBL with rich and basic feedback

Figure 7.3 shows that of the two groups, the numerically more efficient means of instruction was the problem solving CBL exercises with rich feedback. This treatment condition had the higher performance relative to the invested mental effort.
To test whether there was a significant difference in the instructional efficiency (H3) a t-test was used and determined there were no statistically significant differences in the instructional efficiency of the two feedback groups $t(39) = -1.09, p = 0.28$. Based on this analysis, Hypothesis 3 (H3) is not rejected.

7.2.3 Discussion

Study 3 tested the usefulness of rich and basic feedback alternatives in problem solving CBL format for students with a prior knowledge of accounting. The aim was to determine the most efficient form of feedback in the CBL materials measured from a cognitive load perspective.

As all three hypotheses are not rejected, the results indicate that in this instance neither form of feedback proved to be better than the other, with both providing similar benefits and both allowed students to operate at the germane cognitive load level. Although Table 7.1 shows that performance of the students receiving the richer feedback was slightly higher than students receiving basic feedback (11.14 versus 10.85), the difference was not significant. The effort of students completing the CBL with rich and basic feedback also was not significantly different (Table 7.2), and when performance and effort were combined (Table 7.3) there was no significant difference in instructional efficiency. Figure 7.3 does however show that the richer feedback was numerically positive, while the basic feedback was numerically negative.

Because of these results, the conclusions are somewhat mixed. This study suggests there may be a weak tendency for the rich feedback to provide a more useful learning benefit due to higher instructional efficiency (Figure 7.3), though there is no significant difference. Further, the information the rich feedback provided in this instance was not redundant in that it did not decrease performance, and did not interfere with learning. Students completing the problem solving CBL with basic feedback were able to perform as effectively, with only slightly more effort due to their prior knowledge.
7.3 Worked examples CBL Study 4 - Aims and Hypotheses

The aim of Study 4 was to determine the most efficient amount of feedback for students with no prior knowledge of accounting who were to complete a topic in an introductory accounting course using worked examples CBL materials. Two feedback types were analysed, and the efficiency of each of the feedback instructional methods was again measured using cognitive load theory principles.

In this study, the following three hypotheses (H4 – H6) were examined.

**H4:** That there is no significant difference in the performances of the students with no prior knowledge of accounting depending on whether they completed the worked examples CBL with either the rich or basic feedback.

**H5:** That there is no significant difference in the effort of students with no prior knowledge of accounting depending on whether they completed the worked examples CBL with either the rich or basic feedback.

**H6:** That there is no significant difference in the instructional efficiency of students with no prior knowledge of accounting depending on whether they completed the worked examples CBL with the rich or basic feedback.

These hypotheses were tested on participants with no prior knowledge of the accounting subject, and t-tests were used with significance tested at the 5% level.

7.3.1 Method

7.3.1.1 Instruments

The instruments used in Study 4 were similar to those in Study 2 and Study 3. Three instruments were developed. The first was a questionnaire that sought demographic information from students confirming that they had not previously studied accounting, their prior education, computer experiences and attitude to computers (see Appendix 49 for a copy of this questionnaire and the introductory explanatory letter).
The second instrument was a survey form where students recorded the amount of effort expended in completing the CBL material. This was completed as the students worked on the CBL exercise during their tutorial. The subjective effort measures used to estimate effort were again based on the same Likert scale used in Studies 2 and 3, where 1 = very low, 2 = low, 3 = middle, 4 = high, and 5 = very high effort. The participants recorded the amount of mental effort expended to complete both the general journal entry and the adjusted trial balance (see Appendix 54 for a copy of this evaluation).

The final instrument was a diagnostic test, which examined the students’ understanding of the topic area (see Appendix 50 for a copy of this test). The test was exactly the same as the one used in Study 3.

These three instruments were again completed over a three-week period (one instrument per week) – the same as Study 2 and Study 3.

7.3.1.2 Materials used
The item used to test the hypotheses was the worked examples CBL material in two feedback forms: one with rich feedback, and the other with basic feedback. Participants completed this CBL material as part of their normal tutorial class.

7.3.1.3 Procedure
Study 4 followed a similar procedure to the previous two studies. The study was conducted over three weeks and in three stages. The first stage involved all students attending a lecture on the topic (see Appendix 43 for a copy of this lecture on balance day adjustments). Before the lecture had begun, participants were told that a study would be undertaken over the next three weeks on the use of worked examples CBL materials, and that participation was voluntary. Previous research results on the use of the worked examples CBL material was supplied as background information to reinforce that this CBL format and teaching method had led to favourable or better performance results when compared to face-to-face teaching. After it was stressed that the students’ consent was needed to participate in the study (see Appendix 51 for a copy of the consent form) the forms and the first instrument were distributed and completed. After the lecture participants were informed that the following week’s normal tutorial
work (that is in the form of face-to-face teaching) would be replaced by a CBL tutorial. Students were asked not to prepare any work for the tutorial, but attend the class in the normal room, at the normal time.

At the beginning of the second week, students were again reminded that participation in the next stage was voluntary. The students who did not wish to complete the CBL material were given the option to leave, however none left. The students were then randomly assigned to complete the worked examples based CBL material with either the rich or basic feedback. The randomisation in this instance again occurred by the simple toss of a coin (see Rosnow & Rosenthal, 1999). All the students were taken to the computer lab and each given a CD-ROM and an effort evaluation sheet. The students were instructed to work through the worked examples CBL tutorial at their own pace while completing the effort evaluation sheet.

The students worked in isolation in the computer lab. The administrator instructed there to be no collaboration between students when completing the worked examples CBL, though students could ask questions of the staff member. Before beginning the computer exercise, the instructor physically checked the version of the feedback (that is rich or basic) the students were assigned to, and noted this at the top of their evaluation sheet. When the students completed the CBL exercise, they returned the CD-ROMs and the evaluation sheets, and left the room. There were no teacher instructions provided, except that students should work on the material at their own pace. Students read the material from the computer and completed the exercises and the evaluation sheet. Tutor assistance was available in the lab.

The third stage involved a diagnostic test on the topic. Students were asked not to study for this test, as it would not contribute to their grade and to isolate any outside interference on the lecture and tutorial work. After completing the test, students were asked if they had attended the lecture, completed the CBL material, if they had no prior knowledge of accounting and if they had studied for the test. The diagnostic test lasted for around half an hour and was completed in normal lecture time. The test was collected and marked after the lecture (see Appendix 52 for a copy of the solutions to the diagnostic test).
7.3.1.4 Participants
This study was conducted with 45 students who were enrolled in the introductory accounting subject. Demographic information showed that N = 21 were male and N = 24 female, and their ages ranged between 17 and 27 years (mean age = 19.91 years). No participant had prior knowledge of the accounting subject before enrolling, and had completed all aspects of the study, i.e., they had attended the lecture, had completed the worked examples CBL tutorial work, had sat the diagnostic test, and had not completed any extra studying for the test.

While some attrition occurred (a total of 9 students who had completed the initial questionnaire did not complete the test) this was because students were absent on the various days that the studies were undertaken, rather than the disenchantment of participating in a study. No student left the CBL tutorial. The statistical power of the tests was not threatened, as there were sufficient numbers of students who completed all stages of the study.

7.3.2 Results and Analysis
Table 7.4 shows the mean performance marks on the diagnostic test (marked out of 15) for the worked examples CBL students with rich or basic feedback, and the standard deviations (SD).

<table>
<thead>
<tr>
<th>Feedback Type</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>With rich feedback</td>
<td>26</td>
<td>8.98</td>
</tr>
<tr>
<td>With basic feedback</td>
<td>19</td>
<td>7.85</td>
</tr>
</tbody>
</table>

Table 7.4: Diagnostic test mean and standard deviation scores of the worked examples CBL material with rich or basic feedback

Table 7.4 shows that for the worked examples CBL, performance was better for students receiving richer feedback. This is also presented diagrammatically in Figure 7.4.
To test whether there was a significant difference in performance (H4) a t-test was used and determined there were no significant differences in marks of the two groups $t(43) = 1.13, p = 0.27$. Based on this analysis, Hypothesis 4 (H4) is not rejected.

The mean measures of learning effort are shown in Table 7.5. Results are displayed for the first three adjustments, the next five, and the total effort. The results are divided into these groups to see if effort differed across the adjustments, particularly as the first three adjustments had the solutions provided. The “first 3 mean effort” consisted of three effort measures averaged (that is one effort measurement for each of the first three transactions - the general journal adjustment and the related trial balance posting). The “next 5 mean effort” consisted of five effort measures averaged. The “total mean effort” consisted of eight measures averaged. Results of the means (and standard deviations in parenthesis) are shown in Table 7.5.
Table 7.5: Mean effort (and standard deviations) to complete the worked examples CBL material exercises with rich or basic feedback by the first three, next five and total transactions

Table 7.5 shows that the total effort to complete the worked examples CBL exercises with the rich feedback was lower than the basic feedback. To test whether there were any significant differences (H5), a t-test was used and determined there were statistically significant differences in the efforts of the students on basic and rich feedback for the “total mean effort” t(43) = -3.04, p = 0.004; for the effort in the “next 5” adjustments t(43) = -3.83, p < 0.001; but not for the “first 3” adjustments t(43) = 0.87, p = 0.39. Based on this analysis, Hypothesis 5 (H5) is rejected for “total effort” and for the “next 5”. For the “first 3” H5 is not rejected, though this was expected because the answers were provided, and students did not have to complete any CBL work or analyse any feedback from the CBL material.

The instructional efficiency of the two feedback types was again determined by the formula Efficiency (Eff) = (Z test - Z effort) / √2. Using the total effort values, the mean and standard deviations (SD) are reported in Table 7.6.

Table 7.6: Mean Z scores and standard deviations for test marks and effort, and instructional efficiency for worked examples CBL

Table 7.6 shows that the more efficient means of instruction were the worked examples CBL with rich feedback, as this had the higher efficiency rating. The results from Table 7.6 are displayed in Figure 7.5.
Applying cognitive load theory concepts ...

Figure 7.5: Instructional efficiency of worked example CBL with rich and basic feedback

Figure 7.5 shows that the numerically more efficient means of instruction were the CBL materials with rich feedback. This treatment condition had the highest performance relative to the invested mental effort.

To test whether there was a significant difference in the efficiency (H6), a t-test was used and determined there was a significant difference in the instructional efficiency of the two feedback groups t(43) = 2.93, p = 0.005. Based on this analysis, Hypothesis 6 (H6) is rejected.

7.3.3 Discussion
Study 4 tested the usefulness of rich and basic feedback alternatives in worked examples CBL format for students without a prior knowledge of accounting. The aim was to determine the most efficient feedback form for learning in the CBL materials.

The results show the rich feedback resulted in better schema development necessary for learning, and therefore the extra feedback was relevant and led to the optimal (germane)
cognitive load. While Table 7.4 shows that performance of the students receiving the rich feedback was higher (8.98 versus 7.85) the difference was not significant. The total effort of students completing the CBL with basic feedback was however significantly higher (Table 7.5) and when performance and effort were combined (Table 7.6), there was a significant difference in the instructional efficiency favouring richer feedback (see Figure 7.5 & Table 7.6). While the richer feedback may have added extra processing load to working memory, the working memory was not overloaded and schema formation enhanced. Clearly the students with no prior knowledge of the subject required richer feedback for understanding, and the basic feedback was not as beneficial. A Cronbach alpha internal reliability analysis conducted on the three effort measures resulted in a \( \alpha = 0.81 \), indicating a high degree of reliability in the effort measures, and the instructional efficiency results.

7.4 General discussion
The two studies in this chapter have continued and extended research into feedback, and specifically applied the well-established cognitive load theory to analyse the most efficient amount of feedback in CBL materials for students with different levels of prior knowledge. These studies have added to the feedback literature debate concerning the most appropriate format of feedback for effective learning in a CBL environment, particularly evaluating rich and basic types of feedback.

The results of Study 3 suggest that for the students with a prior knowledge of accounting completing the CBL problem solving, the provision of basic feedback did not hinder schema creation and automation, and only led to a slightly less efficient instruction technique (Efficiency = 0.17 for richer feedback versus -0.18 for basic, see Table 7.3 and Figure 7.3). This is then an indication that students with a prior knowledge do not require rich feedback comprising verification, elaboration and praise, but rather only basic feedback. Performance, while being higher with the rich feedback, was also not significantly benefited (mean mark for rich feedback = 11.14 versus 10.85 mean mark for basic feedback). It could also be also argued that the richer feedback did not hinder performance, and there was no redundancy effect, as the students completing the CBL problem solving performed better in numerical terms when provided with rich rather than basic feedback. On the evidence in this study, it appears that basic feedback
in the problem solving CBL for students with prior knowledge is the minimum that is required for effective schema development without overloading working memories. More research would be needed to investigate whether a significant difference would be obtained between rich and basic feedback in CBL for other accounting topics or perhaps different levels of prior knowledge.

The results of Study 4 showed that students with no prior knowledge benefited in some ways from richer feedback. The instructional efficiency measures (see Table 7.6) confirmed that the richer feedback was rated higher than the basic feedback (efficiency = 0.35 versus -0.48) and the difference was statistically significant. Basic feedback put extra load on the working memory, while the rich feedback provided a more optimal (germane) cognitive load for learning. Interestingly, comparisons on the basis of performance alone showed no significant difference between rich and basic feedback though within the sample the mean diagnostic test marks were higher for rich feedback (see Table 7.4). The students receiving basic feedback however had to put in more effort to complete the CBL tasks than student's receiving rich feedback, and the difference in the total effort, and effort for the last (next) five transactions were both sufficiently significant (see Table 7.5). Overall, the participants benefited more from the worked examples with the rich feedback, as the instructional efficiency difference was significant.

7.5 Summary of Studies 3 and 4

Study 3 and Study 4 designed and evaluated the most efficient feedback for students studying introductory accounting CBL material from either rich or basic types. In this instance, it has been demonstrated that for this accounting topic, the most efficient learning is gained when the feedback is richer for students without a prior knowledge. For students with a prior knowledge, the difference between richer and basic feedback was not significant, but the richer feedback did not harm the students and was numerically more efficient.

These two studies have added more useful information and further contributed to the accounting education and feedback literature. This study further reinforces the conclusions of Study 2 that different types of CBL benefit students with different
background knowledge of the subject, and extends the research by concluding that not only should different types of CBL be produced, but that the CBL material should also incorporate different forms of feedback. Different types of feedback can maximise the learning for various students with different backgrounds using CBL material. This is an important finding for educational CBL designers, faculty and students of education and accounting, and in line with the conclusions from Kulhavy and Stock (1989) who noted that while feedback is important, it is how well the feedback properties are adapted to learner needs that is more significant.

A further finding is that since rich feedback benefits those with no prior accounting knowledge and does not harm those with prior accounting knowledge it should be the preferred option if only one form of feedback is to be used and the choice is between rich and basic feedback.

The next chapter will outline the general discussion and conclusions from this series of studies.
CHAPTER 8
GENERAL DISCUSSION AND CONCLUSION

8.1 Overview

This thesis investigated the instructional design, use, effectiveness and efficiency of CBL materials with feedback to teach introductory accounting.

Chapter 2 presented an overview of the three theoretical foundations of this thesis, and linked these topics together. First, the nature of cognitive architecture was considered and this involved an understanding of the sensory, working and long-term memories. Cognitive load theory derives instructional design principles from aspects of our cognitive architecture, and argues that instructional material should be designed so that limited working memory will not be overloaded. Cognitive load theory has been widely researched, and has been used to design and measure the efficiency of instructional techniques to maximise learning opportunities across many subject areas.

The importance of feedback to learning was also outlined in Chapter 2. While extensive research has been conducted on feedback and the importance of feedback to learning is not debated, the relevant aspects of feedback research for this thesis were the importance and validity of feedback instruction in a CBL material context, and examining the form of feedback in CBL materials that contribute the most to learning. Of particular interest was the debate between various forms of feedback, particularly basic feedback that contained verification only, and rich feedback, which contained verification, elaboration and praise.

The third review topic of Chapter 2 was the use of CBL materials in teaching accounting at university level. Research investigating the usefulness of CBL in accounting education has been undertaken since the 1970s, and has generally found that the CBL method is an effective form of instruction. The literature review concentrated on examining the effectiveness of the CBL materials as determined on the basis of student performance and attitudes.
The final section of Chapter 2 drew together these three areas of research, and then outlined the present research that extends beyond the links already established in the literature. Central to the discussion that follows in this section, is that there has been an increasing interest in cognitive factors that affect learning such as mental effort and prior knowledge. The emergence of a cognitive view of learning is noted in the reviews of the feedback literature (see Kulhavy & Wager, 1993; Dempsey, et al., 1993; Mason & Bruning, 1999) and the accounting educational literature (see Bonner & Lewis, 1990; Bonner & Walker, 1994; Wynder & Luckett, 1999; Libby & Tan, 1994; Cloyd, 1997; Rose & Wolfe, 2000; Bryant & Hunton, 2000). While many studies have been performed on the effectiveness of accounting CBL materials and feedback, none have moved beyond the effectiveness output measure to consider an input measure such as effort and combined this with an output measure such as performance. The chapter then outlines the further areas of interest for this thesis, and these involve applying the measure of instructional efficiency from cognitive load theory to CBL accounting materials and forms of feedback. Cognitive load theory is therefore the major contribution of this thesis with respect to both the types of feedback, and CBL use in accounting education.

Chapter 3 then outlined the development of the CFL materials. The in-house CBL material was designed to present accounting concepts and information in a form that was similar to face-to-face teaching, with the feedback modeled on typical teachers' comments. The CBL material was designed through the Toolbook authoring language, and this was most suitable as it allowed the sequential nature of the subject to be taught and adhered to. The CBL materials, as well other study materials were used to test the various hypotheses established.

There were four studies used to assess the effectiveness and efficiency of the CBL materials and various forms of feedback, and Chapter 4 outlined the methodologies used in these studies. The methodologies chosen varied according to the aims and objectives of the studies. A one-shot descriptive design was used in Study 1 to gather broad information on the in-house CBL material and the feedback. Study 1 also compared the performance of groups of students who had used the CBL material with other students who had not used the CBL material in the current semester, as well as comparisons with...
Applying cognitive load theory concepts ...

non-CBL users in prior semesters utilising a between-subjects research design. These comparisons had been extensively used in past accounting CBL studies, and were again used to investigate if a causal relationship existed between performance and CBL material use. Experimental comparisons via randomisation of subjects to treatment conditions were then used in the remaining studies to test causality through a series of post-test only control groups.

Throughout the four studies in this thesis, the CBL material and the feedback was refined, redesigned, modified and re-tested. Four studies were needed to deal with all issues raised in the literature review. The studies extend and enhance the extant cognitive load theory literature, the feedback literature, and the accounting education literature with respect to CBL material use. The same investigator remained the chief examiner of the subject for the duration of the studies, and also designed and then reviewed the CBL material over the course of the studies, as well as conducting all the studies.

8.1.1 Summary and conclusion from Study 1

Study 1 was conducted with distance education students as participants. These students received traditional distance education printed and audio material, as well as the in-house developed CBL material. The CBL was used to supplement the printed materials, and was designed to provide distance students with teacher-like feedback. The CBL instructions and feedback were intended to resemble comments typically provided by a teacher in a face-to-face teaching situation, and the computer screens attempted to resemble what students would see in a class.

The initial CBL material comprised a number of question types, including true / false, multiple choice, practical, and theory questions. The form of the feedback was primarily answer until correct, knowledge of response, and knowledge of correct response, with some elaboration and praise. The same CBL was provided to all students, and student opinion and performance measures were obtained after a number of students voluntarily participated in the study by completing a mailed out questionnaire. The questionnaire sought qualitative and quantitative information about the CBL material and other study material.
The results indicated that most students who used the CBL material irrespective of age, area of residence, computer literacy or gender, found the material and the feedback useful. Students overwhelmingly felt the feedback was satisfactory (91% agreed the feedback was satisfactory) and many (66%) stated that the feedback was similar to that provided in a classroom setting. In terms of instructional design, the materials were well prepared, evidenced by almost universal (94%) agreement that the screen layout was satisfactory and the instructions were easy to follow. The study also found that, on average, the final grades of the present semester's cohorts using CBL were significantly better than students' scores who did not use the CBL material in two prior semesters combined.

The student satisfaction with the CBL material, and the comparisons of performance provide evidence that the CBL material with the feedback was an effective way to teach the sequential accounting subject, in comparison to traditional printed material for distance education students. Printed material contains no feedback beyond verification by checking the correctness of a response, whereas the students using the CBL material were provided with immediate step-by-step verification and elaboration, depending on their answers. The greater learning benefit of the CBL materials for distance students can be derived from an understanding of cognitive load theory. The CBL material structure provides guidance for students regarding what to do, and so their search (cognitive load) for extraneous task components is reduced. Each task in the CBL material is carried out separately, so a student can focus on manageable portions of the larger ask, without overloading the working memory. Finally the immediate feedback in the CBL materials allows the student to develop confidence of knowing a given aspect of the overall procedure without having to try to keep the total procedure in his or her working memory.

Unfortunately, ethical regulations meant students could not be allocated to separate treatment conditions and therefore randomised control groups could not be established in that semester. Thus the speculative result linking CBL use and better performance needed a more rigorous design to test causality.
8.1.2 Summary and conclusion from Study 2

In Study 2 the CBL material from Study 1 was re-designed slightly, and the scope of the study was restricted to only one highly structured topic in the accounting course. This topic required sequential understanding, where one segment of work had to be understood before the next step could be attempted. The topic was practical in nature, considered important to the overall course, and had received favourable descriptive comments from participants in Study 1.

To cater for differences in prior knowledge, the CBL material was designed in two different formats - worked examples and traditional problem solving exercises. Research has shown that prior knowledge is an important factor to consider when determining the efficiency of an instructional design (Kalyuga, et al., 2001a; Renkl & Aitkinson, 2003; Thompson, et al., 1992). The feedback in the CBL materials was slightly adjusted (again based on participants’ comments in Study 1), where some sections of the verification provided by answer until correct were replaced with more knowledge of correct response, and some of the elaboration was modified.

This study was the first to apply the instructional efficiency measures developed in cognitive load theory to CBL materials for accounting studies, where the two CBL versions were measured by a combined effort and performance instrument. The analysis was also conducted taking into account the students’ prior knowledge of the subject. In the results it was found that the numerically, but not significantly, more efficient CBL for students with some background in accounting was problem solving CBL, and the significantly more efficient CBL for students with no background in accounting was worked examples.

These findings can be explained based on prior cognitive load studies that found the most efficient means of instruction is usually determined by the experience of the learner. For the students with no prior knowledge of accounting, the CBL material in the worked examples format provided a form of structured guidance that reduced cognitive load and better allowed schemas to develop. The worked examples improved learning by directly exposing students to solution schemas in a better-structured manner, thus freeing up working memory for the problems that followed. The problem
solving CBL for students with no prior knowledge inhibited schema construction, as they imposed a heavy working memory load that interfered with learning and consumed cognitive resources that became unavailable for the creation of schemas. The means-end search resulted in cognitive overload for these students, even though the search was in the end sometimes successful.

With increasing expertise (prior knowledge), the worked example CBL material was not significantly better than the problem solving CBL material, because the acquired schemas allowed the problem solving CBL students to avoid processing large amounts of new information. The cognitive load associated with a means-end problem solving strategy did not inhibit schema development. Prior learning reduced the benefit of the worked example CBL materials and the guidance and structure was not required.

A further important finding from Study 2 was that the performance of the participants completing the CBL material compared favourably to a randomised control group that received instruction in the traditional face-to-face manner. This finding confirmed the effectiveness of the in-house developed CBL material from Study 1. Results also showed that the students with no prior knowledge of accounting who completed the worked examples CBL performed better than a similar randomised face-to-face control group. The greater learning benefit of the CBL materials for students with no prior knowledge of accounting can be explained from an understanding of cognitive load theory. The worked examples CBL material and the feedback allowed students to progress at their own pace, therefore avoiding the potential of a working memory overload, if students could not keep up with the face-to-face instruction. The worked examples CBL provided an effective form of instruction as the individual step-by-step guidance and feedback allowed students to focus on manageable portions of a task, again without overloading the working memory.

The key learning benefit to be gained from Study 2 was that different CBL designs benefited students with different backgrounds in the subject. Commercially produced accounting CBL material is usually provided in one form, however the results of Study 2 suggest that at least two different instructional versions of accounting CBL material would enhance and maximise the learning of students with different backgrounds.
8.1.3 Summary and conclusion from Study 3
Study 3 investigated student learning with problem solving CBL materials having two different forms of feedback, and was applied to students who had a prior knowledge of accounting. In this study the analysis of feedback was the main issue, particularly the comparison between rich and basic feedback. The rich feedback contained verification, elaboration and praise, while the basic feedback contained only verification. The students in Study 1 initially raised the feedback issue, where some students felt the feedback could be more elaborate, while others felt the feedback should be brief. Feedback research in general and particularly in CBL environments has been inconclusive as to the amount and type of feedback required to maximise learning when comparing basic and rich feedback. Cognitive load theory instruments and concepts were again used to compare these feedback types.

The results found that there was no significant difference between the instructional efficiency of the CBL problem solving material, depending on whether students completed the problem solving CBL materials with rich or basic feedback. The numerically greater learning benefit of the problem solving CBL materials with rich feedback for students with a prior knowledge of accounting can be explained from cognitive load theory principles. The explanations in the rich feedback were not redundant and did not crowd out the main learning issues. Rather the rich feedback led to effective schema creation, with the elaboration and praise being considered useful. The elaboration used in this instance (topic contingent, response contingent, and attribute isolation) extended the knowledge of students rather than being harmful. While the rich feedback did not overload the participants' working memory, it was also not significantly more efficient than basic feedback. The cognitive load associated with basic feedback did not hinder learning as previous schemas enabled efficient understanding of the material, and germane cognitive levels to be reached and maintained. On the basis of these results, more research is needed to conclude which form of feedback is significantly more efficient.

8.1.4 Summary and conclusion from Study 4
Study 4 investigated student learning with worked examples CBL materials having two different forms of feedback, and was applied to students who had no prior knowledge of
accounting. Like Study 3, the analysis of feedback was the main issue, being the comparison between rich and basic feedback. Cognitive load theory concepts were again used to examine which feedback was the more efficient means of instruction.

The results showed that the instruction was significantly more efficient for students completing the CBL with rich feedback and this can be explained on the basis of cognitive load theory. The basic feedback comprising verification alone resulted in too heavy a load placed on the working memory and was too brief for effective schema development, resulting in increased effort and lower performance levels. Even though students had been guided through the worked examples, the basic feedback did not sufficiently reduce the extraneous task components. The guidance of the CBL worked examples combined with the rich feedback on the other hand led to significantly greater learning and schema creation. The elaboration and the praise feedback assisted the knowledge of students, and the longer explanations with the step-by-step worked solutions reduced the burden on the working memory, allowing schemas to develop.

### 8.2 Reliability, internal and external validity

The series of studies in this thesis established a high degree of reliability and internal and external validity.

In terms of reliability, the consistency and stability in measurements can be evidenced in a number of ways. All studies used the same in-house developed CBL material. The CBL material used for Studies 2, 3 and 4 were on the same accounting topic. The research design and procedure for Studies 2, 3 and 4 were exactly the same, as was the performance instrument (test), and the Likert scale used to collect effort measures. Study 2 and Study 4 confirmed the three effort measures as being reliable through the widely used Cronbach alpha analysis (Blaikie, 2003) and the high values indicated a high level of consistency among the effort items (in Study 2 \( \alpha = 0.77 \), and in Study 4 \( \alpha = 0.81 \)). The Cronbach alpha reliability analysis was not performed on Studies 1 and 3 as multiple effort measures were not reported.

A range of demographic information was obtained from the participants in each study. The cohort of students used in Study 1 focused on distance students, while Studies 2, 3
Applying cognitive load theory concepts ...

and 4 were conducted on internal students. Two-way ANOVA comparisons of means based on gender and age in Studies 2, 3 and 4 found there was no significant difference between student gender F(2, 230) = 1.04, p = 0.35, and student age F(2, 230) = 0.97, p = 0.38. Studies 1, 2, 3 and 4 were also not significantly different in terms of student gender when tested via a one-way ANOVA, F(3, 315) = 0.89, p = 0.44. Age was not used as a comparison variable between all four studies as Study 1 asked for "ranges of ages".

The CBL material used in Studies 3 and 4 were based on results of Study 2 (In Study 3 problem solving CBL was used for students with prior accounting knowledge, and in Study 4 CBL worked examples were employed for students with no prior accounting knowledge). One-way ANOVA comparisons on the diagnostic test performances of students completing the problem solving CBL material and who had a prior knowledge of accounting (that is students from Studies 2 and 3) found no significant differences between the students in their diagnostic test results F(3, 85) = 0.58, p = 0.63. A further one-way ANOVA comparison of the performances of students completing the worked examples CBL material, and who had a no prior knowledge of accounting (that is from Studies 2 and 4), also found no significant differences in their diagnostic test results F(3, 86) = 1.32, p = 0.27. These results increase confidence in the designs of both the studies, particularly as the measurements of performance (by the diagnostic test) can be repeated and confirmed from students with the same accounting background knowledge studying the same subject, at different time periods.

Learning times differed for Study 1, but remained the same for Studies 2, 3 and 4. Learning time could not be controlled in Study 1 because distance students used the CBL material in their own personal environment. In the subsequent studies, all students had similar amounts of time to complete the CBL material and the diagnostic test.

Study 1 used a one-shot descriptive study design, as information was collected on student attitude to the CBL materials. Study 1 compared the performances of a group of CBL users and non-users in the current semester and prior semesters (in a between-subjects design) however randomised allocation of subjects to treatments was not
ethically possible, and the analysis accepts a high degree of self-selection bias. Studies 2, 3 and 4 were research designs where an unbiased method was used to allocate students to the treatment conditions to ensure internal validity. Study 2 allocated students on the basis of a random digits table, and Studies 3 and 4 on the basis of a coin toss.

Overall there are many consistencies in the measures, procedure, participants and results across all four studies. These consistencies build confidence in the results and increase the external and internal validity. The causal inferences can then be generalised to circumstances beyond those studied.

8.3 Contribution to existing literature

The results and analysis of the various studies in this thesis has shown that the use of CBL materials with teacher-like feedback can result in an effective and at times better schema development, when compared to traditional teaching methods. The studies have shown that there is no disadvantage in using CBL materials as a teaching method and in some cases CBL is more beneficial (for example Study 2 found that worked examples CBL is significantly better than face-to-face teaching for students with no prior knowledge of accounting). By altering aspects of the CBL materials and the feedback, the CBL can be adapted to maximise the learning for a range of students.

This series of studies has examined the link between cognitive load theory, feedback research (and specifically forms of feedback in CBL materials) and the use of CBL in accounting education. This series of studies has included multiple cognitive data types such as effort and prior knowledge, to analyse the usefulness of the CBL materials, and was the first study to relate the instructional efficiency measures of cognitive load to different forms of accounting CBL materials and various types of feedback.

In terms of findings, this research has made the following contributions to the existing literature and has shown that:

- specifically developed in-house CBL is a useful teaching method (Study 1, 2, 3 and 4);
• students’ attitude to in-house developed CBL materials is positive (Study 1 and 2);

• the performance of students using the CBL materials compares favourably with traditional teaching methods (in Study 1 the comparison was with printed distance education materials, and in Study 2 the comparison was with face-to-face tutoring with printed materials);

• for students with no prior knowledge of accounting, the worked examples CBL material resulted in significantly better performance than face-to-face teaching (Study 2);

• students with a prior knowledge of accounting perform better than students who have not done accounting when using CBL materials (Study 2);

• problem solving and worked examples CBL material do not overall show significant differences in student learning, although the problem solving CBL is numerically more beneficial for students with some prior knowledge of accounting (Study 2), while worked examples CBL material is significantly more beneficial for students with no prior knowledge of accounting (Study 2);

• CBL problem solving with rich feedback is numerically more beneficial for students who have some prior accounting knowledge (Study 3), although the benefit is not significantly different from basic feedback;

• CBL problem solving with rich feedback for students with a prior knowledge of accounting does not result in a redundancy effect (Study 3);

• students who have no prior accounting knowledge benefited significantly more from CBL worked examples with rich feedback (Study 4) than basic feedback; and
8.4 Implications and further research

The findings of the four studies in this thesis have implications to educators and developers of CBL material not only in the area of accounting, but across other subjects. Specifically, the implications of this research can be categorised into a number of areas:

*The specific nature of the CBL material and the course:*

While many commercial CBL packages are available for use in accounting education (see Nicholson, 1993; Nicholson, 1997; Mabey, et al., 1998; Jensen & Sandlin, 1995) these are normally generically designed for use by any student across any university, and problems with commonly designed CBL can occur (see Section 3.2, and Sangster, 1992a; Bagranoff, 1993). A major feature of the CBL material used for the present studies was the integration with other study material. The CBL materials were closely linked to the course content and course materials in that the CBL, for example, made references to the textbook or other study material that the students had access to. The in-house designed CBL material also allowed the lecturers to bring out their own teaching style in the screen layout, instructions and feedback. The open comments from students in Study 1 noted that the feedback added a personal touch (see Section 5.5.4).

*The most appropriate form and adaptability of the feedback:*

Debate continues on the most appropriate feedback for CBL materials. Study 4, for instance, showed that the feedback is more beneficial for students with no prior accounting knowledge if it is rich and contains verification elaboration and praise. Study 3 found that while rich is beneficial, it is equally as beneficial as basic feedback where the participants have a prior knowledge of accounting. The feedback contained in the CBL materials of the future could use these findings, or simply provide rich
feedback to all students since rich feedback benefits those with no prior accounting knowledge and does not harm those with prior accounting knowledge.

An obvious implication is to extend the study beyond feedback in the CBL materials for groups of students to feedback for individual students. Ross and Morrison (1993) noted that an advantage of a computer over printed material is the potential of the computer to vary feedback on the basis of systematic and timely assessment of learner needs. Such an adaptation extends the procedure of presenting standard information frames and feedback according to a particular answer selected, to a more thorough analysis of student responses and makes an adaptive decision regarding what feedback or new instruction would be optimal for learning at each point. CBL feedback that has individual adaptive ability while desirable, would have to be weighed against the obvious cost. Future research would be needed before informed judgements could be made on this aspect.

Mason and Bruning (1999) also noted that adaptive feedback could be implemented by increasing the learner’s control over the learning situation, allowing the feedback to be more individually beneficial (see Sales, 1993). For instance, it is possible to provide basic feedback to all students after a response, and then allow students the option to choose if they would like to receive the additional elaborative (rich) feedback. Further, the students could also decide if their elaborative feedback should be task specific, instruction-based or extra-instructional. This option avoids the presentation of unnecessary feedback to all students, yet allows a student to receive more clarification if desired, and greater control over their learning.

Finally for CBL authors, basic feedback could be designed into all CBL materials, and instructors could then provide their own rich feedback in a HTML form to suit their requirements, course, textbook and particular teaching style.
General Discussion and Conclusion

The debate between the most efficient CBL instructional techniques:

The present series of studies compared problem solving with worked examples designed CBL materials, and found that for students with a prior knowledge, problem solving was numerically more efficient and for students with no prior knowledge worked examples were significantly more efficient. Cognitive load theory has shown there are other designs that also assist learning, for example partially completed problems. In the partially completed problems situation, students are presented with a given state, a partial solution and then asked to complete the remainder of the solution (see Section 2.2.5.3). There is evidence that partly completed problems that require a solution, engage students more than worked examples, and encourage active learning (Sweller, et al., 1998; van Merrienboer, et al., 2003). Partially completed problems could easily be applied to accounting especially to a structured topic such as balance day adjustments. The general journal to complete the balance day adjustment, for example, may have the debit entry account name and amount provided, and students would be required to complete the corresponding credit entry. To complete the credit entry correctly, students would need to be engaged with the question in the early part of the task, before providing an answer. The efficiency of the completion problems may be evaluated by comparing both the effort and performance of that instructional design with other designs in the same manner as in this series of studies.

Other cognitive and ability aspects:

This series of studies has measured efficiency of the CBL material techniques based on students' prior knowledge. Other important cognitive aspects of learning may also need to be considered when designing, and evaluating CBL material, and these could include the students' aptitude, learning style, motivation level, or career aspirations (Sales, 1993). The present studies have not examined these issues, but were restricted to prior knowledge as indicated by the students' previous accounting studies. Other measures of ability such as those obtained when students enter a university may also be another basis for examining the most efficient CBL material design and form of feedback, and could be used as a covariate in the same way as prior knowledge based on students' prior accounting studies was used in this study (Rankin, et al., 2003).
Applying cognitive load theory concepts ...

Other structured and practical accounting topics:

Studies 2, 3 and 4 used one highly structured topic of an introductory accounting course in a CBL material format. Typical introductory accounting courses comprise ten to twelve different topics, and developing CBL in some or all of these topics and testing the topics in a similar manner as this thesis, would provide opportunities to replicate and extend this research and increase the external validity. The conclusions of Studies 2, 3 and 4 can really only be directly applied to one highly structured topic of accounting, even though the studies have shown consistent results when applied to different participants and at different times.

In designing future accounting CBL material, it would be relevant to concentrate on similar highly structured practical topics, where prior research has shown these are particularly well suited to CBL use (see Ryan & Simpson, 1988; Sangster, 1992a). The practical topics of future CBL material may include basic bookkeeping (where general journal entries are prepared involving debit and credit entries, and the posting of these entries into ledger accounts); the preparation of final accounting reports from a trial balance, or the calculation of ratios. In these topics the responses are usually either correct or incorrect, and the learning sequence highly structured.

Analysing the types of verification and elaboration feedback:

It can be concluded from this research that in a CBL context, rich feedback is more useful than basic for those students with prior knowledge of the subject (though this is only numerically different) and also for those students without a prior a prior knowledge (this different is significant). The rich feedback in this case contained aspects of verification (being knowledge of response, answer until correct and knowledge of correct response, and variations of these) elaboration (consisting of forms of topic contingent, response contingent, bug related, and attribute isolation) and praise. While it would appear that the students preferred that the verification type was not answer until correct (see some open comments in Section 5.5.4), there was no instructional efficiency analysis conducted in this feedback type. Rather the feedback analysis was restricted to only rich and basic feedback. Future research may be directed at instructional efficiency
analysis comparing forms of verification feedback such as knowledge of response or answer until correct. Prior research (see section 2.3.7.1.1, and studies by Morrison, et al., 1995; & Clariana, 1990) have analysed different verification forms of feedback, and comparing verification using the same instructional efficiency measure would seem a likely extension. Similar analysis can be undertaken with different forms of elaboration feedback.

**Alternatives to the instructional efficiency measure:**

The instructional efficiency measurement method adopted in this study has been extensively used and well supported by many studies in cognitive load theory literature (see Paas, et al., 2003; Tuovinen & Paas, 2004). Variables other than subjective measures of effort and performance based on test results may be used that provide measures of the cognitive demands of learning tasks. Other procedures to measure cognitive load have been outlined previously in Section 2.2.6.1 and these include psychological techniques and task and performance based indicators, and these effort measures could be applied to future research into CBL accounting materials and feedback forms.

Other measures of cognitive load may also be used. For example, a measure previously used to capture effort has been "time" (see Cloyd, 1997; Rose & Wolfe, 2000) where the greater the time, the more cognitively demanding (effort) a task is seen to be. Measures of time would provide useful cognitive information such as whether or not students spent the required time reading, understanding and completing problems. Further, having students record the time spent on each worked example may provide information on whether worked examples sufficiently engage students. Although some effort measures were collected on worked examples (for instance the "first 3" worked examples and the "next 5") the issue of worked examples engaging students has not been addressed in the present study.

Research has noted the importance of time and recent studies have extended the instructional efficiency measure to incorporate a measure of time. Salden, Paas, Broers and Van Merriënboer (2004) for example, investigated a three dimensional instructional
Applying cognitive load theory concepts ...

efficiency measure incorporating mental effort, performance, and the time factor with useful results for instructional researchers.

A further variable that may be used to measure cognitive engagement could be the number of times students asked for tutorial assistance to complete the required tasks. A "help" variable for instance could provide cognitive load information, particularly as the highest levels of effort would normally require the most help to complete the tasks, whereas the students requesting the least help would experience the least cognitive demands. Research has not yet incorporated a measure for help into the instructional efficiency measure.

Finally, Tuovinen and Paas (2004) explore the utility of employing the instructional efficiency measure as developed by Paas and van Merrienboer (1993) and a new three-dimensional approach, which combines the measures of effort during learning; effort during testing, and performance. Again this new approach has proven useful for instructional researchers, even though it is in the early stages of development.

In summary, these new methods reveal that research into the instructional efficiency measure is continuing and expanding.

Analysing the effort measures

In this thesis, Studies 2 and 4 collected and reported effort measures based on the first three adjustments and the next five adjustments (see Tables 6.9, 6.10 & 7.5). In Study 2 this measure was only used only to determine differences between problem solving CBL and worked examples CBL, and in Study 4 the data was used to compare the worked examples CBL with rich or basic feedback. Only the total effort was used in the calculation of instructional efficiency measures. Future research may investigate whether the total effort, or subsets of the total (such as the “first 3” or “next 5”) add more meaning to instructional efficiency measures, or if instructional efficiency changes as students progress through sections of work. Studies 2 and 4 have shown that the effort measures are reliable, so it may be useful to conduct more analysis on effort, rather than relying on total effort measures for instructional efficiency.
8.5 Conclusion

Bryant and Hutton (2000) stated that the search for excellence in accounting education should begin with the ultimate objective of maximizing student learning. Bonner (1999) also noted that accounting instructors should choose teaching methods based on the learning objectives. Accounting educators should continually scan the technology horizon and incorporate solutions that are most likely to maximise these educational objectives. This research has attempted to assist this endeavor by using aspects of the well-established cognitive load theory to maximise the learning outcomes of different students using various CBL materials with different types of feedback. The research has found that in-house developed CBL material can be an effective learning tool. Further, by using the instructional efficiency paradigm from cognitive load theory, the CBL materials and the feedback can be modified to maximise the learning opportunities of students with different backgrounds.

There are many opportunities to extend this research and further apply aspects of cognitive load theory to accounting education and feedback. Research should continue, particularly as these studies have found that different forms of CBL materials and various types of feedback assist learning, especially when the instructional design suitably targets learner characteristics.
Appendix 1

A screen shot where a blackboard was used to resemble a face-to-face teaching situation.

In the space provided, complete the definition of "assets" from your textbook (page 41). I have started this for you.

...those

Evaluate your answer

Make sure you press the "Evaluate your answer" button (left mouse) after entering your answer!
Appendix 2

An example of a multiple choice question

3 of 5. Trade Creditors would be most interested in which type of information from the statements below?

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Short term liquidity position</td>
<td>A</td>
</tr>
<tr>
<td>B. Annual dividends</td>
<td>B</td>
</tr>
<tr>
<td>C. Net income</td>
<td>C</td>
</tr>
<tr>
<td>D. Continuity of orders for factory</td>
<td>D</td>
</tr>
<tr>
<td>E. Pollution by the firm of the countryside</td>
<td>E</td>
</tr>
</tbody>
</table>


Appendix 3

An example of an incorrect choice of the multiple choice question, where the correct answer is then provided.

### 3 of 5. Trade Creditors would be most interested in which type of information from the statements below?

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Short term liquidity position</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Annual dividends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Net income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Continuity of orders for factory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Pollution by the firm of the countryside</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Although some creditors may be concerned about pollution, all creditors are concerned about collecting their money, hence A is the more correct answer.

Refer to Ratnatunga p4-5 and
Appendix 4

An example of the screen layout where a correct multiple choice is made.

3 of 5. Trade Creditors would be most interested in which type of information from the statements below?

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Short term liquidity position</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Annual dividends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Net income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Continuity of orders for factory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Pollution by the firm of the countryside</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correct. Trade creditors generally provide 30-60 day credit terms. They are therefore interested in the ability of the firm to pay its debts in the short term, that is, the firm's short term liquidity position.
Appendix 5

An example of the screen layout of a true/false question

An owner can only withdraw cash as drawings.

1 of 5

T

F

← →
Appendix 5 (cont)

An example of the screen layout of the true / false questions and the feedback where the correct answer has been provided.

An owner can only withdraw cash as drawings.

Correct. The owner can withdraw cash, stock, and other types of assets from the business for personal use.
Appendix 5 (cont)

An example of the screen layout of the true / false questions and the feedback where the incorrect answer is provided.

Incorrect. An owner can withdraw cash as well as stock, furniture, and other types of assets as drawings. Refer to page 159.
Appendix 6

An example of a higher order learning question seeking application competence
(complete)

In the space provided, complete the definition of "assets" from your textbook (page 41). I have started this for you.

...those

Evaluate your answer

Make sure you press the "Evaluate your answer" button (left mouse) after entering your answer!
Appendix 7

An example of a higher order learning question seeking knowledge competence ("Re-examine")

The definition of assets contained one phrase of particular significance. Re-examine your definition, try to identify this phrase, and record it in the space below.

(Hint: I am looking for three key words)

Good. This phrase is critical to the definition of assets. It refers to the assets scarce capacity to provide services or benefits to the entities that use them.

future economic benefits

Evaluate your answer.
Appendix 8

Screen shot of a theory type question when a correct response was made (feedback contained verification and task specific elaboration)

In the space provided, complete the definition of "assets" from your textbook (page 41). I have started this for you.

...those controlled by the entity that provide future economic benefits

Evaluate your answer

Good. So far we're talking about the same things! You can move on to the next piece of analysis, which tests you on the definition provided.

OK
Appendix 9

Screen layout and feedback where a correct response is made to a theory question

The definition of assets contained one phrase of particular significance. Re-examine your definition, try to identify this phrase, and record it in the space below. (Hint: I am looking for three key words.)

Good. This phrase is critical to the definition of assets. It refers to the assets scarce capacity to provide services or benefits to the entities that use them.

future economic benefits

Evaluate your answer.
Appendix 10

Screen shot of Appendix 8, when an incorrect response was made (feedback contained verification and extra instructional elaboration)

In the space provided, complete the definition of "assets" from your textbook [page 41]. I have started this for you.

Make sure you press the "Evaluate your answer" button (left mouse) after entering your answer!
Appendix 11

Screen layout and feedback of Appendix 9 where an incorrect response is made.

The definition of assets contained one phrase of particular significance. Re-examine your definition, try to identify this phrase, and record it in the space below.

(Hint: I am looking for three key words.)

Incorrect. One or more key words are missing. Here is a cryptic clue: FEBruary is a good beginning.

future

Evaluate your answer.
Appendix 12

An example of the screen layout to complete the initial balance day adjustment general journal entry

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.93</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Wages prepaid*  $500

**TRIAL BALANCE**

<table>
<thead>
<tr>
<th>ACCOUNT NAME</th>
<th>DEBIT</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and Machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depen. Plant</td>
<td></td>
<td>40000</td>
</tr>
<tr>
<td>Accounts Rec.</td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>Rent Expn.</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Staff Wages</td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>Insurance Prepa.</td>
<td></td>
<td>12000</td>
</tr>
</tbody>
</table>

Click with left mouse button on this heading to update your Trial Balance.
Appendix 13

An example of the screen layout to complete the adjusted trial balance

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and Machinery</td>
<td>19,000</td>
</tr>
<tr>
<td>Acc. Drn. - Plant and Machinery</td>
<td>4,000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12,000</td>
</tr>
<tr>
<td>Rent Expense</td>
<td>13,000</td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>25,500</td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1,200</td>
</tr>
<tr>
<td>Office Equipment</td>
<td>600</td>
</tr>
<tr>
<td>Acc. Drn. - Office Equipment</td>
<td>10,000</td>
</tr>
<tr>
<td>Service Van</td>
<td>20,000</td>
</tr>
<tr>
<td>Acc. Drn. - Van</td>
<td>400</td>
</tr>
<tr>
<td>Equipment Rental Income</td>
<td>9,500</td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>2,000</td>
</tr>
<tr>
<td>Advertising</td>
<td>1,000</td>
</tr>
<tr>
<td>Deposit for New Machine</td>
<td>10,000</td>
</tr>
<tr>
<td>Accounts Payable</td>
<td>9,000</td>
</tr>
<tr>
<td>Fuel Expenses</td>
<td>1,120</td>
</tr>
<tr>
<td>Capital</td>
<td>15,000</td>
</tr>
<tr>
<td>Drawings</td>
<td>2,000</td>
</tr>
</tbody>
</table>

When you have checked all your entries, click on the continue button (left mouse) for the next adjustment.

Totals: 299,500

Show Previous General Journal Entry

Continue
Appendix 14

Screen shot used to introduce the practical Topic of “closing the accounts”

The following exercise pertains to the T-accounts in an Accountancy practise (see E7.4; p. 347). You are required to close the relevant accounts to the Income Summary Account.

Enter the transaction in the appropriate ledger account on the side you consider correct. Click on the answer with the right mouse button. I will tell you if you are right or wrong. After that, update the Income Summary Ledger. I will guide your entries and tell you if your actions are correct or not.

Note: you must use the account names as given in the exercise. Do not abbreviate them.
Appendix 14 (cont)

Second screen shot to introduce the practical Topic of "closing the accounts"

2. Click anywhere on the Income Summary Account with your left mouse button to access it for data entry.
Appendix 14 (cont)

Screen shot and feedback when an incorrect response is made in the practical Topic of "closing the accounts"

2. Click anywhere on the Income Summary Account with your left mouse button to access it for data entry.

Incorrect. One or more elements of the full answer is missing from your entry. Have you included the date, corresponding account name and amount?
Appendix 14 (cont)

Screen shot and feedback when a correct response is made in the practical topic “closing the accounts”

2. Click anywhere on the Income Summary Account with your left mouse button to access it for data entry.

Correct. This entry is needed on the debit side to make the Interest Revenue account equal to zero. Now, proceed to the Income Summary account and update it with this corresponding entry. Of course you should know what side to put the answer on in this account!
Appendix 14 (cont)

Screen shots used introduce the second part of the practical Topic of "closing the accounts".

Complete the corresponding entry for Interest Revenue $800

INCOME SUMMARY

When you have entered the closing entry, click on the answer with your right mouse button, and I will evaluate your response. Remember to include all relevant information (date, details, amount). Proceed to next T-account when all is correct. (Double click to clear this instruction.)

Return to Current T-Account?
Go to next T-Account?
Appendix 15

A copy of the Centre for Computers in Teaching Initiatives - Accounting, Finance and Management (CTI - AFM) CBL evaluation checklist

CTI-AFM CBL Evaluation Software


Evaluation Tool for CBL Software

Notes to the Evaluator

The concerns under consideration are:

the use and effect of the software as educational materials
the usefulness of the documentation.

The specific aspects addressed are as follows:

definition of objectives
target users
definition of pre-requisites content
learner activities
learning procedures
internal structure
interactivity
screen management
legibility
response analyser
feedback
evidence of user's progress autonomy
evaluation of achieved learning adaptability
documentation

Of these aspects the most important are (in order of importance):

1. content
2. the learning procedures
3. learner activities
4. interactivity
5. feedback
6. evaluation of achieved learning
Please answer all the questions in the following list and record a positive or negative response on the analysis sheet. The total number of positive and negative responses for each aspect can then be entered in the summary sheet.

Use the relative number of positive or negative responses for each aspect to guide you in preparing your descriptive review of the product. Do not add the scores for each aspect. The numbers simply provide a guide to the attributes of the product and do not have any quantitative significance. As an evaluator you must decide what the most important attributes are. It may be that an aspect has more 'yes' answers than 'no' answers but the negative responses may be of greater significance in your judgement and this should be reflected in your descriptive review.

This evaluation tool does not cover details of the subject content of the package. The tool was developed to be used on a range of packages for business education. It could however be easily adapted for CBL materials for a specific subject area by the addition of a set of questions relevant to that subject and to the level under consideration e.g. a basic course in business accounting or an advanced course in financial analysis. In this way comparative reviews could be produced.

This evaluation tool was developed at CTI-AFM for use on CBL materials for business education, and is based on the MEDA: Evaluating Training Software, edited by Machell and Saunders and published by the Centre for the Study of Education and Training (CSET), at Lancaster University. MEDA, (Methodologie d'Evaluation de Didacticiels pour Adultes) was developed using the expertise of some thirty evaluation specialists and the experience of some forty European enterprises using training software, as part of a project financed by the European Commission.
Applying cognitive load theory concepts...

Analysis Sheet

Product Evaluation: product name

Name of Evaluator:                      Date:

Answers

Yes    No

Aspect 1: Definition of Objectives

Are the objectives clearly set out at the beginning of the software?

Are the objectives relevant to the course for which the learner is studying?

Does the software check that the objectives have been achieved?

Yes/No Total

Aspect 2: Target users

Is information available on the target users?

Yes/No Total

Aspect 3: Definition of Prerequisites

Are the pre-requisites made clear?

Are they tested at the start of the product?

Yes/No Total

Aspect 4: Content

Is the content precise?

Is the content tip to date?

Is the content pitched at the learner's level?

Is the content progressive?

207
Is there a clear structure in the material?

Yes/No Total

Aspect 5 Learning Procedures

Bearing in mind the skills required, is the type of strategy (discovery, interactive dialogue, solving induction etc.) relevant?

Is it possible to use different learning strategies with the software?

Is the software responsive to the learner's needs (e.g. does it supply individualised feedback or to steer the learner to sequences which are based on another teaching approach if necessary)?

Does the software aim to arouse interest (e.g. by informing the user of what is to be learnt and why it is necessary)?

Are attention holding strategies employed (e.g. use of emphasis, repetition etc.)?

Does the software incorporate procedures that will help the learner integrate new knowledge with existing knowledge?

Yes/No Total

Aspect 6 Learner activities

Is the level of complexity of the activities in keeping with the objectives of the software?

Does the learner receive clear information on how a question should be answered?

Is the form of the questions appropriate (open-ended, closed, guided, unguided) bearing in mind the objectives?

Are the questions sufficiently challenging?

Yes/No Total

Aspect 7 Internal Structure

Is the software divided into modules?
Applying cognitive load theory concepts ...

Is the division into modules appropriate?

Are the objectives of each module explained clearly?

Yes/No Total

Aspect 8 Interactivity Can the user

Stop the program and EXIT at will? ask for HELP?
obtain basic instructions at all times?

jump a section?

repeat a section?

return directly to the place left at the end of the previous session?

easily correct or delete mistakes when unsure of a response?

use a menu to select parts of the program?

After a choice by the user

can the software display different messages?

can it select different routes according to difficulty?

can it select different routes according to their content?

can it select different routes according to the learning strategies proposed?

can it provide adapted differentiated feedback?

does it accept several possible entries?

does it accept and recognise partly correct responses?

Yes/No Total
Aspect 9 Screen Management

Is the supplementary material (e.g., instructions/directions) appropriately laid out so that reading is not interrupted?

Is the use of keys (e.g., for Help, to continue etc.) consistent throughout?

Is there a change of page when new information is being presented?

Is there appropriate use of contrast or highlights for emphasis?

Aspect 10 Legibility

Are the screens easy to read?

Is the information well laid out?

Yes/No Total

Aspect 11 Response analyser

Is allowance made for spelling mistakes?

Is allowance made for synonyms?

Are different ways of expressing the same numerical value acceptable?

Yes/No Total

Aspect 12 Feedback

Is the feedback appropriate to the level of the learner?

Is the feedback varied in its form?

Is the feedback helpful?

Is the feedback encouraging?
Applying cognitive load theory concepts ...

Are hints provided after a wrong response?

Does the software make use of reinforcement in feedback?

Does the software give clear feedback?

Yes/No Total

Aspect 13 Evidence of user's progress

Does the learner or tutor record the outcomes of a session?
Does the learner or tutor record the point reached?
Does the learner or tutor receive a diagnosis?
Does the learner or tutor receive a list of suggested further activities?

Aspect 14 Autonomy

Are instructions for use clear and exhaustive?

Is the product reliable? Do crashes occur unexpectedly?

Can the product be used by someone with no computing skills?

Can the learner manage without help from another person?

Yes/No Total

Aspect 15 Achieved learning

Does the product provide a way of evaluating what the learner has retained?

Are the evaluation procedures reliable?

Do these procedures measure the performance of the learner in relation to the initial objectives?

Are the learners informed of the results?

Aspect 16 Adaptability
Missing pages/issues
Appendix 16

The screen layout (with the types of questions) at the beginning of Topic 1 - The Accounting Profession

Interactive Module No. 1

The Accounting Profession

Exercises in this module:
- Multiple Choice Questions
- True/False Questions
- Fill The Blanks
- Exit Module
Appendix 17

The screen layout (with the types of questions) at the beginning of
Topic 2 - Basic Concepts
Appendix 18

The screen layout (with the types of questions) at the beginning of Topic 4 - Changes in Owners Equity

Interactive Module
No. 4

Changes in Owners Equity

Exercises in this module:

- Multiple Choice
- True/False
- Profit/Loss Account
- Cash vs. Accrual
- Exit Module?
Appendix 19

The screen layout (with the types of questions) at the beginning of Topic 5 - Adjusting Entries and Deferrals
Appendix 20

The screen layout (with the types of questions) at the beginning of Topic 6 - Accruals

Interactive Module
No. 6

Accruals

Exercises in this module:
- Multiple Choice
- Practical Question
- Exit Module
Appendix 21

The screen layout (with the types of questions) at the beginning of
Topic 7 - Closing the Accounts
Appendix 22

The screen layout (with the types of questions) at the beginning of
Topic 8 - Computerised Accounting Systems

Interactive Module
No. 8

Computerised
Accounting Systems

Exercises in this module:
- Multiple Choice
- True/False
- Exit Module
Appendix 23

The screen layout (with the types of questions) at the beginning of
Topic 9 - Australian Corporations Law

Interactive Module
No. 9

Australian Corporations Law

Exercises in this module:
- Multiple Choice
- True/False
- Statement Analysis
- Exit Module
Appendix 24

The screen layout (with the types of questions) at the beginning of
Topic 10 - Financial Analysis of Companies

Interactive Module
No. 10

Financial Analysis of Companies

Exercises in this module:
- Multiple Choice
- Ratio Analysis
- Exit Module
Applying cognitive load theory concepts ...

Appendix 25

Copy of the Study: 'Computer-Based Learning Evaluation Questionnaire (CBLEQ) used in Study 1

GBU 1001 Introductory Accounting A
Study Materials Questionnaire

1. Sex: (please tick box) Male □ 1 Female □ 2

2. You reside in: (please tick box) Gippsland □ 1 Melbourne □ 2 Other Victoria □ 3 Interstate □ 4 Overseas □ 5

(please specify city/state) __________________ (please specify country) __________________

3. Your age bracket: (please tick box) 18-25 □ 1 26-35 □ 2 36-45 □ 3 46 and over □ 4

4. Approximately how often did you use each of the study materials listed below? (please place the appropriate number in the space provided)

(1) More than once a week; (2) Once a week; (3) Once a fortnight;
(4) Once a month; (5) Once per half semester; (6) Once per semester;

( ) Unit Guide
( ) Unit Book
( ) Reader
( ) Text Book (Ratnatunga et al.)
( ) Unit Guide Text Book (Waldman et al.) Audio Tape
( ) Computer-Based Learning Package

5. Please rank the study materials from most useful (1) through to least useful (7)

( ) Unit Guide
( ) Unit Book
( ) Reader
( ) Text Book (Ratnatunga et al.)
( ) Unit Guide Text Book (Waldmann et al.) Audio Tape
( ) Computer-Based Learning Package

Why did you find your last ranked (above) least useful?
6. Please rate the following study materials in terms of their usefulness to you. (please circle response)

<table>
<thead>
<tr>
<th>Study Material</th>
<th>Very Useful</th>
<th>Useful</th>
<th>Neutral</th>
<th>Not Very Useful</th>
<th>Useless</th>
<th>Not Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Guide</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Unit Book</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Reader</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Text Book (Rat.)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Unit Guide (Wal.)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Audio Tape</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Computer Package</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**Computer-Based Learning (CBL) Package**

Below are a number of questions specifically related to the Computer-Based Learning package. Please answer them as honestly and as best you can. Complete questions 7-18 if you have used the computer-based learning package. If you did not use the package complete questions 17-19 only.

7. How computer literate do you consider yourself? (please tick box)

   Beginner ☐ 1  Intermediate ☐ 2  Advanced ☐ 3

8. Of the nine (9) study guides sent (i.e., 1, 2, 4 - 10), how many did you use?

9. Were the instructions provided to questions in the CBL package generally easy to follow and understand? (please tick box)

   Yes ☐ 1  No ☐ 2

10. Please rank the following types of questions used in the CBL package from most useful (1) to least useful (4):

    ( ) True or False
    ( ) Multiple Choice
    ( ) Practical Questions (eg., Balance day adjustments; Trial balance)
    ( ) Theory Questions (eg., What is an asset?)

11. Was the feedback (teachers' comments) to each question generally satisfactory? (please tick box)

    Yes ☐ 1  No ☐ 2

    If no, why not?

12. Did the feedback provided to questions reduce the need for telephone contact with tutors? (please tick box)

    Yes ☐ 1  No ☐ 2
13. Do you think the feedback was of the type you would expect to receive in a classroom (i.e. did it successfully mimic a human tutor)? (please tick box)

Yes ☐ 1  No ☐ 2
If no, why not?

14. In general, do you think the screen layouts were, well structured and easy to follow?

Yes ☐ 1  No ☐ 2
If no, why not?

15. Would you like to see some form of test of your answers to the computer based material (e.g., a mark out of ten for each module)? (please tick box)

Yes ☐ 1  No ☐ 2

16. Do you think you will receive a better grade for the unit having used the CBL package? (please tick box)

Yes ☐ 1  No ☐ 2  No opinion ☐ 3

17. Would you like to see the concept of CBL packages developed for other accounting units? (please tick box)

Yes ☐ 1  No ☐ 2  No opinion ☐ 3

18. Would you prefer Weekend Schools or greater reliance on computer-based learning? (please tick box)

Weekend Schools ☐ 1  Computer-based learning ☐ 2  No opinion ☐ 3

19. What are the reasons for you not using the computer-based learning package?

If you would like to receive a copy of the survey results, please supply your name and address below:

Name:

Address:

Thank you for completing this survey.

for completing this survey.
Appendix 26

Study Guide used for the Introductory Accounting A unit, with the instructions for loading and using the CBL materials

CONTENTS

Unit Outline 1
  Welcome to accounting 1
  Unit adviser 1
  Objectives 1
  Structure and organisation of the course 2
  Distance education study program 2
  Syllabus 3
  Study materials 6
  How much time do you need? 6
  Prescribed text 6
  Assessment 7
  Assignments 7
  Submitting assignments 8
  Computer software material 9
  A note on plagiarism 10
  Final examination 11
  Assignment Topics and dates 13
UNIT OUTLINE

Welcome to accounting
As you work through this Unit Guide, you will come across lots of new ideas and new terms for ideas with which you are already familiar.

In any course of study, the more that you put into it the more you will get out. You will see as we proceed that each part of your degree builds on your knowledge from previous sections.

GBU1001 is the first unit in accounting offered at Monash University Gippsland Campus. It introduces students to financial reporting and also management accounting issues.

Unit adviser
Your Unit Adviser is Abdel K Halabi (ph 1 051-226646).

If you are unable to contact any of the above you may leave a message for a return ph1 call at the Business office 61-51-226380.

The fax number for the School of Business is 61-51-226524. Note this is for general queries only. Do not fax assignments to this machine. Students who request a reply to a fax should ensure that their embassy’s fax machine is left on at all times.

Students may wish to use the Email facility. My address is: Abdel.Halabi@bus.eco.monash.edu.au.

New staff may be appointed to specifically answer GBU1001 requests. A memo will be sent advising students of changes in staff and who to contact early in the semester.

Objectives
Students who have studied GBU1001 should be able to:

- define and discuss the major concepts in financial and management accounting.
- prepare profit and loss and balance sheet statements from given source material.
- understand the information requirements for financial decision making by internal managers and external interest groups.
- read and interpret financial statements.
- analyse financial statements for profitability and risk.
- apply the accounting and net present value models to investment situations.
- demonstrate competence in business communications through oral and written assessment.

Structure and organisation of the course
This unit is divided into thirteen Topics spaced over fifteen weeks, of which thirteen are teaching weeks.

Each week’s programme is discussed in a Study Guide - like a chapter in a book. You should allow no less than twelve hours to read each guide, the text book references and then perhaps the associated readings in the reading guide. Note that readings in the reading guide are optional.

The study guide by Waldmann, Baker (and others) is also optional and can be used at the end of the weeks readings. The exercises in this text have solutions supplied and students can monitor their own
progress in the practical areas of the course. You should then attempt the questions at the end of the chapter in the Ratnatunga et al. (1994) text. As an alternative you may wish to use the accounting software developed for this unit. Instructions are in a section further in this guide. Part A first and then check your answers. Doing all this should reinforce your learning.

Part B questions in Ratnatunga et al. (1994) are not for assessment, apart from the assignments specified. They are there to help you focus on key points.

Write down the answers to these questions and store them in a folio. This facilitates revision. Many answers to questions have been provided, but obviously you should first attempt the questions.

Distance education study program
The Study Program which follows is designed to let you know what you should be doing each week and when assignments are due for submission.

Text code


O: Other journal articles in the reader.

All distance education students have been supplied with a Reader in this unit. The Reader covers much of the same material as the Ratnatunga text. Students may wish to refer to the Reader to help them clarify certain points.

Essentially the Reader has been prepared to assist remote distance education students who may not have access to library facilities. The readings are not compulsory, and reinforce the main text book.
### Syllabus

<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Topic</th>
<th>Reading</th>
<th>CBL use</th>
<th>Seminar</th>
</tr>
</thead>
<tbody>
<tr>
<td>22-Jul</td>
<td>1</td>
<td>Introduction to Accounting</td>
<td></td>
<td>Multiple Choice, True False, Fill in Blanks.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.1 Definition of Accounting</td>
<td>R: Ch 1</td>
<td></td>
<td>15-16/7/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.2 Accounting Profession in Australia</td>
<td>WB: Ch 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.3 Regulatory Framework</td>
<td>H: Ch 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.4 Future of Accounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29-Jul</td>
<td>2</td>
<td>Basic Concepts</td>
<td></td>
<td>Multiple Choice, True False, Theory, Classification</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.1 Accounting Cycle</td>
<td>R: Ch 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.2 The Balance Sheet</td>
<td>WB: Ch 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.3 Commencing a Business</td>
<td>H: Ch 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.4 Business Transactions and their effect on the balance sheet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-Aug</td>
<td>3</td>
<td>Rules and Tools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.1 Transaction Analysis Chart</td>
<td>R: Ch.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.2 Introducing Debits and Credits</td>
<td>WB: Ch 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.3 Balancing the Accounts and Preparing a Trial Balance</td>
<td>K: Ch 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.4 Preparing and Analysing a Simple Balance Sheet</td>
<td>O: Mann, G.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-Aug</td>
<td>4</td>
<td>Changes in Owners' Equity</td>
<td></td>
<td>Multiple Choice, True False, Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.1 Transactions which affect Owners' Equity</td>
<td>R: Ch. 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.2 Expansion of Accounting Equation</td>
<td>WB: Ch. 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.3 Preparing a Profit &amp; Loss Statement</td>
<td>K: Ch. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.4 Link between the Profit &amp; Loss Statement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-Aug</td>
<td>5</td>
<td>Adjusting Entries and Deferrals</td>
<td></td>
<td>Multiple Choice, Practical</td>
<td>19-20/8/95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.1 Rationale for Adjusting Entries</td>
<td>R: Ch. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.2 Matching Principle</td>
<td>WB: Ch. 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.3 Deferrals and Accruals</td>
<td>H: Ch. 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.4 Types of Adjustments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>No.</td>
<td>Section</td>
<td>Reading Material</td>
<td>Assessment</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----</td>
<td>----------------------------------------------</td>
<td>------------------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td>26-Aug</td>
<td>6</td>
<td>Accruals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.1 Review of Adjusting Entries</td>
<td>R: Ch. 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.2 Accrued Expenses</td>
<td>WB: Ch. 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.3 Accrued Revenues</td>
<td>H: Ch. 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.4 Preparation of Trial Balance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Sep</td>
<td>7</td>
<td>Closing the Accounts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.1 The Closing Entry Process</td>
<td>R: Ch. 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.2 Closing the Revenue Accounts</td>
<td>WB: Ch. 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.3 Closing the Drawings Account</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.4 The Post Closing Trial Balance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-Sep</td>
<td>8</td>
<td>Computerised Accounting Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.1 Comparison of Manual and Computerised Accounting Systems</td>
<td>R: Ch. 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.2 Computer Input - Processing - Output</td>
<td>WB: Ch. 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relevant newspapers, journals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-Sep</td>
<td>9</td>
<td>Australian Companies Legislation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.1 Types of Company Structures</td>
<td>R: Ch. 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.2 Advantages/Disadvantages of the Corporate Structure</td>
<td>WB: Ch. 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.3 Types of Shares</td>
<td>Relevant newspapers, journals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.4 Consolidated Financial Reports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23-Sep</td>
<td>10</td>
<td>NO TEACHING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-Sep</td>
<td>11</td>
<td>Financial Analysis of Companies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.1 Profitability Ratios</td>
<td>R: Ch. 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.2 Liquidity Ratios</td>
<td>WB: Ch. 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.3 Financial Stability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.4 Limitations of Financial Analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Applying cognitive load theory concepts ...

<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Topics</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-Oct</td>
<td>12</td>
<td><strong>Product Costing</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.1 The Role of the Management Accountant</td>
<td>R: Ch. 11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.2 Cost Concepts and Classification</td>
<td>WB: Ch. 11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.3 Product Costing Methods</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.4 Full Cost of Operations</td>
<td></td>
</tr>
<tr>
<td>14-Oct</td>
<td>13</td>
<td><strong>Planning and Control</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.1 Cost-Volume-Profit Analysis</td>
<td>R: Ch. 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.2 Pricing in Business</td>
<td>WB: Ch. 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.3 Budgeting: An overview</td>
<td>W: Ch. 26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.4 Absorption/Variable Costing</td>
<td></td>
</tr>
<tr>
<td>21-Oct</td>
<td>14</td>
<td><strong>The Time Value of Money</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.1 Simple/Compound Interest</td>
<td>R: Ch. 13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.2 Present Values</td>
<td>WB: Ch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.3 Annuities</td>
<td>W: Appendix A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.4 Loan and Mortgage Repayments</td>
<td></td>
</tr>
</tbody>
</table>

EXAMS WILL BE HELD IN NOVEMBER

**Study materials**

Students should receive the following materials from Monash Distance Education:

1. A Unit Book
2. A Unit Guide
3. A Reader
4. Computer Disks and an audio tape

Included will be 2 assignment cover sheets.

**How much time do you need?**

*Most students will take about 12 hours per week to complete this unit.* A great advantage of off-campus study is that it is self-paced - you study when it suits you.

You may commence work on your assignment at any time you choose.

You will, however, lose marks if you submit late, because your results will be delayed and you may not get feedback to help lift your performance in subsequent tasks and the examination. Your tutor is required to deduct marks for lateness. You should aim to have assignments in on the due date.

**Prescribed text**


Accompanied by:

Supplementary texts

Other texts which may assist as well as the reading guide are:


Journals and magazines you might find useful

Any public company annual report - these can often be obtained by telephoning the company and requesting a copy be sent to you.

Also relevant Australian publications are:

*The Australian Accountant*
*Business Review Weekly*
*The Australian Financial Review*

Assessment

Assessment is by 2 assignments worth 30% collectively, and 1 final examination worth 70%. The examination will be closed book and of 3 hours duration. A memo will be sent later in regards to the structure of the exam.

2 recent exam papers and their solutions are provided at the rear of this unit guide.

Assignments

Assignments have been specified. They do not cover all the unit material but should indicate the standard required. Final dates for submission are given, but submission prior to the due date is encouraged. Please note that *it is the student's responsibility to submit the work not later then the final date and extensions will not normally be granted*. Students must have mailed their assignments so that the supervisor will receive them by the due date. Students must make their own arrangements to ensure compliance with this requirement. Students should order their study program so that work will be submitted at the required time. Work received after the due date may be read and the quality of the work discussed, however the assignment will be returned without assessment.

Assignments should be prepared well in advance of due dates. Problems inevitably occur and need time to overcome.

Students requesting an extension should apply to the Unit Adviser, *prior* to the assignment due date. The date to which the assignment has been extended then becomes the due date. Applications for extension must be in writing and supported by appropriate documentation, such as medical certificates.

Where students are unable to conduct their study program to meet unit requirements the student's ability to continue in the unit should be considered and discussed with the administrative support staff from the school.

No provision is made for students to resubmit work for higher assessment. Where students think their assignment grade is inappropriate they may discuss this grade with their Unit Adviser and Head of Accounting Section.

Students are encouraged to use computers when preparing assignments. When using continuous feed paper, please trim tractor edge.
Applying cognitive load theory concepts ...

**Submitting assignments**

**Cover sheets**

With your study material you will receive individual barcoded cover sheets for each assignment to be submitted. Please attach the correct cover sheet to the front of these and submit to the Distance Education Centre. Do not change the bar codes in any way. If you do not have the correct cover sheet make 1 by clearly writing the details on a sheet of paper.

We will enter your assignments on our Assignment Database and send them to your tutor for marking. When they have been marked they will be returned to you through the post.

Assignments should be submitted:

- by post, addressed to:

  Centre for Learning and Teaching Support  
  Monash University Gippsland Campus  
  Switchback Road  
  CHURCHILL VIC 3842

  or

- by delivering them directly to the Centre for Learning and Teaching Support office during office hours

  or

- by facsimile by dialling (03) 5122 6578. Please note: assignments submitted by facsimile should be typewritten and must be on A4 paper.

**Note:** If assignments have been sent by facsimile, please do not send the originals

Assignments received by any of these methods will be registered on your assignment record as “IN” on the date they are received by the University.

Do not send assignments to the Business Studies facsimile machine as these will be destroyed. Fax’s of assignments should be sent through the Centre for Learning and Teaching Support only. Note also that assignments should only be faxed once.

**Assignment registration**

Assignments should be received by the Distance Education office on the due date, not posted by you on the due date.

Do not post or hand your assignments directly to the Unit Adviser. Assignments submitted in this manner will cause delays in the assignment registration process, and will be returned to the student.

**Assignments grading**

Assignments will be graded according to the following scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD</td>
<td>85 - 100</td>
</tr>
<tr>
<td>D</td>
<td>75 - 84</td>
</tr>
<tr>
<td>C</td>
<td>65 - 74</td>
</tr>
<tr>
<td>P</td>
<td>50 - 64</td>
</tr>
<tr>
<td>N</td>
<td>Below 50</td>
</tr>
</tbody>
</table>
Appendices

All students will receive a solution of the assignment, but these will not be faxed.

Addresses

How can we find you if we don’t know where you live? Please ensure that the Gippsland Registry have your current address.

Preparing of assignments

Assignments should be closely checked for errors of typing, spelling, grammar, etc. Where you use specific material from any source, you must provide reference to the specific quotation and all sources consulted must be included in a bibliography at the end of your assignment. When preparing assignments students should follow the School of Business Student Reference Manual.

Computer software material

Included in the study material are 3 computer disks. These disks are a recent addition to the study material. Included on the disks is unit information which is part of the overall material given to distance students. The computer material was developed in 1994 by the School of Business at Monash University Gippsland, and this is the first time it has been offered.

The computer assisted material may be used to help you understand the unit. You should not rely solely on this to complete the unit. Rather it offers you the opportunity to an alternative way of learning. Students who are unable to use the material for lack of a computer are certainly not disadvantaged. Much of the computer material is provided in written form in the text and the suggested solutions.

Every attempt has been made to ensure the computer material is free from errors, but any new venture has its share of bugs. Please do not feel frustrated by this. A simple call to any of the staff members below should solve the problem and enable you to go on with the objectives of understanding the work.

If you are having difficulties with the computer software, please contact Abdel Halabi (03) 5122 6646, or Geoff Harrington (03) 5122 6617.

Using the disks

You will need as a minimum a 386 IBM compatible machine with Windows and, preferably, 4 mb RAM. There are 3 steps to follow to get up and running.

(i) Make a new directory in your C: drive

(ii) Copy the contents of the disk into your new directory

(iii) Return to your new directory and select the file labelled AcctgA1.

Select File, then choose Associate from the main menu bar of your File Manager.

In the dialogue box that appears, delete any expressions (probably the term [Nl] will appear) and type in C:\Monash\tbook.exe.

Now double click on the file labelled AcctgA1 and your first interactive module will start to run.

For subsequent disks these instructions follow:

If you have successfully installed the first module sent, running the rest of these modules is straightforward. Go to your windows file manager (in the main directory) and select the drive (A or B) that runs these disks for you. Either copy the modules into your “Monash” directory or run a module from the A or B drive - it works both ways.

Select the module by clicking on it (it goes blue), then double click to start the exercise.

Using the CBL software

The timetable above shows the weekly work available through the CBL materials. The Multiple choice, true false and theory questions should be completed after students have attempted the theory questions in
Applying cognitive load theory concepts ...

the weekly study guides. The practical questions in the CBL are to be completed after the practical questions have been attempted.

A note on plagiarism
Paraphrasing or quoting a source without including an appropriate footnote is plagiarism, a polite word for cheating. The opinions or words of others should not be presented as if they were your own.

Final examination
Length: 3 hour duration

Weighting: 70%

In order to pass GBU1001, students must meet the following criteria.

• Complete and submit the 2 assignments.
• Achieve 50% of the marks allocated on the final examination.
• Gain 15 of the 30 marks allocated to the above assignments.
Appendix 27

An example of a question and answer that was provided in printed format (see Appendix 14 for the question provided in CBL format)

E7.4, page 347. This question is the same as the practical CBL exercise in interactive module number 7 of the CBL material

The following T-accounts pertain to an Accountancy practice.

<table>
<thead>
<tr>
<th>Drawings</th>
<th>3,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Expense</td>
<td>1,200</td>
</tr>
<tr>
<td>Consultancy Fees</td>
<td>16,000</td>
</tr>
<tr>
<td>Salaries Expense</td>
<td>9,600</td>
</tr>
<tr>
<td>Depreciation Expense</td>
<td>2,000</td>
</tr>
<tr>
<td>Capital</td>
<td>4,200</td>
</tr>
<tr>
<td>Rent Expense</td>
<td>1,700</td>
</tr>
<tr>
<td>Interest Revenue</td>
<td>800</td>
</tr>
</tbody>
</table>

Required

Prepare closing entries for the following T-accounts as at 30 June, 1993
### Solutions to E7.4

<table>
<thead>
<tr>
<th></th>
<th>Drawings</th>
<th>Electricity Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3,500</td>
<td>1,200</td>
</tr>
<tr>
<td>30.6 Capital</td>
<td>3,500</td>
<td>30.6 Income Summary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30.6 Income Summary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Consultancy Fees</th>
<th>Salaries Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6 Income Sum</td>
<td>16,000</td>
<td>9,600</td>
</tr>
<tr>
<td></td>
<td>16,000</td>
<td>30.6 Income Sum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9,600</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30.6 Income Sum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Depreciation Expense</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2,000</td>
<td>Drawings</td>
</tr>
<tr>
<td>30.6 Income Sum</td>
<td>2,000</td>
<td>3,500</td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td>4,200</td>
</tr>
<tr>
<td></td>
<td>30.6 Income Sum</td>
<td>Income Sum</td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td>2,300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Rent Expense</th>
<th>Interest Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,700</td>
<td>800</td>
</tr>
<tr>
<td>30.6 Income Sum</td>
<td>1,700</td>
<td>30.6 Income Sum</td>
</tr>
<tr>
<td></td>
<td>1,700</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>1,700</td>
<td>30.6 Income Sum</td>
</tr>
</tbody>
</table>

### Income Summary

<table>
<thead>
<tr>
<th></th>
<th>Depreciation</th>
<th>Rent</th>
<th>Salaries</th>
<th>Electricity</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2,000</td>
<td>1,700</td>
<td>9,600</td>
<td>1,200</td>
<td>2,300</td>
</tr>
<tr>
<td>Interest Revenue</td>
<td>800</td>
<td>Consul Fees</td>
<td>16,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.6 Income Sum</td>
<td>800</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>16,800</th>
<th>16,800</th>
</tr>
</thead>
</table>
## Appendix 28

Study 1 weekly timetable for completing the required semesters work for Introductory Accounting A

### INTRODUCTORY ACCOUNTING A

<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Ass'tm Due Dates</th>
<th>Lectures</th>
<th>Tutorials</th>
<th>Tutorial Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>22-Jul</td>
<td>1</td>
<td></td>
<td>Ch 1 - Intro to Accounting</td>
<td>No Tutorials</td>
<td></td>
</tr>
<tr>
<td>29-Jul</td>
<td>2</td>
<td></td>
<td>Ch 2 - Basic Concepts</td>
<td>Ch 2 - Q2.4 Q2.5, Q2.6, Q2.7, Q2.8, Q2.9, E2.7, E2.9, E2.10, E2.11, E2.12</td>
<td></td>
</tr>
<tr>
<td>5-Aug</td>
<td>3</td>
<td></td>
<td>Ch 3 - Rules &amp; Tools</td>
<td>Ch 3 - Q3.6, Q3.7, Q3.9, Q3.10, Q3.13, Q3.14, Q3.15, Q3.17, Q3.18, Q3.21, E3.15, E3.16, E3.22</td>
<td></td>
</tr>
<tr>
<td>12-Aug</td>
<td>4</td>
<td></td>
<td>Ch 4 - Changes in Owners Equity</td>
<td>Ch 4 - Q4.6, Q4.7, Q4.9, Q4.12, Q9, Q11, Q14, E4.14, E4.15, E4.16, E4.19</td>
<td></td>
</tr>
<tr>
<td>19-Aug</td>
<td>5</td>
<td>Ass'tm Due Dates</td>
<td>Ch 5 - Adjusting Entries &amp; Deferrals</td>
<td>Ch 5 - Q5.6, Q5.10, Q5.13, Q5.14, Q5.17, E5.10, E5.14, E5.15</td>
<td></td>
</tr>
<tr>
<td>26-Aug</td>
<td>6</td>
<td></td>
<td>Ch 6 - Accruals</td>
<td>Ch 6 - Q6.4, Q6.5, Q6.8, E6.10, E6.12, E6.16</td>
<td></td>
</tr>
<tr>
<td>2-Sep</td>
<td>7</td>
<td></td>
<td>Ch 7 - Closing the Accounts</td>
<td>Ch 7 - Q7.1, Q7.4, Q7.5, Q7.6, Q7.9, E7.9, E7.13</td>
<td></td>
</tr>
<tr>
<td>9-Sep</td>
<td>8</td>
<td></td>
<td>Ch 8 - Computerised Systems</td>
<td>Ch 8 &amp; 9 - Q8.1, Q8.2, Q8.4, Q8.10, Q8.12, Q9.1, Q9.2, Q9.4, Q9.5, Q9.6, Q9.8, Q9.10, Q9.13, Q9.15, Q9.16</td>
<td></td>
</tr>
<tr>
<td>16-Sep</td>
<td>9</td>
<td></td>
<td>Ch 9 - Companies</td>
<td>Ch 9 - Q11.4, Q11.5, Q11.8, E11.7, E11.8, E11.11, E11.12</td>
<td></td>
</tr>
<tr>
<td>23-Sep</td>
<td>MID SEMESTER BREAK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30-Sep</td>
<td>MID SEMESTER BREAK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-Oct</td>
<td>10</td>
<td></td>
<td>Ch 11 - Product Costing</td>
<td>Ch 10 - Q10.10, Q10.11, Q10.12, Q10.13, Q10.16, E10.6, E10.9, E10.12</td>
<td></td>
</tr>
<tr>
<td>14-Oct</td>
<td>11</td>
<td>Ass'tm Due Dates</td>
<td>Ch 12 - Planning &amp; Control</td>
<td>Ch 11 - Q11.4, Q11.5, Q11.8, E11.7, E11.8, E11.11, E11.12</td>
<td></td>
</tr>
<tr>
<td>28-Oct</td>
<td>13</td>
<td></td>
<td>Revision Lecture</td>
<td>Revision Tutorial</td>
<td></td>
</tr>
</tbody>
</table>

Exams Exams Exams!!!
FACULTY OF BUSINESS & ECONOMICS
GIPPSLAND SCHOOL OF BUSINESS
Head Professor John Anderson
Teleph: (03) 5122 6524 - Facsimile: (03) 9902 6524

Dear students,

Distance students enrolled in Introductory Accounting A have traditionally been supplied with unit guides and unit book. Over the previous 2 years, students have also received a reader, audio tapes, and computer discs to enable them to complete the objectives of the unit.

In 1994, the School of Business received a teaching grant to develop computer-based learning study material in the first-year accounting unit. As stated in the materials distributed at the beginning of semester, these computer-based modules provide students with an alternative way of learning, and do not replace conventional written material. GBU1001 is the first unit in the School of Business to develop computer-based modules.

As the unit adviser, I would like to provide you with the opportunity to evaluate the usefulness of all unit material distributed this semester. In particular, I would like your comments on the computer-based software that has been designed specifically for this unit.

To aid in the evaluation of all material in GBU1001, I have enclosed a questionnaire, and invite you to reply. Please note that participation in this survey is completely voluntary. No student who participates will be advantaged or disadvantaged. To safeguard your privacy, you do not have to identify yourself. The results will only be accessed by the research team. Further, after full analysis of the results, the questionnaires will be destroyed. Students who request a copy of the results will be sent 1.

I hope you can find around 15 minutes to complete this questionnaire. For your convenience a reply paid envelope is enclosed. Teaching is a critical part of the university and it is important that the materials distributed are tested by the market (i.e., the students). The cost of developing the computer material needs to be weighed against the benefits. This questionnaire will provide valuable information, and may give an indication of future development of units by computer-based learning.

If you would like further information on the questionnaire, please feel free to contact myself (051) 22 6646 or Geoff Perks (051) 22 6649 or fax (051) 22 6205. We are happy to provide you with further information.

Should you have any concerns regarding the manner in which this research is conducted, please do not hesitate to contact the Standing Committee on Ethics in Research on Humans at the following address:
The Secretary
The Standing Committee on Ethics in Research on Humans
Monash University Clayton, Victoria 3168

Thank you for your time, and I look forward to your response.

Abdel K Halabi Lecturer in Accounting
Appendix 30

Comparison of two similar screen shots used in Study 1 and Study 2, noting the changes in the Toolbook authoring software versions

Version 1

In this exercise you will work on a Trial Balance for Backhoe Diggers. It is the same question as E5.13 (p. 264) of the text.

You are required to complete the General Journal entries for each adjustment, and then progressively update the Trial Balance. I will guide you with instructions and comments.

The next page has the Trial Balance.
Appendix 30 (cont)

Comparison of two similar screen shots used in Study 1 and Study 2, noting the changes in the Toolbook authoring software versions

Version 2

In this exercise you will work on a Trial Balance for Backhoe Diggers. This question also appears on your handout.

You are required to complete the General Journal entries for each adjustment, and then progressively update the Trial Balance. I will guide you with instructions and comments.

The next page has the Trial Balance.
Appendix 30 (cont)

Comparison of two similar screen shots used in Study 1 and Study 2, noting the changes in the Toolbook authoring software versions

Version 1

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.93</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BALANCE DAY ADJUSTMENT:**

*Wages prepaid* $500

**TRIAL BALANCE**

<table>
<thead>
<tr>
<th>ACCOUNT NAME</th>
<th>DEBIT</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and Machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depn. - Plant</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Staff Wages</td>
<td>1200</td>
<td></td>
</tr>
</tbody>
</table>

Click with left mouse button on this heading to update your Trial Balance.
Appendix 30 (cont)

Comparison of two similar screen shots used in Study 1 and Study 2, noting the changes in the Toolbook authoring software versions

Version 2
Appendix 31

An example of a screen shot used in Study 2 with verification and elaboration feedback (elaboration not attribute isolation). The verification in this instance is knowledge of correct response.

### Balance Day Adjustment

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2000</td>
<td>Wages Expense</td>
<td>500</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Rent</td>
<td>0</td>
<td>500</td>
</tr>
</tbody>
</table>

The correct term here is Accrued wages. Please put this name in before proceeding.

[Image of backhoe diggers trial balance]

The correct term here is Accrued wages. Please put this name in before proceeding.

Button on this heading to update your Trial Balance.

Show instruction

Show Trial Balance
An example of a screen shot used in Study 2 with verification and elaboration feedback (elaboration not attribute isolation)

No you are incorrect. The debit should be to Wages expense since this is the item deferred to the next accounting period.
Appendix 32

An example of a screen shot where students are not able to proceed until all entries have been verified as correct (used in Study 2)

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>19000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>12000</td>
<td>40000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td></td>
<td>25500</td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td></td>
<td>50000</td>
</tr>
</tbody>
</table>

One or more data entries on this page are missing or incorrect. You need to have adjusted Wages Expense, and added a new account name and the right amount. Please check your inputs with the right mouse button. You will not be able to proceed to the next adjustment until everything is correct.

OK
Appendix 33

The first screen shot to introduce the topic balance day adjustments used in Study 2
Appendix 34

The first screen display of the instructions to complete the problem solving CBL exercise in Study 2

In this exercise you will work on a Trial Balance for Backhoe Diggers. This question also appears on your handout.

You are required to complete the General Journal entries for each adjustment, and then progressively update the Trial Balance. I will guide you with instructions and comments.

The next page has the Trial Balance.
Appendix 34 (cont)

The second screen display of the instructions to complete the problem solving exercise in Study 2

Here is the Trial Balance. Read it carefully. There should be no accounts which provide you with any difficulty in terms of classification or understanding. Go to the next page to complete the first General Journal Entry.

### BACKHOE DIGGERS

Trial Balance as at 30.6.2001

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>19000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Wages Expenses</td>
<td>25500</td>
<td></td>
</tr>
<tr>
<td>Insurance Prepaid</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Stationary Stock</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td></td>
<td>1500</td>
</tr>
<tr>
<td>Service Van</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Van</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>Equipment Rental Income</td>
<td>85000</td>
<td></td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>Advertising</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Deposit for New Machine</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Accounts Payable</td>
<td></td>
<td>9000</td>
</tr>
<tr>
<td>Fuel expenses</td>
<td>11200</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td></td>
<td>150000</td>
</tr>
<tr>
<td>Drawings</td>
<td>2000</td>
<td></td>
</tr>
</tbody>
</table>

**Total** 299500

299500
Appendix 35

The first screen display of the instructions to complete the worked examples exercise in Study 2

In this exercise you will work on a Trial Balance for Backhoe Diggers. This question also appears on your handout.

You are required to complete the General Journal entries for each adjustment, and then progressively update the Trial Balance. I will guide you with instructions and comments.

The next page has the Trial Balance.
Appendix 35 (cont)

The second screen display of the instructions to complete the worked examples exercise in Study 2

Here is the Trial Balance. Read it carefully. There should be no accounts which provide you with any difficulty in terms of classification or understanding. The first three Balance Day Adjustments have been done for you. You will need to complete the rest.

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>19000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td></td>
<td>40000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Wages Expense</td>
<td>25000</td>
<td></td>
</tr>
<tr>
<td>Insurance Prepaid</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td></td>
<td>1500</td>
</tr>
<tr>
<td>Service Van</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Van</td>
<td></td>
<td>4000</td>
</tr>
<tr>
<td>Equipment Rental Income</td>
<td></td>
<td>95000</td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>Advertising</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Deposit for New Machine</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Accounts Payable</td>
<td></td>
<td>9000</td>
</tr>
<tr>
<td>Fuel expenses</td>
<td>11200</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td></td>
<td>150000</td>
</tr>
<tr>
<td>Drawings</td>
<td>2000</td>
<td></td>
</tr>
</tbody>
</table>

Total: 295500

295500
Appendix 36

First screen shot of the first worked examples adjustment used in Study 2.

BACKHOE DIGGERS
Trial Balance as at 30.6.2000

BALANCE DAY ADJUSTMENT: 1 of 9

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2000</td>
<td>Wages expense</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accrued wages</td>
<td></td>
<td>500</td>
</tr>
</tbody>
</table>

TRIAL BALANCE

<table>
<thead>
<tr>
<th>ACCOUNT NAME</th>
<th>DEBIT</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and Machinery</td>
<td>19000</td>
<td></td>
</tr>
<tr>
<td>Acc. Deprec. - Plant and Machinery</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Rent Expense</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Staff Wages</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Insurance Prem.</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

Click with left mouse button on this heading to update your Trial Balance.

Show instruction
Show Trial Balance
Appendix 36 (cont)

Second screen shot of the first worked examples adjustment used in Study 2

### BALANCE DAY ADJUSTMENT:

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2000</td>
<td>Wages expense</td>
<td>500</td>
<td></td>
</tr>
</tbody>
</table>

When you work on the Trial Balance, don't forget to add in the new account and amount at the appropriate position (the area will be highlighted in Yellow).
Appendix 36 (cont)

Third screen shot of the first worked examples adjustment used in Study 2

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>19000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance Prepaid</td>
<td>26000</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Service Van</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Van</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Equipment Rental Income</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Advertising</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Deposit for New Machine</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Accounts Payable</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>Fuel expenses</td>
<td>11200</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>15000</td>
<td></td>
</tr>
<tr>
<td>Drawings</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>accrued wages</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30000</td>
<td>30000</td>
</tr>
</tbody>
</table>

Previous General Journal Entry
Show Trial Balance

Continue
Appendix 36 (cont)

Fourth screen shot of the first worked examples adjustment used in Study 2

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid insurance Prepaid</td>
<td>26000</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15000</td>
<td></td>
</tr>
</tbody>
</table>

Notice the trial balance still balances but the totals have increased by $500 due to the new amounts being included. Go to the next balance day adjustment.
Appendix 37

A screen shot where students must complete the problem solving exercise information (compare this to the third screen shot in the worked examples CBL in Appendix 36)

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>19000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation. - Plant and Machinery</td>
<td></td>
<td>40000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>25500</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation. - Office Equipment</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Service Van</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation. - Van</td>
<td></td>
<td>20000</td>
</tr>
<tr>
<td>Equipment Rental Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>Advertising</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Deposit for New Machine</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Accounts Payable</td>
<td></td>
<td>9500</td>
</tr>
<tr>
<td>Fuel expenses</td>
<td>11200</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>15000</td>
<td></td>
</tr>
<tr>
<td>Drawings</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>299500</td>
<td>299500</td>
</tr>
</tbody>
</table>

Previous General Journal Entry

Show Trial Balance
Appendix 38

A copy of the handout used on the face-to-face control group in Study 2, which included the same information completed by the CBL material groups

Bill Caterpillar operates a heavy earthmoving equipment rental company, Blackhoe Diggers. The following information relates to the operations for the year ended 30 June, 2000

**BLACKHOE DIGGERS**

**Trial Balance As At 30 June, 2000**

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Debit $</th>
<th>Credit $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and Machinery</td>
<td>190,000</td>
<td></td>
</tr>
<tr>
<td>Acc. Deprec. - Plant and Machinery</td>
<td></td>
<td>40,000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12,000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13,000</td>
<td></td>
</tr>
<tr>
<td>Staff Wages</td>
<td>25,500</td>
<td></td>
</tr>
<tr>
<td>Insurance Prepaid</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Statutory Stock</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Acc. Deprec. - Office Equipment</td>
<td></td>
<td>1,500</td>
</tr>
<tr>
<td>Service Van</td>
<td>20,000</td>
<td></td>
</tr>
<tr>
<td>Acc. Deprec. - Service Van</td>
<td></td>
<td>4,000</td>
</tr>
<tr>
<td>Equipment Rental Income</td>
<td></td>
<td>95,000</td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>Advertising</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>Deposit for New Machine</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Accounts Payable</td>
<td>9,000</td>
<td></td>
</tr>
<tr>
<td>Fuel Expenses</td>
<td>11,200</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>150,000</td>
<td></td>
</tr>
<tr>
<td>Drawings</td>
<td>2,000</td>
<td></td>
</tr>
</tbody>
</table>

| Totals                             | 299,500 | 299,500  |

The Balance Day Adjustments are as follows

- Wages Owing $ 500
- Rent Paid in Advance $1,000
- Depreciation on Plant and Machinery 10\(^\circ\)pa
- Depreciation on Office Equipment 5\(^\circ\)pa
- Depreciation on Service Van 20\(^\circ\)pa
- $5,000 rental income was received in advance for services to be rendered in July 2000
- Insurance for the year commencing 1 April, 2000 was paid on 28 March, 2000 and debited to Insurance Prepaid
- Statutory stock on hand on 30 June, 2000 was valued at $300
- $250 had been paid in advance for Fuel Expenses

Required:

(i) Prepare the necessary general Journal entries to record the balance day adjustments as at 30 June, 2000
(ii) Post the adjustments to the T-Accounts for 30 June, 2000
(iii) Prepare an adjusted trial balance as at 30 June, 2000.
Appendix 39

The student questionnaire and introductory letter to students regarding Study 2

MONASH UNIVERSITY

Copy of Explanatory Statement

Project Title: Designing Accounting CBL Software Problem solving or Worked Examples.

Hello, I (Abdel Halabi, Lecturer in Accounting and Finance, Monash University) am doing research at the University on students learning materials in Accounting for my PhD research program.

The aim of this research is to evaluate whether certain types of CBL software are more appropriate for accounting students. I am hoping you will find time to participate in this study by completing the CBL tutorial exercise and completing the following questionnaire. The questionnaire and the CBL material will take the entire tutorial to complete.

No findings which could identify any individual participant will be published, however I would like your student number on the survey. This is because I want to compare the results you obtain in the test with your attitudes to accounting and use of computers. Note that I will not be marking any of your examinations in this unit and the information on your grades will be obtained by other staff with only student number to identify it. Please be aware that data must be stored for five years according to university regulations. The questionnaires will be collected and processed by myself and a research assistant with only your student number identification being used and will only be available to us and my PhD supervisors.

I hope that you will agree to participate in the study as it is important to get the feedback about teaching alternatives from the students themselves. However, you can withdraw at any time by not handing in the questionnaire to the administrator who collects the surveys or not signing the consent form. You as students may also choose not to answer some of the questions. No student will be disadvantaged for not having their work included in the research findings.

If you have any queries, please contact telephone (Abdel Halabi) at Monash University Berwick Campus; fax 9904 4100. The aggregate findings will be discussed in class.

Should you have any complaint concerning the manner in which this research (project number ) is conducted, please do not hesitate to contact The Standing Committee on Ethics in Research on Humans at the following address:

The Secretary
The Standing Committee on Ethics in Research on Humans
Monash University
Wellington Road
Clayton Victoria 3168
Teleph Fax (03) 9905 1420

Thank you.
Abdel K Halabi, 9902 6646
Appendices

Appendix 39 (cont)

The student questionnaire and introductory letter to students regarding Study 2
- Student questionnaire

Introductory Accounting A

Student Characteristics and attitudes using CBL Accounting Software.

The first part of this survey asks about your demographics.

1. Sex (please circle correct alternative) Male Female

2. What is your age (in years?) ..............

3. In what course are you enrolled in at Monash? .............................................

4. In what year are you in your Course? ..................................................

5. In what country/countries did you receive your education? ..........................

6. What was your last secondary school / TAFE attended and in what year
..........................................................................................................

Please complete the following table indicating the units studied in your final year of school using the English language and your scores, and where you studied.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Grade/Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. What was your TER or equivalent? .................................

8. Have you undertaken full or part time studies (apart from this course) since completing your highest year of secondary studies? (circle correct alternative). Yes / No. If Yes please answer questions 8 - 10

9. What course did you commence? .............................................

10. How long were you enrolled in this course? .........................................
Accounting Questions

11. Do you think it is important to have studied accounting to get a full time job? (circle best option)

No Use    Little Use    Don’t Know    Useful    Very Useful

12. What job do you hope to do in the next 4 – 5 years? ...........................................

13. Do you think accounting will be important in this future job? Yes / No (Circle Correct Alternative)

14. Have you studied AFW 1001 before at Monash? Yes / No (Circle Alternative)

15. Have you studied an equivalent unit before at another University? Yes / No (Circle Correct Alternative). If yes, where? ..........................................................

16. What is your highest level of accounting studied? ..................................................

17. What are your goals in respect of Accounting this semester (circle best option)?

Pass    Receive a Credit    Distinction    High    Don’t care
the unit    Distinction

Questions about computers

18. Do you have a computer at home? Yes / No (circle correct alternative). If yes answer question 20, if no answer question 21.

19. How long have you had a computer? (in years) .........................

20. Do you intend to purchase a computer in the future? Yes / No (circle correct).

21. Which term best describes your skill in using a computer (circle best option)?

Beginner    Limited Experience    Competent    Experienced    Expert

22. What is your attitude to using computers in tutorials compared to face-to-face teaching?

..................................................................................................................
..................................................................................................................
..................................................................................................................
..................................................................................................................
..................................................................................................................
..................................................................................................................

Thank you for your time and participation in this section of the study.

261
Appendix 40

The evaluation and recording of the effort during learning when completing the problem solving CBL material used in Study 2

Accounting Computer-Based Learning Materials – PROBLEM SOLVING EXERCISES

Instructions:

You will need Windows to run this program.
Insert the CD drive, and click my computer, then the appropriate drive
Click on Problem solving Exercise
The computer material will begin
Press the > and go to the first page
Click on Practical problem
Read the instructions carefully, and examine the trial balance
You will need to complete the balance day adjustments and then update your trial balance with new balances
First complete the general journal entries. Check your entries by clicking with the right mouse
When the general journal is correct, update your trial balance with the correct balances
Complete the evaluation for the computer material, including a record of the time spent, on each adjustment
When finished you may leave
Hand in the evaluation when completed

a). Adjustment: Wages Owing

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

   Very High   High   Middle   Low   Very Low

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).

   Very High   High   Middle   Low   Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

   4. How many times did you ask the tutor for help in the accounting unit matter? (eg. five times)

b). Adjustment - Rent Expense

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

   Very High   High   Middle   Low   Very Low

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).

   Very High   High   Middle   Low   Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)
4. How many times did you ask the tutor for help in the accounting unit matter? (e.g. five times)

\[ \text{c). Adjustment - Depreciation of Plant and Machinery} \]

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

\[ \begin{array}{cccccc}
\text{Very High} & \text{High} & \text{Middle} & \text{Low} & \text{Very Low} \\
\end{array} \]

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).

\[ \begin{array}{cccccc}
\text{Very High} & \text{High} & \text{Middle} & \text{Low} & \text{Very Low} \\
\end{array} \]

3. How much time did you spend reading and completing this adjustment? (e.g. 2 minutes)

\[ \text{4. How many times did you ask the tutor for help in the accounting unit matter? (e.g. five times)} \]

\[ \text{d). Adjustment - Depreciation of Office Equipment} \]

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

\[ \begin{array}{cccccc}
\text{Very High} & \text{High} & \text{Middle} & \text{Low} & \text{Very Low} \\
\end{array} \]

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).

\[ \begin{array}{cccccc}
\text{Very High} & \text{High} & \text{Middle} & \text{Low} & \text{Very Low} \\
\end{array} \]

3. How much time did you spend reading and completing this adjustment? (e.g. 2 minutes)

\[ \text{4. How many times did you ask the tutor for help in the accounting unit matter? (e.g. five times)} \]

\[ \text{e). Adjustment - Depreciation of Service Van} \]

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

\[ \begin{array}{cccccc}
\text{Very High} & \text{High} & \text{Middle} & \text{Low} & \text{Very Low} \\
\end{array} \]

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).

\[ \begin{array}{cccccc}
\text{Very High} & \text{High} & \text{Middle} & \text{Low} & \text{Very Low} \\
\end{array} \]

3. How much time did you spend reading and completing this adjustment? (e.g. 2 minutes)

\[ \text{4. How many times did you ask the tutor for help in the accounting unit matter? (e.g. five times)} \]
Appendices

f). Adjustment - Rental Income Prepaid

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

Very High  High  Middle  Low  Very Low

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).

Very High  High  Middle  Low  Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

........................

4. How many times did you ask the tutor for help in the accounting unit matter? (eg. five times)

........................

g). Adjustment - Stock of Stafilry

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

Very High  High  Middle  Low  Very Low

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).

Very High  High  Middle  Low  Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

........................

4. How many times did you ask the tutor for help in the accounting unit matter? (eg. five times)

........................

h). Adjustment - Prepaid Fuel Expenses

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

Very High  High  Middle  Low  Very Low

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).

Very High  High  Middle  Low  Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

........................

4. How many times did you ask the tutor for help in the accounting unit matter? (eg. five times)

........................
Applying cognitive load theory concepts ...

Other Questions:

1. How useful did you find the Computer-Based Learning material? (Circle best answer)

<table>
<thead>
<tr>
<th>Very Useful</th>
<th>Useful</th>
<th>Neutral</th>
<th>Not very useful</th>
<th>Useless</th>
</tr>
</thead>
</table>

2. More Computer material should be used for other Topics (Circle best answer)

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

3. The computer material should be used (Circle best answer)

(a) instead of face-to-face teaching.
(b) With face-to-face teaching.
(c) Should not be used at all.
Appendix 41

The evaluation and recording of the effort during learning when completing the worked examples CBL material used in Study 2

Accounting Computer-Based Learning Materials – WORKED EXAMPLES EXERCISES

Instructions:

You will need Windows to run this program.
Insert the CD drive, and click my computer, then the appropriate drive
Click on Worked Examples exercise
The computer material will begin
Press the > and go to the first page
Click on Practical problem
Read the instructions carefully, and examine the trial balance
You will need to complete the balance day adjustments and then update your trial balance with new balances
The first 3 balance day adjustments and their related postings have been done for you. You should look at these by clicking the > button.
Make sure you examine the 3 balance day adjustments and the answers. You will then need to complete the other adjustments.
When completing the exercises, first complete the general journal entries. Check your entries by clicking with the right mouse
When the general journal is correct, update your trial balance with the correct balances
Complete the evaluation for the computer material, including a record of the time spend, on each adjustment
When finished you may leave
Hand in the evaluation when completed

a). Adjustment: Wages Owing

1. What was the effort you have put into understanding the General Journal entry for this adjustment (Circle the most correct).

Very High        High        Middle        Low        Very Low

2. What was the effort you have put into understanding the adjusted trial balance after this adjustment (Circle the most correct).

Very High        High        Middle        Low        Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes) ................................

4. How many times did you ask the tutor for help in understanding the accounting unit matter? (eg. five times) ...............................

b). Adjustment - Rent Expense

1. What was the effort you have put into understanding the General Journal entry for this adjustment (Circle the most correct).

Very High        High        Middle        Low        Very Low

2. What was the effort you have put into understanding the adjusted trial balance after this adjustment (Circle the most correct).
Applying cognitive load theory concepts…

<table>
<thead>
<tr>
<th></th>
<th>Very High</th>
<th>High</th>
<th>Middle</th>
<th>Low</th>
<th>Very Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. How many times did you ask the tutor for help in understanding the accounting unit matter? (eg. five times)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

c). Adjustment - Depreciation of Plant and Machinery

1. What was the effort you have put into understanding the General Journal entry for this adjustment (Circle the most correct).

<table>
<thead>
<tr>
<th></th>
<th>Very High</th>
<th>High</th>
<th>Middle</th>
<th>Low</th>
<th>Very Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. What was the effort you have put into understanding the adjusted trial balance after this adjustment (Circle the most correct).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. How many times did you ask the tutor for help in understanding the accounting unit matter? (eg. five times)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d). Adjustment - Depreciation of Office Equipment

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

<table>
<thead>
<tr>
<th></th>
<th>Very High</th>
<th>High</th>
<th>Middle</th>
<th>Low</th>
<th>Very Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. How many times did you ask the tutor for help in completing the accounting unit matter? (eg. five times)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

e). Adjustment - Depreciation of Service Van

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).

<table>
<thead>
<tr>
<th></th>
<th>Very High</th>
<th>High</th>
<th>Middle</th>
<th>Low</th>
<th>Very Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. How many times did you ask the tutor for help in the accounting unit matter? (eg. five times)

f). Adjustment - Rental Income Prepaid

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).
   
   Very High     High     Middle     Low     Very Low

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).
   
   Very High     High     Middle     Low     Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

4. How many times did you ask the tutor for help in the accounting unit matter? (eg. five times)


g). Adjustment - Stock of Statutory

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).
   
   Very High     High     Middle     Low     Very Low

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).
   
   Very High     High     Middle     Low     Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

4. How many times did you ask the tutor for help in the accounting unit matter? (eg. five times)

h). Adjustment - Prepaid Fuel Expenses

1. What was the effort you have put into completing the General Journal entry for this adjustment (Circle the most correct).
   
   Very High     High     Middle     Low     Very Low

2. What was the effort you have put into completing the adjusted trial balance after this adjustment (Circle the most correct).
   
   Very High     High     Middle     Low     Very Low

3. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

4. How many times did you ask the tutor for help in the accounting unit matter? (eg. five times)
Other Questions:

1. How useful did you find the Computer-Based Learning material? (Circle best answer)

<table>
<thead>
<tr>
<th>Very Useful</th>
<th>Useful</th>
<th>Neutral</th>
<th>Not very useful</th>
<th>Useless</th>
</tr>
</thead>
</table>

2. More Computer material should be used for other Topics (Circle best answer)

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

3. The computer material should be used (Circle best answer)

(a) Instead of face-to-face teaching.
(b) With face-to-face teaching.
(c) Should not be used at all.
Appendix 42

The diagnostic test used in Study 2

Monash University
Faculty of Business and Economics

CODE: AFW 1001
TITLE OF PAPER: INTRODUCTORY ACCOUNTING A
EXAM DURATION: 22 minutes writing time
READING TIME 3 minutes

1. Total number of questions: 2 (2)

AUTHORISED MATERIALS
CALCULATORS YES

Candidates must complete this section if required to answer in this paper

STUDENT ID __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
SURNAME ..........................................................................................SIGNATURE..............................................................
OTHER NAMES (in full) ..............................................................................................
1. Selected accounts of Samy Estate Agency (proprietor M. Samy) are shown below at 31 March 2000 before any adjusting entries have been made.

<table>
<thead>
<tr>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepaid Insurance</td>
<td>$900</td>
</tr>
<tr>
<td>Supplies Inventory</td>
<td>400</td>
</tr>
<tr>
<td>Office Equipment</td>
<td>5,000</td>
</tr>
<tr>
<td>Unearned Rental Fees</td>
<td></td>
</tr>
<tr>
<td>Provision for Doubtful Debts</td>
<td>1,800</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>800</td>
</tr>
<tr>
<td>Wages Expense</td>
<td>2,600</td>
</tr>
<tr>
<td>Rental Fees Revenue</td>
<td>8,700</td>
</tr>
</tbody>
</table>

Further information:

(i) Prepaid insurance represents premiums for 3 months paid on 1 March 2000.

(ii) Because of tighter economic conditions, Samy has decided to increase the Provision for Doubtful Debts to 1% of debtors.

(iii) Office Equipment is expected to last 10 years and to contribute equally to revenue over this period. It was purchased on 1 March this year, and is yet to be depreciated. There is no residual value.

(iv) Samy collected four months' rent in advance on 1 March from a tenant renting space for $450 per month.

(v) Staff are owed wages of $300 on 31 March.

(vi) Supplies of $100 were on hand at 31 March.

Required:

(a) Record in the general journal the necessary adjusting entries on 31 March (narrations are not required).

2. What will be the new balance of these accounts after the adjustments?

(answer this part in the spaces below)

Prepaid Insurance
Supplies Inventory
Unearned Rental Fees
Provision for Doubtful Debts
Rental Fees Revenue
Wages Expense

(12 + 3 = 15 marks)
### Answer to Question 1

<table>
<thead>
<tr>
<th>Date</th>
<th>Particulars</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

272
Please answer the following additional questions about this test, and your work.

1. How many hours did you take to prepare for this test? (write number of hours, or nil)..........................

2. Did you go to the lecture on Balance Day Adjustments (held 2 weeks ago?) Yes or No (circle correct answer)

3. Did you attend the tutorial on Balance Day Adjustments (held last week?) Yes or No (circle correct answer)

4. Have you studied Accounting before? Yes or No (circle correct answer).
Appendix 43

The introductory lecture on balance day adjustment used for Study 2, Study 3 and Study 4

Lecture Objectives

Chapter 7: Improving the Accuracy of the Financial Statements: Event Day Adjustments
Introduction

The need for Balance-Day Adjustments

- Financial statements are prepared to help users in making decisions about how to allocate scarce resources.
- Information in financial statements helps in the decision-making process.
- Adjustments reflect transactions and events affecting the financial position.
Revised Accounting Information System

- Implementation of Balance-Day Adjustments

- Recorded in day balance sheet and income statement

- Basis of Adjustments
  - Adjusted in financial statements
  - Accounts Receivable
  - Accounts Payable
  - Bank Balances
  - Allocation of expenses and income

- Report
  - Performance
  - Administer
3DA’s that Record New Information

ACCOUNTS
- PRE-DELIVERY
- DELIVERY
- ACCOUNTS
- DELIVERED
- ACCOUNTS
- DELIVERED
- ACCOUNTS
- DELIVERED

Bad Debt’s
- Direct Write-off
- Write-off of Account
- Bad Debt Expense
- Accounts Receivable
- Allowance for Bad Debts
- Accrued Bad Debts
- Allowance for Bad Debts
- Bad Debt Expense
- Accounts Receivable

3DA’s that Record New Information
3DA’s that Record New Information

Closing inventory
Stock on hand
Stock on order
Invoiced
Invoice

3DA’s that Record New Information
BDA’s that allocation previously recorded transactions

BDA entry for an item initially recorded as:
- Dr. prepaid expense/provision for
- Cr. expense

Recollectolidaysdateentry:
BDA entry for the initial date:
- Dr. prepaid expense/provision for
- Cr. expense

Verify with receipt in inventory:
BDA entry for the final date:
- Dr. revenue/appraisal
- Cr. revenue
BDA's that allocation previously recorded transactions

calculation methods
- straight-line method
- declining balance method
- sum-of-the-years digits method
- double declining balance method
- units of production method
- working life method
- other methods
BDA's that allocation previously recorded transactions

Calculation methods:
- Reducing Balance Method
- Depreciation from the Date of Commencement
- Constant Declining Balance
- Reciprocal Formula: $\frac{1}{n} \times \text{Cost} = \text{Annual Depreciation}$

Example: Equipment cost $125,000, straight-line method of depreciation is 12.5%.

An Illustration of Balance-Day Adjustments

- Example 7, p. 214
- Trial balance is the starting point
- Accountant's role is to:
  - Identify adjustments required
  - Obtain information needed
  - Make informed judgements
  - Make necessary general journal entries
  - Record BDA's in the General Journal
  - Post BDA's to the ledger
  - Prepare the adjusted trial balance
  - Prepare the financial statements
Implications of Balance-day Adjustments

1. New cost-sharing scheme of adjustments
2. More importance to be placed on customer distribution
3. Utilization of internal data
4. Utilization of external data
5. Financial incentives for "cost-sharing" agreements
6. Documented data reviewed
7. Skill recognition system
8. Information to make appropriate adjustments
9. Possible increases in initial survey
Appendix 44

The consent form used in Study 2

Informed Consent Form

Project Title: (Designing Accounting CBL Software in problem solving or worked examples format)

I agree to take part in the above Monash University research project. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to take part means that I am willing to:

- complete questionnaires asking me about Computer-Based Learning materials which will only identify me by my student number.
- use a computer in Accounting completing some tutorial work
- allow the researchers to access my grades in this unit by student number only

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party

Signature ..............................................................
Date..............................................................
Appendix 45

Solutions to the diagnostic test used in Study 2

Answer to Question 1

<table>
<thead>
<tr>
<th>Date</th>
<th>Particulars</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 Mar</td>
<td>Insurance Expense</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prepaid Insurance</td>
<td></td>
<td>300</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Doubtful Debts expense</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allowance for doubtful debts</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Depreciation of Office E</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accumulated Depreciation of Office E</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Unearned Rental Fees</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rental Fees Revenue</td>
<td></td>
<td>450</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Wages Expense</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wages Owing</td>
<td></td>
<td>300</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Supplies Expense</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplies Inventory</td>
<td></td>
<td>300</td>
</tr>
</tbody>
</table>

Balances are:

- Prepaid Insurance: 600
- Supplies Inventory: 100
- Unearned Rental Fees: 1,350
- Provision for Doubtful Debts: 80
- Rental Fees Revenue: 9,150
- Wages Expense: 2,900
Appendix 46

The variation in the answer until correct with rich feedback used in Studies 3 and 4 where after three tries the answer is provided (screen 1, first incorrect response)

**BACKHOE Diggers**

Trial Balance as at 30.6.2001

**BALANCE DAY ADJUSTMENT : 1 of 9**

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2001</td>
<td>Wages Expense</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>wages</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No, that is not correct. Remember that this needs to be a current liability account. Please try again.

Show instruction
Show Trial Balance
Appendix 46 (cont)

The variation in the answer until correct with rich feedback used in Studies 3 and 4 where after three tries the answer is provided (screen 2, second incorrect response)

---

**BACKHOE Diggers**

Trial Balance as at 30.6.2001

**Balance Day Adjustment - 1 of 9**

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2001</td>
<td>Wages Expense</td>
<td></td>
<td>$500</td>
</tr>
</tbody>
</table>

**Wages expense owing**

No, that is again not correct. The current liability account that you need include is an amount owing. Please have one more try before the answer is revealed.

Button on this heading to update your Trial Balance.

---

Show instruction
Show Trial Balance
Appendix 46 (cont)

The variation in the answer until correct with rich feedback used in Studies 3 and 4 where after three tries the answer is provided (screen 3, final incorrect response and provision of the correct answer).
Appendix 47

The variation in the answer until correct with basic feedback used in Study 3 with basic feedback where after three tries the answer is provided (screen 1, first incorrect response)

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2001</td>
<td>Wages Expense</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>wages</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No, that is not correct. Try again.

button on this heading to update your Trial Balance.

Show instruction
Show Trial Balance
Appendix 47 (cont)

The variation in the answer until correct with basic feedback used in Study 3 with basic feedback (screen 2, second incorrect response)

*BACKHOE DIGGERS*

Trial Balance as at 30.6.2001

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2001</td>
<td>Wages Expense</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wages expense owing $500

---

No, that is not correct. Have 1 more try before the answer is revealed.

[OK]

Show instruction

Show Trial Balance
Appendix 47 (cont)

The variation in the answer until correct with basic feedback used in Study 3 (screen 3, final incorrect response, and provision of the correct answer)

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2001</td>
<td>Wages Expense</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No, that is not correct. The correct answer is 'Accrued Wages'. The correct entry will be completed for you. Make sure your spelling is correct throughout this exercise.

- Show instruction
- Show Trial Balance
Appendix 48

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Basic Feedback

```
<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>19000</td>
<td>40000</td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td></td>
<td>1200</td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>13000</td>
<td>600</td>
</tr>
<tr>
<td>Office Equipment</td>
<td>26000</td>
<td>20000</td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Van</td>
<td></td>
<td>20000</td>
</tr>
</tbody>
</table>

Total 299500 299500

Correct.
```
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Rich Feedback

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td></td>
<td>40000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>26000</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>6000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Service Van</td>
<td>20000</td>
<td></td>
</tr>
</tbody>
</table>

Well done, you needed to increase the amount by $500 to recognize some extra wages have been incurred. Now add the new account and amount in the yellow shaded area.

OK

Total 299500 299500

Previous General Journal Entry  MAP  Continue

Show Trial Balance
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Basic Feedback

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>25000</td>
<td></td>
</tr>
<tr>
<td>Stationary Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td>100000</td>
<td></td>
</tr>
<tr>
<td>Service Van</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Van</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No, that is not correct. Please try again.

Total 299500 299500

Previous General Journal Entry  Show Trial Balance  MAP  Continue
Appendices

Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback.

Rich Feedback

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>180000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td></td>
<td>40000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>25000</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Service Van</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Van</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sorry this figure is not correct; please check your General Journal Entry.

Total: 299500

Previous General Journal Entry
Show Trial Balance

see next screen for checking the General Journal Entry
### Account Name

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>25000</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Office Equipment</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Service Van</td>
<td>20000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Van</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>Equipment Rental Income</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Deposit for New Machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts Payable</td>
<td>11200</td>
<td></td>
</tr>
<tr>
<td>Fuel expenses</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>295500</td>
<td>295500</td>
</tr>
</tbody>
</table>

Previous General Journal Entry: Show Trial Balance

#### Previous General Journal Entry

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.81</td>
<td>Wages Expense</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accrued Wages</td>
<td></td>
<td>500</td>
</tr>
</tbody>
</table>

Continue
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Basic Feedback
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Rich Feedback

BACKHOE DIGGERS
Trial Balance as at 30.6.2001

BALANCE DAY ADJUSTMENT :: 1 of 9

<table>
<thead>
<tr>
<th>Date</th>
<th>Account Name</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.6.2001</td>
<td>Wages Expense</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accrued Wages</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correct. You shouldn't really be getting this wrong!

button on this heading to update your Trial Balance.
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Basic Feedback
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Rich Feedback

![Image of a screenshot showing a balance day adjustment with feedback text]
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Basic Feedback

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>25000</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td>600</td>
</tr>
<tr>
<td>Accrued Wages</td>
<td>2000</td>
<td></td>
</tr>
</tbody>
</table>

Correct.

Total

Previous General Journal Entry
Show Trial Balance
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Rich Feedback

![Account Name Table]

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>40000</td>
<td></td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>25000</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Supplies</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Office Supplies</td>
<td>40000</td>
<td></td>
</tr>
</tbody>
</table>

"Well done. You have put in the right account name. Remember this account is a current liability. Also remember to always use the correct name, and the correct spelling! This is important in Accounting."
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

**Basic Feedback**

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>190000</td>
<td></td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td></td>
<td>40000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>13000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>25000</td>
<td></td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>Office Equipment</td>
<td>600</td>
<td></td>
</tr>
</tbody>
</table>

Correct.

```
Total
```

|               | 299500 | 296500 |

Previous General Journal Entry

Show Trial Balance

302
Appendix 48 (cont)

Screen shots where examples of rich feedback (including attribute isolation) are provided in comparison to basic feedback

Rich Feedback

<table>
<thead>
<tr>
<th>Account Name</th>
<th>Dr</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant and machinery</td>
<td>190000</td>
<td>40000</td>
</tr>
<tr>
<td>Acc. Depreciation - Plant and Machinery</td>
<td>12000</td>
<td>12000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>13000</td>
<td>13000</td>
</tr>
<tr>
<td>Rent Expenses</td>
<td>25000</td>
<td>25000</td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>Stationery Stock</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Office Equipment</td>
<td>10000</td>
<td>10000</td>
</tr>
</tbody>
</table>

Correct. Well done. You need to add $500 to the credit side, but make sure the Trial Balance still balances!
Appendix 49

The student questionnaire and introductory letter to students for Studies 3 and 4

- Introductory letter

MONASH UNIVERSITY

Copy of Explanatory Statement

Date May 2002

Project Title: Designing Accounting CBL Software with appropriate student feedback.

Hello, I (Abdel Halabi, Lecturer in Accounting and Finance, Monash University) am doing research at the University on students learning materials in Accounting for my PhD research program.

The aim of this research is to evaluate whether certain types of feedback in CBL software are more appropriate for accounting students.

I am hoping you will find time to participate in this study by completing the CBL tutorial exercise and completing the following questionnaire. The questionnaire and the CBL material will take the entire tutorial to complete.

No findings which could identify any individual participant will be published, however I would like your student number on the survey. This is because I want to compare the results you obtain in the test with your attitudes to accounting and use of computers. Note that I will not be marking any of your examinations in this unit and the information on your grades will be obtained by other staff with only student number to identify it. Please be aware that data must be stored for five years according to university regulations. The questionnaires will be collected and processed by myself and a research assistant with only your student number identification being used and will only be available to us and my PhD supervisors.

I hope that you will agree to participate in the study as it is important to get the feedback about teaching alternatives from the students themselves. However, you can withdraw at any time by not handing in the questionnaire to the administrator who collects the surveys or not signing the consent form. You as students may also choose not to answer some of the questions. No student will be disadvantaged for not having their work included in the research findings.

If you have any queries, please contact telephone myself (Abdel Halabi) at Monash University Berwick Campus; fax 9904 4100. The aggregate findings will be discussed in class.

Should you have any complaint concerning the manner in which this research (project number ) is conducted, please do not hesitate to contact The Standing Committee on Ethics in Research on Humans at the following address:

The Secretary
The Standing Committee on Ethics in Research on Humans
Monash University
Wellington Road
Clayton Victoria 3168
Telephone Fax (03) 9905 1420

Thank you.
Appendix 49 (cont)

The student questionnaire and introductory letter to students for Studies 3 and 4

- Student questionnaire

AFW 1001 Introductory Accounting A

1. Your student Number

2. Sex (please circle correct alternative)
   Male          Female

3. Your age in years (please write)

4. What course are you enrolled in at Monash?

5. In what year are you in your Monash Course?

6. Did you study outside Australia before coming to Monash University?
   (please circle) Yes / No. If, Yes, which country?

7. In what year did you last study before attending Monash?

8. Where did you study before attending Monash? (eg, school)

9. If you went to a high school, what was your TER?

10. Have you studied accounting before? (please circle) Yes / No.

11. If yes, to what level

12. What was your mark/grade

Accounting Questions

13. Do you think it is important to have studied accounting to get a full time job? (circle best option)
   No Use  Little Use  Don't Know  Useful  Very Useful

14. What job do you hope to do in the next 4 – 5 years?

15. Do you think Accounting will be important in this future job? Yes or No (Circle Correct Alternative)
16. How committed are you to pass accounting this semester? (Circle the best alternative)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very Committed</td>
<td></td>
<td></td>
<td></td>
<td>Not Committed</td>
</tr>
</tbody>
</table>

17. Have you studied this unit before at Monash, or another University? Yes or No (Circle Correct Alternative).

If yes, where? ........................................

18. What are your goals in respect of Accounting this semester (circle best option)?

- To pass the unit
- Receive a Credit
- Distinction
- High Distinction
- Don’t care

19. What are your goals in respect of the Course you are studying (circle best option)?

- To pass the degree
- Credit average
- Distinction (or better) average
- Don’t care

Questions about computers

20. Do you have a computer at home? Yes/ or No (circle correct alternative).

If yes, how long have you had a computer? (years) .........................
If no, do you intend to purchase a computer in the future? Yes/ or No

21. How much time (on average) do you spend using a computer (circle best option)?

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>&lt; 1 hr per week</td>
<td>1-5 hrs</td>
<td>6-15 hrs</td>
<td>&gt;15 hours</td>
</tr>
</tbody>
</table>

22. Which term best describes your skill in using a computer (circle best option)?

- Beginner
- Limited Experience
- Competent
- Experienced
- Expert

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited Experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experienced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expert</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23. Circle the term which best describes your general experiences as a computer user

- Very negative
- Negative
- Neutral
- Positive
- Very Positive

24. Circle the term that describes how feel when you think about using the computer

- Very negative
- Negative
- Neutral
- Positive
- Very Positive

25. In Accounting this semester a range of materials will be available on line. How important is it to you to have the following information on line (circle best option)?
Lecture Notes

<table>
<thead>
<tr>
<th></th>
<th>Totally Unimportant</th>
<th>Not Important</th>
<th>Neutral</th>
<th>Important</th>
<th>Very Important</th>
</tr>
</thead>
</table>

Exam papers

<table>
<thead>
<tr>
<th></th>
<th>Totally Unimportant</th>
<th>Not Important</th>
<th>Neutral</th>
<th>Important</th>
<th>Very Important</th>
</tr>
</thead>
</table>

26. On line chat sessions will be conducted. What is your opinion of these?

<table>
<thead>
<tr>
<th></th>
<th>Totally Unimportant</th>
<th>Not Important</th>
<th>Neutral</th>
<th>Important</th>
<th>Very Important</th>
</tr>
</thead>
</table>

27. Have you used computers before in Accounting? Yes/or No (circle correct alternative). If yes explain your experiences with accounting and computers

28. What is your attitude to working on computer-based tasks with tutors to help you in tutorials compared to pencil and paper tasks with tutor led discussions?

...
Appendix 50

Evaluation of the effort to complete the CBL problem solving material used in Study 3

Accounting Computer-Based Learning Materials – Complete exercise with feedback

Instructions:

You will need Windows to run this program.
Insert the CD drive, and click my computer, then the appropriate drive
Click on Exercise
The computer material will begin to load.
Press the > and go to the first page
Click on Practical problem
Read the instructions carefully, and examine the trial balance
You will need to complete the balance day adjustments and then update your trial balance with new balances
First complete the general journal entries. Check your entries by clicking with the right mouse
When the general journal is correct, update your trial balance with the correct balances
Complete the evaluation for the computer material, including a record of the time spent, on each adjustment
When finished you may leave
Hand in the evaluation when completed
Applying cognitive load theory concepts...

Office Use Only:  Rich/ Basic (please circle)

a). Adjustment: Wages Owing
1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

   Very High  High  Middle  Low  Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

b). Adjustment - Rent Expense
1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

   Very High  High  Middle  Low  Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

c). Adjustment - Depreciation of Plant and Machinery
1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

   Very High  High  Middle  Low  Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

d). Adjustment - Depreciation of Office Equipment
1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

   Very High  High  Middle  Low  Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)
e). Adjustment - Depreciation of Service Van

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

<table>
<thead>
<tr>
<th>Very High</th>
<th>High</th>
<th>Middle</th>
<th>Low</th>
<th>Very Low</th>
</tr>
</thead>
</table>

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

f). Adjustment - Rental Income Prepaid

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

<table>
<thead>
<tr>
<th>Very High</th>
<th>High</th>
<th>Middle</th>
<th>Low</th>
<th>Very Low</th>
</tr>
</thead>
</table>

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

g). Adjustment - Stock of Stationery

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

<table>
<thead>
<tr>
<th>Very High</th>
<th>High</th>
<th>Middle</th>
<th>Low</th>
<th>Very Low</th>
</tr>
</thead>
</table>

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

h). Adjustment - Prepaid Fuel Expenses

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

<table>
<thead>
<tr>
<th>Very High</th>
<th>High</th>
<th>Middle</th>
<th>Low</th>
<th>Very Low</th>
</tr>
</thead>
</table>

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)
Applying cognitive load theory concepts ...

**Other General Questions:**

1. More Computer material should be used for other Topics (Circle best answer)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
</tbody>
</table>

2. Name the Topics (if any) you would like to see

3. The computer material should be used (tick the best answer)
   - Instead of face-to-face teaching
   - With face-to-face teaching
   - Should not be used at all

4. I think the best feedback is 1 that (tick the best answer):
   - Only provides a correct response and no explanation
   - Only provides the incorrect answer and no explanation
   - Provides both the correct or incorrect answer with no explanation
   - Only provides a correct response with an explanation
   - Only provides the incorrect answer with an explanation
   - Provides both the correct or incorrect answer with explanations

5. Would you like to see more personalised messages from the computer (Eg instead of “incorrect”, “incorrect Jane”)? Yes or No (Circle answer)

6. Would you like to see more or less feedback in the answers provided by the computer? Why?
Appendix 51

The diagnostic test used in Studies 3 and 4

Monash University
Semester 1, 2002, Class Test
Faculty of Business and Economics

CODE: AFW 1001
TITLE OF PAPER: INTRODUCTORY ACCOUNTING A
EXAM DURATION: 20 minutes writing time
READING TIME: 3 minutes

1. Total number of questions: 2 (2)

AUTHORISED MATERIALS
CALCULATORS YES

Candidates must complete this section if required to answer in this paper

STUDENT ID DESK NUMBER
SURNAME Signature
OTHER NAMES (in full)
1. Selected accounts of Martin Estate Agency (proprietor M. Martin) are shown below at 31 March 2002 before any adjusting entries have been made.

<table>
<thead>
<tr>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepaid Insurance</td>
<td>$1200</td>
</tr>
<tr>
<td>Supplies Inventory</td>
<td>400</td>
</tr>
<tr>
<td>Office Equipment</td>
<td>5,000</td>
</tr>
<tr>
<td>Unearned Rental Fees</td>
<td>1,800</td>
</tr>
<tr>
<td>Provision for Doubtful Debts</td>
<td>50</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>800</td>
</tr>
<tr>
<td>Wages Expense</td>
<td>2,600</td>
</tr>
<tr>
<td>Rental Fees Revenue</td>
<td>8,700</td>
</tr>
</tbody>
</table>

Further information:

(vii) Prepaid insurance represents premiums for six months paid on 1 March 2002.

(viii) Because of tighter economic conditions, Martin has decided to increase the Provision for Doubtful Debts to 1% of debtors.

(ix) Office Equipment is expected to last 10 years and to contribute equally to revenue over this period. It was purchased on 1 March this year, and is yet to be depreciated. There is no residual value.

(x) Martin collected four months’ rent in advance on 1 March from a tenant renting space for $450 per month.

(xi) Staff are owed wages of $300 on 31 March.

(xii) Supplies of $100 were on hand at 31 March.

Required:

(b) Record in the general journal the necessary adjusting entries on 31 March (narrations are not required).

2. What will be the new balance of these accounts after the adjustments? (answer this part in the spaces below)

Prepaid Insurance       
Supplies Inventory       
Unearned Rental Fees    
Provision for Doubtful Debts 
Rental Fees Revenue     
Wages Expense           

(12 + 3 = 15 marks)
Appendices

Answer to Question 1

<table>
<thead>
<tr>
<th>Date</th>
<th>Particulars</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Please answer the following additional questions about this test, and your work.

1. How much mental effort did you put into completing this test? (Circle the most correct)
   - Very High
   - High
   - Middle
   - Low
   - Very Low

2. How many hours did you take to prepare for this test? (write number of hours, or n1)

3. Did you go to the lecture on Balance Day Adjustments (held 2 weeks ago?) Yes or No (circle correct answer)

4. Did you attend the tutorial on Balance Day Adjustments (held last week?) Yes or No (circle correct answer)

5. Have you studied Accounting before? Yes or No (circle correct answer).
Appendix 52

The consent form used in Studies 3 and 4

*Informed Consent Form*

**Project Title:** (Designing Accounting CBL Software with appropriate student feedback)

I agree to take part in the above Monash University research project. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to take part means that I am willing to:

- complete questionnaires asking me about Computer-Based Learning materials which will only identify me by my student number.
- use a computer in Accounting completing some tutorial work
- allow the researchers to access my grades in this unit by student number only

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.

Signature .......................................................... Date.................................
Appendix 53

Solutions to the diagnostic test used in Studies 3 and 4

Answer to Question 1

<table>
<thead>
<tr>
<th>Date</th>
<th>Particulars</th>
<th>Debit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 Mar</td>
<td>Insurance Expense</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prepaid Insurance</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Doubtful Debts expense</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allowance for doubtful debts</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Depreciation of Office E</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accumulated Depreciation of Office E</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Unearned Rental Fees</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rental Fees Revenue</td>
<td></td>
<td>450</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Wages Expense</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wages Owing</td>
<td></td>
<td>300</td>
</tr>
<tr>
<td>31 Mar</td>
<td>Supplies Expense</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplies Inventory</td>
<td></td>
<td>300</td>
</tr>
</tbody>
</table>

Balances are:

- Prepaid Insurance: 1,000
- Supplies Inventory: 100
- Unearned Rental Fees: 1,350
- Provision for Doubtful Debts: 80
- Rental Fees Revenue: 9,150
- Wages Expense: 2,900
Appendices

Appendix 54

Evaluation of the effort to complete the CBL worked examples material used in Study 4

Accounting Computer-Based Learning Materials – Worked Examples with feedback

Instructions:

You will need Windows to run this program.
Insert the CD drive, and click my computer, then the appropriate drive
Click on Worked Example Exercise
The computer material will begin to load.
Press the > and go to the first page
Click on Practical problem
Read the instructions carefully, and examine the trial balance
You will need to complete the balance day adjustments and then update your trial balance with new balances
The first 3 balance day adjustments and their related postings have been done for you. You should look at these by clicking the > button.
You will then need to complete the other adjustments.
When completing the adjustments, first complete the general journal entries. Check your entries by clicking with the right mouse
When the general journal is correct, update your trial balance with the correct balances
Complete the evaluation for the computer material, including a record of the time spent, on each adjustment
When finished you may leave, and hand in the evaluation when completed
a). Adjustment: Wages Owing

1. How much mental effort did you put into understanding both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

   Very High  High  Middle  Low  Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

b). Adjustment - Rent Expense

1. How much mental effort did you put into understanding both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

   Very High  High  Middle  Low  Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)


c). Adjustment - Depreciation of Plant and Machinery

1. How much mental effort did you put into understanding both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

   Very High  High  Middle  Low  Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)


d). Adjustment - Depreciation of Office Equipment

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

   Very High  High  Middle  Low  Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)


Appendices

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

..........................

e). Adjustment - Depreciation of Service Van

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

      Very High      High      Middle      Low      Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

..........................

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

..........................

f). Adjustment - Rental Income Prepaid

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

      Very High      High      Middle      Low      Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

..........................

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

..........................

g). Adjustment - Stock of Statilry

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

      Very High      High      Middle      Low      Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

..........................

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

..........................

h). Adjustment - Prepaid Fuel Expenses

1. How much mental effort did you put into completing both the General Journal entry and the adjusted trial balance for this adjustment (Circle the most correct)?

      Very High      High      Middle      Low      Very Low

2. How much time did you spend reading and completing this adjustment? (eg 2 minutes)

..........................

3. How many times did you ask the tutor for help in the accounting unit matter? (eg five times)

..........................
Other General Questions:

1. More Computer material should be used for other Topics (Circle best answer)

   |   |   |   |   |   |
   | 1 | 2 | 3 | 4 | 5 |
   | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |

2. Name the Topics (if any) you would like to see

3. The computer material should be used (tick the best answer)
   - Instead of face-to-face teaching
   - With face-to-face teaching
   - Should not be used at all

4. I think the best feedback is that (tick the best answer):
   - Only provides a correct response and no explanation
   - Only provides the incorrect answer and no explanation
   - Provides both the correct or incorrect answer with no explanation
   - Only provides a correct response with an explanation
   - Only provides the incorrect answer with an explanation
   - Provides both the correct or incorrect answer with explanations

5. Would you like to see more personalised messages from the computer (Eg instead of “incorrect”, “incorrect Jane”)? Yes or No (Circle answer)

6. Would you like to see more or less feedback in the answers provided by the computer? Why?
Applying cognitive load theory concepts ...

Bibliography


Applying cognitive load theory concepts...


Bibliography


Applying cognitive load theory concepts ...


Applying cognitive load theory concepts ...


Bibliography


Applying cognitive load theory concepts ...


Applying cognitive load theory concepts ...


Applying cognitive load theory concepts ...


Applying cognitive load theory concepts ...


Bibliography


Applying cognitive load theory concepts...


Winter, R. P. & Harrington, G. (1994). Hypertext: A supplementary tool for teaching management theory by distance education?, in *Research in Distance Education 3*. Edited by Evans, T., and Murphy, D. Deakin University, Geelong: Deakin University Press, 137-149.


Applying cognitive load theory concepts ...
